MMK TOLL ROAD PVT. LTD.
(A subsidiary of
IRB INFRASTRUCTURE DEVELOPERS LTD)
Corporate Office:
3rd Floor,IRB Complex, Chandivali Farm, Chandivali Village,
Andheri (E), Mumbai-400 072
Tel: 91-22-6640 4220 / 4880 4200 • Fax: 91-22-2857 3441
e-mail: info@irb.co.in • www.irb.co.in
CIN : U45200MH2002PTC135512

May 25, 2023

To,
National Stock Exchange of India Limited
Exchange Plaza
Plot no. C/1, G Block
Bandra-Kurla Complex, Bandra (East)
Mumbai 400051

Dear Sir,

Ref.: NSE Symbol: IRBIT / Series: IV

Subject: Valuation Report & Toll Revenue Projection Report for the financial year ended March 31, 2023

We are enclosing herewith the Valuation Report dated May 12, 2023, as issued by the Valuer, i.e. Mr. Sunit Khandelwal (IBBI Registration Number - IBBI/RV/05/2018/10426) for the financial year ended March 31, 2023 for IRB Infrastructure Trust (the "**Trust**").

The Net Asset Value pursuant to Regulation 10 of SEBI (Infrastructure Investment Trusts) Regulations, 2014 based on the Valuation Report issued by the Valuer is as follows:

Particulars	**Amount in Rs. Crore**
A. Assets	28,733.90
B. Liabilities (adjusted for present value of standalone expenses of Trust, net off cash and cash equivalent & surplus assets)	10,459.20
C. Net Assets	18,274.70
Outstanding Units (in Crore)	87.92
NAV at Fair Value (per Unit)	**207.83**

Further, the Trust has engaged M/s. Incwert Advisory Private Limited (IBBI/RV-E/05/2019/108) to serve as an independent advisor to provide a review opinion on the Valuation Report of the Assets of the Trust prepared by Mr. Sunit Khandelwal. We are enclosing herewith the review opinion by M/s. Incwert Advisory Private Limited.

You are requested to note the same.

For MMK Toll Road Private Limited
(in its capacity as Investment Manager to IRB Infrastructure Trust)

Kaustubh Purushottam Shevade
Digitally signed by Kaustubh Purushottam Shevade
Date: 2023.05.25 19:58:26 +05'30'

Kaustubh Shevade
Company Secretary

Encl.: As above.

SUNIT KHANDELWAL
Registered Valuer under Companies (Registered Valuers and Valuation) Rules, 2017
IBBI Registration No. IBBI/RV/05/2018/10426
Asset class: Securities or Financial Assets

Valuation report

Valuation date: 31 March 2023
Report date: 12 May 2023

Registered office:
1006 A&B, 10th floor,
Welldone TechPark, Sohna Rd.,
Sector-48, Gurgaon – 122018
Haryana, India

Telephone: +91 124-4696689
Fax: +91 124-4696689
Mobile: +91 9560680444
Email: sunitkhandelwal@gmail.com

Contents

1. Definitions, abbreviations & glossary of terms

Abbreviations	Definitions/Meaning
AETL	AE Tollway Limited
BOT	Build, Operate and Transfer
BV	Break Up Value
CA	Concession Agreement
CAGR	Compounded Annual Growth Rate
CCM	Comparable Companies Multiple
COD	Commercial Operation Date
D/E Ratio	Debt-Equity ratio
DBFOT	Design, Build, Finance, Operate, Transfer
DCF	Discounted Cash Flow
EBIT	Earnings Before Interest and Taxes
EBITDA	Earnings Before Interest, Taxes and Depreciation and Amortization
EPC	Engineering, Procurement and Construction
ETC	Electronic Toll Collection
EV	Enterprise value
FCFF	Free Cash Flows to Firm
FY	Financial Year ending 31st March
GDP	Gross Domestic Product
GVA	Gross Value Added
HAM	Hybrid-Annuity Model
HUDCO	Housing and Urban Development Corporation
IBEF	India Brand Equity Foundation
IHMTL	IRB Hapur Moradabad Tollway Limited
INR	Indian Rupees
Investor Manager or IM	MMK Toll Road Pvt Ltd
InvIT	Infrastructure Investment Trust
IRBIDL	IRB Infrastructure Developers Limited
IRR	Internal rate of return
IWTL	IRB Westcoast Tollway Limited
KGTL	Kishangarh Gulabpura Tollway Limited
Kms	Kilometres
KTL	Kaithal Tollway Limited
Management	Management and representatives of the Sponsor
MAT	Minimum Alternative Tax
MDR	Major District Roads
MoRTH	Ministry of Road Transport & Highways
NAV	Net Asset Value
NH	National Highway
NHAI	National Highways Authority of India
NHDP	National Highways Development Project
ODR	Other District Roads
OMT	Operate-Maintain-Transfer
PAT	Profit After Tax
PBT	Profit before Tax
PCU	Passenger Car Equivalent
PDTPL	Palsit Dhankuni Tollway Private Limited
PMGSY	Pradhan Mantri Gram Sadak Yojana
PPP	Public Private Partnership
SEBI InvIT Regulations	Securities Exchange Board of India (Infrastructure Investment Trusts) Regulations, 2014
SH	State Highway
SPV	Special Purpose Vehicle
SYTL	Solapur Yedeshi Tollway Limited
The Trust	IRB Infrastructure Trust
TOT	Toll Operate and Transfer
Trustee	IDBI Trusteeship Services Limited
UTL	Udaipur Tollway Limited
Valuer or I or me or or my or We	Sunit Khandelwal
WACC	Weighted Average Cost of Capital
WPI	Wholesale Price Index
YATL	Yedeshi Aurangabad Tollway Limited
You or Client or Company	IRB Infrastructure Trust (acting through the Investment Manager)

2. Background

2.1 Brief Background and Purpose

1. IRB Infrastructure Developers Limited (referred to as “IRBIDL” or “Sponsor”) is one of the largest infrastructure development and construction companies in India in the roads and highways sector. It was incorporated on 27 July 1998 and is based in Mumbai, India.
2. IRBIDL’s Build Operate and Transfer (“BOT”) infrastructure development business involves the construction, development, operation, and maintenance of road projects.
3. IRB Group's portfolio (including Private and Public InvIT) comprises 24 projects in all, including 23 highway projects that further include 19 BOT projects, 1 TOT project and 4 HAM projects and 1 Airport project in Sindhudurg District of Maharashtra. IRBIDL is referred as "the Sponsor".
4. The management of the Sponsor ("the Management") has informed that it has a registered Indian Infrastructure Investment Trust ("InvIT") under the Securities Exchange Board of India (Infrastructure Investment Trusts) Regulations, 2014 ("SEBI InvIT Regulations") named as IRB Infrastructure Trust ("the Trust"). The Trust had undertaken a private placement of units (the “Offering”).
5. The Management further informed that the below Special Purpose Vehicles (hereinafter together referred to as "InvIT Assets", "10 SPVS" or "the SPVs”) were acquired by the Trust and the Trust holds 100 per cent equity interest:
    I. IRB Westcoast Tollway Limited (“IWTL” or “Goa Kundapur”)
    II. Solapur Yedeshi Tollway Limited (“SYTL” or “Solapur Yedeshi”)
    III. Yedeshi Aurangabad Tollway Limited (“YATL” or “Yedeshi Aurangabad”)
    IV. Kaithal Tollway Limited (“KTL” or “Kaithal Rajasthan”)
    V. AE Tollway Limited (“AETL” or “Agra Etawah”)
    VI. Udaipur Tollway Limited (“UTL” or “Udaipur Rajasthan/ Gujarat border”)
    VII. CG Tollway Limited (“CGTL” or “Gulabpura Chittorgarh”)
    VIII. KG Tollway Limited (“KGTL” or “Kishangarh Gulabpura”)
    IX. IRB Hapur Moradabad Tollway Limited (“IHMTL” or “Hapur Moradabad”)
    X. Palsit Dankuni Tollway Private Limited (“PDTPL” or “Dankuni Palsit”)
6. In accordance with the terms of reference set out in our Letter of Engagement dated 18 October 2019 (“LoE”), wherein Incwert Advisory Private Limited (“Incwert” or “we” or “us”) will provide valuation services to IRB Infrastructure Trust ("IRB" or “Trust” or “You” or “the Client”) acting through its Investment Manager, MMK Toll Road Private Limited, the Trust is evaluating to get the valuation of the Trust done in accordance with Regulation 21 of the Securities Exchange Board of India (Infrastructure Investment Trusts) Regulations, 2014 (“Proposed Transaction”) where it is required to be conducted by a Registered Valuer (as defined under section 247 of the Companies Act, 2013) and such valuation report is required to be in compliance with the SEBI InvIT Regulations (“Purpose”).
7. In this regard, the Valuer has been appointed to determine the Enterprise Value (“EV”) of the 10 SPVs on a standalone basis under the SEBI InvIT Regulations along with equity valuation of the Trust as on 31 March 2023 (“Valuation Date”).

3. Sources of Information

We have relied on the following sources of information:

- As provided by the Management:
  - Information on business and profile of the SPVs as provided by the Management.
  - Concession Agreement of each SPV between NHAI and individual SPV.
  - Unaudited Financial Statements on a standalone basis from the date of operation of individual SPV till 31 March 2023.
  - Unaudited Consolidated financial statements of the Trust on a consolidated basis as on 31 March 2023.
  - Financial projections of the SPVs from FY 2024 till the end of the concession period of the respective SPV as provided by the Management.
  - Income tax returns for AY 2022-23 for 10 SPVs
  - Traffic consultant reports prepared by consultants as noted in the table below for each SPV as provided by the Management. Management has represented that the traffic studies shared are the most recent studies available. Management has further represented that operations and maintenance (O&M) would be done by IRBIDL (Sponsor and Project Manager) based on a fixed price contract in line with technical due diligence done earlier. O&M payments are fixed for 10 years - after that the terms can be renegotiated upon renewal of the project implementation agreements.

Traffic consultants for the various SPVs

Sl. No	Name of SPV	Short name of SPV	Name of traffic consultant
1	Goa Kundapur	IWTL	GMD Consultants
2	Solapur Yedeshi	SYTL	GMD Consultants
3	Yedeshi Aurangabad	YATL	GMD Consultants
4	Kaithal - Rajasthan	KTL	GMD Consultants
5	Agra Etawah	AETL	GMD Consultants
6	Udaipur Rajasthan Gujarat	UTL	GMD Consultants
7	Gulabpura Chittorgarh	CGTL	GMD Consultants
8	Kishangarh Gulabpura	KGTL	GMD Consultants
9	Hapur Moradabad	IHMTL	GMD Consultants
10	Dankuni - Palsit	PDTPL	GMD Consultants

  - Completion certificates or provisional completion certificates as applicable for the various SPVs
  - Management has represented that out of 10 SPVs that are managed under the Trust, 9 SPVs are fully operational & 1 SPV is under operation and under tolling and construction phase. Management has assumed an extension in the end date of the concession period with respect to all SPVs to compensate for the loss of revenue due to lockdown situation, based on the formula as per the provisions of CA ("Concession Agreement") via Policy No. 8.3.33/2020 dated 26 May 2020, the same is in the process of approval from NHAI. Further, management has factored extension in concession period as well as on account of Target

Traffic – Article 29 of CA in line with Traffic reports.

Concession period assumed by Management(not yet approved by NHAI)

Sl. No	Name of Project	Short name of SPV	Construction Phase	Lane Kms	Scheduled Concession period ends	Management expected concession period ends - 31 March 2023
1	Goa Kundapur	IWTL	Fully operational	758	Mar-42	Feb-48
2	Solapur Yedeshi	SYTL	Fully operational	395	Jan-44	Apr-44
3	Yedeshi Aurangabad	YATL	Fully operational	756	Jun-41	Feb-44
4	Kaithal - Rajasthan	KTL	Fully operational	665	Jul-42	Feb-49
5	Agra Etawah	AETL	Fully operational	747	Jul-40	Oct-45
6	Udaipur Rajasthan Gujarat	UTL	Fully operational	683	Sep-38	Feb-43
7	Gulabpura Chittorgarh	CGTL	Fully operational	749	Nov-37	Feb-42
8	Kishangarh Gulabpura	KGTL	Fully operational	540	Feb-38	Jun-42
9	Hapur Moradabad	IHMTL	Fully operational	599	May-41	Jan-46
10	Palsit-Dhankuni	DP	Tolling & Under Construction	383	Apr-39	Nov-36

- Toll rate notification/validation letters for the SPVs
- The list of all the permits and licenses of the individual SPVs as provided by the Management.

- The estimates and timing of the proposed major repairs to be carried out by the SPVs as provided by the Management.
- Management has represented that money payable to related parties (INR 3,594.6 crores) forming part of non-current liabilities (INR 3,577.8 crores) and current liabilities (INR 16.8 crores) on the Trust's combined balance sheet as of Valuation Date and shall be settled against amount receivable from NHAI against the claim.
- Management has represented that other operating income mentioned in the consolidated management business plan is operating in nature and is on DSRA created for each SPV.
- Proprietary databases
- Site Visits and Physical inspection for all the SPVs
- Other industry-related information from various publicly available sources
- Other discussions with the Management
- In addition to the above, we have also obtained such other information and explanations which were considered relevant for the purpose of our analysis. While we have relied on the information, we have not independently verified or audited this information

Please note that with respect to the audited, provisional and projected financial statements, rounding-off of amounts in the underlying financial information could result in immaterial arithmetic differences.

3.1 Details of Site Visit

The site visit of the 10 SPVs was conducted during the fortnight ending 30 April 2023. Please refer to respective sections of each SPV in the later part of this report for the site photographs of the relevant SPV.

Exclusions and Limitations

3.2 Context and Purpose

The Management has appointed the Valuer to determine the Enterprise Value of the 10 SPVs pursuant to the SEBI InvIT Regulations and also compute the equity value of the Trust which owns these specified 10 SPVs.

This valuation analysis exercise and valuation report are solely for the Purpose mentioned herein in the Report.

3.3 Restricted Audience

This report and the information contained herein are absolutely confidential and are intended for use only in connection with the Purpose set out in the report.

It should not be copied, disclosed, circulated, quoted or referred to, either in whole or in part, in correspondence or in discussion with any other person except to whom it is issued without the written consent of the Valuer. It can however be relied upon and disclosed in connection with any statutory and regulatory filing in connection with the SEBI InvIT Regulations. This report and summary of valuation included herein can be reproduced and included in the statutory filings and may be made available for inspection in the manner specified therein. In the event, that the Client or its management extend the use of the report beyond the Purpose mentioned earlier in the report, with or without the consent of the Valuer, the Valuer will not accept any responsibility to any other party to whom this report may be shown or who may acquire a copy of the report.

It is clarified that this report is not a fairness opinion under any of the stock exchange/listing regulations. In case of any third-party has access to this report, please note that this report is not a substitute for the third party's own due diligence/appraisal / enquiries / independent advice that the third party should undertake for its purpose.

[This space has been left intentionally blank]

3.4 Limitation Clause

The report is subject to the limitations detailed hereinafter. This Report is to be read in totality, and not in parts, in conjunction with the relevant documents referred to therein.

The scope of the assignment did not include performing audit tests for the purpose of expressing an opinion on the fairness or accuracy of any financial or analytical information that was used during the course of the work. Further, conducting a financial or technical feasibility study was also not covered. During the course of this work, the Valuer has relied upon assumptions and projections related to the Trust and the SPVs made by the management of the Sponsor. These assumptions require exercise of judgment and are subject to uncertainties. Also, the Valuer has relied on the traffic study reports.

Further, this valuation Report is based on the extant regulatory environment and the financial, economic, monetary and business/market conditions, and the information made available to the Valuer or used by the Valuer up to the date hereof, which are dynamic in nature and may change in future, thereby impacting the valuation of the SPVs. Subsequent developments in the aforementioned conditions may affect this Report and the assumptions made in preparing this report and the Valuer shall not be obliged to update, review or reaffirm this report if the information provided to the Valuer changes. The information presented in this valuation Report does not reflect the outcome of any due diligence procedures, which may change the information contained herein and, therefore, the valuation Report materially.

Valuation is not a precise science and the conclusions arrived at in many cases will of necessity be subjective and dependent on the exercise of individual judgment. There is therefore no indisputable single value. While the Valuer has provided an assessment of the value based on an analysis of information available and within the scope of engagement, others may place a different value on the businesses.

Valuation is based on estimates of future financial performance or opinions, which represent reasonable expectations at a particular point in time, but such information, estimates or opinions are not offered as a prediction or as assurances that a particular level of income or profit will be achieved, a particular event will occur or that a particular price will be offered or accepted. Actual results achieved during the period covered by the prospective financial analysis will vary from these estimates and the variations may be material.

The realization of these projections is dependent on the continuing validity of the assumptions on which they are based. Since the projections relate to the future, actual results are likely to be different from the projected results in case of events and circumstances not occurring as projected and the differences may be material. The Valuer's work did not constitute a validation of the financial projections of the Trust and the SPVs under consideration and accordingly, the Valuer does not express any opinion on the same. The Valuer has not commented on the appropriateness of or independently verified the assumptions or Information provided to us for arriving at the financial projections. Further, while the Valuer has discussed the assumptions and projections with the management of the Sponsor, the Valuer's reliance on them for the purpose of valuation should not be construed as an assurance about the accuracy of the assumptions or the achievability of the financial projections.

This Report is based on information received from sources mentioned herein and discussions with the management of the Sponsor. This information has not been independently verified by the Valuer. The Valuer has assumed that the Sponsor has furnished all information, that it is aware of concerning the financial statements and respective liabilities, which may have an impact on my report.

The Valuer has not done any independent technical valuation or appraisal or due diligence of the assets or liabilities of the Trust or a SPV or any of other entity mentioned in this Report and has

considered them at the value as disclosed by the Trust in their regulatory filings or in submissions, oral or written, made to me. Nothing has come to the Valuer's knowledge to indicate that the material provided to the Valuer was misstated or incorrect or would not afford reasonable grounds upon which to base my Report.

The Valuer has not made any independent verification with respect to the Sponsor's claim to title of assets or property for the purpose of this valuation. With respect to the claim to the title of assets or property, the Valuer has solely relied on representations, whether verbal or otherwise, made by the Management to us for the purpose of this Report.

For the present valuation analysis exercise, the Valuer has also relied upon information available in the public domain; however, the accuracy and timeliness of the same has not been independently verified. Further, the Valuer has not verified the publicly available information cited in this Report.

In the particular circumstances of this case, the Valuer shall be liable only to the Sponsor, the Trust and the Investment Manager. The Valuer shall have no liability (in contract or under statute or otherwise) to any other party for any economic loss or damage arising out of or in connection with this engagement, however, the loss or damage is caused other than in cases of fraud, gross negligence or wilful misconduct, or on account of any natural calamities, shall be limited to the amount of fees actually received by the Valuer as laid out in the engagement letter, for such valuation work.

Whilst all reasonable care has been taken to ensure that facts stated in the Report are accurate and opinions given are fair and reasonable, neither the Valuer nor any of the Valuer's team members shall in any way be responsible for the management content, third party content or other any content sourced from publicly available information, stated herein. Accordingly, the Valuer makes no representation or warranty, express or implied, in respect of the completeness, authenticity or accuracy of such content. The Valuer expressly disclaims any and all liabilities, which may arise based upon such content used in this Report.

This Report does not look into the business / commercial reasons behind the transaction nor the likely benefits arising out of the same. Similarly, it does not address the relative merits of investing in InvIT as compared with any other alternative business transaction, or other alternatives, or whether or not such alternatives, or whether or not such alternatives could be achieved or are available. The assessment of commercial and investment merits of the Trust are sole responsibility of the investors of the Trust and the Valuer does not express opinion on the suitability or otherwise of entering into any financial or other transactions with the Investment Manager, the Trust or the Sponsor.

The Valuer is not an advisor with respect to legal tax and regulatory matters for the transaction. No investigation of the SPVs' claims to title or assets has been made for the purpose of this Report and the SPVs' claim to such right has been assumed to be valid. No consideration has been given to liens or encumbrances against the assets beyond the loans disclosed in the accounts. Therefore, no responsibility is assumed for matters of a legal nature.

Except to the extent required under the SEBI InvIT Regulations and other applicable laws, the Valuer is not responsible for matters of legal nature including issues of legal title and compliance with local laws in respect of the SPVs and also no consideration has been given to litigation and other contingent liabilities that are not recorded in the financials of the SPVs.

The valuation analysis in this Report should not be construed as investment advice; specifically, and the Valuer does not express any opinion on the suitability or otherwise of entering into any financial or other transactions with the Investment Manager, the Trust or any of the SPVs.

The estimate of value contained herein are not intended to represent value of the SPVs at any time

other than the dates specifically mentioned for each valuation result, as per the agreed scope of engagement and as required under the SEBI InvIT Regulations.

The Valuer's work in preparing the report was undertaken, and the report has been produced in accordance with the terms of engagement between the Valuer and the Client. Provision of valuation opinions and consideration of the issues described herein are areas of our regular practice. The services do not represent accounting, assurance, diligence services, or consulting/ tax-related services.

This Valuation Report, its contents, and results herein are specific to (i) the purpose of valuation agreed as per the terms of our engagement along with subsequent discussions with the management; (ii) the date of this Valuation Report, and (iii) are based on the data detailed in the section – Sources of information. An analysis of this nature is necessarily based on the prevailing stock market, financial, economic, and other conditions in general and industry trends in particular, and the information made available to us as of the Valuation Date. Events occurring after the Valuation Date may affect this Valuation Report and the assumptions used in preparing it, and we do not assume any obligation to update, revise or reaffirm this Valuation Report.

Management has represented that the business activities of the Company have been carried out in the normal and ordinary course and that no material adverse change has occurred in operations between the Valuation Date and the date of issue of the Valuation Report.

The Valuer is not responsible for updating this Valuation Report because of events or transactions occurring subsequent to the date of issue of this Report.

[This space has been left intentionally blank]

4. Overview of the 10 SPVs

4.1 IRB Westcoast Tollway Limited ("IWTL" or "Goa Kundapur")

IRB Westcoast Tollway Limited ("**IWTL**") was awarded a grant of INR 536.22 crores from the NHAI during the construction period. For this project, IWTL was engaged to expand the existing two-lane road to a four-lane road in the Goa/ Karnataka Border to Kundapur Section of NH17 (from 93.70 Km to 283.30 Km) in Karnataka under National Highway Development Program Phase IV on a Design-Build-Finance-Operate-Transfer basis. A concession agreement dated 25 March 2013 was entered into between the NHAI and IWTL. The project received a provisional completion certificate and commenced tolling in February 2020.

Concession Period: The concession period for this project is 28 years commencing from 03 March 2014. As per the concession agreement, IWTL is entitled to collect fees from project highway users, subject to the National Highways fee rules. The toll rates are revised annually on April 1st subject to and in accordance with such fee rules.

Operation and Maintenance: IWTL is required to carry out the operation and maintenance of this project, and if required, modify, repair or otherwise make improvements to the project highway in accordance with the concession agreement.

The key details of IRB Westcoast Tollway Limited are as follows:

Particulars	Details
Project name	Goa/Karnataka Border to Kundapur
Name of Concessionaire	IRB Westcoast Tollway Limited
State	Karnataka
NH/ SH	NH 17
PPP mode	Design, Build, Finance, Operate and Transfer ("DBFOT")
Execution of CA	March 25, 2013
Appointed date	March 3, 2014
Scheduled Concession End Date	March 2, 2042
Original Concession period	28 Years
Expected Concession End Date due to actual (estimated) traffic being lower than Target Traffic and covid 19 lockdown as per CA	February 6, 2048
Tollable Length (Kms)	189.6
Toll Plaza	3

The shareholding pattern of IRB Westcoast Tollway Limited as on 31 March 2023 is as follows:

Name of shareholder	No. of Shares held	Stake%
IRB Infrastructure Trust	17,41,94,297	100
Nominee of IRB Infrastructure Trust	6	Less than 0.01
Total	**17,41,94,303**	**100**

For the list of approvals and disclosure on litigation please refer relevant annexure related to the above SPV which have been spread between annexure I to X.

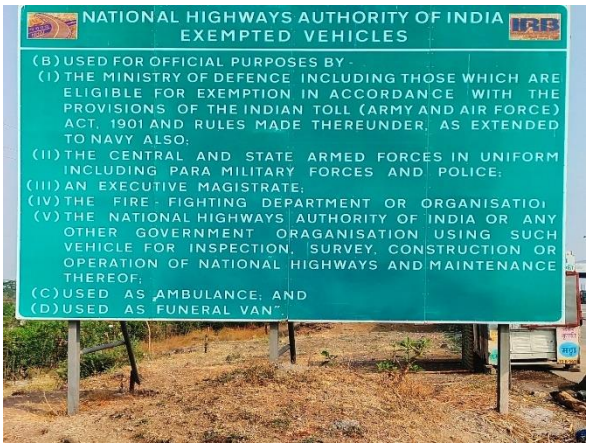
[This space has been left intentionally blank]

4.2 Solapur Yedeshi Tollway Limited ("SYTL" or "Solapur Yedeshi")

Solapur Yedeshi Tollway Limited ("**SYTL**") was awarded a grant of INR 189 crores from the NHAI during the construction period. For this project, SYTL was engaged to expand the existing two-lane road to a four-lane road in the Solapur to Yedeshi Section of NH-211 from 0.00 Km to 100.00 Km (design length of 98.717 Km) in the State of Maharashtra under National Highway Development Program Phase IV on a Design-Build-Finance-Operate-Transfer basis. A concession agreement dated 03 March 2014 was entered into between the NHAI and SYTL. The project received a final completion certificate in October 2019.

Concession Period: The concession period for this project is 29 years commencing from 21 January 2015. As per the concession agreement, SYTL is entitled to collect fees from project highway users, subject to the National Highways fee rules. The toll rates are revised annually on April 1st subject to and in accordance with such fee rules.

Operation and Maintenance: SYTL is required to carry out the operation and maintenance of this project, and if required, modify, repair or otherwise make improvements to the project highway in accordance with the concession agreement.



The key details of Solapur Yedeshi Tollway Limited are as follows:

Particulars	Details
Project name	Solapur Yedeshi
Name of Concessionaire	Solapur Yedeshi Tollway Limited
State	Maharashtra
NH/ SH	NH 211
PPP mode	Design, Build, Finance, Operate and Transfer ("DBFOT")
Execution of CA	March 3, 2014
Appointed date	January 21, 2015
Provisional Completion certificate date	March 5, 2018
Scheduled Concession End Date	January 20, 2044
Original Concession period	29 Years
Expected Concession End Date due to covid 19 lockdown as per CA	April 20, 2044
Tollable Length (Kms)	98.7
Toll Plaza	2

The shareholding pattern of Solapur Yedeshi Tollway Limited as on 31 March 2023 is as follows:

Name of shareholder	No. of Shares held	Stake%
IRB Infrastructure Trust	9,82,49,994	100
Nominee of IRB Infrastructure Trust	6	Less than 0.01
Total	**9,82,50,000**	**100**

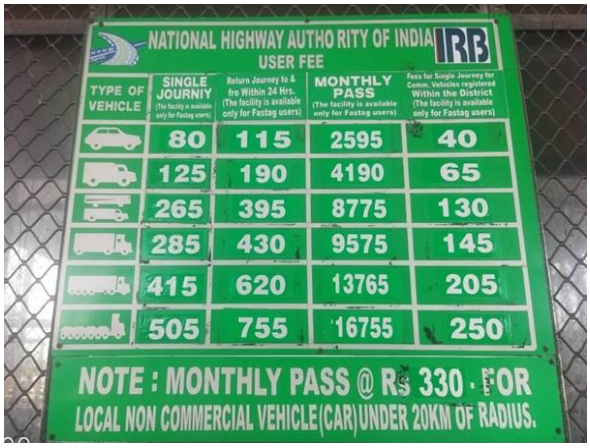
For the list of approvals and disclosure on litigation please refer relevant annexure related to the above SPV which have been spread between annexure I to X.

4.3 Yedeshi Aurangabad Tollway Limited ("YATL" or "Yedeshi Aurangabad")

Yedeshi Aurangabad Tollway Limited ("YATL") was awarded a grant of INR 558 crores from NHAI during the construction period. For this project, YATL was engaged to expand the existing two-lane road to a four-lane road in the Yedeshi to Aurangabad Section of NH-211 from 100.00 Km to 290.20 Km (design length of 189.09 Km) in the State of Maharashtra under National Highway Development Program Phase IV on a Design-Build-Finance-Operate-Transfer basis. A concession agreement dated 30 May 2014 was entered into between the NHAI and YATL. The project received a final completion certificate in September 2020.

Concession Period: The concession period for this project is 26 years commencing from 01 July 2015. As per the concession agreement, YATL is entitled to collect fees from project highway users, subject to the National Highways fee rules. The toll rates are revised annually on April 1st subject to and in accordance with such fee rules.

Operation and Maintenance: YATL is required to carry out the operation and maintenance of this project, and if required, modify, repair or otherwise make improvements to the project highway in accordance with the concession agreement.



The key details of Yedeshi Aurangabad Tollway Limited are as follows:

Particulars	Details
Project name	Yedeshi Aurangabad
Name of Concessionaire	Yedeshi Aurangabad Tollway Limited
State	Maharashtra
NH/ SH	NH 211
PPP mode	Design, Build, Finance, Operate and Transfer (“DBFOT”)
Execution of CA	May 30, 2014
Appointed date	July 1, 2015
Provisional Completion certificate date	March 17, 2018
Scheduled Concession End Date	June 30, 2041
Original Concession period	26 Years
Expected Concession End Date due to covid 19 lockdown as per CA	February 13, 2044
Tollable Length (Kms)	189.1
Toll Plaza	3

The shareholding pattern of Yedeshi Aurangabad Tollway Limited as on 31 March 2023 is as follows:

Name of shareholder	No. of Shares held	Stake%
IRB Infrastructure Trust	21,57,56,995	100
Nominee of IRB Infrastructure Trust	6	Less than 0.01
Total	**21,57,57,001**	**100**

For the list of approvals and disclosure on litigation please refer relevant annexure related to the

above SPV which have been spread between annexure I to X.

4.4 Kaithal Tollway Limited ("KTL" or "Kaithal Rajasthan")

Kaithal Tollway Limited ("**KTL**"), was awarded a grant of INR 234 crores from NHAI during the construction period. For this project, KTL was engaged to expand the existing two-lane road to a four-lane road in the Kaithal to Rajasthan Border Section of NH-152/65 from 33.25 Km (design - 0.500 Km) to 241.58 Km (design 165.759 Km i.e. total design length of 166.259 Km) in the State of Haryana under National Highway Development Program Phase IV on a Design-Build-Finance-Operate-Transfer basis. A concession agreement dated 23 June 2014 was entered into between the NHAI and KTL. The project received provisional completion certificates in September 2017 and July 2018 and commenced tolling in September 2017. The project received a final completion certificate in March 2019.

Concession Period: The concession period for this project is 27 years commencing from 15 July 2015. As per the concession agreement, KTL is entitled to collect fees from project highway users, subject to the National Highways fee rules. The toll rates are revised annually on 01 April subject to and in accordance with such fee rules.

Operation and Maintenance: KTL carries out the operation and maintenance of this project, and if required, modify, repair or otherwise make improvements to the project highway in accordance with the concession agreement.

The key details of Kaithal Tollway Limited are as follows:

Particulars	Details
Project name	Kaithal - Rajasthan Border
Name of concessionaire	Kaithal Tollway Limited
State	Haryana
NH	NH- 152/65
PPP mode	Design, Build, Finance, Operate and Transfer ("DBFOT")
Execution of concession agreement date	June 23, 2014
Appointed date	July 15, 2015
Provisional Completion certificate date – I	September 6, 2017
Provisional Completion certificate date – II	July 9, 2018
Completion certificate date	March 29, 2019
Scheduled concession end date	July 14, 2042
Original concession period (yrs)	27 years
Expected Concession End Date due to covid 19 lockdown as per CA	February 6, 2049
Tollable length (Kms)	166.3
Toll plaza (No.)	3

The shareholding pattern of Kaithal Tollway Limited as on 31 March 2023 is as follows:

Name of shareholder	No. of Shares held	Stake%
IRB Infrastructure Trust	32,79,99,994	100
Nominee of IRB Infrastructure Trust	6	Less than 0.01
Total	**32,80,00,000**	**100**

For the list of approvals and disclosure on litigation please refer relevant annexure related to the above SPV which have been spread between annexure I to X.

4.5 AE Tollway Limited ("AETL" or "Agra Etawah")

AE Tollway Limited ("AETL") was awarded on the basis of a premium of INR 81 crores payable to the NHAI in the first year of concession period increased annually at by an additional 5 per cent as compared to the immediately preceding year. For this project, AETL was engaged to expand the Agra to Etawah Bypass Section of NH-2 from 199.660 Km to 323.525 Km (design length of 124.52 Km) in the State of Uttar Pradesh from four to six lanes under National Highway Development Program Phase V on a design-build-finance-operate-transfer basis. A concession agreement dated 01 September 2015 was entered into between the NHAI and AETL. Being a four to six laning project, tolling commenced in August 2016. The project received a final completion certificate in November 2020.

Concession Period: The concession period for this project is 24 years commencing from 01 August 2016. As per the concession agreement, AETL is entitled to collect fees from project highway users, subject to the National Highways fee rules. The toll rates are revised annually on April 1st subject to and in accordance with such fee rules.

Operation and Maintenance: During the concession period, AETL is required to operate and maintain the facilities relating to this project, and if required, modify, repair or otherwise make improvements to the project highway in accordance with the concession agreement.

The key details of AE Tollway Limited are as follows:

Particulars	Details
Project name	Agra - Ethawah
Name of concessionaire	AE Tollway Limited
State	Uttar Pradesh
NH	NH-2
PPP mode	Build, Operate and Transfer ("BOT")
Execution of concession agreement date	September 1, 2015
Appointed date	August 1, 2016
Provisional Completion certificate date	August 1, 2016
Scheduled concession end date	July 31, 2040
Original concession period (yrs)	24 years
Expected Concession End Date due to covid 19 lockdown as per CA	October 19, 2045
Tollable length (Kms)	124.52
Toll plaza (No.)	2

The shareholding pattern of AE Tollway Limited as on 31 March 2023 is as follows:

Name of shareholder	No. of Shares held	Stake%
IRB Infrastructure Trust	43,64,99,994	100
Nominee of IRB Infrastructure Trust	6	Less than 0.01
Total	**43,65,00,000**	**100**

For the list of approvals and disclosure on litigation please refer relevant annexure related to the above SPV which have been spread between annexure I to X.

4.6 Udaipur Tollway Limited ("UTL" or "Udaipur Rajasthan/ Gujarat border")

Udaipur Tollway Limited ("**UTL**") was awarded on the basis of a premium of INR 163.80 crores payable to the NHAI immediately after the third anniversary year of COD and for each subsequent year till the 9th anniversary of COD, the premium shall increase by an additional 3 per cent as compared to the previous year. From the 9th anniversary of COD until the end of the concession period the premium shall increase by an additional 8 per cent each year as compared to the previous year. For this project, UTL was engaged to expand the Udaipur Bypass (287.40 Km) to the Rajasthan/Gujarat Border (401.20 Km) section of NH-8 in the states of Rajasthan & Gujarat (approx. length 113.80 Km) from four to six lanes under National Highway Development Program Phase V on a design-build-finance-operate-transfer basis. A concession agreement dated 09 December 2016 was entered into between the NHAI and UTL. Being a four to six laning project, tolling commenced in September 2017.

Concession Period: The concession period for this project is 21 years from 03 September 2017. As per the concession agreement, UTL is entitled to collect fees from project highway users, subject to the National Highways fee rules. The toll rates are revised annually on 01 April subject to and in accordance with such fee rules. Being a four to six laning project, tolling commenced from the appointed date i.e. 03 September 2017.

Operation and Maintenance: During the concession period, UTL is required to operate and maintain the facilities relating to this project, and if required, modify, repair or otherwise make improvements to the project highway in accordance with the concession agreement.

The key details of Udaipur Tollway Limited are as follows:

Particulars	Details
Project name	Udaipur Gujarat Border
Name of concessionaire	Udaipur Tollway Limited
State	Rajasthan/ Gujarat
NH	NH-8
PPP mode	Design, Build, Finance, Operate and Transfer ("DBFOT")
Execution of concession agreement date	December 9, 2016
Appointed date	September 3, 2017
Provisional Completion certificate date	September 3, 2017
Scheduled concession end date	September 2, 2038
Original concession period (yrs)	21 years
Expected Concession End Date due to covid 19 lockdown as per CA	February 13, 2043
Tollable length (Kms)	113.8
Toll plaza (No.)	1

The shareholding pattern of Udaipur Tollway Limited as on 31 March 2023 is as follows:

Name of shareholder	No. of Shares held	Stake%
IRB Infrastructure Trust	11,67,99,994	100
Nominee of IRB Infrastructure Trust	6	Less than 0.01
Total	**11,68,00,000**	**100**

For the list of approvals and disclosure on litigation please refer relevant annexure related to the above SPV which have been spread between annexure I to X.

4.7 CG Tollway Limited ("CGTL" or "Gulabpura Chittorgarh")

CG Tollway Limited ("CGTL") was awarded on the basis of a premium of INR 228.60 crores payable to the NHAI immediately after the third anniversary year of COD and for each subsequent year till the 9th anniversary of COD the premium shall increase by an additional 3 per cent as compared to the previous year. From the 9th anniversary of COD until the end of the concession period the premium shall increase by an additional 8 per cent each year as compared to the previous year. For this project, CGTL was engaged to expand the Gulabpura (90.00 Km) to the end of Chittorgarh Bypass (214.87 Km) Section of NH-79 in the state of Rajasthan from four to six lanes under National Highway Development Program Phase V on a design-build-finance-operate-transfer basis. A concession agreement dated 09 December 2016 was entered into between the NHAI and CGTL. Being a four to six laning project, tolling commenced in November 2017.

Concession Period: The concession period for this project is 20 years commencing from 04 November 2017. As per the concession agreement, CGTL is entitled to collect fees from project highway users, subject to the National Highways fee Rules. The toll rates are revised annually on 01 April subject to and in accordance with such fee rules.

Operation and Maintenance: During the concession period, CGTL is required to operate and maintain the facilities relating to this project, and if required, modify, repair or otherwise make improvements to the project highway in accordance with the concession agreement.

The key details of CG Tollway Limited are as follows:

Particulars	Details
Project name	Gulabpura Chittorgarh
Name of concessionaire	CG Tollway Limited
State	Rajasthan
NH	NH-79
PPP mode	Build, Operate and Transfer ("BOT")
Execution of concession agreement date	December 9, 2016
Appointed date	November 4, 2017
Provisional Completion certificate date	November 4, 2017
Scheduled concession end date	November 3, 2037
Original concession period (yrs)	20 years
Expected Concession End Date due to covid 19 lockdown as per CA	February 3, 2042
Tollable length (Kms)	124.87
Toll plaza (No.)	2

The shareholding pattern of CG Tollway Limited as on 31 March 2023 is as follows:

Name of shareholder	No. of Shares held	Stake%
IRB Infrastructure Trust	20,34,99,994	100
Nominee of IRB Infrastructure Trust	6	Less than 0.01
Total	**20,35,00,000**	**100**

For the list of approvals and disclosure on litigation please refer relevant annexure related to the above SPV which have been spread between annexure I to X.

4.8 Kishangarh Gulabpura Tollway Limited ("KGTL" or "Kishangarh Gulabpura")

Kishangarh Gulabpura Tollway Limited ("**KGTL**") was awarded on the basis of a premium of INR 186.30 crores payable to the NHAI immediately after the third anniversary year of COD and for each subsequent year till the 9th anniversary of COD the premium shall increase by an additional 3 per cent as compared to the previous year. From the 9th anniversary of COD until the end of the concession period the premium shall increase by an additional 8 per cent each year as compared to the previous year. For this project, KGTL was engaged to expand the Kishangarh (0.83 Km to 36.10 Km of NH 79A and 15.00 KM to 69.73 Km of NH-79) to Gulabpura section of NH 79A and NH 79 in the state of Rajasthan (length 90.00 Km) from four to six lanes under National Highway Development Program Phase V on a design-build-finance-operate-transfer basis. A concession agreement dated 22 February 2017 was entered into between the NHAI and KGTL. Being a four to six laning project, tolling commenced in February 2018.

Concession Period: The concession period for this project is 20 years commencing from 21 February 2018. As per the concession agreement, KGTL is entitled to collect fees from project highway users, subject to the National Highways fee rules. The toll rates are revised annually on 01 April subject to and in accordance with such fee rules.

Operation and Maintenance: During the concession period, KGTL is required to operate and maintain the facilities relating to this project, and if required, modify, repair or otherwise make improvements to the project highway in accordance with the concession agreement

The key details of Kishangarh Gulabpura Tollway Limited are as follows:

Particulars	Details
Project name	Kishangarh Gulabpura
Name of concessionaire	Krishangarh Gulabpura Tollway Limited
State	Rajasthan
NH	NH-79A & NH-79
PPP mode	Design, Build, Finance, Operate and Transfer ("DBFOT")
Execution of concession agreement date	February 22, 2017
Appointed date	February 21, 2018
Provisional Completion certificate date	February 21, 2018
Scheduled concession end date	February 20, 2038
Original concession period (yrs)	20 years
Expected Concession End Date due to covid 19 lockdown as per CA	June 20, 2042
Tollable length (Kms)	90
Toll plaza (No.)	1

The shareholding pattern of Kishangarh Gulabpura Tollway Limited as on 31 March 2023 is as follows:

Name of shareholder	No. of Shares held	Stake%
IRB Infrastructure Trust	15,54,99,994	99.99
Nominee of IRB Infrastructure Trust	6	Less than 0.01
Total	**15,55,00,000**	**100**

For the list of approvals and disclosure on litigation please refer relevant annexure related to the above SPV which have been spread between annexure I to X.

4.9 IRB Hapur Moradabad Tollway Limited ("IHMTL" or "Hapur Moradabad")

IRB Hapur Moradabad Tollway Limited ("**IHMTL**") was awarded on the basis of a premium of INR 31.5 crores payable to the NHAI immediately after the third anniversary year of COD and for each subsequent year until the ninth anniversary of COD the premium will increase by an additional 3 per cent as compared to the previous year. From the ninth anniversary of COD until the end of the concession period the premium will increase by an additional 8 per cent each year as compared to the previous year. For this project, IHMTL was engaged to expand the Hapur Bypass (50.000 Km) to Moradabad (149.867 Km) Section of NH-24 (design length of 99.867 Km) in the state of Uttar Pradesh from four to six lanes under National Highway Development Program Phase V on a design-build-finance-operate-transfer basis. A concession agreement dated 29 May 2018 was entered into between the NHAI and IHMTL. Being a four to six laning project, tolling commenced in May 2019.

Concession Period: The concession period for this project is 22 years commencing from 28 May 2019. As per the concession agreement, IHMTL is entitled to collect fees from project highway users, subject to the National Highways fee rules. The toll rates are revised annually on 01 April subject to and in accordance with such fee rules.

Operation and Maintenance: During the concession period, IHMTL is required to operate and maintain the facilities relating to this project, and if required, modify, repair or otherwise make improvements to the project highway in accordance with the concession agreement.

The key details of IRB Hapur Moradabad Tollway Limited are as follows:

Particulars	Details
Project name	Hapur Moradabad
Name of concessionaire	IRB Hapur Moradabad Tollway Limited
State	Uttar Pradesh
NH	NH-24
PPP mode	Design, Build, Finance, Operate and Transfer ("DBFOT")
Execution of concession agreement date	May 29, 2018
Appointed date	May 28, 2019
Provisional Completion certificate date	May 28, 2019
Scheduled concession end date	May 31, 2041
Original concession period (yrs)	22 years
Expected Concession End Date due to covid 19 lockdown as per CA	January 24, 2046
Tollable length (Kms)	99.87
Toll plaza (No.)	2

The shareholding pattern of IRB Hapur Moradabad Tollway Limited as on 31 March 2023 is as follows:

Name of shareholder	No. of Shares held	Stake%
IRB Infrastructure Trust	37,14,99,994	100
Nominee of IRB Infrastructure Trust	6	Less than 0.01
Total	**37,15,00,000**	**100**

For the list of approvals and disclosure on litigation please refer relevant annexure related to the above SPV which have been spread between annexure I to X.

4.10 Palsit Dankuni Private Tollway Limited ("PDPTL" or "Dankuni Palsit")

Palsit Dankuni Private Tollway Limited ("PDPTL" or "Dankuni Palsit") was awarded on the basis of premium payable to the Authority immediately after the first (1st) anniversary of Project Completion Date, a premium in the form of an additional concession fee for every year of the remaining Concession Period, to be calculated on total Realisable Fee. The Premium to be paid for the 2nd year after Project Completion Date shall equal to 10.80% of the total Realisable Fee during that year. For all subsequent years, the Premium shall be determined on the total Realisable Fee in the respective year at the percentage to be arrived at by increasing the percentage of Premium by an additional 1% as compared to the immediately preceding year. For this project, PDTPL was engaged for six laning of National Corridor NH-19 from Palsit to Dankuni (up to NH-6 Connector) from km. 588.870 to km. 652.700 (total design length- 63.830 km) in the State of West Bengal under Bharatmala Pariyojana to be executed on BOT (Toll) basis. A concession agreement dated 14 June 2021 was entered into between the NHAI and IHMTL. Being a four to six laning project, tolling commenced in April 2022.

Concession Period: The concession period for this project is 17 years commencing from 31 January 2022. As per the concession agreement, PDTPL is entitled to collect fees from project highway users, subject to the National Highways fee rules. The toll rates are revised annually on 01 April subject to and in accordance with such fee rules.

Operation and Maintenance: During the concession period, PDTPL is required to operate and maintain the facilities relating to this project, and if required, modify, repair or otherwise make improvements to the project highway in accordance with the concession agreement.

The key details of Palsit Dankuni Private Tollway Limited are as follows:

Particulars	Details
	6 laning of Dankuni to Palsit of NH-79 in West
Project name	Bengal on BOT (Toll) basis
Name of concessionaire	Palsit Dankuni Tollway Private Limited
State	West Benngal
NH	NH-79
PPP mode	Design, Build, Finance, Operate and Transfer ("DBFOT")
Execution of concession agreement date	Jun 14, 2021
Appointed date	Jan 31, 2022
Provisional Completion certificate date	Jul 29, 2024
Scheduled concession end date	Apr 01, 2039
Original concession period (yrs)	17 years
Expected Concession End Date as per Target traffic – Article 29 of CA	November 5, 2036
Tollable length (Kms)	74.72
Toll plaza (No.)	1

The shareholding pattern of Palsit Dankuni Private Tollway Limited as on 31 March 2023 is as follows:

Name of shareholder	No. of Shares held	Stake%
IRB Infrastructure Developers Limited	49,994	0.04%
IRB Infrastructure Trust	121200000	99.96%
Nominee of IRB Infrastructure Developers Limited	6	Less than 0.01
Total	**12,12,50,000**	**100**

For the list of approvals and disclosure on litigation please refer relevant annexure related to the above SPV which have been spread between annexure I to X.

5. Industry Overview

5.1 Indian Economy

India is on track to become the world's third-largest economy in under a decade from now. With a V-shaped recovery following the pandemic shocks, India's run of success continues and her economy is anticipated to repeat a similar growth trajectory in 2023. The construction of expressways at a record pace, coupled with new freight corridors are set to accelerate the pace of the already flourishing Brand India.

India intends to raise its ranking in the Logistics Performance Index to 25 and bring down the logistics cost from 14 per cent to 8 per cent of GDP, leading to a reduction of approximately 40 per cent, within the next five years. This would ensure that logistics play the role of a growth engine in the Indian economy, according to National Logistics Policy. India's National Logistics Policy is expected to give a massive boost to the country's USD 200 billion logistics sector.

Market Size and Growth:

Real GDP or GDP at Constant (2011-12) Prices in the year FY2023 is estimated at INR 157.60 lakh crore, as against the Provisional Estimate of GDP for the year FY2022 of INR 147.36 lakh crore, released on 31 May 2022. The growth in real GDP during FY2024 is estimated at 6.3 per cent as compared to 6.9 per cent in FY2023.

5.2 Infrastructure Sector in India

The infrastructure sector is a key driver for the Indian economy. The infrastructure sector includes power, bridges, dams, roads, and urban infrastructure development. In Budget 2023-24, capital investment outlay for infrastructure is being increased by 33 per cent to INR 10 lakh crore (USD 122 billion), which would be 3.3 per cent of GDP.

Market Size:

India is expected to become the third-largest construction market globally by 2022. India plans to spend USD 1.4 trillion on infrastructure projects through the National Infrastructure Pipeline (NIP), from 2019 to 2023, to ensure sustainable development in the country. Foreign Direct Investment (FDI) in construction development (townships, housing, built-up infrastructure and construction development projects) and construction (infrastructure) activity sectors stood at USD 26.22 billion and USD 28.64 billion, respectively, between April 2000-June 2022.

5.3 Road and Highway Sector in India (Sector background)

India has the second largest road network in the world of about 63.32 lakh kilometers (kms).

As on 31 March 2023, the length of various categories of roads is as under:

National Highways	1,44,955 km
State Highways	1,67,079 km
Other Roads	60,19,757 km
Total	**63,31,791 km**

5.4 Sector Trends

The Government of India has launched major initiatives to upgrade and strengthen National Highways through various phases of the National Highways Development Project (NHDP). The status of various components of Bharatmala Pariyojana Phase-1 and other schemes up to 31.12.2022 are as under:

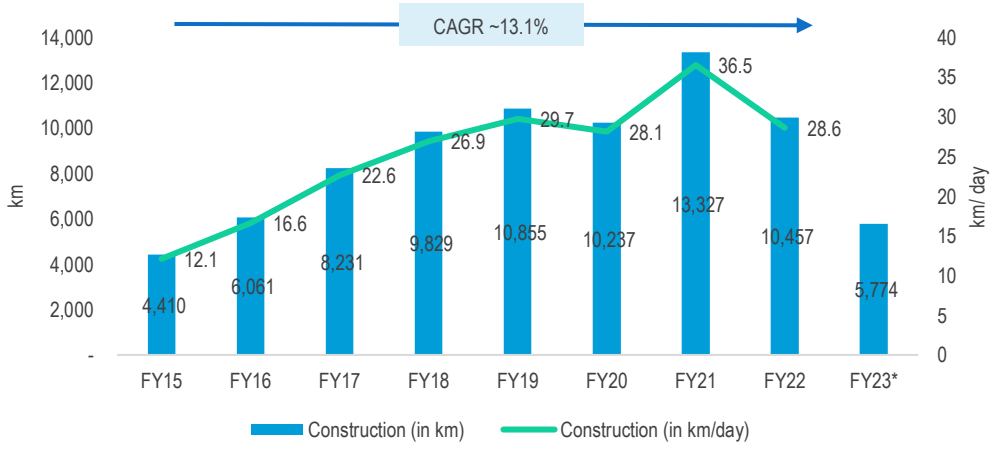
[This space has been left intentionally blank]

Components / Scheme	Total Length in km	Length completed up to 31.03.2022 in km	Length completed during 01.04.2022 to 31.12.2022 in km	Length Completed up to 31.12.2022 in km
A. BharatmalaPariyojana Phase-I				
Economic Corridors	9,000	2,165	990	3,155
Inter Corridors & Feeder Roads	6,000	883	498	1,381
National Corridor Efficiency	5,000	1,282	130	1,412
Border & International Road	2,000	1,134	79	1,213
Coastal & Port Connectivity	2,000	69	24	93
Expressways	800	621	158	779
Subtotal	**24,800**	**6,154**	**1,879**	**8,033**
Balance road works under NHDP	10,000	2,788	968	3,756
Grand Total	**34,800**	**8,942**	**2,847**	**11,789**
B. Other Schemes				
SARDP-NE (Phase A+Arunachal Pradesh)	6,418	4,212	261	4,473
LWE (including Vijayawada Ranchi Route)	6,085	5,797	31	5,818
EAP(WB+JICA+ADB)	2,855	1,521	243	1,764

Source: https://www.livemint.com/news/india/india-will-become-world-s-third-largest-economy-by-11681191872156.html; https://www.india-briefing.com/news/indias-national-logistics-policy-key-targets-and-implementation-plan-26020.html/#:~:text=Key%20targets%20of%20India's%20National%20Logistics%20Policy&text=Reduce%20cost%20of%20logistics%20in,incurred%20by%20most%20developed%20economies.; https://www.worldbank.org/en/news/press-release/2023/04/04/indian-economy-continues-to-show-resilience-amid-global-uncertainties#:~:text=The%20overall%20growth%20remains%20robust,half%20of%20FY%2022%2F23.; https://www.pib.gov.in/PressReleasePage.aspx?PRID=1889192; https://pib.gov.in/PressReleasePage.aspx?PRID=1888480; https://www.ibef.org/industry/infrastructure-sector-india; https://www.ibef.org/industry/infrastructure-presentation; https://morth.nic.in/sites/default/files/MoRTH%20Annual%20Report%20for%20the%20Year%202022-23%20in%20English.pdf

5.5 Momentum in the Expansion of Roadways

- Highway construction in India increased at 13.1 per cent CAGR between FY2015-22. The pace of National Highways (NH) construction has increased consistently between FY2015 and FY2023 due to the systematic push through corridor-based National Highway development approach. In FY2015, the pace of NH construction was about 12.1 km/ day which increased to about 28.6 km/ day in FY2022.



Note: FY23 data is upto 29 December 2022

- The Government of India has allocated INR 111 lakh crore (USD 1.34 trillion) under the National Infrastructure Pipeline for FY2019-25. The roads sector is expected to account for 18 per cent of capital expenditure over FY2019-25.

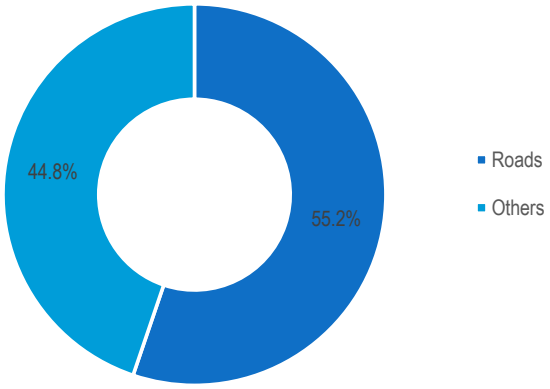
- In October 2022, Prime Minister of India laid the foundation of road and ropeway projects worth more than INR 3,400 crore (USD 410 million) in Mana, Uttarakhand.
- Government is working towards the development of a national highway network of 2 lakh kilometres by 2025.

5.6 Private Financing under Public Private Partnership (PPP)

The PPP framework was introduced to increase the efficiency of infrastructure projects through long-term collaboration between the public sector and private businesses.

- In FY21, there were 125 PPP projects worth USD 23.25 billion in India.
- NHAI targets 450 kilometers of the Build–operate–transfer (BOT) projects in FY2022 and is looking forward to bidding out 600-1000 kilometers of highway stretch under the Build–operate–transfer (BOT) model as of November 2021.
- In August 2020, the Government of India revised the Model Concession Agreement for BOT projects to plug delays by imposing a deadline on the NHAI and incentivizing timely work by concessionaires. According to revised norms, the NHAI will have to hand over 90 per cent of the project land (vacant and ready to build) to private developers, thus creating a more market-friendly sector and attracting more private players.
- In November 2020, L&T Construction bagged a contract to build India's longest river bridge, across the Brahmaputra River connecting Dhubri in Assam to Phulbari in Meghalaya, valued at INR 2,500–5,000 crore (USD 339.76–679.53 million).
- KKR, a global investment firm, announced to acquire the entire stake of Global Infrastructure Partners in Highway Concessions One (HC1) and seven other highway assets totaling 487 kms.

Total PPP Projects in India (FY2021)



Source: https://www.ibef.org/industry/roads-india

5.7 Evolution of PPP in road sector in India

PPP in the road sector in India has passed through several distinct phases:

- Build- Operate-Transfer:
  It is a form of project financing, wherein a private entity receives a concession from the private or public sector to finance, design, construct, own, and operate a facility stated in the concession contract. This enables the project proponent to recover its investment, operating, and maintenance expenses in the project. But significant improvements in private participation were observed. Private sector participation in BOT projects peaked till Financial Year (FY)12. But a steep decline in PPP participation was observed in FY13 and FY14 with many viable projects unable to attract even a single bid.

- Hybrid Annuity Mode (HAM):
  HAM was introduced to reinvigorate PPP participation in the road sector after interest in BOT projects waned. It has mainly provided advantages to the developers in form of reduction in Initial funding requirements in PPP projects as 60 per cent of the bid project cost is to be arranged by the concessionaire. This reduces the initial equity requirement and encourages participation by mid-sized developers to invest in PPP projects. Further, debt requirements go down from 70 per cent to around 42 per cent of the project cost. The introduction and strong implementation of HAM has seen HAM become the preferred PPP mode in India.

- Toll- Operate- Transfer (TOT)
  TOT is a model for 31 operational national highway projects where investors make a lump sum payment in return for long-term toll collection rights backed by a sound tolling system. Three TOT bundles have been floated by NHAI so far out of which financial closure of one bundle was achieved in August 2018 with the highest bidder bid at least 1.5 times the IECV and for one bundle bid process is ongoing.

  The National Highways Authority of India is looking to tweak the BOT framework as the Government plans to revive the BOT model to make it more attractive to private investors and lenders.

5.8 Policy Initiatives

- Under the Union Budget 2023-24, the Government of India allocated INR 19,000 (USD 2.37 billion) for Pradhan Mantri Gram Sadak Yojana (PMGSY),which is the same as the budget allocation and revised estimate for 2022-2023. According to recent reports, the number of roads constructed under PMGSY is of total length of 735,683 kms.

- The government of India has set up the India Infrastructure Finance Company (IIFCL) to provide long-term funding for infrastructure projects. Interest payments on external commercial borrowings for infrastructure are now subject to a lower withholding tax of 5 per cent vis-a-vis 20 per cent earlier. Infrastructure debt funds income is exempt from income tax.

- The Bhoomi Rashi portal accelerates the process of publication of notifications for land acquisition. It has been useful in reducing the time taken for providing notification regarding approval and publication of land acquisition.

- In October 2020, a memorandum of understanding (MoU) has been signed with the NHAI by Guru Nanak Dev University (GNDU) to conduct advanced research on various aspects, including highway architecture, protection, and revitalisation, The GNDU will undertake

studies on ~137 km length of the National Highways passing through Pathankot, Gurdaspur and Amritsar districts.

- In October 2021, the government announced rules to improve road safety, such as fixed driving hours for commercial truck drivers and a mandate to install sleep detection sensors in commercial vehicles.

- In December 2020, the Ministry of Road Transport and Highways signed an MoU with the Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology of the Republic of Austria on technology cooperation in the road infrastructure sector.

- FASTag is an electronic toll collection system, operated by NHAI. A mobile application has been launched for the purchase of tags and top-up of FASTags. Toll collections at national and state highways through FASTag touched INR 50,855 crore in FY2022, the highest yearly figure and 46 per cent more than in FY2021.

- The Indian government launched the Gati Shakti-National Master Plan, which will help lead a holistic and integrated development of infrastructure generating immense employment opportunities in the country. The aim of the plan is to create a digital platform that would enable 16 ministries to collaborate on integrated planning and coordinated implementation of projects. The plan will also bring together departments such as railways, roads & highways and others and implementation will be done with the help of geo-satellite imaging and Big Data, land and logistics. India's Gati Shakti program has consolidated a list of 81 high-impact projects, out of which road infrastructure projects were the top priority. The major highway projects include the Delhi-Mumbai expressway (1,350 kms), Amritsar-Jamnagar expressway (1,257 kms) and Saharanpur-Dehradun expressway (210 kms). The main aim of this program is a faster approval process which can be done through the Gati shakti portal and digitized the approval process completely.

Source: https://www.business-standard.com/article/current-affairs/fastag-collections-hit-rs-50k-crore-up-46-year-on-year-in-2022-123012401078_1.html; http://omms.nic.in/Home/CitizenPage/

5.9 Budgetary Outlay for Roads

- Under the Union Budget 2023-24, the Government of India has allocated INR 2.7 lakh crore (USD 33 billion) to the Ministry of Road Transport and Highways.

- In 2023-24, NHAI is allocated INR 1.62 lakh crore (USD 20 billion), all of which is budgetary support.
- In Andhra Pradesh, 70 projects underway, totaling 2,014 kms and costing INR 33,540 crore (USD 4.09 billion) are currently in progress.

- In March 2023, NHAI has invited bid to help in developing wayside amenities at more than 600 locations on National Highways and expressways by FY2025.

- In February 2023, Mr. Nitin Gadkari has approved the development of a 32 km long 6-lane Access Controlled Greenfield Highway on NH-544G Bengaluru–Vijayawada Economic Corridor in Hybrid Annuity Mode in Andhra Pradesh worth USD 157 million (INR 1,292.65 crores).

- In February 2022, NHAI rolled out a plan to construct 5,795 kilometres of highways that will connect 117 districts. The plan was worth INR 1 trillion (USD 13.09 billion).

5.10 Way Forward (Outlook)

- The market for roads and highways has projected a CAGR of 36.16 per cent during 2016-2025, on account of growing government initiatives to improve transportation infrastructure in the country.

- The Indian road network is on track to reach world-class standards with widescale expansions and makeovers. Highways are the most integral aspect of a country's functioning, connecting people, goods, and other raw materials.

- The central government's 'Bharatmala' project has helped in vigorously building a solid network of roads, highways, and expressways. India also plans to build at least 26 green expressways by 2025.

- The government's focus has not just been restricted to building premier roads but also aims to connect major industrial towns. The government will also connect every metro, town and village through a robust road connectivity system.

- India's expanding road and highway network has even reached the neglected and treacherous terrains of the Northeastern and Northern parts of the country.

- The Border Road Organisation has been working overtime to build roads along the Indian border, enhancing the country's military capabilities and road infrastructure is of paramount importance for speedy logistical support.

- The roadmap to India's infrastructure is exciting and the new decade seems to be promising. More and more green and clean initiatives are happening across government bodies in major countries, especially, the Indian government has given the much-needed push to the infrastructure sector in the recent 2023 budget. India is looking at a USD 5 trillion economy dream.

- India's logistics market is estimated to reach USD 410.75 billion in FY2022 and is expected to reach USD 556.97 billion by FY2027, growing at a CAGR of 6.28 per cent.

- India is now at a juncture where a huge investment in research and development for energy-efficient and green fuel is much-needed. Thus, boosting the overall infrastructure.

Source: https://www.ibef.org/blogs/growth-of-infrastructure-sector-a-potential-boost-to-the-indian-economy; https://economictimes.indiatimes.com/industry/transportation/roadways/indian-growth-story-accelerated-by-highway-expansion/articleshow/93945121.cms?from=mdr

6. Valuation Approach

The standard of value used in our analysis is fair value, which is often defined as the price, in terms of cash or equivalent, that a buyer could reasonably be expected to pay, and a seller could reasonably be expected to accept, if the business were exposed for sale on the open market for a reasonable period of time, with both buyer and seller being in possession of the pertinent facts and neither being under any compulsion to act.

There are several commonly used and internationally accepted methods for determining the fair value of companies, which have been considered in the present case, to the extent relevant and applicable. Accordingly, we have carried out valuation of the SPVs as on 31 March 2023.
It should be understood that the valuation of any company or its assets is inherently subjective and is subject to certain uncertainties and contingencies, all of which are difficult to predict and are beyond our control. In performing our analysis, we made assumptions with respect to industry performance and general business and economic conditions, many of which are beyond the control of the SPVs. In addition, this valuation will fluctuate with changes in prevailing market conditions, the conditions and prospects, financial and otherwise, of the SPVs, and other factors which generally influence the valuation analysis.

The application of any particular method of valuation depends on the purpose for which the valuation is done. Although different values may exist for different purposes, it cannot be too strongly emphasized that a valuer can only arrive at one value for one purpose. Our choice of methodology of valuation has been arrived at using usual and conventional methodologies adopted for transactions of a similar nature and our reasonable judgment, in an independent and bona fide manner is based on our previous experience of assignments of a similar nature.

We have estimated the fair value of equity of the InvIT using Sum of the Parts ("Sum of the Parts") method by adding the individual EV of each SPV and adjusting with below the line items of the Unaudited Consolidated financial statements of the Trust as on 31 March 2023. EV of each SPV has been estimated using DCF method under the income approach.

In respect of going concerns, certain valuation techniques have evolved over time and are commonly in vogue. These can be broadly categorised as follows:

Comparable Companies Market Multiple ("CCM") Method

Under this method, the value of the equity shares of a company/ business undertaking is arrived at by using multiples derived from valuations of comparable companies, as apparent through stock market valuations of listed companies. This valuation is based on the principle that market valuations, taking place between informed buyers and informed sellers, incorporate all factors relevant for the assessment of the value of the company.

Relevant multiples need to be chosen carefully and adjusted for differences between the circumstances. In identifying the comparable companies, the business description and various operating metrics were analysed.

We have not considered this method in our valuation analysis in the absence of closely comparable listed companies having similar geographical locations, stage of growth, size, terms and profitability. Further, road tolling assets are finite life assets having unique revenue drivers like unexpired concession period, traffic expected at those specified tolls being the major idiosyncratic variables. Further every company has a variety of such unique road tolling assets which makes the overall company even more specific. This makes every road toll asset unique and hence unless a comparable road toll asset ca be found that matches all such variables, comparable companies method shall not be relevant. In the current situation, we could not find any such companies in the

listed space that was comparable in the light of the above explained factors and hence CCM Method was not applied.

Comparable Companies Transaction Multiple ("CTM") Method

Under the CTM method, the value of the equity shares of a company/ business undertaking is arrived at by using the prices implied by reported transactions/ deals of comparable companies.

Relevant multiples need to be chosen carefully and adjusted for differences between the circumstances.

Road tolling assets are finite life assets having unique revenue drivers like unexpired concession period, traffic expected at those specified tolls being the major idiosyncratic variables. Further every company has a variety of such unique road tolling assets which makes the overall company even more specific. This makes every road toll asset unique and hence unless a comparable road toll asset transaction ca be found that matches all such variables, comparable transactions method shall not be relevant. In the current situation, we could not find any such transactions in the last one year, we believe that the older transactions are not relevant for our valuation considering share price movements and changes in the macro-economic situation in India. Also, transactions multiples as times tend to be biased due to premium which may be embedded in the price for strategic benefits and synergies which an acquirer may perceive in the target.

Accordingly, we have not applied the Comparable Transactions Multiple Method for the valuation of the SPVs.

Net Asset Value (NAV) Method

The asset-based valuation technique is based on the value of the underlying net assets of the business either on a book value basis or realisable value basis or replacement cost basis. The cost approach assumes that a prudent investor would pay no more for an entity than the amount for which he could replace or re-create it or an asset with similar utility. Under a going-concern premise, the cost approach usually is best suited for use in valuing asset-intensive companies, such as investment or real estate holding companies, or companies with unstable or unpredictable earnings.

In the present case of valuing the SPVs, we have not considered this method as the underlying earnings are fairly stable, and a going concern business plan has been provided by the Management. Further, in the extant case, the entire business is based on finite period cash flow generation and a cost approach would not capture the present value of such expected cash flow as cost approach is not forward looking.

Discounted Cash Flows (DCF) Method

DCF method has been considered suitable to value road projects because cash flow for such assets is the base premise of such assets based on revenue drivers like concession period awarded, expected traffic on the specific road asset and inflation-based price increase DCF is a method that shall ensure capturing such idiosyncratic features and hence has been considered suitable for the current valuation and has been applied.

Under the DCF method, the projected free cash flows to the firm are discounted at the weighted average cost of capital. The sum of the discounted value of such free cash flows is the value of the firm.

Using the DCF analysis involves determining the following:

Estimating future free cash flows:

Free cash flows are the cash flows expected to be generated by the company that is available to all

providers of the company's capital — both debt and equity.

Appropriate discount rate to be applied to cash flows, i.e., the cost of capital:

This discount rate, which is applied to the free cash flows, should reflect the opportunity cost to all the capital providers (namely shareholders and creditors), weighted by their relative contribution to the total capital of the company. The opportunity cost to the capital provider equals the rate of return the capital provider expects to earn on other investments of equivalent risk.

The value so computed by discounting the cash flows to the firm is adjusted for net borrowings, surplus asset including investments, minority interests, equity instruments granted as part of the share-based payment, and other matters to arrive at an aggregate equity value of the company.

In the present case, we have been provided with the financial projections of all the 10 SPVs. As such, we have considered this method for valuing the SPVs.

7. Valuation Analysis

Discounted Cash Flow Method (Free Cash Flows to Firm)

Using the DCF analysis involves determining the following:

Estimating future free cash flows:
Free cash flows are the cash flows expected to be generated by each individual SPV and available to the capital providers in each SPV has been estimated based on projected financial information provided by the Management. Projections provided by the Management are only the best estimates of each individual SPV's growth and sustainability of profitability margins. Although we have reviewed the financial forecast provided by the Management for consistency and reasonableness, we have not specifically validated these financial projections and have relied on the estimates provided by the Management.

Appropriate discount rate to be applied to cash flows i.e., the cost of capital:
This discount rate, which is applied to the free cash flows, should reflect the opportunity cost to all the capital providers (namely shareholders and creditors), weighted by their relative contribution to the total capital for each individual SPV. The opportunity cost to the capital provider equals the rate of return the capital provider expects to earn on other investments of equivalent risk.

Arriving at equity value from enterprise value:
The fair value basis of combined equity of the 10 SPVs for this purpose has been determined after taking into consideration all the factors and methodologies mentioned hereinabove. As explained above, we have given 100 per cent weightage to the DCF methodology to arrive at the EV of a specific SPV.

As a next step, we have adopted a sum-of-parts methodology and arrive at the EV for the entire portfolio of 10 SPVs. Later, we have then made adjustments for debt, debt-like-items, surplus assets, cash and cash equivalents and other adjustments at the Trust level and arrived at the value of 100 per cent interest in equity (on a control, marketable basis) for the Trust.

The key assumptions under the DCF Method

For the DCF analysis, we have relied on the projected financials of the SPVs provided by the Management based on their best estimates on the growth and sustainability of profitability margins of the individual SPVs. Please note that though we have reviewed the financial forecast provided by the Management for consistency and reasonableness based on data available in public domain and

traffic consultant reports provided by the Management for each SPV, we have not independently investigated or otherwise verified the data and key inputs estimated by the Management for all the 10 SPVs. Nothing has come to our attention to indicate that the information provided by the Management had material misstatements or would not afford reasonable grounds upon which to base our Report. The Free Cash Flows to Firm ("FCFF") have been calculated for each individual SPV as on the Valuation Date based on the Financial Projections.

The key assumptions and the basis for the valuation are explained in detail below:

Discounting Factor

The discount rate considered for arriving at the present value of the free cash flows to the firm is the Weighted Average Cost of Capital ("WACC"). The WACC for the SPVs as on the Valuation Date are derived as follows:

WACC= (ke x we) + (kd x (1 – t) x wd)
where,
we = weight of equity in the capital structure

wd = weight of debt in the capital structure

ke = cost of equity

kd = cost of debt, and

t = effective tax rate

Cost of Equity ("ke")

The cost of equity is computed using the Capital Asset Pricing Model (CAPM) as shown below:

ke = rf + β (rm-rf) where

ke = Cost of Equity,

rf = Risk Free Return,

β = Beta, a measure of Market Risk

rm = Market Return

Cost of Equity is estimated using the following factors:

- Risk Free Return (rf) – The risk-free rate (rf) is the return on investment with zero risk where actual returns are equal to the expected return. Rf at 7.17 per cent has been considered for each SPV based on the 10 Year normalized Wholesale Debt Market Zero Coupon Bond Yield as of the Valuation Date

- Beta (β) – Beta has been computed by re-levering the average asset beta of comparable companies. Beta has been considered based on 2 year weekly trailing Beta of comparable companies, relevered for each of the SPV specific debt to equity ratio and effective taxes. Refer to Appendix X for a list of comparable companies.

- Debt to Equity Ratio (DER) – The DER of peers displays significant variation owing to the difference in the stage of operations and maturity. Accordingly, DER was concluded based

on management input for the debt-to-equity ratio of each individual SPV over the projected period.

- Income Tax – Effective tax rate has been applied after considering 80IA and 35AD benefits and applicable MAT credit (if any) in the projected period as represented to us by the Management for each SPV.

- Equity Risk Premium (ERP) – ERP is considered at 7.25 per cent for each SPV.

- Alpha - Alpha premium for each individual SPV is based on the valuer's assessment and reflects idiosyncratic risks. Idiosyncratic risks considered are combination of operational parameters like construction phase and credit parameters like credit rating.

Cost of Debt ("kd")

Marginal cost of raising debt for each SPV is considered based on Management input. Management has represented that for 9 SPVs debt can be refinanced at 8.75 per cent per annum and for PDTPL the debt can be refinanced at 9.0 per cent per annum.

Other notes

- Mid-year convention in arriving at the present value of free cash flows is considered appropriate.
- Management has represented that the probability of devolvement of contingent liabilities is insignificant and accordingly no adjustment was required to be carried out in the valuation of the 10 SPVs.

Debt: There are external borrowing of INR 10,508.0 crores on the combined balance sheet of the Trust. This has been reduced from the combined EV for the computation of equity value the Trust.

Surplus assets: There are interest accrued on fixed deposits, interest receivable from bank, advance income tax and investments which are a part of the current assets of the Trust. Such items have been considered as surplus assets and have accordingly been removed from current assets. The combined value of such surplus assets is INR 132.3 crores. This has been added to the combined EV for the computation of equity value of the Trust.

Cash and cash equivalents: There are approximately INR 74.8 crores of cash and cash equivalent on the Trust combined balance sheet. This has been added to the combined EV for the computation of equity value of the Trust.

Other adjustments: Present Value of standalone expenses pertaining to InvIT as on 31 March 2023 amounts to INR 158.3 crores. This has been reduced from the combined EV for the computation of the equity value of the Trust.

8. Valuation of the SPVs

8.1 IRB Westcoast Tollway Limited

Key Inputs in Projections:
The key inputs of the projections provided by the Management supported by independent traffic as follows:

a) Revenue

Revenue is expected to grow at an average rate of 10 per cent-11 per cent in the steady state forecasted period based on the financial plan provided by management which is based on a traffic study.

b) Traffic Volume

Traffic volume as received from the Management supported by traffic study report carried out by GMD Consultants dated April 2023 are considered.

c) Toll rates

- Toll rates have been estimated as per the recent MoRTH notification and Schedule R of the contract agreement. Factor of inflation/growth has been incorporated as per Schedule R. Increase in WPI was calculated based on the WPI numbers based on the latest year number provided by RBI and the forecast are based on the numbers estimated in annual report published by Consensus.

- WPI has been projected to grow by 5 per cent for the projected period.

d) Periodic Maintenance & Routine Maintenance Costs

Estimates for projected Periodic Maintenance & Routine Maintenance cost from the Management are considered.

DCF Method:

- The key assumptions and other key inputs, mentioned on the previous paragraphs, as provided by the Management are considered in the projections.

- The projections provided by the Management, based on Independent traffic, are only the best estimates of growth and sustainability of profitability margins. The financial forecast provided by the Management was reviewed for consistency and reasonableness and have relied on them.

- The explicit period has been considered from 01 April 2023 to 06 February 2048.

- The tax has been calculated as per the provisions of the Income Tax Act, 1961. The interest expense is adjusted in the same for arriving at the tax computation under FCFF.

- The assumptions for Weighted average cost of capital is as follows:

WACC calculation		
		Basis
Risk free rate of return	*7.2%*	10yrs ZCYC as at 31 March 2023
India risk premium	*7.3%*	Incwert Analysis
Beta	0.8	Peer median of 2 yr weekly beta
Alpha	*0.5%*	Valuer judgement
Cost of Equity	***13.4%***	
Cost of Debt	*8.8%*	Management input
Tax Rate	*17.5%*	Rates as per IT Act as applicable here
After Tax Cost of Debt	***7.2%***	
Debt/Equity	*150.0%*	Management input
Debt to Capital %	*60.0%*	
Equity to Capital %	*40.0%*	
Weighted Average Cost of Capital	***9.7%***	
Marginal tax rate	*17.5%*	*MAT rates as per IT applicable here*

- The Business/ Enterprise Value of IWTL as on 31 March 2023 is arrived at INR 3,569.8 crores.

Discounted cash flow

INR crores	FY2024 12 months	FY2025 12 months	FY2026 12 months	FY2027 12 months	FY2028 12 months	FY2029 12 months	FY2030 12 months	FY2031 12 months	FY2032 12 months	FY2033 12 months	FY2034 12 months
Net Revenue	158.6	193.8	217.0	243.0	272.0	302.8	337.6	375.2	416.6	461.4	512.9
yoy growth	*33.6%*	*23.4%*	*12.0%*	*12.0%*	*11.9%*	*11.3%*	*11.5%*	*11.2%*	*11.0%*	*10.7%*	*11.2%*
EBITDA	**91.9**	**124.6**	**189.2**	**212.8**	**242.0**	**161.3**	**265.1**	**342.3**	**382.6**	**424.8**	**465.0**
EBITDA margin	*58%*	*64%*	*87%*	*88%*	*89%*	*53%*	*79%*	*91%*	*92%*	*92%*	*91%*
Depreciation	23.7	27.7	31.0	34.7	38.9	43.3	48.2	50.0	48.6	46.0	42.2
EBIT	**68.3**	**96.9**	**158.2**	**178.1**	**203.2**	**118.0**	**216.8**	**292.3**	**334.0**	**378.8**	**422.8**
EBIT margin	*43%*	*50%*	*73%*	*73%*	*75%*	*39%*	*64%*	*78%*	*80%*	*82%*	*82%*
Less: tax on EBIT	(11.9)	(16.9)	(27.6)	(31.1)	(35.5)	(20.6)	(37.9)	(51.1)	(58.4)	(66.2)	(73.9)
Change in working capital	35.2	-	-	-	-	-	-	-	-	-	-
Capex	(20.0)	-	-	-	-	-	-	-	-	-	-
Free cash flows to the Firm	**95.2**	**107.6**	**161.6**	**181.7**	**206.5**	**140.7**	**227.2**	**291.2**	**324.2**	**358.6**	**391.1**
Continuing value											
Discounting period (mid-period)	0.50	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.50	9.50	10.50
Discount factor	0.95	0.87	0.79	0.72	0.66	0.60	0.55	0.50	0.46	0.41	0.38
Present value of cash flows as at 31 March 2023	**90.9**	**93.7**	**128.2**	**131.4**	**136.1**	**84.5**	**124.4**	**145.4**	**147.6**	**148.8**	**147.9**

Discounted cash flow

INR crores	FY2035 12 months	FY2036 12 months	FY2037 12 months	FY2038 12 months	FY 2039 12 months	FY2040 12 months	FY2041 12 months	FY2042 12 months	FY2043 12 months	FY2044 12 months	FY2045 12 months	FY2046 12 months	FY2047 12 months	FY2048 10.3months
Net Revenue	570.7	632.4	699.1	775.5	859.4	956.5	1058.4	1172.4	1303.9	1450.5	1607.3	1783.1	1972.9	1869.0
yoy growth	*11.3%*	*10.8%*	*10.5%*	*10.9%*	*10.8%*	*11.3%*	*10.7%*	*10.8%*	*11.2%*	*11.2%*	*10.8%*	*10.9%*	*10.6%*	*n/m*
EBITDA	**367.2**	**592.4**	**660.0**	**735.5**	**669.9**	**861.1**	**1,014.2**	**1,125.9**	**1,255.2**	**1,399.2**	**1,553.6**	**1,726.7**	**1,913.7**	**1,815.8**
EBITDA margin	*64%*	*94%*	*94%*	*95%*	*78%*	*90%*	*96%*	*96%*	*96%*	*96%*	*97%*	*97%*	*97%*	*97%*
Depreciation	36.7	30.0	33.2	36.8	40.8	45.4	50.2	55.6	61.8	68.8	76.2	84.6	93.6	88.6
EBIT	**330.5**	**562.4**	**626.9**	**698.7**	**629.1**	**815.7**	**964.0**	**1,070.3**	**1,193.4**	**1,330.4**	**1,477.4**	**1,642.1**	**1,820.1**	**1,727.2**
EBIT margin	*58%*	*89%*	*90%*	*90%*	*73%*	*85%*	*91%*	*91%*	*92%*	*92%*	*92%*	*92%*	*92%*	*92%*
Less: tax on EBIT	(57.7)	(98.3)	(109.5)	(122.1)	(109.9)	(142.5)	(168.4)	(187.0)	(208.5)	(232.5)	(348.7)	(413.3)	(458.1)	(434.7)
Change in working capital	-	-	-	-	-	-	-	-	-	-	-	-	-	(0.2)
Capex	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Free cash flows to the Firm	**309.5**	**494.1**	**550.5**	**613.4**	**560.0**	**718.6**	**845.7**	**938.9**	**1,046.7**	**1,166.8**	**1,204.9**	**1,313.4**	**1,455.6**	**1,380.9**
Continuing value														
Discounting period (mid-period)	11.50	12.50	13.50	14.50	15.50	16.50	17.50	18.50	19.50	20.50	21.50	22.50	23.50	24.43
Discount factor	0.34	0.31	0.29	0.26	0.24	0.22	0.20	0.18	0.16	0.15	0.14	0.12	0.11	0.10
Present value of cash flows as at 31 March 2023	**106.7**	**155.3**	**157.7**	**160.2**	**133.3**	**155.9**	**167.3**	**169.3**	**172.0**	**174.8**	**164.5**	**163.5**	**165.2**	**143.8**

Valuation Conclusion	
Present value of cash flows	3,568.1
Present value of terminal value	-
Release of WC at the end of concession period	1.7
Enterprise value	**3,569.8**

8.2 Solapur Yedeshi Tollway Limited

Key Inputs in Projections:
The key inputs of the projections provided by the Management supported by independent traffic as follows:

a) Revenue

Revenue is expected to grow at an average rate of 10 per cent- 11 per cent in the steady state forecasted period based on the financial plan provided by management which is based on a traffic study.

b) Traffic Volume

Traffic volume as received from the Management supported by traffic study report carried out by GMD Consultants dated April 2023 are considered.

c) Toll rates

- Toll rates have been estimated as per the recent MoRTH notification and Schedule R of the contract agreement. Factor of inflation/growth has been incorporated as per Schedule R. Increase in WPI was calculated based on the WPI numbers are based on the latest year number provided by RBI and the forecast are based on the numbers estimated in annual report published by Consensus

- WPI has been projected to grow by 5 per cent for the projected period.

d) Periodic Maintenance & Routine Maintenance Costs

Estimates for projected Periodic Maintenance & Routine Maintenance cost from the Management are considered.

DCF Method:

- The key assumptions and other key inputs, mentioned on the previous paragraphs, as provided by the Management are considered in the projections.

- The projections provided by the Management, based on Independent traffic and technical studies, are only the best estimates of growth and sustainability of profitability margins. The financial forecast provided by the Management was reviewed for consistency and reasonableness and have relied on them.

- The explicit period has been considered from 01 April 2023 to 20 April 2044.

- The tax has been calculated as per the provisions of the Income Tax Act, 1961. The interest expense is adjusted in the same for arriving at the tax computation under FCFF.

- The assumptions for Weighted average cost of capital is as follows:

WACC calculation		
		Basis
Risk free rate of return	*7.2%*	10yrs ZCYC as at 31 March 2023
India risk premium	*7.3%*	Incwert Analysis
Beta	0.8	Peer median of 2 yr weekly beta
Alpha	*0.5%*	Valuer judgement
Cost of Equity	***13.4%***	
Cost of Debt	*8.8%*	Management input
Tax Rate	*17.5%*	Rates as per IT Act as applicable here
After Tax Cost of Debt	***7.2%***	
Debt/Equity	*150.0%*	Management input
Debt to Capital %	*60.0%*	
Equity to Capital %	*40.0%*	
Weighted Average Cost of Capital	***9.7%***	
Marginal tax rate	*17.5%*	*MAT rates as per IT applicable here*

- The Business/ Enterprise Value of SYTL as on 31 March 2023 is arrived at INR 2,385.3 crores.

Discounted cash flow												
	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032	FY2033	FY2034	FY2035
INR crores	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months
Net Revenue	139.8	154.5	170.7	188.7	211.0	232.8	258.2	286.3	318.7	354.4	392.0	437.9
yoy growth	*6.1%*	*11.1%*	*11.3%*	*11.3%*	*12.0%*	*10.4%*	*11.0%*	*10.9%*	*11.4%*	*11.2%*	*10.6%*	*11.8%*
EBITDA	**121.9**	**123.3**	**131.8**	**147.8**	**189.3**	**210.1**	**234.4**	**261.3**	**292.4**	**265.7**	**298.8**	**340.2**
EBITDA margin	*87%*	*80%*	*77%*	*78%*	*90%*	*90%*	*91%*	*91%*	*92%*	*75%*	*76%*	*78%*
Depreciation	17.9	19.9	22.2	24.7	27.6	30.5	33.9	37.6	41.8	46.5	51.5	57.5
EBIT	**104.0**	**103.4**	**109.6**	**123.1**	**161.7**	**179.6**	**200.5**	**223.7**	**250.5**	**219.1**	**247.3**	**282.6**
EBIT margin	*74%*	*67%*	*64%*	*65%*	*77%*	*77%*	*78%*	*78%*	*79%*	*62%*	*63%*	*65%*
Less: tax on EBIT	(18.2)	(18.1)	(19.1)	(21.5)	(28.3)	(31.4)	(35.0)	(39.1)	(43.8)	(38.3)	(43.2)	(49.4)
Change in working capital	0.5	12.6	19.4	11.8	0.8	0.8	(2.1)	(1.9)	(1.5)	(1.3)	1.8	1.8
Capex	-	-	-	-	-	-	-	-	-	-	-	-
Free cash flows to the Firm	**104.3**	**117.8**	**132.0**	**138.0**	**161.9**	**179.4**	**197.3**	**220.3**	**247.1**	**226.1**	**257.3**	**292.5**
Continuing value												
Discounting period (mid-period)	0.50	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.50	9.50	10.50	11.50
Discount factor	0.95	0.87	0.79	0.72	0.66	0.60	0.55	0.50	0.46	0.41	0.38	0.34
Present value of cash flows as at 31 March 2023	**99.5**	**102.5**	**104.7**	**99.8**	**106.7**	**107.8**	**108.1**	**110.0**	**112.5**	**93.8**	**97.3**	**100.8**

Discounted cash flow										
	FY2036	FY2037	FY2038	FY 2039	FY2040	FY2041	FY2042	FY2043	FY2044	FY2045
INR crores	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	0.7months
Net Revenue	485.8	537.3	594.3	660.2	732.9	808.6	894.2	988.0	1099.5	66.6
yoy growth	*11.0%*	*10.6%*	*10.6%*	*11.1%*	*11.0%*	*10.4%*	*10.6%*	*10.7%*	*11.3%*	*n/m*
EBITDA	**453.9**	**503.9**	**559.2**	**623.3**	**694.1**	**768.0**	**809.3**	**898.9**	**1,005.8**	**63.9**
EBITDA margin	*93%*	*94%*	*94%*	*94%*	*95%*	*95%*	*91%*	*91%*	*91%*	*96%*
Depreciation	63.9	70.7	78.2	86.9	96.5	106.5	117.8	130.4	145.1	8.8
EBIT	**390.0**	**433.2**	**481.0**	**536.4**	**597.6**	**661.5**	**691.5**	**768.5**	**860.7**	**55.1**
EBIT margin	*80%*	*81%*	*81%*	*81%*	*82%*	*82%*	*77%*	*78%*	*78%*	*83%*
Less: tax on EBIT	(68.1)	(75.7)	(84.0)	(93.7)	(104.4)	(115.6)	(120.8)	(134.3)	(150.4)	(9.6)
Change in working capital	1.8	(3.9)	2.3	(0.5)	2.6	2.7	30.7	-	-	-
Capex	-	-	-	-	-	-	-	-	-	-
Free cash flows to the Firm	**387.6**	**424.3**	**477.4**	**529.0**	**592.2**	**655.1**	**719.2**	**764.7**	**855.4**	**54.2**
Continuing value										
Discounting period (mid-period)	12.50	13.50	14.50	15.50	16.50	17.50	18.50	19.50	20.50	21.03
Discount factor	0.31	0.29	0.26	0.24	0.22	0.20	0.18	0.16	0.15	0.14
Present value of cash flows as at 31 March 2023	**121.8**	**121.5**	**124.7**	**125.9**	**128.5**	**129.6**	**129.7**	**125.7**	**128.1**	**7.7**

Valuation Conclusion	
Present value of cash flows	2,386.6
Present value of terminal value	-
Release of WC at the end of concession period	(1.3)
Enterprise value	**2,385.3**

8.3 Yedeshi Aurangabad Tollway Limited

Key Inputs in Projections:
The key inputs of the projections provided by the Management supported by independent traffic reports as follows:

a) Revenue

Revenue is expected to grow at an average rate of 8 per cent- 9 per cent in the steady state forecasted period based on the financial plan provided by management which is based on a traffic study.

b) Traffic Volume

Traffic volume as received from the Management supported by the traffic study report carried out by GMD Consultants dated April 2023 are considered.

c) Toll rates

- Toll rates have been estimated as per the recent MoRTH notification and Schedule R of the contract agreement. Factor of inflation/growth has been incorporated as per Schedule R. Increase in WPI was calculated based on the WPI numbers are based on the latest year number provided by RBI and the forecast are based on the numbers estimated in annual report published by Consensus.

- WPI has been projected to grow by 5 per cent for the projected period.

d) Periodic Maintenance & Routine Maintenance Costs

Estimates for projected Periodic Maintenance & Routine Maintenance cost from the Management are considered.

DCF Method:

- The key assumptions and other key inputs, mentioned on the previous paragraphs, as provided by the Management are considered in the projections.

- The projections provided by the Management, based on Independent traffic and technical studies, are only the best estimates of growth and sustainability of profitability margins. The financial forecast provided by the Management was reviewed for consistency and reasonableness and have relied on them.

- The explicit period has been considered from 01 April 2023 to 13 February 2044.

- The tax has been calculated as per the provisions of the Income Tax Act, 1961. The interest expense is adjusted in the same for arriving at the tax computation under FCFF.

- The assumptions for Weighted average cost of capital is as follows:

WACC calculation		
		Basis
Risk free rate of return	7.2%	10yrs ZCYC as at 31 March 2023
India risk premium	7.3%	Incwert Analysis
Beta	0.8	Peer median of 2 yr weekly beta
Alpha	0.5%	Valuer judgement
Cost of Equity	**13.4%**	
Cost of Debt	8.8%	Management input
Tax Rate	17.5%	Rates as per IT Act as applicable here
After Tax Cost of Debt	**7.2%**	
Debt/Equity	150.0%	Management input
Debt to Capital %	60.0%	
Equity to Capital %	40.0%	
Weighted Average Cost of Capital	**9.7%**	
Marginal tax rate	17.5%	*MAT rates as per IT applicable here*

- The Business/ Enterprise Value of YATL as on 31 March 2023 is arrived at INR 4,143.1 crores.

Discounted cash flow

INR crores	FY2024 12 months	FY2025 12 months	FY2026 12 months	FY2027 12 months	FY2028 12 months	FY2029 12 months	FY2030 12 months	FY2031 12 months	FY2032 12 months	FY2033 12 months	FY2034 12 months	FY2035 12 months
Net Revenue	273.5	302.8	330.6	361.8	399.2	435.3	477.0	519.5	568.4	617.8	674.0	734.6
yoy growth	*4.6%*	*11.3%*	*9.9%*	*10.1%*	*9.9%*	*9.2%*	*9.7%*	*9.0%*	*9.5%*	*8.8%*	*9.2%*	*9.1%*
EBITDA	**248.7**	**252.5**	**272.9**	**301.2**	**369.2**	**403.9**	**444.0**	**484.8**	**531.8**	**469.8**	**518.5**	**571.6**
EBITDA margin	*91%*	*83%*	*83%*	*83%*	*92%*	*93%*	*93%*	*93%*	*94%*	*76%*	*77%*	*78%*
Depreciation	58.7	65.3	71.8	79.0	86.8	94.9	104.1	113.5	124.2	135.1	147.5	161.0
EBIT	190.0	187.2	201.1	222.1	282.4	309.0	339.9	371.4	407.6	334.6	371.0	410.6
EBIT margin	*69%*	*62%*	*61%*	*61%*	*71%*	*71%*	*71%*	*71%*	*72%*	*54%*	*55%*	*56%*
Less: tax on EBIT	(33.2)	(32.7)	(35.1)	(38.8)	(49.3)	(54.0)	(59.4)	(64.9)	(71.2)	(58.5)	(64.8)	(71.7)
Change in working capital	(1.7)	24.4	30.5	(26.0)	3.3	3.1	(4.0)	(3.2)	(1.7)	(0.9)	7.2	7.0
Capex	-	-	-	-	-	-	-	-	-	-	-	-
Free cash flows to the Firm	**213.9**	**244.3**	**268.3**	**236.4**	**323.2**	**353.0**	**380.6**	**416.7**	**458.9**	**410.4**	**460.9**	**506.9**
Continuing value												
Discounting period (mid-period)	0.50	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.50	9.50	10.50	11.50
Discount factor	0.95	0.87	0.79	0.72	0.66	0.60	0.55	0.50	0.46	0.41	0.38	0.34
Present value of cash flows as at 31 March 2023	**204.2**	**212.5**	**212.8**	**170.9**	**213.0**	**212.1**	**208.5**	**208.1**	**208.8**	**170.2**	**174.3**	**174.7**

Discounted cash flow

INR crores	FY2036 12 months	FY2037 12 months	FY2038 12 months	FY 2039 12 months	FY2040 12 months	FY2041 12 months	FY2042 12 months	FY2043 12months	FY2044 10months
Net Revenue	800.6	868.6	946.7	1030.3	1124.6	1222.6	1330.6	1446.4	1382.4
yoy growth	*9.1%*	*8.6%*	*9.0%*	*8.9%*	*9.2%*	*8.8%*	*8.9%*	*9.0%*	*-4.4%*
EBITDA	**756.3**	**822.3**	**898.1**	**979.2**	**1,010.5**	**1,103.1**	**1,205.0**	**1,384.3**	**1,317.1**
EBITDA margin	*94%*	*95%*	*95%*	*95%*	*90%*	*90%*	*91%*	*96%*	*95%*
Depreciation	175.6	190.8	207.9	226.5	247.4	269.1	293.1	319.6	305.5
EBIT	580.7	631.6	690.2	752.7	763.1	833.9	911.9	1,064.8	1,011.7
EBIT margin	*73%*	*73%*	*73%*	*73%*	*68%*	*68%*	*69%*	*74%*	*73%*
Less: tax on EBIT	(101.5)	(110.3)	(120.6)	(131.5)	(133.3)	(145.7)	(159.3)	(186.0)	(176.8)
Change in working capital	7.3	(7.0)	9.2	2.1	10.3	6.7	84.9	-	-
Capex	-	-	-	-	-	-	-	-	-
Free cash flows to the Firm	**662.2**	**705.0**	**786.7**	**849.8**	**887.5**	**964.0**	**1,130.6**	**1,198.3**	**1,140.4**
Continuing value									
Discounting period (mid-period)	12.50	13.50	14.50	15.50	16.50	17.50	18.50	19.50	20.44
Discount factor	0.31	0.29	0.26	0.24	0.22	0.20	0.18	0.16	0.15
Present value of cash flows as at 31 March 2023	**208.1**	**201.9**	**205.4**	**202.2**	**192.5**	**190.7**	**203.8**	**196.9**	**171.8**

Valuation Conclusion	
Present value of cash flows	4,143.6
Present value of terminal value	
Release of WC at the end of concession period	(0.5)
Enterprise value	**4,143.1**

8.4 Kaithal Tollway Limited

Key Inputs in Projections:
The key inputs of the projections provided by the Management supported by independent traffic study report as follows:

a) Revenue

Revenue is expected to grow at an average rate of 7 per cent- 8 per cent in the steady state forecasted period based on the financial plan provided by management which is based on traffic study.

b) Traffic Volume

Traffic volume as received from the Management supported by the traffic study report carried out by GMD Consultants dated April 2023 are considered.

c) Toll rates

- Toll rates have been estimated as per the recent MoRTH notification and Schedule R of the contract agreement. Factor of inflation/growth has been incorporated as per Schedule R. Increase in WPI was calculated based on the WPI numbers are based on the latest year number provided by RBI and forecast are based on the numbers estimated in annual report published by Consensus

- WPI has been projected to grow by 5 per cent for the projected period.

d) Periodic Maintenance & Routine Maintenance Costs

Estimates for projected Periodic Maintenance & Routine Maintenance cost from the Management are considered.

DCF Method:

- The key assumptions and other key inputs, mentioned on the previous paragraphs, as provided by the Management are considered in the projections.

- The projections provided by the Management, based on Independent traffic studies, are only the best estimates of growth and sustainability of profitability margins. The financial forecast provided by the Management were reviewed for consistency and reasonableness and have relied on them.

- The explicit period has been considered from 01 April 2023 to 06 February 2049

- The tax has been calculated as per the provisions of the Income Tax Act, 1961. The interest expense is adjusted in the same for arriving at the tax computation under FCFF.

- The assumptions for Weighted average cost of capital is as follows:

WACC calculation		
		Basis
Risk free rate of return	*7.2%*	10yrs ZCYC as at 31 March 2023
India risk premium	*7.3%*	Incwert Analysis
Beta	0.8	Peer median of 2 yr weekly beta
Alpha	*0.5%*	Valuer judgement
Cost of Equity	***13.4%***	
Cost of Debt	*8.8%*	Management input
Tax Rate	*17.5%*	Rates as per IT Act as applicable here
After Tax Cost of Debt	***7.2%***	
Debt/Equity	*150.0%*	Management input
Debt to Capital %	*60.0%*	
Equity to Capital %	*40.0%*	
Weighted Average Cost of Capital	***9.7%***	
Marginal tax rate	*17.5%*	*MAT rates as per IT applicable here*

- The Business/ Enterprise Value of KTL as on 31 March 2023 is arrived at INR 2,483.7 crores.

Discounted cash flow

INR crores	FY2024 12 months	FY2025 12 months	FY2026 12 months	FY2027 12 months	FY2028 12 months	FY2029 12 months	FY2030 12 months	FY2031 12 months	FY2032 12 months	FY2033 12 months	FY2034 12 months	FY2035 12 months
Net Revenue	165.4	178.3	194.3	211.9	230.6	249.8	271.5	294.1	319.5	345.8	374.2	405.9
yoy growth	*10.7%*	*8.3%*	*9.0%*	*9.1%*	*8.8%*	*8.3%*	*8.7%*	*8.3%*	*8.6%*	*8.3%*	*8.2%*	*8.4%*
EBITDA	**123.1**	**111.8**	**124.3**	**188.4**	**205.9**	**223.9**	**244.3**	**265.4**	**161.3**	**180.6**	**200.7**	**371.2**
EBITDA margin	*74%*	*63%*	*64%*	*89%*	*89%*	*90%*	*90%*	*90%*	*51%*	*52%*	*54%*	*91%*
Depreciation	23.5	25.4	27.7	30.2	32.9	35.6	38.7	42.0	45.6	49.3	53.4	57.9
EBIT	99.6	86.3	96.6	158.2	173.0	188.2	205.6	223.5	115.8	131.3	147.3	313.3
EBIT margin	*60%*	*48%*	*50%*	*75%*	*75%*	*75%*	*76%*	*76%*	*36%*	*38%*	*39%*	*77%*
Less: tax on EBIT	(17.4)	(15.1)	(16.9)	(27.6)	(30.2)	(32.9)	(35.9)	(39.0)	(20.2)	(22.9)	(25.7)	(54.7)
Change in working capital	14.5	-	-	-	-	-	-	-	-	-	-	-
Capex	-	-	-	-	-	-	-	-	-	-	-	-
Free cash flows to the Firm	**120.2**	**96.7**	**107.4**	**160.8**	**175.7**	**191.0**	**208.4**	**226.4**	**141.1**	**157.7**	**175.0**	**316.5**
Continuing value												
Discounting period (mid-period)	0.50	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.50	9.50	10.50	11.50
Discount factor	0.95	0.87	0.79	0.72	0.66	0.60	0.55	0.50	0.46	0.41	0.38	0.34
Present value of cash flows as at 31 March 2023	**114.7**	**84.1**	**85.2**	**116.2**	**115.8**	**114.8**	**114.1**	**113.0**	**64.2**	**65.4**	**66.2**	**109.1**

Discounted cash flow

INR crores	FY2036 12 months	FY2037 12 months	FY2038 12 months	FY 2039 12 months	FY2040 12 months	FY2041 12 months	FY2042 12 months	FY2043 12 months	FY2044 12 months	FY2045 12 months	FY2046 12 months	FY2047 12 months	FY2048 12 months	FY2049 10.3months
Net Revenue	440.4	475.6	514.3	557.6	605.9	654.4	707.1	763.9	828.7	894.1	967.8	1043.9	1084.3	1000.6
yoy growth	*8.5%*	*8.0%*	*8.1%*	*8.4%*	*8.6%*	*8.0%*	*8.1%*	*8.0%*	*8.5%*	*7.9%*	*8.2%*	*7.9%*	*3.9%*	*n/m*
EBITDA	**403.9**	**437.5**	**474.3**	**515.5**	**467.5**	**509.4**	**554.7**	**712.8**	**774.8**	**837.7**	**908.6**	**981.7**	**1,018.9**	**942.1**
EBITDA margin	*92%*	*92%*	*92%*	*92%*	*77%*	*78%*	*78%*	*93%*	*94%*	*94%*	*94%*	*94%*	*94%*	*94%*
Depreciation	62.8	67.9	73.4	78.0	76.4	82.5	89.2	96.4	104.5	112.8	122.1	131.7	136.8	126.2
EBIT	341.1	369.6	400.9	437.6	391.0	426.9	465.5	616.4	670.3	724.9	786.5	850.0	882.1	815.9
EBIT margin	*77%*	*78%*	*78%*	*78%*	*65%*	*65%*	*66%*	*81%*	*81%*	*81%*	*81%*	*81%*	*81%*	*82%*
Less: tax on EBIT	(59.6)	(64.6)	(70.0)	(76.5)	(68.3)	(74.6)	(81.3)	(107.7)	(117.1)	(126.7)	(137.4)	(148.5)	(203.2)	(205.3)
Change in working capital	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Capex	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Free cash flows to the Firm	**344.3**	**372.9**	**404.3**	**439.1**	**399.1**	**434.8**	**473.4**	**605.1**	**657.7**	**711.0**	**771.2**	**833.2**	**815.7**	**736.7**
Continuing value														
Discounting period (mid-period)	12.50	13.50	14.50	15.50	16.50	17.50	18.50	19.50	20.50	21.50	22.50	23.50	24.50	25.43
Discount factor	0.31	0.29	0.26	0.24	0.22	0.20	0.18	0.16	0.15	0.14	0.12	0.11	0.10	0.09
Present value of cash flows as at 31 March 2023	**108.2**	**106.8**	**105.6**	**104.5**	**86.6**	**86.0**	**85.3**	**99.4**	**98.5**	**97.1**	**96.0**	**94.5**	**84.4**	**69.9**

Valuation Conclusion	
Present value of cash flows	2,485.8
Present value of terminal value	-
Release of WC at the end of concession period	(2.1)
Enterprise value	**2,483.7**

8.5 AE Tollway Limited

Key Inputs in Projections:
The key inputs of the projections provided by the Management supported by an independent traffic study report as follows:

a) Revenue

Revenue is expected to grow at an average rate of 10 per cent- 11 per cent in the steady state forecasted period based on the traffic study report and financial plan provided by management.

b) Traffic Volume

Traffic volume as received from the Management supported by the traffic study report carried out by GMD Consultants dated April 2023 are considered.

c) Toll rates

- Toll rates have been estimated as per the recent MoRTH notification and Schedule R of the contract agreement. Factor of inflation/growth has been incorporated as per Schedule R. Increase in WPI was calculated based on the WPI numbers are based on the latest year number provided by RBI and the forecast are based on the numbers estimated in annual report published by Consensus.

- WPI has been projected to grow by 5 per cent for the projected period.

d) Periodic Maintenance & Routine Maintenance Costs

Estimates for projected Periodic Maintenance & Routine Maintenance cost from the Management are considered.

e) Premium Payable to NHAI

The Premium payable to NHAI is considered as given by the management and validated the same from concession agreement
.

DCF Method:

- The key assumptions and other key inputs, mentioned on the previous paragraphs, as provided by the Management are considered in the projections.

- The projections provided by the Management, based on an Independent traffic study, are only the best estimates of growth and sustainability of profitability margins. The financial forecast provided by the Management were reviewed for consistency and reasonableness and have relied on them.

- The explicit period has been considered from 01 April 2023 to 19 October 2045.

- The tax has been calculated as per the provisions of the Income Tax Act, 1961. The interest expense is adjusted in the same for arriving at the tax computation under FCFF.

- The assumptions for Weighted average cost of capital is as follows:

WACC calculation		
		Basis
Risk free rate of return	*7.2%*	10yrs ZCYC as at 31 March 2023
India risk premium	*7.3%*	Incwert Analysis
Beta	0.8	Peer median of 2 yr weekly beta
Alpha	*0.5%*	Valuer judgement
Cost of Equity	***13.4%***	
Cost of Debt	*8.8%*	Management input
Tax Rate	*17.5%*	Rates as per IT Act as applicable here
After Tax Cost of Debt	***7.2%***	
Debt/Equity	*150.0%*	Management input
Debt to Capital %	*60.0%*	
Equity to Capital %	*40.0%*	
Weighted Average Cost of Capital	***9.7%***	
Marginal tax rate	*17.5%*	*MAT rates as per IT applicable here*

- The Business/ Enterprise Value of AETL as on 31 March 2023 is arrived at INR 3,150.0 crores.

Discounted cash flow												
	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032	FY2033	FY2034	FY2035
INR crores	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months
Net Revenue	134.1	155.3	180.9	210.0	242.7	279.8	320.2	366.7	420.0	477.1	543.6	616.0
yoy growth	*12.5%*	*11.7%*	*11.5%*	*11.5%*	*11.6%*	*11.4%*	*11.2%*	*11.4%*	*11.7%*	*11.0%*	*11.5%*	*11.2%*
EBITDA	**64.3**	**76.9**	**98.4**	**166.5**	**197.0**	**232.0**	**270.0**	**190.7**	**234.8**	**283.5**	**482.6**	**552.0**
EBITDA margin	*48%*	*50%*	*54%*	*79%*	*81%*	*83%*	*84%*	*52%*	*56%*	*59%*	*89%*	*90%*
Depreciation	35.0	39.1	43.6	48.6	54.3	60.5	67.3	75.0	83.8	93.0	103.8	115.4
EBIT	29.2	37.8	54.8	117.9	142.7	171.5	202.7	115.7	151.0	190.5	378.8	436.6
EBIT margin	*22%*	*24%*	*30%*	*56%*	*59%*	*61%*	*63%*	*32%*	*36%*	*40%*	*70%*	*71%*
Less: tax on EBIT	(5.1)	(6.6)	(9.6)	(20.6)	(24.9)	(30.0)	(35.4)	(20.2)	(26.4)	(33.3)	(66.2)	(76.3)
Change in working capital	42.4	-	-	-	-	-	-	-	-	-	-	-
Capex	-	-	-	-	-	-	-	-	-	-	-	-
Free cash flows to the Firm	**101.6**	**70.3**	**88.8**	**145.9**	**172.0**	**202.0**	**234.6**	**170.5**	**208.4**	**250.2**	**416.4**	**475.7**
Continuing value												
Discounting period (mid-period)	0.50	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.50	9.50	10.50	11.50
Discount factor	0.95	0.87	0.79	0.72	0.66	0.60	0.55	0.50	0.46	0.41	0.38	0.34
Present value of cash flows as at 31 March 2023	**97.0**	**61.2**	**70.4**	**105.5**	**113.4**	**121.4**	**128.5**	**85.1**	**94.8**	**103.8**	**157.5**	**164.0**

Discounted cash flow											
	FY2036	FY2037	FY2038	FY 2039	FY2040	FY2041	FY2042	FY2043	FY2044	FY2045	FY2046
INR crores	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	6.6months
Net Revenue	693.4	774.7	865.3	967.6	1,087.1	1,195.6	1,323.6	1,458.4	1,615.4	1,778.4	1,075.7
yoy growth	*10.8%*	*10.1%*	*10.2%*	*10.4%*	*11.0%*	*9.0%*	*9.7%*	*9.3%*	*9.9%*	*9.2%*	*n/m*
EBITDA	**626.1**	**704.3**	**717.9**	**812.6**	**924.0**	**1,109.9**	**1,233.7**	**1,363.9**	**1,516.0**	**1,674.3**	**1,015.2**
EBITDA margin	*90%*	*91%*	*83%*	*84%*	*85%*	*93%*	*93%*	*94%*	*94%*	*94%*	*94%*
Depreciation	126.3	118.9	118.7	131.1	145.5	158.6	173.9	190.1	208.8	228.1	137.2
EBIT	499.7	585.4	599.1	681.4	778.5	951.3	1,059.8	1,173.9	1,307.2	1,446.1	878.0
EBIT margin	*72%*	*76%*	*69%*	*70%*	*72%*	*80%*	*80%*	*80%*	*81%*	*81%*	*82%*
Less: tax on EBIT	(87.3)	(102.3)	(104.7)	(119.1)	(136.0)	(166.2)	(185.2)	(211.5)	(329.0)	(364.0)	(221.0)
Change in working capital	-	-	-	-	-	-	-	-	-	-	-
Capex	-	-	-	-	-	-	-	-	-	-	-
Free cash flows to the Firm	**538.7**	**602.0**	**613.2**	**693.5**	**788.0**	**943.7**	**1,048.5**	**1,152.5**	**1,187.0**	**1,310.3**	**794.2**
Continuing value											
Discounting period (mid-period)	12.50	13.50	14.50	15.50	16.50	17.50	18.50	19.50	20.50	21.50	22.28
Discount factor	0.31	0.29	0.26	0.24	0.22	0.20	0.18	0.16	0.15	0.14	0.13
Present value of cash flows as at 31 March 2023	**169.3**	**172.4**	**160.1**	**165.1**	**171.0**	**186.6**	**189.0**	**189.4**	**177.8**	**178.9**	**100.9**

Valuation Conclusion	
Present value of cash flows	3,163.2
Present value of terminal value	-
Release of WC at the end of concession period	(13.2)
Enterprise value	**3,150.0**

8.6 Udaipur Tollway Limited

Key Inputs in Projections:
The key inputs of the projections provided by the Management supported by independent traffic and study report as follows:

a) Revenue

Revenue is expected to grow at an average rate of 9 per cent - 10 per cent in the steady state forecasted period based on the traffic study report and financial plan provided by management.

b) Traffic Volume

Traffic volume as received from the Management supported by the traffic study report carried out by GMD Consultants dated April 2023 are considered.

c) Toll rates

- Toll rates have been estimated as per the recent MoRTH notification and Schedule R of the contract agreement. Factor of inflation/growth has been incorporated as per Schedule R. Increase in WPI was calculated based on the WPI numbers are based on the latest year number provided by RBI and the forecast are based on the numbers estimated in annual report published by Consensus

- WPI has been projected to grow by 5 per cent for the projected period.

d) Periodic Maintenance & Routine Maintenance Costs

Estimates for projected Periodic Maintenance & Routine Maintenance cost from the Management are considered.

e) Premium Payable to NHAI

The Premium payable to NHAI is considered as given by the management and validated the same from concession agreement.

DCF Method:

- The key assumptions and other key inputs, mentioned on the previous paragraphs, as provided by the Management are considered in the projections.

- The projections provided by the Management, based on Independent traffic studies, are only the best estimates of growth and sustainability of profitability margins. The financial forecast provided by the Management were reviewed for consistency and reasonableness and have relied on them.

- The explicit period has been considered from 01 April 2023 to 13 February 2043.

- The tax has been calculated as per the provisions of the Income Tax Act, 1961. The interest expense is adjusted in the same for arriving at the tax computation under FCFF.

- The assumptions for Weighted average cost of capital is as follows:

WACC calculation		
		Basis
Risk free rate of return	*7.2%*	10yrs ZCYC as at 31 March 2023
India risk premium	*7.3%*	Incwert Analysis
Beta	0.8	Peer median of 2 yr weekly beta
Alpha	*0.5%*	Valuer judgement
Cost of Equity	***13.4%***	
Cost of Debt	*8.8%*	Management input
Tax Rate	*17.5%*	Rates as per IT Act as applicable here
After Tax Cost of Debt	***7.2%***	
Debt/Equity	*150.0%*	Management input
Debt to Capital %	*60.0%*	
Equity to Capital %	*40.0%*	
Weighted Average Cost of Capital	***9.7%***	
Marginal tax rate	*17.5%*	*MAT rates as per IT applicable here*

- The Business/ Enterprise Value of UTL as on 31 March 2023 is arrived at INR 2,661.8 crores.

Discounted cash flow												
INR crores	**FY2024** 12 months	**FY2025** 12 months	**FY2026** 12 months	**FY2027** 12 months	**FY2028** 12 months	**FY2029** 12 months	**FY2030** 12 months	**FY2031** 12 months	**FY2032** 12 months	**FY2033** 12 months	**FY2034** 12 months	**FY2035** 12 months
Net Revenue	144.6	173.2	204.9	241.1	279.6	311.9	348.2	386.3	429.2	473.4	526.3	581.4
yoy growth	*25.6%*	*10.5%*	*10.6%*	*10.8%*	*10.4%*	*10.0%*	*10.2%*	*9.8%*	*10.0%*	*9.3%*	*10.0%*	*9.6%*
EBITDA	**53.5**	**74.0**	**177.2**	**216.6**	**134.7**	**160.3**	**193.8**	**353.6**	**400.6**	**358.0**	**404.9**	**430.9**
EBITDA margin	*37%*	*43%*	*87%*	*90%*	*48%*	*51%*	*56%*	*92%*	*93%*	*76%*	*77%*	*74%*
Depreciation	42.7	47.2	52.2	57.8	63.8	70.2	77.4	85.0	93.5	102.2	112.4	123.2
EBIT	10.9	26.8	125.1	158.8	70.8	90.1	116.4	268.6	307.1	255.8	292.4	307.7
EBIT margin	*8%*	*15%*	*61%*	*66%*	*25%*	*29%*	*33%*	*70%*	*72%*	*54%*	*56%*	*53%*
Less: tax on EBIT	(1.9)	(4.7)	(21.9)	(27.7)	(12.4)	(15.7)	(20.3)	(46.9)	(53.7)	(44.7)	(51.1)	(53.8)
Change in working capital	(0.0)	-	-	-	-	-	-	-	-	-	-	38.9
Capex	-	-	-	-	-	-	-	-	-	-	-	-
Free cash flows to the Firm	**51.6**	**69.3**	**155.4**	**188.8**	**122.3**	**144.6**	**173.5**	**306.7**	**346.9**	**313.3**	**353.8**	**416.0**
Continuing value												
Discounting period (mid-period)	0.50	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.50	9.50	10.50	11.50
Discount factor	0.95	0.87	0.79	0.72	0.66	0.60	0.55	0.50	0.46	0.41	0.38	0.34
Present value of cash flows as at 31 March 2023	**49.3**	**60.3**	**123.3**	**136.6**	**80.6**	**86.9**	**95.0**	**153.1**	**157.9**	**130.0**	**133.8**	**143.4**

Discounted cash flow								
INR crores	**FY2036** 12 months	**FY2037** 12 months	**FY2038** 12 months	**FY 2039** 12 months	**FY 2040** 12 months	**FY 2041** 12 months	**FY 2042** 12 months	**FY 2043** 10.5months
Net Revenue	640.3	703.2	773.7	851.6	940.3	1,022.9	1,119.4	1,069.8
yoy growth	*9.7%*	*9.1%*	*9.3%*	*9.3%*	*9.7%*	*8.4%*	*8.9%*	*n/m*
EBITDA	**608.3**	**670.4**	**740.3**	**816.5**	**903.6**	**984.3**	**1,080.6**	**1,041.5**
EBITDA margin	*95%*	*95%*	*96%*	*96%*	*96%*	*96%*	*97%*	*97%*
Depreciation	135.1	147.4	161.1	176.1	193.2	209.4	228.2	217.1
EBIT	473.2	523.0	579.3	640.4	710.4	774.9	852.4	824.3
EBIT margin	*74%*	*74%*	*75%*	*75%*	*76%*	*76%*	*76%*	*77%*
Less: tax on EBIT	(82.7)	(91.4)	(101.2)	(111.9)	(124.1)	(135.4)	(148.9)	(144.0)
Change in working capital	-	-	-	-	-	-	-	-
Capex	-	-	-	-	-	-	-	-
Free cash flows to the Firm	**525.6**	**579.0**	**639.1**	**704.6**	**779.4**	**848.9**	**931.6**	**897.4**
Continuing value								
Discounting period (mid-period)	12.50	13.50	14.50	15.50	16.50	17.50	18.50	19.44
Discount factor	0.31	0.29	0.26	0.24	0.22	0.20	0.18	0.17
Present value of cash flows as at 31 March 2023	**165.2**	**165.8**	**166.9**	**167.7**	**169.1**	**167.9**	**168.0**	**148.3**

Valuation Conclusion	
Present value of cash flows	2,669.0
Present value of terminal value	-
Release of WC at the end of concession period	(7.2)
Enterprise value	**2,661.8**

8.7 CG Tollway Limited

Key Inputs in Projections:
The key inputs of the projections provided by the Management supported by an independent traffic study report as follows:

a) Revenue

Revenue is expected to grow at an average rate of 8 per cent- 9 per cent in the steady state forecasted period based on the traffic study report and financial plan provided by management.

b) Traffic Volume

Traffic volume as received from the Management supported by the traffic study report carried out by GMD Consultants dated April 2023 are considered.

c) Toll rates

- Toll rates have been estimated as per the recent MoRTH notification and Schedule R of the contract agreement. Factor of inflation/growth has been incorporated as per Schedule R. Increase in WPI was calculated based on the WPI numbers are based on the latest year number provided by RBI and the forecast are based on the numbers estimated in annual report published by Consensus.

- WPI has been projected to grow by 5 per cent for the projected period.

d) Periodic Maintenance & Routine Maintenance Costs

Estimates for projected Periodic Maintenance & Routine Maintenance cost from the Management are considered.

e) Premium Payable to NHAI

The Premium payable to NHAI is considered as given by the management and validated the same from the concession agreement.

DCF Method:

- The key assumptions and other key inputs, mentioned on the previous paragraphs, as provided by the Management are considered in the projections.

- The projections provided by the Management, based on an Independent traffic study, are only the best estimates of growth and sustainability of profitability margins. The financial forecast provided by the Management were reviewed for consistency and reasonableness and have relied on them.

- The explicit period has been considered from 01 April 2023 to 03 February 2042.

- The tax has been calculated as per the provisions of the Income Tax Act, 1961. The interest expense is adjusted in the same for arriving at the tax computation under FCFF.

- The assumptions for Weighted average cost of capital is as follows:

WACC calculation		
		Basis
Risk free rate of return	*7.2%*	10yrs ZCYC as at 31 March 2023
India risk premium	*7.3%*	Incwert Analysis
Beta	0.8	Peer median of 2 yr weekly beta
Alpha	*0.5%*	Valuer judgement
Cost of Equity	***13.4%***	
Cost of Debt	*8.8%*	Management input
Tax Rate	*17.5%*	Rates as per IT Act as applicable here
After Tax Cost of Debt	***7.2%***	
Debt/Equity	*150.0%*	Management input
Debt to Capital %	*60.0%*	
Equity to Capital %	*40.0%*	
Weighted Average Cost of Capital	***9.7%***	
Marginal tax rate	*17.5%*	*MAT rates as per IT applicable here*

- The Business/ Enterprise Value of CGTL as on 31 March 2023 is arrived at INR 2,833.8 crores.

Discounted cash flow												
	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032	FY2033	FY2034	FY2035
INR crores	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months
Net Revenue	143.9	178.7	218.5	261.3	310.7	350.1	395.6	436.1	483.0	532.7	588.5	650.3
yoy growth	*14.2%*	*10.8%*	*11.1%*	*10.7%*	*11.1%*	*10.4%*	*10.7%*	*9.3%*	*9.7%*	*9.2%*	*9.4%*	*9.5%*
EBITDA	**109.7**	**115.9**	**152.3**	**191.9**	**269.2**	**306.6**	**349.9**	**301.9**	**341.6**	**385.0**	**532.9**	**583.2**
EBITDA margin	*76%*	*65%*	*70%*	*73%*	*87%*	*88%*	*88%*	*69%*	*71%*	*72%*	*91%*	*90%*
Depreciation	42.1	46.6	51.8	57.3	63.7	70.3	77.9	85.1	93.3	101.9	111.6	122.1
EBIT	67.5	69.3	100.5	134.6	205.5	236.2	272.0	216.8	248.3	283.1	421.4	461.1
EBIT margin	*47%*	*39%*	*46%*	*52%*	*66%*	*67%*	*69%*	*50%*	*51%*	*53%*	*72%*	*71%*
Less: tax on EBIT	(11.8)	(12.1)	(17.6)	(23.5)	(35.9)	(41.3)	(47.5)	(37.9)	(43.4)	(49.5)	(73.6)	(80.6)
Change in working capital	-	-	-	-	-	-	-	-	-	-	-	50.0
Capex	-	-	-	-	-	-	-	-	-	-	-	-
Free cash flows to the Firm	**97.8**	**103.8**	**134.8**	**168.4**	**233.3**	**265.3**	**302.4**	**264.0**	**298.3**	**335.6**	**459.3**	**552.6**
Continuing value												
Discounting period (mid-period)	0.50	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.50	9.50	10.50	11.50
Discount factor	0.95	0.87	0.79	0.72	0.66	0.60	0.55	0.50	0.46	0.41	0.38	0.34
Present value of cash flows as at 31 March 2023	**93.4**	**90.3**	**106.9**	**121.8**	**153.8**	**159.4**	**165.6**	**131.8**	**135.7**	**139.2**	**173.7**	**190.5**

Discounted cash flow							
	FY2036	**FY2037**	**FY2038**	**FY 2039**	**FY2040**	**FY2041**	**FY2042**
INR crores	12 months	12 months	12 months	12 months	12 months	12 months	10.2months
Net Revenue	710.3	777.3	852.3	933.4	1,029.3	1,121.5	1,038.1
yoy growth	*9.1%*	*8.7%*	*9.0%*	*8.9%*	*9.5%*	*8.5%*	*n/m*
EBITDA	**602.6**	**664.8**	**734.1**	**862.7**	**954.9**	**1,043.6**	**968.8**
EBITDA margin	*85%*	*86%*	*86%*	*92%*	*93%*	*93%*	*93%*
Depreciation	133.2	144.8	157.8	171.8	188.1	204.0	187.9
EBIT	469.4	520.0	576.3	690.9	766.8	839.6	780.9
EBIT margin	*66%*	*67%*	*68%*	*74%*	*74%*	*75%*	*75%*
Less: tax on EBIT	(82.0)	(90.8)	(100.7)	(120.7)	(134.0)	(146.7)	(159.0)
Change in working capital	-	-	-	-	-	-	-
Capex	-	-	-	-	-	-	-
Free cash flows to the Firm	**520.6**	**573.9**	**633.4**	**742.0**	**820.9**	**896.9**	**809.7**
Continuing value							
Discounting period (mid-period)	12.50	13.50	14.50	15.50	16.50	17.50	18.42
Discount factor	0.31	0.29	0.26	0.24	0.22	0.20	0.18
Present value of cash flows as at 31 March 2023	**163.6**	**164.4**	**165.4**	**176.6**	**178.1**	**177.4**	**147.0**

Valuation Conclusion	
Present value of cash flows	2,834.6
Present value of terminal value	-
Release of WC at the end of concession period	(0.8)
Enterprise value	**2,833.8**

8.8 Kishangarh Gulabpura Tollway Private Limited

Key Inputs in Projections:
The key inputs of the projections provided by the Management supported by an independent traffic study report as follows:

a) Revenue

Revenue is expected to grow at an average rate of 9 per cent-10 per cent in the steady state forecasted period based on the traffic study report and financial plan provided by management.

b) Traffic Volume

Traffic volume as received from the Management supported by the traffic study report carried out by GMD Consultants dated April 2023 are considered.

c) Toll rates

- Toll rates have been estimated as per the recent MoRTH notification and Schedule R of the contract agreement. Factor of inflation/growth has been incorporated as per Schedule R. Increase in WPI was calculated based on the WPI numbers are based on the latest year number provided by RBI and the forecast are based on the numbers estimated in annual report published by Consensus

- WPI has been projected to grow by 5 per cent for the projected period.

d) Periodic Maintenance & Routine Maintenance Costs

Estimates for projected Periodic Maintenance & Routine Maintenance cost from the Management are considered.

e) Premium Payable to NHAI

The Premium payable to NHAI is considered as given by the management and validated the same from the concession agreement.

DCF Method:

- The key assumptions and other key inputs, mentioned on the previous paragraphs, as provided by the Management are considered in the projections.

- The projections provided by the Management, based on an Independent traffic study, are only the best estimates of growth and sustainability of profitability margins. The financial

forecast provided by the Management were reviewed for consistency and reasonableness and have relied on them.

- The explicit period has been considered from 01 April 2023 to 20 June 2042.
- The tax has been calculated as per the provisions of the Income Tax Act, 1961. The interest expense is adjusted in the same for arriving at the tax computation under FCFF.
- The assumptions for Weighted average cost of capital is as follows:

WACC calculation		
		Basis
Risk free rate of return	*7.2%*	10yrs ZCYC as at 31 March 2023
India risk premium	*7.3%*	Incwert Analysis
Beta	0.8	Peer median of 2 yr weekly beta
Alpha	*0.5%*	Valuer judgement
Cost of Equity	***13.4%***	
Cost of Debt	*8.8%*	Management input
Tax Rate	*17.5%*	Rates as per IT Act as applicable here
After Tax Cost of Debt	***7.2%***	
Debt/Equity	*150.0%*	Management input
Debt to Capital %	*60.0%*	
Equity to Capital %	*40.0%*	
Weighted Average Cost of Capital	***9.7%***	
Marginal tax rate	*17.5%*	*MAT rates as per IT applicable here*

- The Business/ Enterprise Value of KGTL as on 31 March 2023 is arrived at INR 2,191.8 crores.

Discounted cash flow												
INR crores	**FY2024** 12 months	**FY2025** 12 months	**FY2026** 12 months	**FY2027** 12 months	**FY2028** 12 months	**FY2029** 12 months	**FY2030** 12 months	**FY2031** 12 months	**FY2032** 12 months	**FY2033** 12 months	**FY2034** 12 months	**FY2035** 12 months
Net Revenue	105.4	129.4	157.6	190.3	224.0	262.7	292.9	324.6	361.2	400.4	444.0	493.2
yoy growth	*46.2%*	*10.5%*	*10.4%*	*10.8%*	*10.1%*	*10.1%*	*9.9%*	*9.5%*	*9.9%*	*9.5%*	*9.6%*	*9.8%*
EBITDA	**81.5**	**104.5**	**131.3**	**62.4**	**195.1**	**232.4**	**261.1**	**291.2**	**325.9**	**259.2**	**303.3**	**342.2**
EBITDA margin	*77%*	*81%*	*83%*	*33%*	*87%*	*88%*	*89%*	*90%*	*90%*	*65%*	*68%*	*69%*
Depreciation	31.2	34.5	34.9	34.0	37.4	41.2	45.3	49.6	54.5	59.7	65.4	71.8
EBIT	50.3	70.0	96.4	28.4	157.7	191.2	215.9	241.6	271.4	199.5	237.8	270.4
EBIT margin	*48%*	*54%*	*61%*	*15%*	*70%*	*73%*	*74%*	*74%*	*75%*	*50%*	*54%*	*55%*
Less: tax on EBIT	(8.8)	(12.2)	(16.8)	(5.0)	(27.6)	(33.4)	(37.7)	(42.2)	(47.4)	(34.9)	(41.6)	(47.2)
Change in working capital	36.0	-	-	-	-	-	-	-	-	-	-	-
Capex	-	-	-	-	-	-	-	-	-	-	-	-
Free cash flows to the Firm	**108.7**	**92.2**	**114.5**	**57.4**	**167.5**	**199.0**	**223.4**	**249.0**	**278.5**	**224.3**	**261.7**	**294.9**
Continuing value												
Discounting period (mid-period)	0.50	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.50	9.50	10.50	11.50
Discount factor	0.95	0.87	0.79	0.72	0.66	0.60	0.55	0.50	0.46	0.41	0.38	0.34
Present value of cash flows as at 31 March 2023	**103.8**	**80.3**	**90.8**	**41.5**	**110.4**	**119.6**	**122.4**	**124.3**	**126.8**	**93.1**	**99.0**	**101.7**

Discounted cash flow								
INR crores	**FY2036** 12 months	**FY2037** 12 months	**FY2038** 12 months	**FY 2039** 12 months	**FY2040** 12 months	**FY2041** 12 months	**FY2042** 12 months	**FY2043** 2.7months
Net Revenue	545.3	597.2	659.1	725.8	800.1	876.7	958.5	231.7
yoy growth	*9.6%*	*8.8%*	*9.4%*	*9.3%*	*9.5%*	*8.8%*	*8.8%*	*n/m*
EBITDA	**502.6**	**552.6**	**612.2**	**676.6**	**748.3**	**822.5**	**901.5**	**218.4**
EBITDA margin	*92%*	*93%*	*93%*	*93%*	*94%*	*94%*	*94%*	*94%*
Depreciation	78.7	85.6	93.7	102.4	112.1	122.0	132.7	32.0
EBIT	423.8	466.9	518.6	574.2	636.2	700.5	768.8	186.5
EBIT margin	*78%*	*78%*	*79%*	*79%*	*80%*	*80%*	*80%*	*80%*
Less: tax on EBIT	(74.1)	(81.6)	(90.6)	(100.3)	(111.2)	(122.4)	(180.1)	(46.9)
Change in working capital	-	-	-	-	-	-	-	-
Capex	-	-	-	-	-	-	-	-
Free cash flows to the Firm	**428.5**	**471.0**	**521.6**	**576.2**	**637.1**	**700.1**	**721.4**	**171.5**
Continuing value								
Discounting period (mid-period)	12.50	13.50	14.50	15.50	16.50	17.50	18.50	19.11
Discount factor	0.31	0.29	0.26	0.24	0.22	0.20	0.18	0.17
Present value of cash flows as at 31 March 2023	**134.6**	**134.9**	**136.2**	**137.2**	**138.2**	**138.5**	**130.1**	**29.2**

Valuation Conclusion	
Present value of cash flows	2,192.4
Present value of terminal value	-
Release of WC at the end of concession period	(0.6)
Enterprise value	**2,191.8**

8.9 IRB Hapur Moradabad Tollway Private Limited

Key Inputs in Projections:
The key inputs of the projections provided by the Management supported by an independent traffic study report as follows:

a) Revenue

Revenue is expected to grow at an average rate of 7 per cent - 8 per cent in the steady state forecasted period based on traffic study report and financial plan provided by management.

b) Traffic Volume

Traffic volume as received from the Management supported by the traffic study report carried out by GMD Consultants dated April 2023 are considered.

c) Toll rates

- Toll rates have been estimated as per the recent MoRTH notification and Schedule R of the contract agreement. Factor of inflation/growth has been incorporated as per Schedule R. Increase in WPI was calculated based on the WPI numbers are based on the latest year number provided by RBI and the forecast are based on the numbers estimated in annual report published by Consensus.

- WPI has been projected to grow by 5 per cent for the projected period.

d) Periodic Maintenance & Routine Maintenance Costs

Estimates for projected Periodic Maintenance & Routine Maintenance cost from the Management are considered.

e) Premium Payable to NHAI

The Premium payable to NHAI is considered as given by the management and validated the same from the concession agreement.

DCF Method:

- The key assumptions and other key inputs, mentioned on the previous paragraphs, as provided by the Management are considered in the projections.

- The projections provided by the Management, based on Independent traffic and technical studies, are only the best estimates of growth and sustainability of profitability margins. The financial forecast provided by the Management were reviewed for consistency and reasonableness and have relied on them.

- The explicit period has been considered from 01 April 2023 to 24 January 2046.

- The tax has been calculated as per the provisions of the Income Tax Act, 1961. The interest expense is adjusted in the same for arriving at the tax computation under FCFF.

- The assumptions for Weighted average cost of capital is as follows:

WACC calculation		
		Basis
Risk free rate of return	*7.2%*	10yrs ZCYC as at 31 March 2023
India risk premium	*7.3%*	Incwert Analysis
Beta	0.8	Peer median of 2 yr weekly beta
Alpha	*0.5%*	Valuer judgement
Cost of Equity	***13.4%***	
Cost of Debt	*8.8%*	Management input
Tax Rate	*17.5%*	Rates as per IT Act as applicable here
After Tax Cost of Debt	***7.2%***	
Debt/Equity	*150.0%*	Management input
Debt to Capital %	*60.0%*	
Equity to Capital %	*40.0%*	
Weighted Average Cost of Capital	***9.7%***	
Marginal tax rate	*17.5%*	*MAT rates as per IT applicable here*

- The Business/ Enterprise Value of IHMTL as on 31 March 2023 is arrived at INR 4,186.8 crores.

Discounted cash flow											
	FY2024	**FY2025**	**FY2026**	**FY2027**	**FY2028**	**FY2029**	**FY2030**	**FY2031**	**FY2032**	**FY2033**	**FY2034**
INR crores	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months
Net Revenue	268.7	299.9	330.3	363.2	402.2	437.7	477.3	524.0	570.9	620.6	680.2
yoy growth	*33.5%*	*11.4%*	*9.4%*	*9.3%*	*10.1%*	*8.3%*	*9.0%*	*9.6%*	*8.9%*	*8.6%*	*9.5%*
EBITDA	**255.6**	**290.8**	**231.7**	**263.5**	**306.8**	**427.2**	**461.0**	**438.4**	**482.6**	**551.8**	**665.5**
EBITDA margin	*95%*	*97%*	*70%*	*73%*	*76%*	*98%*	*97%*	*84%*	*85%*	*89%*	*98%*
Depreciation	46.4	51.7	56.6	56.8	62.5	67.7	73.8	80.9	88.1	95.7	104.8
EBIT	209.2	239.1	175.1	206.7	244.3	359.5	387.2	357.5	394.5	456.0	560.7
EBIT margin	*78%*	*80%*	*53%*	*57%*	*61%*	*82%*	*81%*	*68%*	*69%*	*73%*	*82%*
Less: tax on EBIT	(36.5)	(41.8)	(30.6)	(36.1)	(42.7)	(62.8)	(67.7)	(62.5)	(68.9)	(79.7)	(98.0)
Change in working capital	51.6	-	-	-	-	-	-	-	-	-	-
Capex	(106.4)	-	-	-	-	-	-	-	-	-	-
Free cash flows to the Firm	**164.2**	**249.1**	**201.1**	**227.4**	**264.1**	**364.4**	**393.4**	**376.0**	**413.7**	**472.1**	**567.5**
Continuing value											
Discounting period (mid-period)	0.50	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.50	9.50	10.50
Discount factor	0.95	0.87	0.79	0.72	0.66	0.60	0.55	0.50	0.46	0.41	0.38
Present value of cash flows as at 31 March 2023	**156.8**	**216.7**	**159.5**	**164.4**	**174.1**	**219.0**	**215.5**	**187.7**	**188.3**	**195.9**	**214.6**

Discounted cash flow												
INR crores	FY2035 12 months	FY2036 12 months	FY2037 12 months	FY2038 12 months	FY 2039 12 months	FY2040 12 months	FY2041 12 months	FY2042 12 months	FY2043 12 months	FY2044 12 months	FY2045 12 months	FY2046 9.8months
Net Revenue	740.3	795.8	854.4	922.4	994.3	1,074.3	1,153.8	1,243.4	1,336.5	1,447.2	1,554.7	1,371.4
yoy growth	*8.8%*	*7.6%*	*7.4%*	*8.0%*	*7.8%*	*8.1%*	*7.4%*	*7.8%*	*7.5%*	*8.3%*	*7.4%*	*n/m*
EBITDA	**727.7**	**571.0**	**611.6**	**670.8**	**973.3**	**1,059.9**	**1,138.7**	**1,227.6**	**1,319.9**	**1,429.7**	**1,536.4**	**1,355.6**
EBITDA margin	*98%*	*72%*	*72%*	*73%*	*98%*	*99%*	*99%*	*99%*	*99%*	*99%*	*99%*	*99%*
Depreciation	114.0	122.6	131.7	142.2	153.3	165.6	177.9	191.8	206.2	223.3	239.9	211.7
EBIT	613.7	448.4	479.9	528.6	820.0	894.3	960.8	1,035.8	1,113.7	1,206.4	1,296.4	1,143.9
EBIT margin	*83%*	*56%*	*56%*	*57%*	*82%*	*83%*	*83%*	*83%*	*83%*	*83%*	*83%*	*83%*
Less: tax on EBIT	(107.2)	(78.3)	(83.9)	(92.4)	(143.3)	(156.2)	(167.9)	(181.0)	(212.2)	(303.6)	(326.3)	(287.9)
Change in working capital	-	-	-	-	-	-	-	-	-	-	-	-
Capex	-	-	-	-	-	-	-	-	-	-	-	-
Free cash flows to the Firm	**620.4**	**492.7**	**527.7**	**578.4**	**830.0**	**903.6**	**970.8**	**1,046.6**	**1,107.7**	**1,126.1**	**1,210.1**	**1,067.7**
Continuing value												
Discounting period (mid-period)	11.50	12.50	13.50	14.50	15.50	16.50	17.50	18.50	19.50	20.50	21.50	22.41
Discount factor	0.34	0.31	0.29	0.26	0.24	0.22	0.20	0.18	0.16	0.15	0.14	0.13
Present value of cash flows as at 31 March 2023	**213.9**	**154.8**	**151.2**	**151.0**	**197.5**	**196.1**	**192.0**	**188.7**	**182.0**	**168.7**	**165.2**	**134.0**

Valuation Conclusion	
Present value of cash flows	4,187.5
Present value of terminal value	-
Release of WC at the end of concession period	(0.8)
Enterprise value	**4,186.8**

8.10 Palsit Dankuni Tollway Private Limited

Key Inputs in Projections:
The key inputs of the projections provided by the Management supported by an independent traffic study report as follows:

f) Revenue

Revenue is expected to grow at an average rate of 12 per cent -13 per cent in the steady state forecasted period based on the traffic study report and financial plan provided by management.

g) Traffic Volume

Traffic volume as received from the Management supported by the traffic study report carried out by GMD Consultants dated April 2023 are considered.

h) Toll rates

- Toll rates have been estimated as per the recent MoRTH notification and Schedule R of the contract agreement. Factor of inflation/growth has been incorporated as per Schedule R. Increase in WPI was calculated based on the WPI numbers are based on the latest year number provided by RBI and the forecast are based on the numbers estimated in annual report published by Consensus.

- WPI has been projected to grow by 5 per cent for the projected period.

i) Periodic Maintenance & Routine Maintenance Costs

Estimates for projected Periodic Maintenance & Routine Maintenance cost from the Management are considered.

j) Premium Payable to NHAI

The Premium payable to NHAI is considered as given by the management and validated the same from the concession agreement.

DCF Method:

- The key assumptions and other key inputs, mentioned on the previous paragraphs, as provided by the Management are considered in the projections.
- The projections provided by the Management, based on Independent traffic and technical studies, are only the best estimates of growth and sustainability of profitability margins. The financial forecast provided by the Management were reviewed for consistency and reasonableness and have relied on them.
- The explicit period has been considered from 01 April 2023 to 05 November 2036.
- The tax has been calculated as per the provisions of the Income Tax Act, 1961. The interest expense is adjusted in the same for arriving at the tax computation under FCFF.
- The assumptions for Weighted average cost of capital is as follows:

WACC calculation		
		Basis
Risk free rate of return	*7.2%*	10yrs ZCYC as at 31 March 2023
India risk premium	*7.3%*	Incwert Analysis
Beta	0.8	Peer median of 2 yr weekly beta
Alpha	*1.5%*	Valuer judgement
Cost of Equity	***14.1%***	
Cost of Debt	*9.0%*	Management input
Tax Rate	*25.2%*	Rates as per IT Act as applicable here
After Tax Cost of Debt	***6.7%***	
Debt/Equity	150%	Management input
Debt to Capital %	*60.0%*	
Equity to Capital %	*40.0%*	
Weighted Average Cost of Capital	***9.7%***	
Marginal tax rate	*25.2%*	MAT rates as per IT applicable here

- The Business/ Enterprise Value of PDTPL as on 31 March 2023 is arrived at INR 1,127.7 crores.

Discounted cash flow									
	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032
INR crores	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months	12 months
Net Revenue	219.1	285.7	353.2	365.3	399.7	433.3	471.6	506.9	548.9
yoy growth	*6.7%*	*30.4%*	*29.2%*	*10.3%*	*10.8%*	*9.7%*	*10.2%*	*8.8%*	*9.6%*
EBITDA	**175.4**	**238.2**	**303.0**	**312.3**	**343.6**	**338.4**	**367.2**	**402.9**	**479.8**
EBITDA margin	*80%*	*83%*	*86%*	*85%*	*86%*	*78%*	*78%*	*79%*	*87%*
Depreciation	64.7	84.7	109.4	120.7	133.7	146.7	161.6	175.9	192.9
EBIT	110.7	153.5	193.6	191.6	209.9	191.7	205.6	227.0	286.9
EBIT margin	*51%*	*54%*	*55%*	*52%*	*53%*	*44%*	*44%*	*45%*	*52%*
Less: tax on EBIT	(27.9)	(38.6)	(48.7)	(48.2)	(52.8)	(48.3)	(51.7)	(57.1)	(72.2)
Change in working capital	(0.0)	(85.0)	-	-	-	-	-	-	-
Capex	(995.8)	(322.8)	-	-	-	-	-	-	-
Free cash flows to the Firm	**(848.2)**	**(208.3)**	**254.3**	**264.1**	**290.8**	**290.2**	**315.5**	**345.8**	**407.6**
Continuing value									
Discounting period (mid-period)	0.50	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.50
Discount factor	0.95	0.87	0.79	0.72	0.66	0.60	0.55	0.50	0.46
Present value of cash flows as at 31 March 2023	**(809.8)**	**(181.2)**	**201.8**	**191.0**	**191.7**	**174.4**	**172.9**	**172.8**	**185.7**

Discounted cash flow					
INR crores	FY2033 12 months	FY2034 12 months	FY2035 12 months	FY2036 12 months	FY2037 7.2months
Net Revenue	587.4	633.1	681.6	729.5	469.6
yoy growth	*8.3%*	*9.2%*	*9.0%*	*8.4%*	*-35.3%*
EBITDA	**514.8**	**556.6**	**601.1**	**594.0**	**429.5**
EBITDA margin	*88%*	*88%*	*88%*	*81%*	*91%*
Depreciation	209.0	228.1	248.8	269.7	174.5
EBIT	305.8	328.5	352.4	324.3	255.0
EBIT margin	*52%*	*52%*	*52%*	*44%*	*54%*
Less: tax on EBIT	(77.0)	(82.7)	(88.7)	(81.6)	(64.2)
Change in working capital	-	-	-	-	85.0
Capex	-	-	-	-	-
Free cash flows to the Firm	**437.8**	**474.0**	**512.4**	**512.4**	**450.3**
Continuing value					
Discounting period (mid-period)	9.50	10.50	11.50	12.50	13.30
Discount factor	0.42	0.38	0.35	0.31	0.29
Present value of cash flows as at 31 March 2023	**181.8**	**179.4**	**176.8**	**161.2**	**131.6**

Valuation Conclusion	
Present value of cash flows	1,130.0
Present value of terminal value	-
Release of WC at the end of concession period	(2.3)
Enterprise value	**1,127.7**

8.11 Valuation Summary

The derived enterprise value and equity value, based on the valuation approach and methodology as discussed above, as on 31 March 2023 is as under:

FCFF method- Equity value of the Trust			
Sl. No	Name of SPV	Short name of SPV	Enterprise value (INR crores)
1	Goa Kundapur	IWTL	3,569.8
2	Solapur Yedeshi	SYTL	2,385.3
3	Yedeshi Aurangabad	YATL	4,143.1
4	Kaithal - Rajasthan	KTL	2,483.7
5	Agra Etawah	AETL	3,150.0
6	Udaipur Rajasthan Gujarat	UTL	2,661.8
7	Gulabpura Chittorgarh	CGTL	2,833.8
8	Kishangarh Gulabpura	KGTL	2,191.8
9	Hapur Moradabad	IHMTL	4,186.8
10	Dankuni - Palsit	PDTPL	1,127.7
	Total Enterprise Value	**Total**	**28,733.9**

Computation of fair value of the equity of the Trust			
Valuation approach	**Method**	**INR crores**	**Weight (%)**
Income approach	DCF	28,733.9	100%
Market approach	Comparable companies method	n/a	0%
Cost approach	NAV	n/a	0%
Enterprise value for the combined portfolio of 10 SPVs		28,733.9	100%
Less: Debt		(10,508.0)	
Less: Debt-like-items		0.0	
Less: Present value of stand alone expenses pertaining to InvIT as on 31 March 2023		(158.3)	
Add: Cash and cash equivalents		74.8	
Add: Surplus assets		132.3	
Value of 100% interest in equity (on a control, marketable basis)		**18,274.7**	
Number of units outstanding		879,293,265	
Value per unit		**207.83**	

Notes:

1. *Adjustments for debt, cash & cash equivalents and surplus assets have been made considering Unaudited Consolidated financial statements of InvIT as on 31 March 2023.*
2. *Debt of INR 10,508.0 crores includes loan from banks, loan from financial institutions, non-convertible debentures and loan from related parties.*
3. *Surplus assets of INR 132.3 crores primarily comprise investments in Canara Robeco liquid fund, Canara Robeco overnight fund, IDBI liquid fund, SBI liquid fund, SBI overnight fund interest accrued on fixed deposit, interest receivable from bank and current tax assets (advance income tax(net of provision for tax)).*
4. *Standalone expenses pertaining to InvIT has been considered based on Management business plan.*
5. *Management has represented that the probability of devolvement of contingent liabilities is insignificant and accordingly no adjustment was required to be carried out in the valuation of the 10 SPVs.*
6. *Money payable to related parties (INR 3,594.6 crores) forming part of non-current liabilities (INR 3,577.8 crores) and current liabilities (INR 16.8 crores) on the Trust combined balance sheet as on Valuation Date and will be settled against amount receivable from NHAI against claim. Hence, the same has not been considered as a Debt-like item based on management representation.*

Fair value of 100 per cent equity interest in the Trust has been computed at INR 18,274.7 crores. Value per fully paid up unit is INR 207.83/- (Indian Rupees Two Hundred and Seven Point Eighty Three Only) (face value per unit: INR 100/-) based on 87,92,93,265 number of units as of the Valuation Date.

[This space has been left intentionally blank]

9. Annexures

Additional procedures to be complied with in accordance with SEBI InvIT Regulations
List of Disclosures

Additional procedures to be complied with in accordance with SEBI InvIT regulations as per Schedule V of the SEBI InvIT Regulations:

a) List of one-time sanctions/approvals which are obtained or pending along with up to date/overdue periodic clearances.

As given by the Management, the list of one-time sanctions/approvals which are obtained or pending along with up to date/overdue periodic clearances of all the 10 SPVs are included in earlier sections in the Report and details are mentioned in Annexures.

b) Statement of assets

Management has represented that all assets and liabilities of the 10 SPVs till the date of transfer of assets to InvIT has been taken over by the Trust.

c) Estimates of already carried as well as proposed major repairs & improvements.

Past major repairs and improvements as on the Valuation Date

Management has represented that major repairs have not been carried out in the past as the 10 SPVs being transferred have been recently operationalized or are being constructed.

Future estimate of major repairs and improvements as on the Valuation Date

Future estimates of major repairs and improvements as on the Valuation Date (Amt in INR crores)

Name of SPV	FY2024 12mths Forecast	FY2025 12mths Forecast	FY2026 12mths Forecast	FY2027 12mths Forecast	FY2028 12mths Forecast	FY2029 12mths Forecast	FY2030 12mths Forecast	FY2031 12mths Forecast	FY2032 12mths Forecast	FY2033 12mths Forecast	FY2034 12mths Forecast
IWTL	40.9	42.5	-	1.3	-	110.6	40.6	-	-	1.6	11.9
SYTL	-	12.6	19.4	20.3	-	-	-	-	-	61.2	64.3
YATL	-	24.4	30.5	32.1	-	-	-	-	-	109.8	115.4
KTL	21.9	45.2	47.6	-	-	-	-	-	128.0	133.7	140.5
AETL	32.1	39.1	41.1	-	-	-	-	123.1	129.6	135.4	-
UTL	69.1	76.5	4.1	-	119.7	125.5	127.5	4.8	-	85.9	91.2
CGTL	-	27.0	28.4	29.9	-	-	-	86.1	90.7	94.7	-
KGTL	-	-	-	100.4	-	-	-	-	-	104.4	102.0
IHMTL	4.4	-	89.2	89.9	85.2	-	5.4	74.3	76.7	56.9	2.4
PDTPL	0.2	0.0	0.0	0.0	0.0	35.9	42.2	38.6	0.0	0.0	0.0

Future estimates of major repairs and improvements as on the Valuation Date (Amt in INR crores)

Name of SPV	FY2035 12mths Forecast	FY2036 12mths Forecast	FY2037 12mths Forecast	FY2038 12mths Forecast	FY 2039 12mths Forecast	FY 2040 12mths Forecast	FY2041 12mths Forecast	FY2042 12mths Forecast	FY 2043 12mths Forecast	FY2044 12mths Forecast
IWTL	166.5	1.9	-	-	148.5	53.2	-	-	-	-
SYTL	67.4	-	-	-	-	-	-	42.1	44.2	46.5
YATL	120.9	-	-	-	-	60.4	63.3	66.5	-	-
KTL	-	-	-	-	-	94.1	98.6	103.6	-	-
AETL	-	-	-	73.5	77.3	81.3	-	-	-	-
UTL	119.3	-	-	-	-	-	-	-	-	-
CGTL	8.9	46.3	48.4	50.8	-	-	-	-	-	-
KGTL	110.5	-	-	-	-	-	-	-	-	-
IHMTL	-	211.8	229.5	238.0	7.0	-	-	-	-	-
PDTPL	0.0	50.5	12.5	-	-	-	-	-	-	-

d) Revenue pendencies including local authority taxes associated with InvIT asset & compounding charges.

Management has represented that there are no revenue pendencies including local authority taxes pending to be payable to the Government authorities with respect to all the 10 SPVs.

e) On-going material litigations including tax disputes in relation to the assets.

As represented by the Management, the list of the ongoing material litigations of all the 10 SPVs, have been included In Annexures 1 to 10.

f) Vulnerability to natural to induced hazards that may not have been covered in town planning/building control.

Management has represented that there are no such natural or induced hazards that have been not considered in town planning/building control with respect to all the 10 SPVs.

g) Site Visit Photographs

Site visit of all the 10 SPVs was conducted. Photographs taken during the site visit have been included in earlier sections in the Report.

Caveat to Disclosures in Annexures:

The Valuer has not independently verified the documents related to the disclosures mentioned in the Annexures and have relied on the representation by the Management for the same.

[This space has been left intentionally blank]

9.1 Annexure I IWTL – Table 1: List of one-time sanctions/approvals

Sl.No	Description	Remarks
A	Permission of State government for extraction of boulders from quarry.	Received
B	Permission of Village Panchayat & Pollution control board for installation of crushers	Received
C-1	License for use of explosives.	Received
C-2	Permission of state government for drawing water from Rivers & reservoir.	Not Applicable
D-1	License from Inspector of factories or competent authorities for setting up Batching Plant.	Received
D-2	Clearance from Pollution control board for Setting up Batching Plant	Received
E-1	Permission of Village Panchayat & Pollution control board for Asphalt Plant	Received
E-2	Permission of Village Panchayat & State government for Borrow earth	Received
F-1	Permission of State Government for Cutting of trees	Received
F-2	Any other permits or clearance required under applicable Laws	Labour License taken.

9.2 Annexure I IWTL – Table 2 List of ongoing material litigations or litigations where financial implication cannot be ascertained

Sl. No.	Complainant/Applicant/Plaintiff	Respondents	Name & Address of the Court and case number	Brief Description of Case	Status as on date	Financial implications	Whether below the materiality limit of Rs. 7.89 Crores
1	Mr. Sachhidananda Shetty.	The Chief General Manager, Modern Road Makers Pvt. Ltd.	Judicial Magistrate First Class Court, Kundapura.	The plaintiff has filed this suit praying that stay should be given for the stoppage work of NH-66 to set right certain anomalies in the tree cutting tender awarded to him by the NHAI in Kundapur forest division in respect of cutting of reserved categories of trees like teak, Bethonne, Matti, Sandalwood & seasom.	There are no Adverse orders against the company. The matter is pending	Land acquisition and related cost, cutting the necessary trees for road widening work, and related cost, etc are the sole responsibilities of NHAI. Further the concessionaire is not a party in the tender awarded to the plaintiff for cutting of the trees. Hence, there are no financial implications in this matter.	Cannot be ascertained.
2	Laxman Neelakanth Desai, Goangeri, Majali, Karwar	IRB West Coast Tollway Pvt Ltd,	Civil Judge & JMFC II Court, Karwar	The plaintiff has filed the suit to restrain the defendants from undertaking the blasting of the rocks/hill in unscientific manner as it has caused loss to the plaintiff.	There are no Adverse orders against the company. The matter is pending	The company and plaintiff had mediated the dispute partly and the company has paid a sum of Rs. 175000/- to the plaintiff in the interest of the project. The matter is pending for final determination. As the company has complied with all the necessary provisions and undertaken the work with all safety precautions, the company feels that there are no financial implications in this matter.	Cannot be ascertained.
3	Venkatramana S	Chief General Manager (IRB), Kumta	JMFC at Bhatkal (O.S. No. 103/2018)	The plaintiff has filed this suit challenging the land acquisition and has prayed that the respondents should be restrained from doing the work against the provisions of the land acquisition act.	The matter is dosposed by the court.	The responsibility of the entire process of land acquisition and payment of compensation is of NHAI. Hence, that there are no financial implications in this matter.	Cannot be ascertained.
4	Mr. Vithobha Ganesh Naik	IRB West Coast Tollway Pvt Ltd,	Principal Judge, Karwar	The complainant is alleging that IRB WTL is encroaching upon the Petitioner's land to construct the highway	There are no Adverse orders against the company. The matter is pending		

9.3 Annexure II SYTL – Table 1: List of one-time sanctions/Approvals

Note. Management has represented that one-time sanctions/approvals are not applicable for SYTL as the project has achieved commercial operational date (COD). These sanctions/approvals are applicable during the construction phase only.

9.4 Annexure II SYTL – Table 2: List of ongoing material litigations

Nil

9.5 Annexure III YATL – Table 1: List of one-time sanctions/approvals

Note. Management has represented that one-time sanctions/approvals are not applicable for YATL as the project has achieved commercial operational date (COD). These sanctions/approvals are applicable during the construction phase only.

9.6 Annexure III YATL – Table 2: List of ongoing material litigations

Sl. No.	Complainant/Applicant/Plaintiff	Respondents	Name & Address of the Court and case number	Brief Description of Case	Status as on date	Financial implications	Whether below the materiality limit of Rs. 7.89 Crores
1	Shaikh Rafiq and others	IRB Infrastructure Developers Limited and others	Bombay High Court Aurangabad Bench Writ Petition 5410/2015	This matter is pertaining to Yedeshi Aurangabad Project. The petitioner is aggrieved by the award wherein his land is acquired by NHAI, for construction of highway. Hence, the petitioners have prayed not to change the existing alignment of the proposed road widening of NH 211 passing through petitioners village and to restrain respondents from proceeding further with any change in the existing alignment	The matter is pending.	The responsibility of the entire process of land acquisition and payment of compensation is of NHAI. Hence, there are no financial implications on the company.	Cannot be ascertained.
2	Panditrao Chausalkar and others	IRB Infrastructure Developers Limited And Others	Bombay High Court Aurangabad Bench Writ Petition 92/2017	This matter is pertaining to Yedeshi Aurangabad Project. The petitioner is aggrieved by the award wherein his land is acquired by NHAI, for construction of highway. Hence, the petitioners have prayed that the land acquisition should be set aside, the respondents should be restrained from acquiring the land belonging to the petitioners, etc..	The matter is pending.	The responsibility of the entire process of land acquisition and payment of compensation is of NHAI. Hence, there are no financial implications on the company.	Cannot be ascertained.
3	Pruthviraj shahane	IRB Infrastructure Developers Limited and others	Civil Judge senior division, Beed. Civil suit number 10/2016	This matter is pertaining to Yedeshi Aurangabad Project. The Plaintiff claims that the electricity poles & DP coming within road alignment / area have been replaced but erected & installed within his private land which has not been acquired.	The matter is pending.	The responsibility of the entire process of land acquisition and payment of compensation is of NHAI. Utility shifting is being done on the land provided by NHAI Hence, there are no financial implications on the company.	Cannot be ascertained.
4	Yedeshi Aurangabad Tollway Ltd	NHAI	Arbitration	YATL (Claimant) had submitted claims to NHAI for compensation as per Clause 35.2 and Clause 35.3 of the Concession Agreement on account of delays attributable to NHAI. The claim for cost stands at Rs. 1,501.84 Crore in terms of Clause 35.2 and extension of Concession Period for 831.08 days in terms of Clause 35.3 of the Concession Agreement. YATL had proposed to NHAI for amicable settlement through CCIE. Since no written settlement reached between the Parties, YATL invoked arbitration on 09.03.2022 in terms of Clause 44.3 of the Concession Agreement.	The matter is pending.	Rs. 1720.80 Cr +interest & extension of 869.41 days	No

9.7 Annexure IV KTL – Table 1: List of one-time sanctions/approvals

Note. Management has represented that one-time sanctions/approvals are not applicable for KTL as the project has achieved commercial operational date (COD). These sanctions/approvals are applicable during the construction phase only.

[This space has been left intentionally blank]

9.8 Annexure IV KTL – Table 2: List of ongoing material litigations

Sl. No.	Complainant/Applicant/Plaintiff	Respondents	Name & Address of the Court and case number	Brief Description of Case	Status as on date	Financial implications	Whether below the materiality limit of Rs. 7.89 Crores
1	SirsaEagle CHS Ltd. and another	National Highways Authority of India and Others (Kaithal Tollway Pvt. Ltd. is Respondent Number 5)	Punjab and Haryana High Court, Writ Petition Number 27756/2017	The Petitioner has challenged the levy and collection of toll on the project, and has prayed that the notification by which the toll is collected should be quashed and issue the directions for frame policy for the local transporters which may not act against the financial interest of the poor local villagers who travel in busses.	The matter is pending.	Financial implications cannot be ascertained as not mentioned in the petition. Similar writ petition challenging the toll collection on the project was filed in Punjab and Haryana High Court by Azad Singh (reported under closed litigations writ petition number 22648/2017), has been dismissed by the High Court. The concessionaire has been collecting the toll on the project as per the concession agreement and the toll notification. The provisional completion certificate has been issued to the concessionaire as per the terms of the concession agreement. Considering the merits of the case, there are no financial implications in this matter.	Cannot be ascertained.
2	Kaithal Tollway Ltd	NHAI	Arbitration	Claimant had submitted claims to NHAI for compensation as per Clause 35.2 and Clause 35.3 of the Concession Agreement on account of delays attributable to NHAI. The claim for cost stands at Rs. 190.68 Crore in terms of Clause 35.2 and extension of Concession Period for 136.77 days in terms of Clause 35.3 of the Concession Agreement. The Claimant crystallised dispute on 09.03.2022 (and subsequently invoked arbitration on 19.04.2022) Against the claim of Rs 100.1 Cr on account of Farmer's strike, Rs 58.48 Cr was released by NHAI on 10.10.2022 NHAI recommended extension of Concession Period of 365 days. The Balance claim amount of Rs 41.62 Crore was disputed. and arbitration was invoked This matter is clubbed with the above referred arbitration.	The matter is pending	Rs. 288.07 Cr + 582.77 days of extension of Concesison Period	No

9.9 Annexure V AETL – Table 1: List of one-time sanctions/approvals

Note. Management has represented that one-time sanctions/approvals are not applicable for AETL as the project has achieved commercial operational date (COD). These sanctions / approvals are applicable during the construction phase only.

9.10 Annexure V AETL – Table 2: List of ongoing material litigations

Sl. No.	Complainant/Applicant/Plaintiff	Respondents	Name & Address of the Court and case number	Brief Description of Case	Status as on date	Financial implications	Whether below the materiality limit of Rs. 7.89 Crores
1	AE Tollway Limited	NHAI	Arbitration	Arbitraion is invoked. AETL filed Statement of Claim account of delay in completion of construction and other Force Majeure claims such as Covid 19 etc. along with claim for loss of revenue during the delayed period..	The matter is pending	Rs. 1317.98 Cr + interest & Extension to Concession Period by 351.41 days	No
2	Hakim Singh Yadav and others	AE Tollway Private Limited	High Court of Allahabad	The petitiner filed a writ petition before the High Court of Allahabad against the Sponsor and others (the "Respondents") in relation to the drainage system for the road asset operated by AETL. AETL had crystallised dispute and requested NHAI to take up the matter of payment of premium with proportionate reduction of revenue losses (the figures under dispute are excess payment of Premium of Rs. 12.84 Cr and outstanding payment of Premium including interest of Rs.55.34 Cr as on June 07, 2021) on account of Covid and delay in completion of construction as a dispute and for amicable settlement though Conciliation. Since no written settlement reached between the Parties, the AETL on 14.03.2022 invoked arbitration as per Clause 44.3 of the Concession Agreement. The matter is pending.	the matter is pending.		

9.11 Annexure VI UTL – Table 1: List of one-time sanctions/approvals

Note. Management has represented that one-time sanctions/approvals are not applicable for UTL as the project has achieved commercial operational date (COD). These sanctions/approvals are applicable during the construction phase only.

9.12 Annexure VI UTL – Table 2: List of ongoing material litigations

Sl. No.	Complainant/Applicant/Plaintiff	Respondents	Name & Address of the Court and case number	Brief Description of Case	Status as on date	Financial implications	Whether below the materiality limit of Rs. 7.89 Crores
1	Hiteshkumar Ramanlal Gandhi	Bhairulal Salvi (Bus Driver)	FIR number 0299 dated 18/11/2017, Kherwada Police Station	Bus driver Mr. Bhairulal Salvi has damaged the toll booths by pelting the stone & created violence in smooth tolling operations at Khandiobri Toll.	The matter is being investigated by the police.	The FIR is filed against the Bus driver, by the employee of the company. The FIR is filed by the employee of the company against the bus driver. There are no proceedings against the company.	Cannot be ascertained.
2	(Shift Incharge Khandiobri Toll)	Dist - Bhilwada.	Tah – Kherwara, Dist – Udaipur State – Rajasthan				
3	Udaipur Tollway Ltd	NHAI	Arbitration	Claimants filed Statement of Claim including the claim on account of compensation of Force Majeure Cost and extension in Concession Period on account of COVID 19) , Claim for compensation under Clause 35.2 & 35.3 along with a prayer that Premium is applicable after 6 months of Actual completion	The matter is pending	Commencement of Premium after 6 months of actual completion Claim Rs. 906.08 Cr + interest & extension of 214.99 days	No

9.13 Annexure VII CGTL – Table 1: List of one-time sanctions/approvals

Note. Management has represented that one-time sanctions/approvals are not applicable for CGTL as the project has achieved commercial operational date (COD). These sanctions/approvals are applicable during the construction phase only.

9.14 Annexure VII CGTL – Table 2: List of ongoing material litigations

Sl. No.	Complainant/Applicant/Plaintiff	Respondents	Name & Address of the Court and case number	Brief Description of Case	Status as on date	Financial implications	Whether below the materiality limit of Rs. 7.89 Crores
1	Shri Azad Sharma & Other	NHAI and others (The Manager, IRB is respondent number 7)	Lok Adalat, Bhilwara	The plaintiff has filed case challenging the collection of toll without completion of six lane. Plaintiff /Petitioners have prayed that collection of toll shall be stopped until works of six lanes are completed and toll collected in the name of six laning shall be returned with interest.	The matter is pending	The company is collecting the toll as per the toll notification and concession agreement with NHAI. Since, the project consists from 4 laining to 6 laining, hence, during the construction period, the company collects only 75% of the prescribed toll amount as per the toll fee notification. These toll rates are fixed for construction period. The company has good case on merits. The company has not violated any of the concession agreement provisions and hence, there are no financial implications in the matter.	Cannot be ascertained.
2	CGTollway Ltd	NHAI	Arbitration	Claimants filed Statement of Claim including the claim on account of compensation of Force Majeure Cost and extension in Concession Period on account of COVID 19) , Claim for compensation under Clause 35.2 & 35.3 along with a prayer that Premium is applicable after 6 months of Actual completion	The matter is pending	Commencement of Premium after 6 months of actual completion Claim: Rs. 502.12 + + interest & extension of 241.37 days	No

9.15 Annexure VIII KGTL – Table 1: List of one-time sanctions/approvals

Note. Management has represented that one-time sanctions/approvals are not applicable for KGTL as the project has achieved commercial operational date (COD). These sanctions/approvals are applicable during the construction phase only.

9.16 Annexure VIII KGTL – Table 2: List of ongoing material litigations

Sl. No.	Complainant/Applicant/Plaintiff	Respondents	Name & Address of the Court and case number	Brief Description of Case	Status as on date	Financial implications	Whether below the materiality limit of Rs. 7.89 Crores
1	Kishangarh Gulabpura Tollway Ltd	NHAI	Arbitration	Claimants filed Statement of Claim including the claim on account of compensation of Force Majeure Cost and extension in Concession Period on account of COVID 19) , Claim for compensation under Clause 35.2 & 35.3 along with a prayer that Premium is applicable after 6 months of Actual completion	The matter is pending	Commencement of Premium after 6 months of actual completion Claim :Rs. 868.96 + + interest & extension of 387.18 days	

9.17 Annexure IX IHMTL – Table 1: List of one-time sanctions/approvals

Note. Management has represented that one-time sanctions/approvals are not applicable for IHMTL as the project has achieved commercial operational date (COD). These sanctions/approvals are applicable during the construction phase only.

9.18 Annexure IX IHMTL – Table 2: List of ongoing material litigations

Nil

9.19 Annexure X PDTPL – Table 1: List of one-time sanctions/approvals

Sl.No	Description	Remarks
A	Permission of the State Government for extraction of boulder from quarry.	Applied
B	Permission of Village Panchayat and Pollution Control Board for installation of crusher;	Applied
C	License for use of explosives	Applied
D	Permission of state government for drawing water from river/reservoir	Not Applicable
E	License from the inspector of factories or other competent authority for setting up Batching plant.	Received
F	Clearance of Pollution Control Board for setting up Batching Plant;	Received
G	Clearance of Village Panchayats and Pollution Control Board for Asphalt Plant	Received
H	Permission of Village Panchayat and State Government for borrow areas	Received
I	Permission of State Government for cutting of trees	Received
J	Any other permits or clearances required under Applicable Laws	Labour License taken.

9.20 Annexure X PDTPL – Table 2: List of ongoing material litigations

Nil

9.21 Annexure XI – Comparable companies' description

List of comparable companies
Sadbhav Engineering Limited
MEP Infrastructure Developers Limited
IRB Infrastructure Developers Limited
Ashoka Buildcon Limited

9.22 Annexure XII – Parties to the InvIT

- IRB Infrastructure Trust ("the Trust")
- IRB Infrastructure Developers Limited (in its capacity as "Sponsor" of the Trust)
- MMK Toll Road Private Limited (in its capacity as "Investment Manager" of the Trust) &
- IDBI Trusteeship Services Limited (as the "Trustee" of the Trust)

**********END OF REPORT**********

Incwert Advisory Private Limited
1006 A&B, 10th floor,
Welldone TechPark, Sohna Rd.,
Sector-48, Gurgaon – 122018
Haryana, India

Telephone: +91 124-436-2995
Fax: +91 124-436-2995
Internet: www.incwert.com
Email: queries@incwert.com

STRICTLY PRIVATE & CONFIDENTIAL

To,

IRB Infrastructure Trust,
1101 Hiranandani Knowledge Park,
Technology Street,
Hill Side Avenue, Powai,
Mumbai – 400076

MMK Toll Road Private Limited
IRB Infrastructure Trust,
1101 Hiranandani Knowledge Park,
Technology Street,
Hill Side Avenue, Powai,
Mumbai – 400076

12 May 2023

Sub: Confirmation Certificate on the valuation report issued by Sunit Khandelwal on valuation of 10 SPVs as per Securities and Exchange Board of India (Infrastructure Investment Trusts) Regulations, 2014, as amended along with equity valuation of the Trust

Dear Sir(s)/ Madam(s),

Incwert ("We" or "Us") was engaged vide engagement letter dated 18 October 2019 to provide confirmation certificate (**"Confirmation Certificate"** or **"Certificate"**) to IRB Infrastructure Trust (**"Trust"**) acting through its Investment Manager, MMK Toll Road Private Limited (referred to as "**the Client**" or "**You**") on the valuation report (**"Valuation Report"**) submitted by Sunit Khandelwal (**"Valuer"**) of identified 10 Special Purpose Vehicles of the Sponsor which were acquired by the Trust, as per Securities Exchange Board of India (Infrastructure Investment Trusts) Regulations, 2014, and amendments thereto including any circulars, notifications, clarifications and guidelines issued thereunder ("SEBI InvIT Regulations").

The valuation date is 31 March 2023 (**"Valuation Date"**).

Sunit Khandelwal ("Valuer") is an IBBI Registered Valuer for the asset class 'Securities or Financial Assets' with registration number IBBI/RV/05/2018/10426.

Incwert, is a Registered Valuer Entity with Insolvency and Bankruptcy Board of India ("IBBI") for the asset class 'Securities or Financial Assets' having registration number IBBI/RV-E/05/2019/108.

The Confirmation Certificate has been prepared on the basis of the review of information including the Valuation Report provided to Incwert. This Confirmation Certificate does not entail conducting a valuation exercise or providing any value to underlying assets but is only limited to offering a confirmation on the valuation provided by the Valuer.

The information given in this Certificate is selective and does not purport to contain all information that the recipients may require.

Based on the Valuer's report, we understand that as per SEBI InvIT Regulations, the Sponsor ("the Management") has set up an Indian Infrastructure Investment Trust ("InvIT") named as IRB Infrastructure Trust. MMK Toll Road Pvt. Ltd is appointed as the Investment Manager ("Investment Manager" or "IM") and IDBI Trusteeship Services Limited is the Trustee acting on behalf of the Trust ("Trustee").

The identified Special Purpose Vehicles which were acquired by the Trust in which the Trust holds 100% equity interest are as follows (hereinafter together referred to as "the InvIT Assets", "10 SPVs" or "the SPVs" or the "Business"):

1. IRB Westcoast Tollway Limited ("IWTL" or "Goa Kundapur")
2. Solapur Yedeshi Tollway Limited ("SYTL" or "Solapur Yedeshi")
3. Yedeshi Aurangabad Tollway Limited ("YATL" or "Yedeshi Aurangabad")
4. Kaithal Tollway Limited ("KTL" or "Kaithal Rajasthan")
5. AE Tollway Limited ("AETL" or "Agra Etawah")
6. Udaipur Tollway Limited ("UTL" or "Udaipur Rajasthan/ Gujarat border")
7. CG Tollway Limited ("CGTL" or "Gulabpura Chittorgarh")
8. Kishangarh Gulabpura Tollway Limited ("KGTL" or "Kishangarh Gulabpura")
9. IRB Hapur Moradabad Tollway Limited ("IHMTL" or "Hapur Moradabad")
10. Palsit Dankuni Tollway Private Limited ("PDTPL" or "Palsit Dankuni")

The Valuer has carried out the valuation of InvIT Assets as per internationally accepted valuation methodologies and in cognizance of international valuation standards and ICAI Valuation Standards 2018 issued by the Institute of Chartered Accountants of India.

The Valuer has used the projections provided by the Management which is based on independent traffic and technical studies. The Valuation Report states that the Valuer has reviewed the financial forecast provided by the Management for consistency and reasonableness and has relied on the estimates provided.

The fair market value of each SPV is assessed by the Valuer using Discounted Cash Flow methodology under the income approach to compute the Enterprise Value ("EV"). The valuation approach of the Valuer assumes that the cash flows are free and available for distribution to the investors.

The Valuer has estimated the fair value of equity of the InvIT using the Sum of the Parts ("Sum of the Parts") method by adding the individual EV of each SPV and adjusting with below the line items of the Condensed Interim Special Purpose Consolidated financials of the Trust as on 31 March 2023.

Scope and Limitations / Caveats

(a) Our opinion and analysis are limited to the extent of the review of the documents provided to us by the Client including the Valuation Report. We have relied on the accuracy and completeness of all the information and documents without carrying out any independent due diligence or independent validation or verification of such information to establish its accuracy or sufficiency.

(b) We assume no responsibility for updating or revising our opinion based on circumstances or events occurring after the date hereof.

(c) Our opinion is strictly for the internal evaluation of the Client and not intended for any other purpose including any kind of capital market activity like raising a loan / debt. We explicitly state that this opinion is *not* for any regulatory purpose including any submission to SEBI, any other regulatory / statutory authorities.

(d) We understand that you require us to issue this Confirmation Certificate which is not required to be carried by a registered valuer as per the Companies Act 2013 ("Act"), or the Companies (Registered

Valuers And Valuation) Rules, 2017 (Rules) or as per any other rules, regulations, standards, bye-laws, ordinance, notifications issued pursuant to such Act or Rules. As such, our scope of work comprising opinion on the valuation of the Valuer including the usage of this Confirmation Certificate should be strictly construed accordingly.

Opinion:

Considering the above and subject to our caveats, we hereby confirm that the following valuation as computed by the Valuer is the fair valuation as on the Valuation Date:

- Combined EV of the 10 SPVs is INR 28,733.9 crores
- Equity value of the Trust is INR 18,274.7 crores
- Value per fully paid up unit is INR 207.83/- (Indian Rupees Two Hundred and Seven Point Eight Three Only) (face value per unit: INR 100/-).

Respectfully submitted,

For Incwert Advisory Private Limited

Registered Valuer Entity under Companies (Registered Valuers and Valuation) Rules, 2017
IBBI Registration No. IBBI/RV-E/05/2019/108
Asset class: Securities or Financial Assets

Punit Khandelwal

Director
Registered Valuer under Companies (Registered Valuers and Valuation) Rules, 2017
IBBI Registration No. IBBI/RV/05/2019/11375
Asset class: Securities or Financial Assets

Place: Mumbai
Date: 12 May 2023

IRB INFRASTRUCTURE TRUST

GOA/KARNATAKA BORDER TO KUNDARPUR (KM 93.300 TO KM 283.300) SECTION OF NH-17 IN THE STATE OF GOA & KARNATAKA

TRAFFIC STUDY & REVENUE PROJECTION REPORT (FINAL)

APRIL 2023

GMD Consultants

2, Park View Society, Sector -17,
Nerul East, Navi Mumbai. 400706. Maharashtra.
Phone : +91-22-27716391 / 27700233 / 27700991
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

GMD CONSULTANTS NAVI MUMBAI

GMD Adding Value

GOA/KARNATAKA BORDER TO KUNDARPUR

(KM 93.300 TO KM 283.300)

SECTION OF NH-17 IN THE STATE OF

GOA & KARNATAKA

TRAFFIC STUDY & REVENUE PROJECTION REPORT (FINAL)

APRIL 2023

Contents

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AADT	-	Annual Average Daily Traffic	**NHAI**	-	National Highway Authority of India
BOT	-	Build Operate Transfer	**NHDP**	-	National Highways Development Project
CAGR	-	Compound Annual Growth Rate	**NSDP**	-	Net State Domestic Product
CTV	-	Classified traffic volume	**O&M**	-	Operation & Maintenance
DBFOT	-	Design, Build, Finance, Operate & Transfer	**PCDP**	-	Per Capita Domestic Product
EME	-	Earth Moving Equipment	**PCI**	-	Per Capita Income
GDP	-	Gross Domestic Product	**PCU**	-	Passenger Car Unit
GSDP	-	Gross State Domestic Product	**PSC**	-	Pre-stressed Concrete
HCM	-	Heavy Construction Machinery	**RCC**	-	Reinforced cement concrete
HCV	-	Heavy Commercial Vehicle	**RHS**	-	Right Hand Side
HTMS	-	Highway Traffic Management System	**SH**	-	State Highway
IRC	-	Indian Road Congress	**TP**	-	Toll Plaza
IRR	-	Internal Rate of Return	**WPI**	-	Wholesale Price Index
LCV	-	Light Commercial Vehicle	**SIR**	-	Special Investment Region
LHS	-	Left Hand Side	**c.**	-	Circa
LGV	-	Light Goods Vehicle	**ROB**	-	Railway Over Bridge
MAV	-	Multi Axle Vehicle	**MDR**	-	Major District Road
MORTH	-	Ministry of Road Transport and Highways	**ODR**	-	Other District Road
NH	-	National Highway	**CA**	-	Concession Agreement
PCC	-	Plain Cement Concrete	**RMT**	-	Running Meter
CR	-	Coarse Rubble			

CHAPTER 1

INTRODUCTION

1.1 Background

The Government of India through National Highway Authority of India (NHAI) embarked upon a program to enhance the traffic capacity and safety for efficient transportation of goods as well as passenger traffic on National Highway Sections under various phases of NHDP. Under Phase IV NHAI has planned to convert existing 2-lane National Highways into 4-lane National Highway.

The project under consideration, Four Laning of **Goa / Karnataka Border** to **Kundapur** section of NH-17 from km 93.300 to km 283.300 is one such road project NHAI intended to implement on a BOT basis in the DBFOT format. *M/s IRB Westcoast Tollway Ltd*. (Concessionaire) has been awarded the Project for a concession period of 28 years starting from appointed date of 3rd March 2014. The Project is under capacity augmentation to six lanes. Tolling operation under current concession has commenced in February 2020 after partial COD on 31th January 2020.Further to it additional length of 161.050 Km has been completed and put to commercial operation in February 2022. PCOD-3 has been received in March 2023 & the rest of length is expected to complete by Financial Year 2024.

Project road from Goa/ Karnataka Border (Near Karwar) to Kundapur is about 190 km section of Mumbai - Goa highway (NH-17) from Km 93.700 to Km 283.300. NH-17 is most important transportation corridor along west cost of India. It starts at Panvel, at the junction of National Highway 4 (NH 4), and ends at Kanyakumari. NH-17 mainly traverses through the west coast of India, sometimes touching the shores of the Arabian Sea. The NH 17 touches the Arabian Sea at Maravanthe in Karnataka, Thalassery, Alappuzha and Kollam in Kerala. It passes through the Indian states of Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu

Following figure shows the project road alignment.

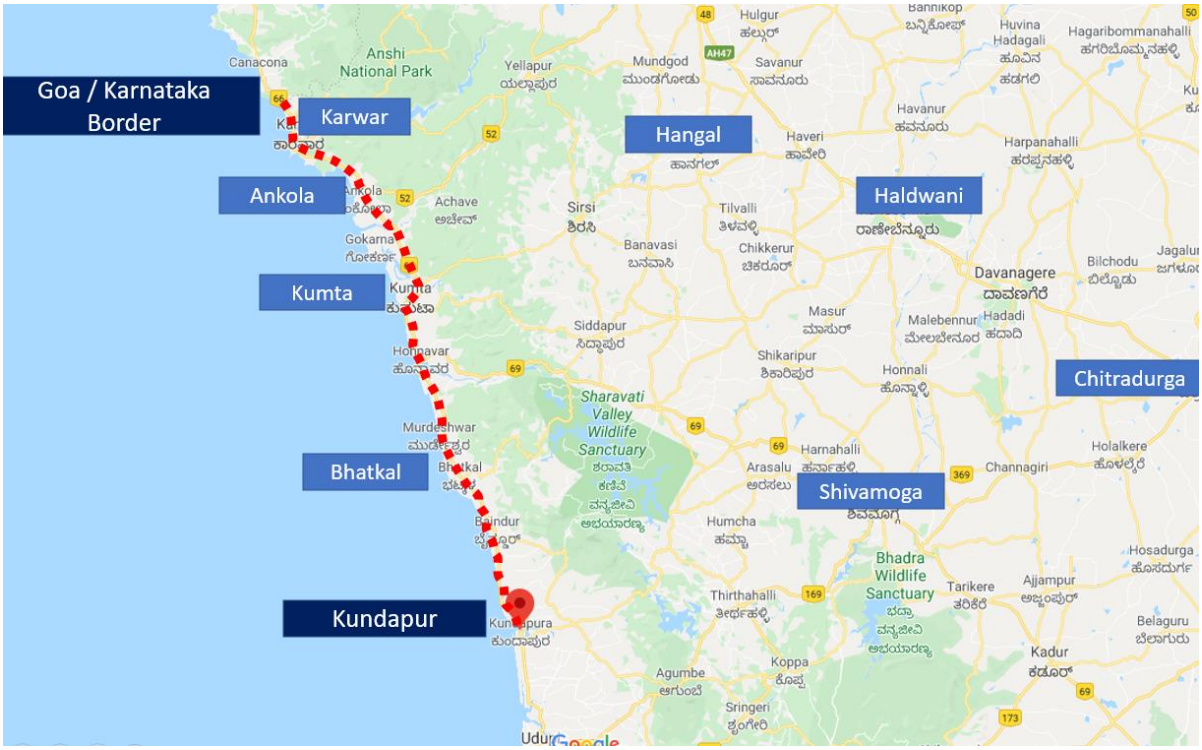


Figure 1-1 : Alignment of Project Stretch

1.2 Objective of the Study

M/s IRB INFRASTRUCTURE TRUST has engaged *GMD Consultants* to assess the future traffic and toll potential of project along with related operation & maintenance expenditure involved.

This report named as **"Traffic Study & *Toll Revenue Projection Report*"** mainly focuses on traffic and revenue aspects of the project. Other parameters like competing road, area developments etc. have been considered from a traffic development point of view.

1.2.1 Scope of Services

The broad scope of work covered in the assignment is as follows

a) Analysis of Traffic Growth
b) Toll Rate Growth
c) Revenue Forecasting

The Concessionaire has provided basic traffic data and other project details on the basis of which the above analysis has been carried out.

CHAPTER 2

PROJECT DETAILS

2.1 Project Corridor

Project of Four Laning of Goa / Karnataka Border – Kundapur section of NH-17 from Km 93.700 to Km 283.300 is Phase-IV project of NHAI on PPP basis under DBFOT pattern. Ankola, Bhatkal, Kumta and Karwar are the main urban centers on project Corridor. For most of the length project road runs parallel to western coast.

It can be observed that project road forms a main connectivity between Mumbai and southern parts on west coast like Goa, Kanoor, Kocchi, Thiruanantpuram and finally Kanyakumai. Thus transportation requirement in terms of passenger and goods are largely dependent on this spinal road

2.2 Project Stretch Description

project road section of NH-17 (now NH-66) passes through the important places like Karwar, Bhatkal, Ankola. This is the main connectivity between Mumbai and-Goa and Kerala. The Project Road passes through the districts of Karnataka and Goa.

National Highway 66, commonly referred to as NH 66 (Erstwhile NH-17 and a part of NH-47),is a busy National Highway that runs roughly north–south along the western coast of India, parallel to the Western Ghats. It connects Panvel (a city south of Mumbai) to Kanyakumari, passing through the states of Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu

Following are the major centers of areas which have impact on project road in terms of traffic.

Goa: is a state in India within the coastal region known as the Konkan, in Western India. It is bounded by Maharashtra to the north and Karnataka to the east and south, with the Arabian Sea forming its Western coast. It is India's smallest state by area and the fourth smallest by population. Goa has the highest GDP per capita among all Indian states,[3] that is two and a half times that of the country. It was ranked the 'best placed State' by the "Eleventh Finance

Commission" for its infrastructure and ranked on top for the 'best quality of life' in India by the National Commission on Population based on the 12 Indicators

Kumta: is a town and a taluk in the Uttara Kannada district of Karnataka, India. Kumta is about 142 km south of Margao and 58 km north of Bhatkal. It is situated 72.7 km from Karwar, the district headquarters. It is one of the important stations along the Konkan Railway line running between Mumbai and Mangalore.

Bhatkal: is a port town in the Uttara Kannada District of the South Indian state of Karnataka. The town of Bhatkal lies on National Highway 66, which runs between Mumbai and Kochi, and has one of the major railway stations along the Konkan Railway line, which runs between Mumbai and Mangaluru

As project highway runs along the west coast for most parts of its alignment, there are only radial roads connecting to project highway which work as feeder network to project road.

Four laning of project highway is higher priority of both central & concerned state governments. Currently highway has bottlenecks at many places which are being improved on priority. Due to poor condition of NH-17 and higher number of accidents some part of traffic uses Mumbai -Pune Expressway and then take Bangalore Highway (NH-48) to go to Goa and parts of Karnataka and Kerala. This traffic is expected to come back on project highway

There are three operative toll plazas at project stretch. at km 119.00, km 184.00 and km 243.00 respectively. Following figure show project alignment and toll plaza locations.

Figure 2-1 : Project Alignment with Toll Plaza

2.3 Project Corridor Illustration

Six laning of project stretch is complete. The following photographs illustrate project section along the corridor.

Figure 2-2 : Photographs showing Project Corridor

CHAPTER 3

TRAFFIC SURVEYS AND ANALYSIS

3.1 Traffic Surveys

The Consultants have collected the required information for project corridor to understand the general traffic and travel characteristics on the corridor.

The following traffic data has been collected from a client for project.

- Classified traffic volume counts at toll plaza locations on Goa Karnataka Border to Kundapur section of NH17 for period for February 2020 to March 2020, 2020-21, 2021-22 and 2022-23.
- Local Component of traffic
- Component of Return Journey
- Component of Monthly Pass Journey

The main objective of the traffic data analysis is to:

- Determine the existing traffic movement characteristics of the project
- Establish base year traffic
- Identification of travel patterns and modal split of project traffic
- Deriving growth factors for traffic forecasting
- Estimation of corridor traffic including traffic diversion if any
- Preparation of revenue model and projection of revenue as per toll policy for various scenarios

Table 3-1 below lists provides details of locations from where traffic details have been collected.

Table 3-1 : Traffic Data Details

SR. NO	LOCATION	CTV	Single Journey Traffic	Daily Return Journey	Monthly Pass	Local Pass
1	Km 119 Toll Plaza	AADT for Period from February 2020 to March 2020, 2020-21, 2021-2022 & 2022-23	For Period from February 2020 to March 2020, 2020-21, 2021-2022 & 2022-23	For Period from February 2020 to March 2020, 2020-21, 2021-2022 & 2022-23	For Period from February 2020 to March 2020, 2020-21, 2021-2022 & 2022-23	For Period from February 2020 to March 2020, 2020-21, 2021-2022 & 2022-23
2	Km 184 Toll Plaza	AADT for Period from February 2020 to March 2020, 2020-21, 2021-2022 & 2022-23	For Period from February 2020 to March 2020, 2020-21, 2021-2022 & 2022-23	For Period from February 2020 to March 2020, 2020-21, 2021-2022 & 2022-23	For Period from February 2020 to March 2020, 2020-21, 2021-2022 & 2022-23	For Period from February 2020 to March 2020, 2020-21, 2021-2022 & 2022-23
3	Km 243 Toll Plaza	AADT for Period from February 2020 to March 2020, 2020-21, 2021-2022 &	For Period from February 2020 to March 2020, 2020-21, 2021-2022	For Period from February 2020 to March 2020, 2020-21,	For Period from February 2020 to March 2020, 2020-21, 2021-2022	For Period from February 2020 to March 2020, 2020-21, 2021-2022 &

		2022-23	& 2022-23	2021-2022 & 2022-23	& 2022-23	2022-23

3.2 Classified Traffic Volume

The objective of conducting a Classified Traffic Volume Count is to understand the traffic flow pattern including modal split on a roadway. The Classified Traffic Volume Count survey has been provided by the concessionaire of project highway from actual traffic data gathered at toll plaza locations based on monthly data shared with NHAI.

The vehicles can broadly be classified into fast moving / motorized and slow moving / non-motorized vehicles, which can be further classified into specific categories of vehicles. The groupings of vehicles are further segregated to capture the tollable vehicle categories specifically and toll exempted vehicles are counted separately. The detailed vehicle classification system as per IRC: 64-1990 is given in table below.

Table 3-2 : Vehicle Classification System

Vehicle Type	
Auto Rickshaw	
Passenger Car	Car, Jeep, Taxi & Van (Old / new technology)
Bus	Minibus
	Standard Bus
Truck	Light Goods Vehicle (LCV)
	2 – Axle Truck
	3 Axle Truck (HCV)
	Multi Axle Truck (4-6 Axle)
	Oversized Vehicles (7 or more axles)
Other Vehicles	Agriculture Tractor, Tractor & Trailer

Source - IRC: 64 – 1990

However, since project highway is currently under toll operation, the data collected is corresponding to category of tollable vehicles. Following are the type of vehicles as per concession agreement.

- Car / Jeep / van
- Minibus /LCV
- Bus
- Truck
- 3 Axle commercial vehicle
- Multi Axle

3.3 Traffic Characteristic

Toll revenue of project highway does not solely depend on traffic volume. There are certain characteristics of traffic which have substantial potential to affect toll collection. Component of local traffic, component of passenger and commercial traffic, portion of return journey traffic, % of monthly pass traffic are some of such characteristics of traffic. These will be discussed in subsequent sections of report.

3.3.1 Traffic Data

Project concessionaire has provided Traffic data for base year 2019-20, 2020-21, 2021-22 and from April 2022 to March 2023 as under for both toll plazas–

Table 3-3 : Traffic Data at Belekeri Toll Plaza at Km 119.00

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)- February 20 to March 20	Annual Average Daily Traffic (Nos.)- 2020-21	Annual Average Daily Traffic (Nos.)- 2021-22	Annual Average Daily Traffic (Nos.)- 2022-23
1	CAR	1485	1639	1974	3061
2	Minibus/LCV	380	360	150	130
3	Bus	308	101	159	234
4	Truck	177	256	240	259
5	3 Axle	162	130	155	182

6	Multi Axle	339	329	519	627
7	Oversized Vehicles	8	7	5	6
Total		**2859**	**2821**	**3202**	**4497**

Table 3-4 : Traffic Data at Holegadde Toll Plaza at Km 184.00

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)- February 20 to March 20	Annual Average Daily Traffic (Nos.)- 2020-21	Annual Average Daily Traffic (Nos.)- 2021-22	Annual Average Daily Traffic (Nos.)- 2022-23
1	CAR	2587	2759	3240	5084
2	Minibus/LCV	830	582	266	292
3	Bus	455	293	343	532
4	Truck	662	676	693	844
5	3 Axle	312	272	277	303
6	Multi Axle	888	815	869	1139
7	Oversized Vehicles	2	5	6	6
Total		**5736**	**5401**	**5693**	**8198**

Table 3-5 : Traffic Data at Shirur Toll Plaza at Km 243.00

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)- February 20 to March 20	Annual Average Daily Traffic (Nos.)- 2020-21	Annual Average Daily Traffic (Nos.)- 2021-22	Annual Average Daily Traffic (Nos.)- 2022-23
1	CAR	2600	2953	3644	5778
2	Minibus/LCV	756	602	318	394
3	Bus	463	295	334	523

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)- February 20 to March 20	Annual Average Daily Traffic (Nos.)- 2020-21	Annual Average Daily Traffic (Nos.)- 2021-22	Annual Average Daily Traffic (Nos.)- 2022-23
4	Truck	700	684	814	950
5	3 Axle	305	273	315	319
6	Multi Axle	853	805	873	1123
7	Oversized Vehicles	2	7	6	6
Total		**5679**	**5619**	**6304**	**9092**

Pandemic of COVID-19 (Corona Virus) had impacted entire world. Taking precaution, government of India announced a complete lockdown in last of March 2020 and traffic on highways was stopped which was eased out progressively later. There after India was hit by Covid-19 second and third wave in February 21 to July -21 and December 21 to March-22. Recovering traffic pattern was somewhat again disturbed due to second and third wave of Covid-19. Traffic numbers for period from April-2020 to March 2021 were not representative of traffic pattern at project corridor due to pandemic lockdown impact. However, for integrity of data same shown above. Traffic has almost recovered from Covid -19 impact as of now.

Since the traffic data is available year 2022-23 report has been updated taking this as base year traffic.

This data was then bifurcated to various components like through local, monthly, return journey etc. category. Same is discussed in detail in following section.

3.4 Data Analysis

3.4.1 Analysis of Traffic Volume Count

Understanding the character of existing traffic forms the basis of the traffic forecast. The various vehicle types having different sizes and characteristics can be converted into a single unit called Passenger Car Unit (PCU). Passenger Car equivalents for various vehicles are adopted based on recommendations of Indian Road Congress prescribed in “IRC-64-1990: Guidelines for Capacity of Roads in Rural areas”. The adopted passenger car unit values (PCU) are presented in ***Table 3-6.***

Table 3-6 : PCU Factors Adopted for Study

Vehicle Type	PCUs
Car	1.0
Minibus	1.5
Standard Bus	3.0
LCV/LGV	1.5
2 Axle Truck	3.0
3 – 6 Axle Truck	4.5
MAV	4.5
Auto Rickshaw	1.0
Van/Tempo	1.0
Agriculture Tractor with Trailer	4.5
Agriculture Tractor without Trailer	1.5

Source: IRC: 64-1990

Traffic volume at each toll plaza was converted to PCU and same is presented as under

Table 3-7 : Traffic in PCU at Project Stretch Base Year 2022-23

Year	Toll Plaza Location (Km)	Traffic No	PCU	PCU Index
2019-20	Belekeri at Km 119.00	2859	5557	1.94
	Holegadde at Km 184.00	5736	12124	2.11
	Shirur at Km 243.00	5679	11986	2.11
2020-21	Belekeri at Km 119.00	2821	5150	1.83
	Holegadde at Km 184.00	5401	11043	2.04
	Shirur at Km 243.00	5619	11266	2.00

2021-22	Belekeri at Km 119.00	3202	6219	1.94
	Holegadde at Km 184.00	5693	11512	2.02
	Shirur at Km 243.00	6304	12465	1.98
2022-23	Belekeri at Km 119.00	4497	8125	1.81
	Holegadde at Km 184.00	8198	15705	1.92
	Shirur at Km 243.00	9092	16823	1.85

It can be observed from above that project traffic has PCU index from 1.8 to 2.0 which is an indicator of good proportion of commercial traffic in traffic mix in project corridor. The following figure illustrates variation of PCU index at three toll plaza locations.

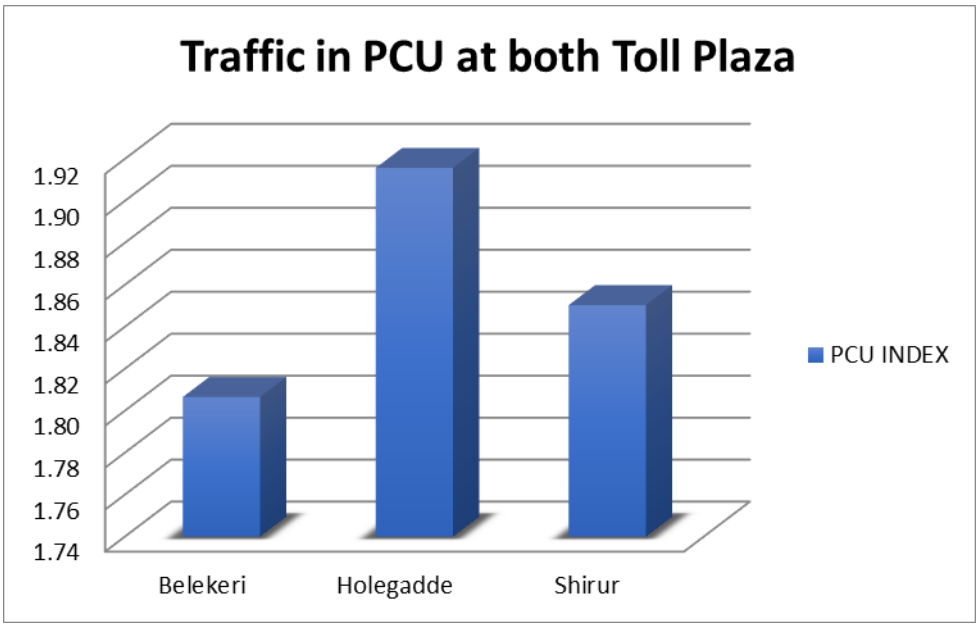


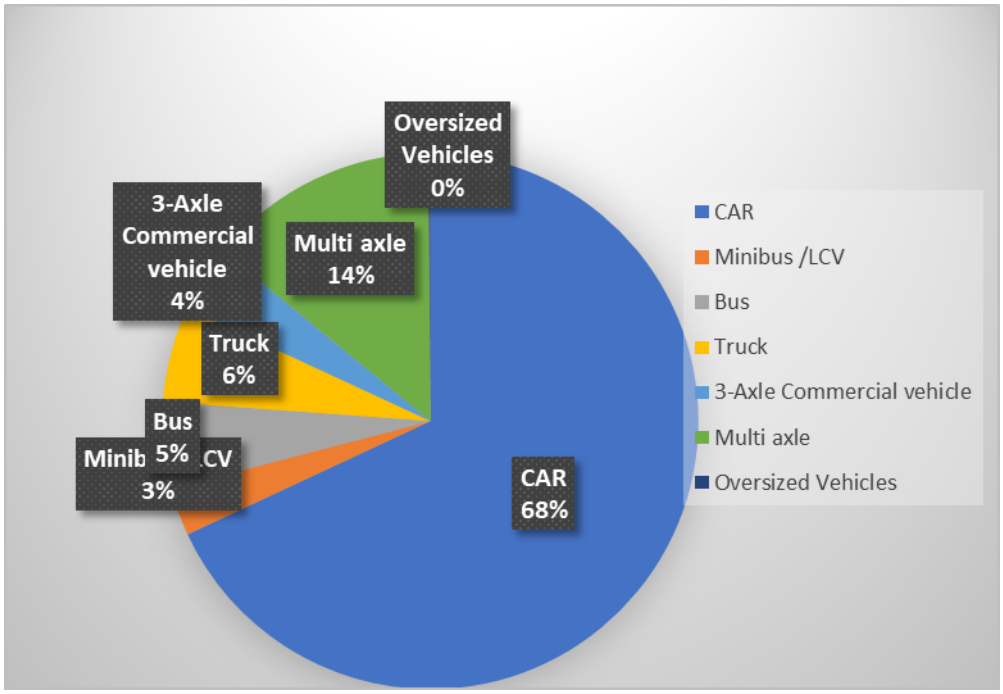
Figure 3-1 : Comparison of PCU Index

It can be observed that PCU index is consistent at all three plaza locations.

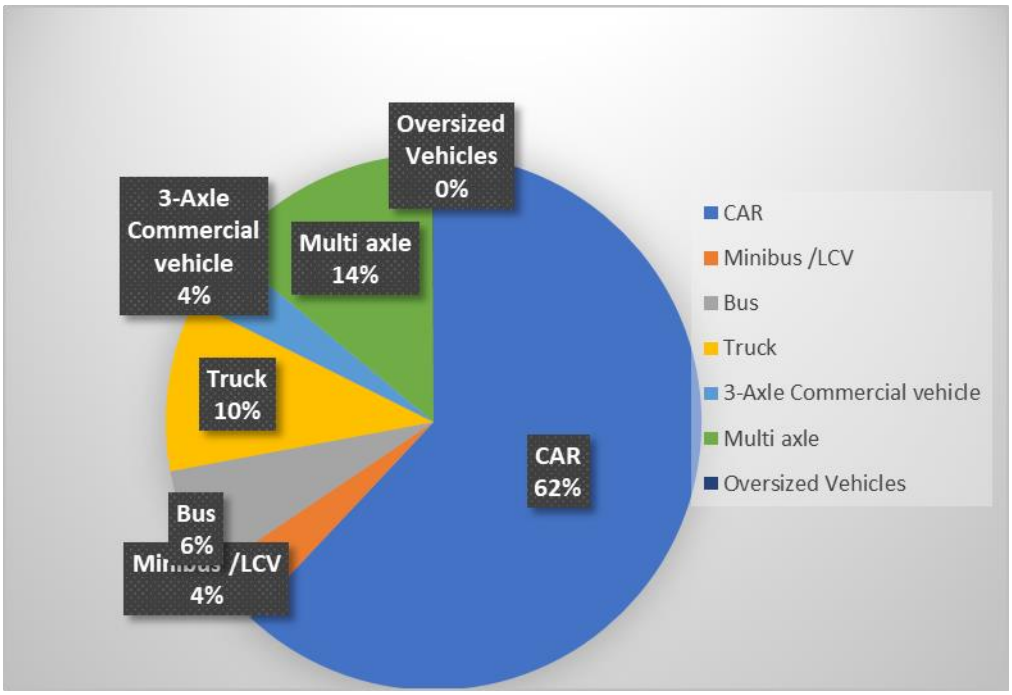
3.4.2 Components of Traffic

As discussed previously, components of traffic volume play an important role in determining project revenue. A larger component of commercial traffic with higher

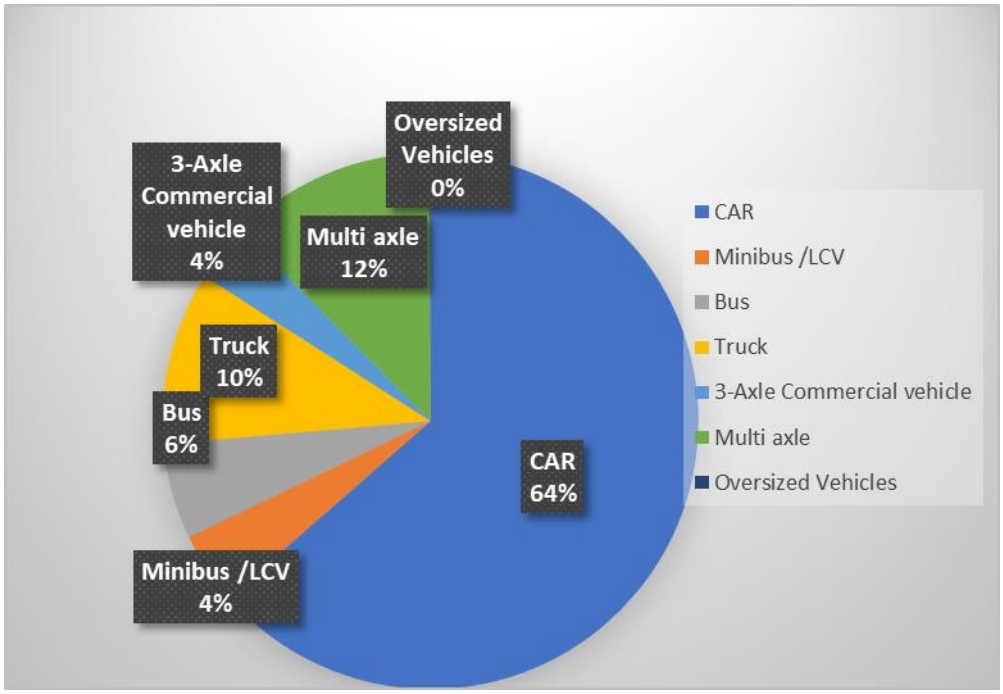
axle configuration adds to project revenue positively. Similarly, a larger component of local traffic affects the project revenue potential negatively.



Model Split of Tollable Vehicle @ KM 119.000



Model Split of Tollable Vehicle @ KM 184.000



Model Split of Tollable Vehicle @ KM 243.000

It is observed that car traffic forms about 68% of total traffic at toll plaza location 1 while multi axle along with 3 axle commercial vehicles are about 18% of total traffic. Truck / Bus and LCV share about 11% and 3% of traffic volume respectively at toll plaza on 119.000 km.

It is observed that car traffic forms about 62% of total traffic at toll plaza location 2 while multi axle along with 3 axle commercial vehicles are about 18% of total traffic. Truck / Bus and LCV share about 16% and 4% of traffic volume respectively at toll plaza on 184.000 km.

It is observed that car traffic forms about 64% of total traffic at toll plaza location 3 while multi axle along with 3 axle commercial vehicles are about 16% of total traffic. Truck / Bus and LCV share about 16% and 4% of traffic volume respectively at toll plaza on 243.000 km.

Thus project corridor has good mix of about 60% -70% passenger and 30-40% commercial traffic.

Another important bifurcation of traffic is components of traffic with respect various type of toll ticketing like

1. Single Journey
2. Multi Journey

3. Monthly Pass (Local and General)

The following table provides numbers of vehicles falling in each of above category on base year 2019-20, 2020-21, 2021-22 & April 2022 to March 2023.

Table 3-8 : Journey Type Bifurcation of Traffic at TP-1 KM 119.00

Sr. No	Type	Traffic Volume (Nos.)2022-23
1	Single Journey	2572
2	Return Journey	1764
3	Local Commercial Single Journey	159
4	Monthly Pass Local	2
5	Monthly Pass	0

Table 3-9 : Journey Type Bifurcation of Traffic at TP KM 184.00

Sr. No	Type	Traffic Volume (Nos.)2022-23
1	Single Journey	4940
2	Return Journey	2868
3	Local Commercial Single Journey	386
4	Monthly Pass Local	4
5	Monthly Pass	0

Table 3-10 : Journey Type Bifurcation of Traffic at TP KM 243.00

Sr. No	Type	Traffic Volume (Nos.)2022-23
1	Single Journey	4893
2	Return Journey	3852
3	Local Commercial Single Journey	337

4	Monthly Pass Local	10
5	Monthly Pass	0

Most dominant part of the above is the single journey type followed by return journey at project stretch. Monthly pass commuters are a very low fraction of the total traffic on the project corridor.

The single journey component in total traffic numbers is a high as 57%. Return journey component is 39% and Local Commercial Single Journey is 4% at toll plaza at Km 119.00

The single journey component in total traffic numbers is a high as 60%. Return journey component is 35% and Local Commercial single journey 5% at toll plaza at Km 184.00

The single journey component in total traffic numbers is a high as 54%. Return journey component is 42% and Local Commercial Single Journey is 4% at toll plaza at Km 243.00

It is observed that the project corridor demonstrates a similar pattern of single journey dominated mix of traffic across the entire stretch which is typical of major national highways.

3.5 Secondary Data Collection

There are several other factors which have a substantial impact on traffic pattern and growth on any project corridor. Following are some of such important factors.

- Industrial development around project corridor and its catchment
- Educational infrastructure along project corridor
- Demographic pattern
- Urban area development
- Tourism potential
- Upcoming major infrastructural or Industrial projects
- Special Industry in project corridor
- Overall trends of economic growth local as well as national / regional

Hence in addition to traffic details on project site, secondary data was also collected from various other sources. Typical secondary data includes the following:

1. Vehicle registration data of regional and national level.
2. Economic Data
   a) GDP
   b) NSDP
   c) Population Growth
   d) Per Capita Income growth
   e) Industrial Growth
   f) Special Industry Potential
   g) Regional and National development vision / plan
   h) Any other relevant data
3. Competing road network

We have collected and utilized such underlying data in the study to estimate the growth and risk factors for traffic along the project corridor.

CHAPTER 4
INFLUENCE ZONE TRANSPORT NETWORK ANALYSIS

4.1 Introduction

Highway corridors behave like integrated circuit network and more often than not every road is connected to various networks having different origin and destinations. Traffic running on these networks behave like fluid and flow on network on alignment of least friction.

Following Factors can be considered as major contributors to friction on transportation network

- Travel Speed / Travel Time
- Geometric deficiencies like blind horizontal curves and steep vertical gradients etc,
- Configuration of road
- Riding quality
- Traffic delays,
- Length of road,
- Passing through built up or Urban Area,
- Terrain,
- Facilities,

4.2 Competing / Alternate route

Project stretch runs on west coast of India. Most of the roads other than NH-17 run radial to NH-17 as complimentary network. There are large number of stream and rivers falling into Arabian sea on west coast. Hence any parallel road would require many major bridges. This has prevented any parallel road to NH-17. Following figure show bird's eye view of project corridor.

Figure 4-1 : Project corridor and radial roads

Still geographically there can be alternate routes to project road between certain pairs of origin and destinations. Following figure show such routes which are much longer than project road practically cannot be considered as alternate routes.

Figure 4-2 : Alternate route at regional level

Thus practically there is no alternate route to project road between Goa/ Karnataka border and Kundapur. Under these circumstances it is not envisaged that commercial or passenger traffic would switch to alternate roads from the project road. Further with completion of Mumbai Kanyakumari section of road traffic on project road would get a boost in period 2024-2026 when it would be completed.

CHAPTER 5
GROWTH OF TRAFFIC ON PROJECT HIGHWAY

5.1 Introduction

Traffic growth is a function of the interplay of a number of contributory factors such as National economy, Government policy, socio-economic conditions of the people, and changes in land uses along the project corridor precincts etc. As these factors have a number of uncertainties associated with them, forecasts of traffic are dependent on the projections of other factors such as population, gross domestic product (GDP), vehicle ownership, per capita income (PCI), agricultural output, fuel consumption etc. Future pattern of change in these factors can be estimated with only a reasonable degree of accuracy and hence the resultant traffic forecast levels may not be precise.

Traffic growth forecast for project corridor Goa/ Karnataka Border – Kundapur section of NH-17 has been done taking the above factors into consideration. "**IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**" is established best practice and has been used for traffic growth forecast.

5.2 Trend Analysis

One of the methods of estimation of future rate of growth is to assume the same rate of growth as in the past. Although such a method is more suitable to projects of short durations say 5-10 years, however for long term projections it would-be erroneous to assume that the past rate of growth will continue to prevail for a long time in future. Economic conditions, which are major influencing factors, are bound to change over a long period of time. Thus, it would be necessary to modify the past trends of growth suitably.

Elasticity model of growth projection is one of the most widely acceptable methods for traffic forecast. The same is recommended in **IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**.

In this method the past trend of vehicular data is paired with an economic

indicator and a regression analysis is done to yield the economic model of growth. Growth of vehicle traffic varies for different type of vehicle. It is a proven fact that the growth pattern for passenger and goods vehicle is different. Traffic growth on any highway typically depends on number of economic parameters. Most important and direct parameters are given as under

- Per Capita Income
- Net State Domestic Product (NSDP)
- Population

It can be observed that the ownership of a car is more closely related to affordability; hence per capita is the index which closely fits the growth of car traffic among other criteria. In a similar fashion, the following can be pairs of vehicle type and independent variable for elasticity modeling of growth.

- Car / Jeep – Par Capita Income
- Bus / Minibus – Population
- Goods Vehicle – NSDP

5.3 Estimation of Traffic Demand Elasticity

Elasticity of traffic demand is defined as the rate at which traffic intensity varies due to a change in the corresponding indicator selected. Hence, In order to estimate the elasticity of traffic demand, it is necessary to establish relationship between the growth in number of given category of vehicles with the relevant economic variable considered, such as NSDP, per capita income and population growth. Latest available data for vehicle registration, per capita income, NSDP and population is used in analysis.

As per IRC: 108-1996 the model for estimating elasticity index for the project corridor is of the following form and is given as below:

$$Log (P) = k \times Log (EI) + A$$

Where,

P	=	*Number of Vehicles (Mode wise)*
EI	=	*Economic Indicator*
A	=	*Regression constant*
k	=	*Elasticity coefficient (Regression coefficient)*

The elasticity for car and bus (passenger vehicles) is calculated based on the Population and Per Capita Domestic Product (PCDP) and the elasticity for trucks is calculated based on the Net State Domestic Product (NSDP).

The project corridor spreads across state of Karnataka. Toll plazas at Km 119.00. Km 184.00 and 243.00 are in the state of Karnataka. Contribution of Goa / Maharashtra is also substantial at stretch. For elasticity calculations, working data from Karnataka and Maharashtra / Goa has been analyzed.

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Karnataka State.

Table 5-1 : Per Capita Income Vs Car Karnataka

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	90269	1269430	4.96	6.10		
2013	94382	1420767	4.97	6.15	5%	
2014	101864	1572521	5.01	6.20	8%	
2015	105703	1741831	5.02	6.24	4%	
2016	116819	1916373	5.07	6.28	11%	
2017	131260	2110493	5.12	6.32	12%	7.83%

Regression analysis of same is given in figure below

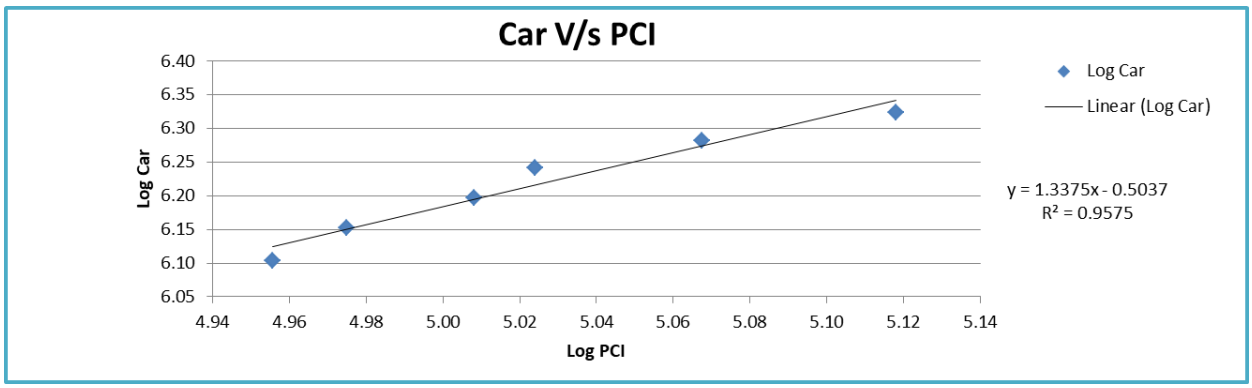


Figure 5-1 : Regression and Elasticity PCI vs. Car – Extrapolation Karnataka

Table 5-2 : Population Vs Bus Karnataka

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	1458545	9513	6.16	3.98		
2013	1466020	9956	6.17	4.00	1%	
2014	1473384	10925	6.17	4.04	1%	
2015	1480636	11224	6.17	4.05	0%	
2016	1487779	11503	6.17	4.06	0%	
2017	1494812	11888	6.17	4.08	0%	0.49%

Regression analysis of same is given in figure below

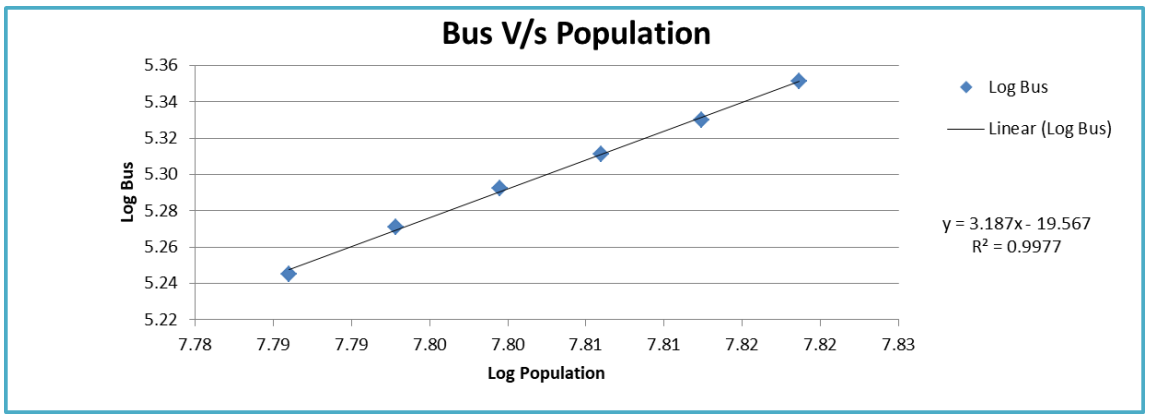


Figure 5-2 : Regression and Elasticity Population vs. Bus – Extrapolation Karnataka

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details

Table 5-3 : Goods Traffic Vs NSDP Karnataka

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth
2012	554990	221160	5.74	5.34		
2013	586592	258701	5.77	5.41	6%	
2014	639981	294266	5.81	5.47	9%	
2015	671322	331381	5.83	5.52	5%	
2016	749990	367572	5.88	5.57	12%	7.85%

Following figure depict regression analysis and extrapolation.

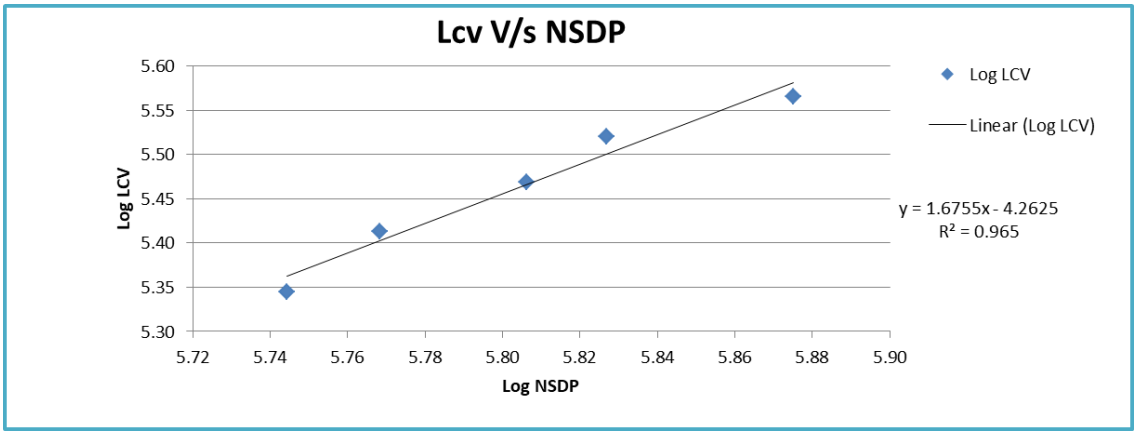


Figure 5-3 : Regression and Elasticity NSDP vs. LCV Traffic - extrapolation Karnataka

Table 5-4 : Traffic Truck Vs NSDP Karnataka

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	554990	233422	5.74	5.37		
2013	586592	247639	5.77	5.39	6%	
2014	639981	260989	5.81	5.42	9%	
2015	671322	274971	5.83	5.44	5%	
2016	749990	290415	5.88	5.46	12%	
2017	851880	306290	5.93	5.49	14%	9.00%

Following figure depict regression analysis and extrapolation.

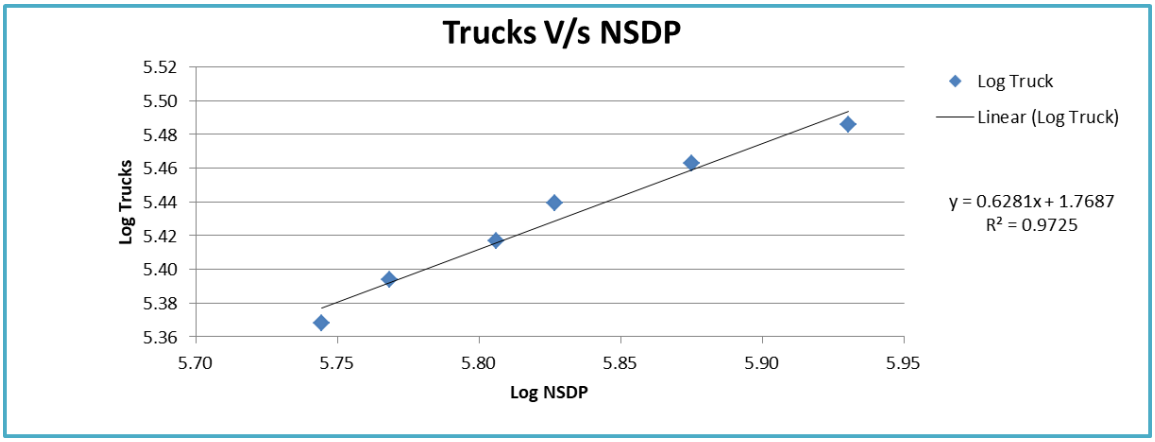


Figure 5-4 : Regression and Elasticity NSDP vs. Truck Traffic - extrapolation Karnataka

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below

Table 5-5 : Summary Regression Analysis Karnataka

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average Growth	Growth Elastic Model
Karnataka	Car/Jeep	PCI	y = 1.3375x + -0.5037	R² = 0.9575	1.3375	7.83%	10.47%
	Bus	Population	y = 3.187x - -19.567	R² = 0.9977	3.1870	1.52%	4.83%
	LCV	NSDP	y = 1.6755x - -4.2625	R² = 0.965	1.6755	7.85%	13.16%
	Truck	NSDP	y = 0.6281x - 1.7687	R² = 0.9725	0.6281	9.00%	5.65%

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Maharashtra State.

Table 5-6 : Per Capita Income Vs Car Maharashtra

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	99564	2307841	5.00	6.36		
2013	103904	2592565	5.02	6.41	4%	
2014	109399	2834847	5.04	6.45	5%	
2015	114746	3113773	5.06	6.49	5%	
2016	122422	3406872	5.09	6.53	7%	
2017	132899	3715744	5.12	6.57	9%	5.96%

Regression analysis of same is given in figure below

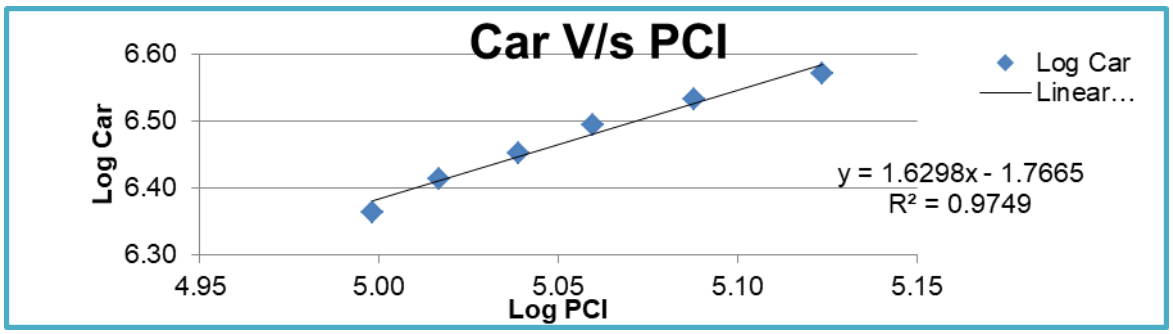


Figure 5-5 : Regression and Elasticity PCI vs. Car – Extrapolation Maharashtra

Table 5-7 : Population Vs Bus Maharashtra

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	112374333	119298	8.05	5.08		
2013	113807248	129535	8.06	5.11	1%	
2014	115229410	140087	8.06	5.15	1%	
2015	116640546	140102	8.07	5.15	1%	
2016	118040394	150427	8.07	5.18	1%	

2017	119428710	160042	8.08	5.20	1%	1.23%

Regression analysis of same is given in figure below

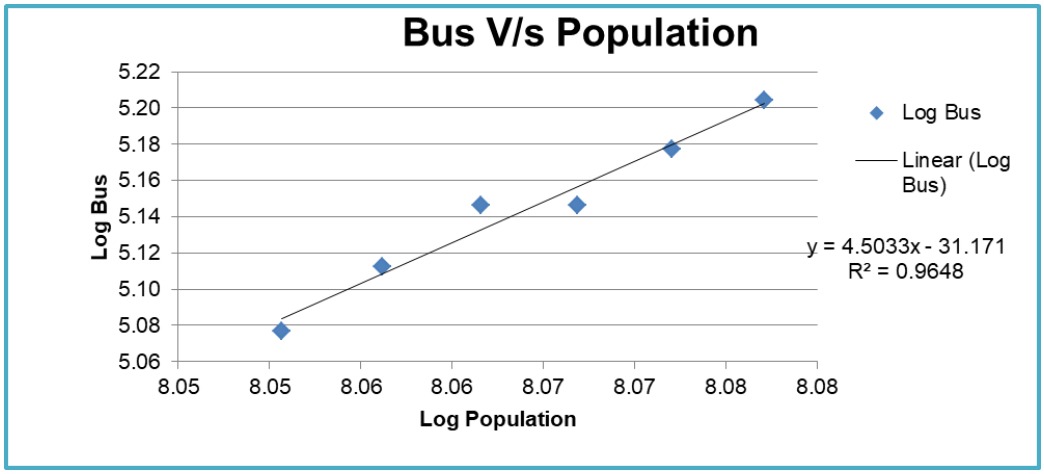


Figure 5-6 : Regression and Elasticity Population vs. Bus – Extrapolation Maharashtra

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-8 : LCV Traffic Vs NSDP Maharashtra

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth (5 Year)
2012	1126595	656407	6.05	5.82		
2013	1189711	739725	6.08	5.87	6%	
2014	1267551	803128	6.10	5.90	7%	
2015	1345341	868632	6.13	5.94	6%	
2016	1452439	927903	6.16	5.97	8%	6.56%

Following figure depict regression analysis and extrapolation.

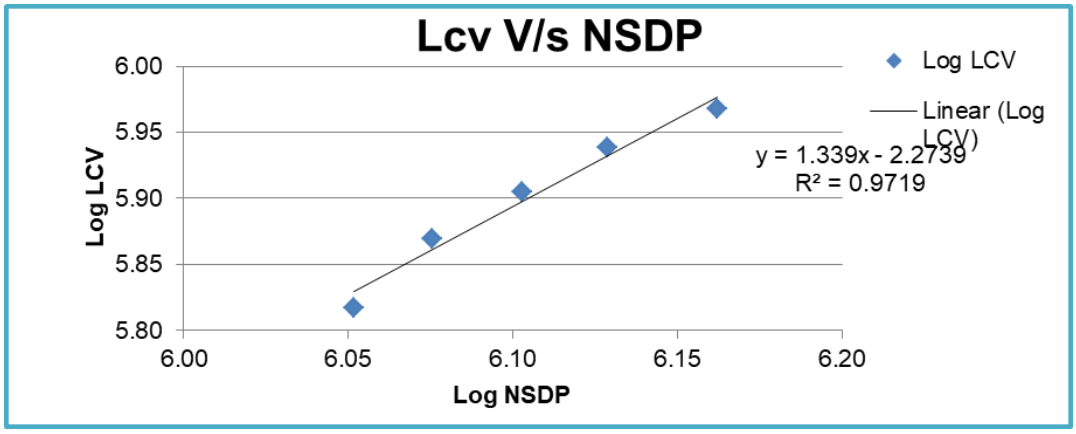


Figure 5-7 : Regression and Elasticity NSDP vs. Goods Traffic - extrapolation Maharashtra

Table 5-9 : Trucks Traffic Vs NSDP Maharashtra

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	1126595	411418	6.05	5.61		
2013	1189711	402366	6.08	5.60	6%	
2014	1267551	470128	6.10	5.67	7%	
2015	1345341	491582	6.13	5.69	6%	
2016	1452439	468810	6.16	5.67	8%	
2017	1595514	496439	6.20	5.70	10%	7.22%

Following figure depict regression analysis and extrapolation.

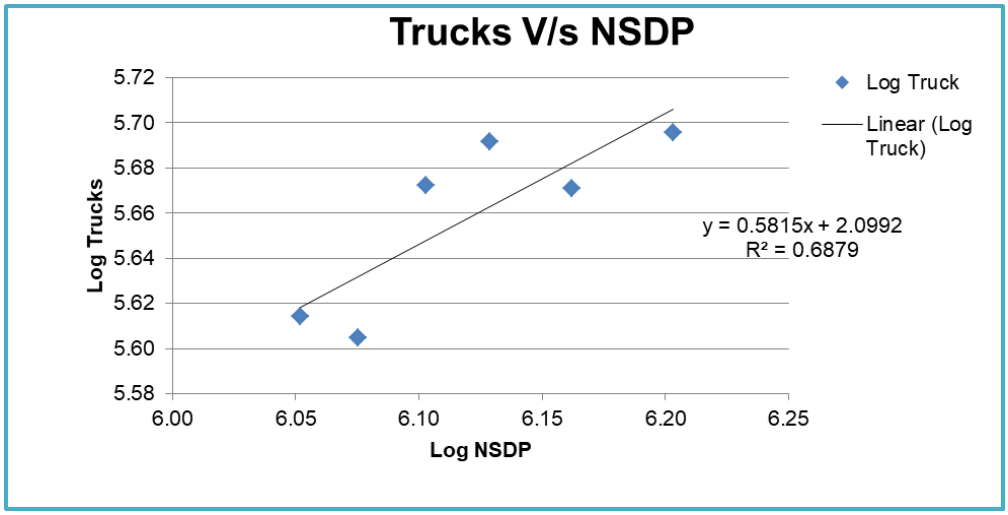


Figure 5-8 : Regression and Elasticity NSDP vs. Goods Traffic - extrapolation Maharashtra

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below

Table 5-10 : Summary Regression Analysis Maharashtra.

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average Growth	Growth Elastic Model
Maharashtra	Car/Jeep	PCI	y = 1.6298x + -1.7665	R² = 0.9749	1.6298	5.96%	9.71%
	Bus	Population	y = 4.5033x - -31.1713	R² = 0.9648	4.5033	1.23%	5.52%

	LCV	NSDP	y = 1.339x - -2.2739	R^2 = 0.9719	1.3390	6.56%	8.78%
	Truck	NSDP	y = 0.5815x - 2.0992	R^2 = 0.6879	0.5815	7.22%	4.20%

Economical model for predicting growth is good tool, however other local, regional, national factors should also be considered before finalizing growth factors. Considering factors such as proposed developments and other influencing economic factors, moderated growth should be considered. These factors are discussed in subsequent sections.

5.4 Analysis of Historic Traffic Data

Historical traffic data forms useful information for any highway project. It provides useful information for establishing past trend of growth. Project stretch of Goa/ Karnataka Border to Kundapur is under tolling operation with current concessionaire and has only two month of tolling history from February 2020. Further for last two years traffic is impacted by COVID-19 pandemic. Hence sufficient data points to be able to establish a reliable past trend of traffic growth are not available. A minimum of about 5 -6 years' consistent traffic data is required for establishing a reliable past trend.

5.5 Other Factors Influencing Growth

There are many factors which have impact on traffic growth. As discussed previously these factors can be economical, social, educational, and industrial.

Potentiality of such factors for project highway is discussed as under.

ECONOMY

After witnessing a slowdown during 2011-12, the economy recovered in 2013-14, and a high growth rate of GDP was recorded in up to 2018-19. Pandemic of COVID-19 impacted all economies of world including India. Following figure show trend of GDP growth in India.

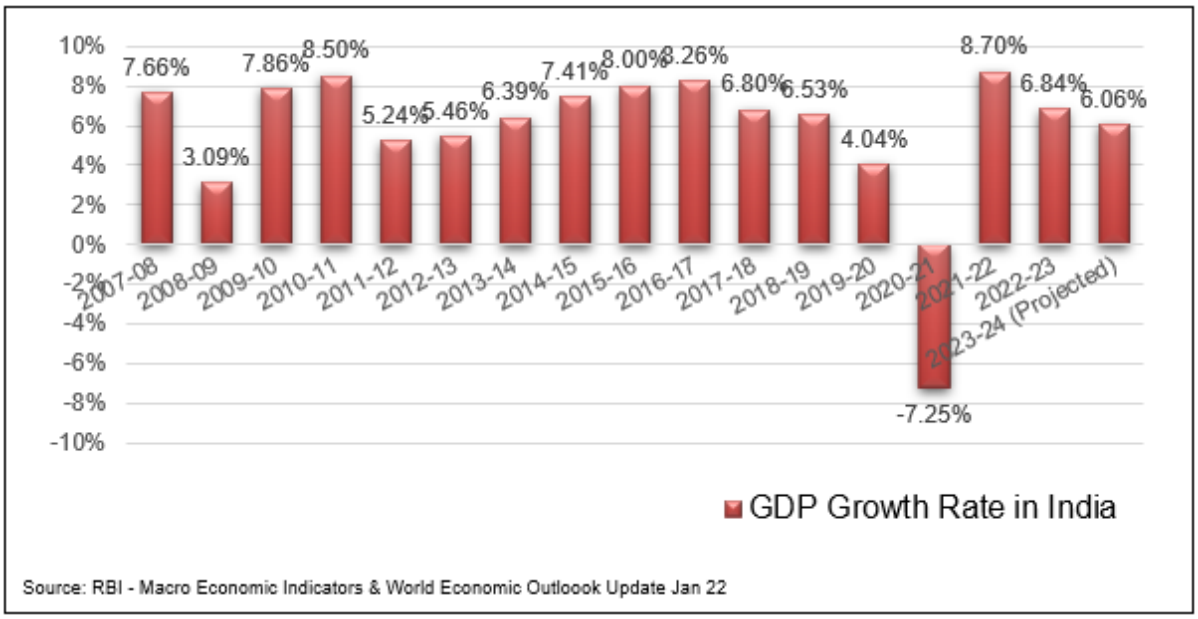


Figure 5-9 : Growth of GDP in India

FY 2017-18 recorded a growth of 6.7% which had slight impact of GST and demonetization. Indian economy appears on recovery path with estimated growth of 6.8% in FY 2018-19. Government took major policy decision including tax infrastructure reforming, banking sector improvement and ease of doing business.

Major economies of world collapsed due to pandemic COVID-19 including India. Indian economy is also registered negative growth in financial year 2020-21. After that Indian economy recovered handsomely and registered a growth of about 9% in Year 2021-22. This was partly due to low base of year 2020-21 as well.

Honorable Prime Minister has announced a major relief package of Rs. 20 lakh crores which is about 10% of GDP. This is aimed at turning this major crisis of COVID-19 into opportunity by providing major impetus to industrial production to the limit of becoming a self-reliant economy. With major thrust of this package being on **Make -In- India** it is expected that industry in India would grow at rapid pace and recover handsomely in post COVID-19 scenario. World Economic Outlook update also has predicted a growth rate of about 7.5 % in year 2022-23.

5.6 Developments along and around the Project Corridor & State

West Coast Ports - West coast is coast of submergence (except Malabar Coast) while east coast is an emergent coast. These imply that sea is deeper in west coast than sea on east coast. So, west coast has favourable conditions for natural

harbours. This is the reason that ports on west coast of India contribute more in terms of commercial cargo traffic. Expansion of JNPT port may further boost cargo traffic from Kerala, Karnataka and Parts of Tamilnaduon project corridor.

Mangalore - The coastal city of Mangalore is one of the upcoming and fastest developing metropolises of Karnataka. While Mangalore embeds itself in the conventional city affairs, what sets it apart from others is the amalgamation of its heritage, history, culture, food and scenic coastal lines.

Known for its architectural marvels, temples, churches and pristine beaches, the city attracts tourists throughout the year. Some of the popular tourist spots include Mangaladevi temple, St. Aloysius church, Pilikula Nisarga Dhama (a biological park and a picnic spot), Panambur beach and Surathkal beach. Its proximity to Agumbe, Coorg, Kaup beach and temple town Udupi also makes for a quick getaway for city folks.

Mangalore is the largest exporter of coffee in India. One of the flourishing industries in the city is the automobile leaf spring business. Petrochemicals, iron-ore, fertilizers and agricultural processing are some other thriving industries.

In addition, three special economic zones (SEZs) are being set up in the city with IT companies such as TCS, Wipro and Lotus estimated to invest up to Rs.30 billion, creating 67,000 jobs over the next three years. Mangalore is also one of the top five emerging cities of India for outsourcing, according to Alsbridge.

The city is witnessing aggressive industrial development, aiding in its economic growth. Growth of Mangalore as tourism and Industrial hub would have positive impact on growth of traffic on project road

5.7 Recommended Growth Rates of Traffic

Based on the above analysis and after giving due consideration to the entire listed factors, the following overall growth rates are recommended for each category of vehicle as under. Rate of growth is moderated in light of overall regional trend.

Growth of Multi-Axle is kept slightly higher as trend of technological advances in logistic industry favors multi-axle over 2/3 axle carriage. It is also expected that as the economy moves from developing to developed, rate of growth diminishes. Same growth rate is not sustainable for long. Traffic growth is suitably stepped down for future years.

Growth rates are recommended for three scenarios for sensitivity analysis namely **Optimistic, Pessimistic** and **Most Likely** with a positive and negative variation 0.5% from Most Likely case for corridor in both states.

5.7.1 Recommended Growth Rates of Traffic for Project Stretch

Table 5-11 : Recommended Growth Rates Optimistic

Category / Year	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045	2046-2050
Car/Jeep/Van	10.02%	9.29%	8.50%	8.14%	8.03%	7.57%
Bus	5.59%	5.28%	4.97%	4.90%	4.75%	4.52%
LCV	5.80%	4.95%	4.12%	3.72%	3.70%	3.28%
2- Axle	5.71%	5.04%	4.36%	4.04%	4.02%	3.68%
3 - Axle	6.04%	5.32%	4.60%	4.26%	4.24%	3.88%
4 to 6 Axle	7.02%	6.17%	5.33%	4.93%	4.90%	4.47%
7 and Above Axle	7.02%	6.17%	5.33%	4.93%	4.90%	4.47%

Table 5-12 : Recommended Growth Rates Pessimistic

Category / Year	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045	2046-2050
Car/Jeep/Van	9.52%	8.79%	8.00%	7.64%	7.53%	7.07%
Bus	5.09%	4.78%	4.47%	4.40%	4.25%	4.02%
LCV	5.30%	4.45%	3.62%	3.22%	3.20%	2.78%
2- Axle	5.21%	4.54%	3.86%	3.54%	3.52%	3.18%
3 - Axle	5.54%	4.82%	4.10%	3.76%	3.74%	3.38%
4 to6 Axle	6.52%	5.67%	4.83%	4.43%	4.40%	3.97%
7 and Above Axle	6.52%	5.67%	4.83%	4.43%	4.40%	3.97%

Table 5-13 : Recommended Growth Rates Most Likely

Category / Year	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045	2046-2050
Car/Jeep/Van	9.77%	9.04%	8.25%	7.89%	7.78%	7.32%
Bus	5.34%	5.03%	4.72%	4.65%	4.50%	4.27%
LCV	5.34%	5.03%	4.72%	4.65%	4.50%	4.27%
2- Axle	5.55%	4.70%	3.87%	3.47%	3.45%	3.03%
3 - Axle	5.46%	4.79%	4.11%	3.79%	3.77%	3.43%
4 to 6 Axle	5.79%	5.07%	4.35%	4.01%	3.99%	3.63%

7 and Above Axle	6.77%	5.92%	5.08%	4.68%	4.65%	4.22%

Project road is part of planned Mumbai- Kochi Economic Corridor under Bharatmala Pariyojna. At present various sections of corridor are under advance stage of construction and planning. Out of total about 1300 km of total length of corridor approximately 900 km is either completed or in under construction. Balance 400 km is to be awarded soon under Bharatmala Pariyojna. It is expected that substantial part of Mumbai – Kochi Economic Corridor would be operational by year 2024-25. This would be shorter than current preferred route of Bangalore highway (NH-48) by about 100 km. In such case it is expected that in horizon year 2024-25 certain part of traffic between Gujarat / Mumbai and Kochi / Kanyakumari would starts using project corridor as most preferred route. Further development of Tuticorin – Kochi economic corridor and ports at Mangalore, Goa and Kochi would also boost traffic on project corridor by year say 2024-25. Same has been considered while taking additional growth of traffic as discussed above.

Traffic and revenue has been worked out on the basis of above growths and same is presented in subsequent chapter of report.

5.8 COVID Impact

All social and economic activities had been completely disrupted due worldwide pandemic of Corona Virus. This had affected traffic on project stretch as well. Traffic was severely affected form March-2020 due to lockdown and then in second wave and third waves.

Government has announced a mega economic stimulate and package of Rs. 20 Lakh Crore to bring the economy back on track and recover the losses. Traffic has shown impressive recovery post lockdown period and has recovered to normal level.

Taking recommended traffic growth and additional factors as discussed above into consideration traffic forecast for concession period is done and presented in next chapter

CHAPTER 6
TRAFFIC FORECAST

6.1 Traffic Projections

Growth rates recommended in previous section of report are used to arrive at traffic projections for future years. Toll plaza wise futuristic traffic projection is given in tables below.

These projections have been done for following three cases of growth up to concession period

1. Optimistic Scenario
2. Pessimistic Scenario
3. Most Likely Scenario

Table 6-1 : Total Tollable Traffic @ Toll Plaza 1- 119 KM
(Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	3367	137	247	273	192	671	6	4893	8755
2024-25	3704	145	261	289	204	718	6	5327	9442
2025-26	4048	152	275	304	214	762	6	5761	10111
2026-27	4424	159	290	319	226	809	6	6233	10835
2027-28	4835	167	305	335	238	858	6	6744	11608
2028-29	5284	175	321	352	251	910	6	7299	12441
2029-30	5775	184	338	370	264	965	6	7902	13337
2030-31	6266	191	355	386	276	1016	6	8496	14203
2031-32	6798	199	372	403	289	1070	6	9137	15131
2032-33	7376	207	391	421	302	1127	6	9830	16127
2033-34	8003	216	410	439	316	1187	6	10577	17191

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2034-35	8683	225	430	459	330	1250	6	11383	18330
2035-36	9389	234	451	477	344	1311	6	12212	19483
2036-37	10153	243	473	497	358	1375	6	13105	20716
2037-38	10978	252	497	517	373	1442	6	14065	22033
2038-39	11870	261	521	538	389	1513	6	15098	23441
2039-40	12835	270	547	560	406	1587	6	16211	24948
2040-41	13865	280	573	582	423	1664	6	17393	26534
2041-42	14978	291	600	605	441	1745	6	18666	28232
2042-43	16181	302	628	629	459	1831	6	20036	30049
2043-44	17481	313	657	654	478	1921	6	21510	31989
2044-45	18884	324	689	680	499	2015	6	23097	34069
2045-46	20314	335	721	705	518	2105	6	24704	36148
2046-47	21852	346	754	730	538	2199	6	26425	38360
2047-48	23506	357	788	757	559	2298	6	28271	40722

Table 6-2 : Total Tollable Traffic @ Toll Plaza 2- 184KM

(Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	5594	309	562	891	320	1219	6	8901	16889
2024-25	6155	326	594	942	339	1305	6	9667	18169
2025-26	6727	342	626	989	357	1385	6	10432	19416
2026-27	7352	359	659	1039	375	1471	6	11261	20756
2027-28	8035	376	694	1091	394	1561	6	12157	22188
2028-29	8781	394	731	1146	415	1657	6	13130	23732
2029-30	9597	413	769	1204	437	1758	6	14184	25385
2030-31	10413	430	807	1256	457	1852	6	15221	26979

2031-32	11299	447	848	1311	478	1950	6	16339	28683
2032-33	12260	465	890	1368	500	2054	6	17543	30502
2033-34	13302	484	935	1428	522	2164	6	18841	32448
2034-35	14432	504	981	1491	545	2280	6	20239	34526
2035-36	15606	523	1029	1551	568	2392	6	21675	36626
2036-37	16875	542	1079	1614	591	2510	6	23217	38862
2037-38	18248	562	1132	1679	616	2633	6	24876	41248
2038-39	19733	582	1187	1747	642	2763	6	26660	43795
2039-40	21338	604	1245	1817	669	2899	6	28578	46510
2040-41	23052	626	1303	1890	697	3041	6	30615	49373
2041-42	24904	649	1365	1966	727	3190	6	32807	52434
2042-43	26905	672	1430	2045	758	3346	6	35162	55696
2043-44	29065	697	1497	2127	790	3509	6	37691	59170
2044-45	31399	722	1568	2213	824	3681	6	40413	62889
2045-46	33776	745	1639	2295	855	3845	6	43161	66590
2046-47	36335	770	1713	2379	887	4018	6	46108	70535
2047-48	39087	795	1791	2466	921	4198	6	49264	74732

Table 6-3 : Total Tollable Traffic @ Toll Plaza 3- Chainage 243 KM

(Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	6356	417	551	1004	338	1203	6	9875	18101
2024-25	6993	441	582	1062	358	1288	6	10730	19484
2025-26	7643	463	613	1115	376	1367	6	11583	20828
2026-27	8352	487	645	1170	396	1451	6	12507	22272
2027-28	9128	511	679	1229	417	1540	6	13510	23827
2028-29	9975	537	714	1291	439	1635	6	14597	25497
2029-30	10901	563	752	1356	461	1736	6	15775	27292

2030-31	11827	587	790	1415	482	1829	6	16936	29026
2031-32	12833	611	830	1477	504	1926	6	18187	30877
2032-33	13924	637	871	1542	526	2028	6	19534	32850
2033-34	15108	663	915	1609	550	2136	6	20987	34964
2034-35	16392	691	961	1679	575	2249	6	22553	37221
2035-36	17726	717	1008	1747	599	2360	6	24163	39511
2036-37	19168	743	1058	1817	624	2476	6	25892	41949
2037-38	20727	771	1109	1890	650	2597	6	27750	44544
2038-39	22414	799	1164	1966	678	2725	6	29752	47326
2039-40	24238	829	1221	2046	707	2859	6	31906	50296
2040-41	26184	859	1278	2128	736	2999	6	34190	53421
2041-42	28287	891	1338	2213	767	3146	6	36648	56762
2042-43	30559	923	1401	2302	799	3299	6	39289	60322
2043-44	33013	958	1467	2395	832	3460	6	42131	64129
2044-45	35664	993	1536	2491	867	3629	6	45186	68193
2045-46	38365	1025	1605	2582	900	3791	6	48274	72250
2046-47	41270	1058	1677	2676	935	3960	6	51582	76568
2047-48	44395	1093	1753	2774	971	4137	6	55129	81172

Table 6-4 : Total Tollable Traffic @ Toll Plaza 1- Chainage 119 KM (Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	3352	136	247	271	191	668	6	4871	8716
2024-25	3671	143	259	286	201	711	6	5277	9350
2025-26	3993	149	271	299	210	751	6	5679	9963
2026-27	4344	156	283	312	220	793	6	6114	10619
2027-28	4725	163	296	327	230	838	6	6585	11327
2028-29	5141	170	311	342	242	886	6	7098	12095
2029-30	5593	177	326	358	254	936	6	7650	12912

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2030-31	6040	184	341	372	264	981	6	8188	13689
2031-32	6524	191	356	387	274	1029	6	8767	14519
2032-33	7045	198	373	402	286	1078	6	9388	15403
2033-34	7608	205	390	418	298	1130	6	10055	16346
2034-35	8217	212	407	434	310	1185	6	10771	17348
2035-36	8844	219	424	449	322	1237	6	11501	18351
2036-37	9519	226	443	465	334	1292	6	12285	19425
2037-38	10246	233	462	481	347	1349	6	13124	20563
2038-39	11028	240	482	498	360	1408	6	14022	21771
2039-40	11871	247	503	516	373	1470	6	14986	23060
2040-41	12765	254	524	534	387	1535	6	16005	24416
2041-42	13726	263	546	552	401	1603	6	17097	25858
2042-43	14760	272	570	572	416	1674	6	18270	27402
2043-44	15871	281	594	592	432	1748	6	19524	29040
2044-45	17065	290	619	612	448	1825	6	20865	30777
2045-46	18271	298	644	632	463	1897	6	22211	32499
2046-47	19564	307	670	652	479	1972	6	23650	34329
2047-48	20948	316	697	672	495	2050	6	25184	36266

Table 6-5 : Total Tollable Traffic @ Toll Plaza 2- Chainage 184 KM (Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	5568	308	559	887	319	1213	6	8860	16811
2024-25	6098	324	588	933	336	1292	6	9577	17996
2025-26	6633	338	616	976	352	1365	6	10286	19142
2026-27	7216	353	646	1021	369	1442	6	11053	20370

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2027-28	7850	368	677	1067	386	1525	6	11879	21682
2028-29	8540	384	709	1116	404	1612	6	12771	23084
2029-30	9290	401	743	1166	423	1703	6	13732	24578
2030-31	10033	415	776	1211	440	1786	6	14667	26001
2031-32	10836	430	811	1258	458	1872	6	15671	27513
2032-33	11702	445	847	1307	476	1962	6	16745	29116
2033-34	12637	461	884	1357	495	2057	6	17897	30820
2034-35	13647	478	924	1409	515	2156	6	19135	32637
2035-36	14689	493	965	1459	534	2252	6	20398	34464
2036-37	15810	509	1007	1510	554	2351	6	21747	36393
2037-38	17017	525	1052	1563	575	2455	6	23193	38449
2038-39	18316	542	1098	1619	596	2563	6	24740	40629
2039-40	19715	559	1146	1677	618	2676	6	26397	42946
2040-41	21200	576	1194	1736	641	2794	6	28147	45377
2041-42	22796	594	1244	1797	664	2917	6	30018	47956
2042-43	24512	613	1297	1860	689	3045	6	32022	50699
2043-44	26358	633	1352	1925	715	3178	6	34167	53612
2044-45	28342	653	1409	1993	741	3317	6	36461	56704
2045-46	30346	671	1466	2056	766	3448	6	38759	59760
2046-47	32492	690	1524	2121	792	3585	6	41210	62998
2047-48	34790	709	1585	2189	818	3728	6	43825	66433

Table 6-6 : Total Tollable Traffic @ Toll Plaza 3- Chainage 243 KM (Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	6327	415	550	1000	337	1197	6	9832	18024

2024-25	6929	437	578	1052	355	1275	6	10632	19304
2025-26	7537	456	605	1099	372	1347	6	11422	20538
2026-27	8199	476	634	1149	390	1424	6	12278	21867
2027-28	8919	498	665	1201	408	1504	6	13201	23283
2028-29	9703	520	697	1255	427	1589	6	14197	24798
2029-30	10554	544	731	1312	448	1679	6	15274	26426
2030-31	11398	563	763	1362	466	1760	6	16318	27963
2031-32	12309	583	797	1414	485	1845	6	17439	29601
2032-33	13295	605	832	1469	505	1934	6	18646	31351
2033-34	14358	627	868	1526	526	2027	6	19938	33207
2034-35	15507	650	908	1584	547	2124	6	21326	35184
2035-36	16691	672	948	1639	568	2218	6	22742	37172
2036-37	17965	694	989	1697	589	2316	6	24256	39280
2037-38	19337	716	1033	1757	611	2418	6	25878	41522
2038-39	20813	740	1078	1819	633	2524	6	27613	43898
2039-40	22403	764	1125	1884	657	2636	6	29475	46436
2040-41	24091	788	1173	1951	681	2752	6	31442	49099
2041-42	25905	814	1223	2020	706	2873	6	33547	51929
2042-43	27856	840	1274	2091	732	2999	6	35798	54930
2043-44	29953	867	1328	2164	759	3131	6	38208	58123
2044-45	32209	895	1385	2240	787	3268	6	40790	61521
2045-46	34487	920	1441	2311	813	3397	6	43375	64876
2046-47	36926	946	1499	2384	841	3532	6	46134	68438
2047-48	39537	972	1559	2460	869	3673	6	49076	72215

Traffic projections for Most Likely scenario are given as under

Table 6-7 : Total Tollable Traffic @ Toll Plaza 1- Chainage 119 KM (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	3360	137	247	273	192	670	6	4885	8744
2024-25	3687	144	260	288	204	715	6	5304	9404
2025-26	4020	151	272	302	214	757	6	5722	10044
2026-27	4383	158	286	317	224	802	6	6176	10737
2027-28	4778	165	301	332	236	850	6	6668	11485
2028-29	5210	172	316	348	248	901	6	7201	12286
2029-30	5680	180	332	365	261	955	6	7779	13149
2030-31	6149	187	348	380	273	1003	6	8346	13973
2031-32	6656	194	365	396	285	1054	6	8956	14855
2032-33	7204	201	382	412	297	1108	6	9610	15792
2033-34	7798	208	400	429	310	1164	6	10315	16792
2034-35	8442	216	419	447	323	1223	6	11076	17864
2035-36	9108	223	438	464	336	1280	6	11855	18944
2036-37	9826	230	458	482	349	1340	6	12691	20095
2037-38	10600	238	479	500	363	1402	6	13588	21319
2038-39	11435	247	501	518	377	1467	6	14551	22622
2039-40	12337	256	525	538	392	1535	6	15589	24021
2040-41	13297	265	549	558	408	1606	6	16689	25494
2041-42	14332	274	573	579	424	1680	6	17868	27058
2042-43	15447	283	599	601	441	1758	6	19135	28733
2043-44	16649	292	625	623	458	1839	6	20492	30508
2044-45	17944	303	653	646	476	1924	6	21952	32409
2045-46	19259	312	681	668	493	2005	6	23424	34303
2046-47	20669	321	710	691	511	2089	6	24997	36314
2047-48	22182	330	740	714	529	2177	6	26678	38450

Table 6-8 : Total Tollable Traffic @ Toll Plaza 2- Chainage 184 KM (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	5581	308	561	890	320	1216	6	8882	16855
2024-25	6126	325	591	939	338	1299	6	9624	18090
2025-26	6679	340	621	984	355	1375	6	10360	19284
2026-27	7282	356	653	1031	373	1457	6	11158	20571
2027-28	7940	373	685	1080	391	1543	6	12018	21938
2028-29	8656	390	719	1131	410	1635	6	12947	23406
2029-30	9437	408	755	1185	431	1732	6	13954	24983
2030-31	10215	423	791	1234	449	1820	6	14938	26489
2031-32	11057	439	828	1284	468	1913	6	15995	28091
2032-33	11969	456	868	1337	489	2010	6	17135	29807
2033-34	12956	473	909	1392	510	2112	6	18358	31630
2034-35	14024	491	951	1450	532	2219	6	19673	33572
2035-36	15130	508	996	1505	553	2323	6	21021	35535
2036-37	16323	525	1042	1563	575	2431	6	22465	37617
2037-38	17610	543	1090	1622	598	2545	6	24014	39834
2038-39	18999	562	1140	1684	621	2664	6	25676	42192
2039-40	20497	581	1193	1747	646	2789	6	27459	44704
2040-41	22091	601	1246	1813	672	2918	6	29347	47344
2041-42	23810	621	1302	1882	698	3054	6	31373	50158
2042-43	25662	642	1360	1953	725	3196	6	33544	53148
2043-44	27658	664	1421	2026	754	3345	6	35874	56337
2044-45	29809	687	1485	2102	784	3501	6	38374	59734
2045-46	31991	707	1549	2174	812	3649	6	40888	63104
2046-47	34332	728	1615	2248	842	3803	6	43574	66680
2047-48	36846	750	1684	2325	872	3963	6	46446	70475

Table 6-9 : Total Tollable Traffic @ Toll Plaza 3- Chainage 230 KM (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	6341	415	550	1002	337	1199	6	9850	18053
2024-25	6960	439	580	1057	356	1280	6	10678	19385
2025-26	7589	460	610	1107	374	1355	6	11501	20677
2026-27	8275	482	641	1160	392	1435	6	12391	22062
2027-28	9023	505	673	1215	411	1520	6	13353	23545
2028-29	9838	529	707	1273	432	1609	6	14394	25135
2029-30	10727	554	742	1334	454	1704	6	15521	26843
2030-31	11612	576	777	1389	473	1791	6	16624	28480
2031-32	12570	598	813	1446	494	1881	6	17808	30218
2032-33	13607	622	852	1506	515	1976	6	19084	32078
2033-34	14730	646	892	1568	537	2077	6	20456	34064
2034-35	15945	671	934	1633	560	2182	6	21931	36179
2035-36	17203	695	978	1695	582	2284	6	23443	38316
2036-37	18560	719	1023	1760	605	2390	6	25063	40585
2037-38	20023	744	1070	1827	629	2502	6	26801	43003
2038-39	21602	770	1120	1897	654	2619	6	28668	45583
2039-40	23306	796	1172	1969	680	2741	6	30670	48325
2040-41	25120	823	1224	2043	706	2868	6	32790	51207
2041-42	27075	851	1280	2119	734	3001	6	35066	54282
2042-43	29181	880	1337	2198	763	3140	6	37505	57552
2043-44	31452	910	1397	2281	793	3286	6	40125	61044
2044-45	33899	941	1460	2367	825	3438	6	42936	64765
2045-46	36382	969	1523	2448	854	3583	6	45765	68461
2046-47	39045	998	1588	2533	885	3734	6	48789	72390
2047-48	41903	1028	1655	2620	917	3892	6	52021	76562

6.2 Modification in Concession Period

As per Article 29 of the concession agreement, if actual traffic on the project falls short or exceeds Target Traffic on project highway on defined date, concession period shall be modified subject to calculation stipulated therein. For Goa/ Karnataka - Moradabad project, the Target Date and Target Traffic are defined as under:

Target Date - 1st April 2022

Target Traffic - 21307 in PCU

It was observed that as per traffic projections, average traffic volume falls short of target traffic in all scenarios. Probable extension of concession period is estimated according to article 29 of concession agreement which comes to about 6 years. Traffic forecast and revenue projections are done for probable extended period accordingly.

Most Likely

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2022	21307	12120	-43%	65%	20%	28	5.6

Optimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2022	21307	12131	-43%	65%	20%	28	5.6

Pessimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2022	21307	12109	-43%	65%	20%	28	5.6

CHAPTER 7

FORECAST OF TOLL REVENUE

7.1 General

This chapter presents the tolling rate calculations, categories and toll revenue of the project.

7.2 Discount Categories

The fee schedule in the CA of Goa / Karnataka Border- Kundapur section of NH-17 is based on the old toll policy. As per the Toll Notification (Schedule - G) the discounts and special provisions have been considered. In addition to discounts as per Fee Notification concessionaire has declared special category rates also. Salient features of toll rate structure are given as under

1. Monthly Pass: For frequent users monthly pass would be issued for 50 trips in month at 2/3d rate..
2. Multiple Journeys (for Return Trip): Will be charged at 1.5 times single journey.
3. Single Journey: Full single journey toll would be charged to this category of vehicles who are infrequent travelers or whose frequency does not yield any discount from the above categories.
4. Local Discounts: There are several categories of local discounts.
    a) Local Passenger Car Jeep Van I - Rs. 275 per month as per fee notification
    b) Local commercial vehicles single at 50% rate for normal single trip

Building of inflation and escalation of rate on the basis of WPI are done as per toll notification (Schedule G) as given under as extract from concession agreement.

The formula for determining the applicable rate of fee shall be as follows:-

$$\text{Applicable rate of fee} = \text{base rate} + \text{base rate} \times \left\{ \frac{\text{WPI A-WPI B}}{\text{WPI B}} \right\} \times 0.4$$

Factor of inflation / growth has been incorporated as per Schedule R. WPI numbers (2011-12 series) are available up to 2018-19. A moderate growth in Wholesale Price Index (WPI) has been assumed after that. The following graph provides historical rate of inflation (WPI) in India. Data has been sourced from the Office of Economic Advisor web site (www.eaindustry.nic.in) WPI for year 2017-18 and 2018-2019 is worked back by applying a correlation factor for 2004-05 series as 2017-18 and 2018-2019 data is available in 2011-12 series only. Ratio of WPI for year 2016-17 for both series is used for conversion of WPI in 2004-05 series

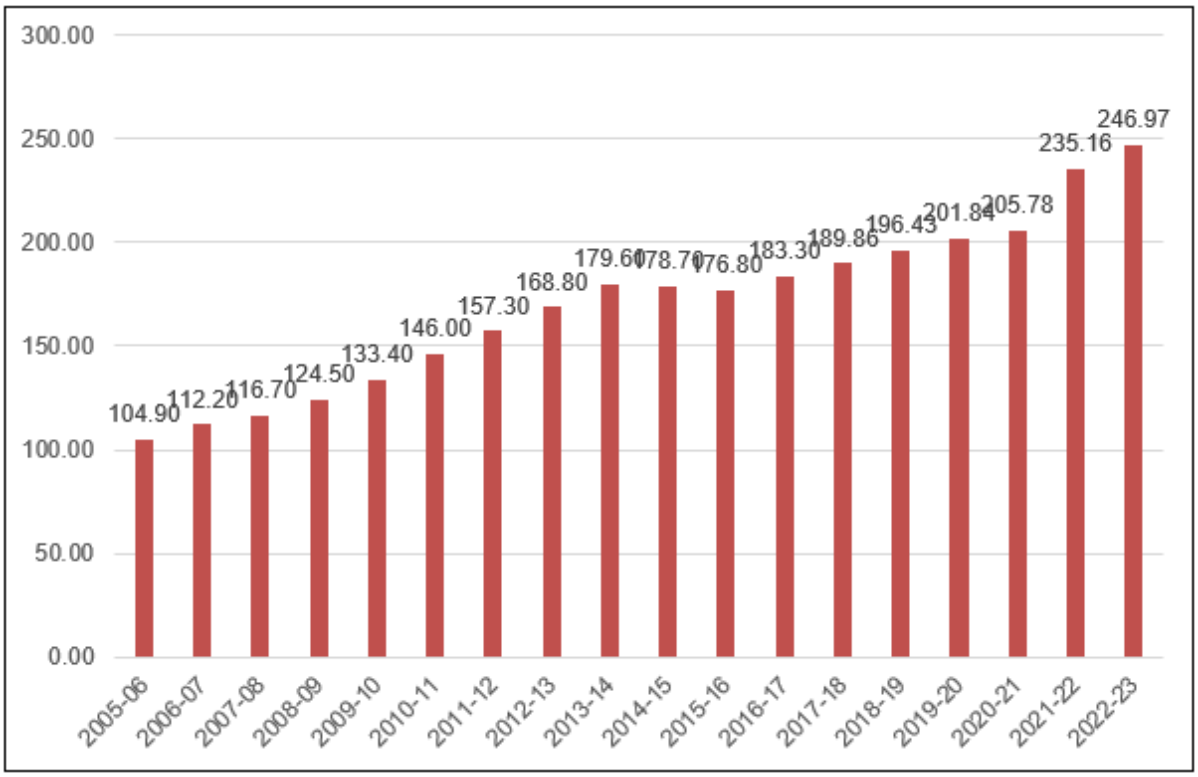


Figure 7-1 : Historical Rate of WPI Inflation in India

Average inflation in WPI in last few years is steadily growing. It grew in range of 4% - 5% in previous years. For future years initially it is takes 5% and Suitably Stepped down for future years.

7.3 Estimation of Toll Rates

As per the applicable MORTH notification and Schedule R of contract agreement, the following Base rate of fee for the categories mentioned in the table stands true in the National Highways Fee Rules applicable for contract.

Table 7-1 : Base Toll Rates June 2007-08

Type of Vehicle	Base Rate of Fee / Km (in Rs.)
Car, Jeep, Van or Light Motor Vehicle	0.65
Light Commercial Vehicle, Light Goods Vehicle or Minibus	1.05
Bus or Truck (Two Axles)	2.20
Three Axle Commercial Vehicles	2.40
Heavy Construction Machinery (HCM) or Earth Moving Equipment (EME) or Multi Axle Vehicle (MAV) (4 to 6 axles)	3.45
Oversized Vehicles (7 or more Axles)	4.20

There is no bypass or structure to be factored in for rates calculations.

Toll rates are calculated as per guidelines provided in schedule R (rounded to nearest Rs.) for the concession period and are given below.

Thus worked out rates for various categories of vehicle and discounts are given as under

Table 7-2 : Toll Rates for Single Journey @ Km 119.000

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	110	175	360	360	390
2023-24	125	195	405	405	440
2024-25	130	200	415	415	455
2025-26	135	210	440	440	480
2026-27	140	225	460	460	505

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2027-28	150	235	485	485	530
2028-29	155	245	505	505	555
2029-30	165	260	530	530	580
2030-31	170	270	560	560	610
2031-32	180	285	585	585	640
2032-33	190	300	615	615	675
2033-34	200	315	645	645	705
2034-35	210	330	680	680	740
2035-36	220	345	715	715	780
2036-37	230	365	750	750	820
2037-38	245	380	785	785	860
2038-39	255	400	825	825	905
2039-40	270	420	870	870	950
2040-41	280	445	915	915	1000
2041-42	295	465	960	960	1050
2042-43	310	490	1010	1010	1105
2043-44	330	515	1060	1060	1160
2044-45	345	540	1115	1115	1220
2045-46	365	570	1175	1175	1285
2046-47	380	600	1235	1235	1355
2047-48	400	630	1300	1300	1425

Table 7-3 : Toll Rates for Single Journey @ Km 184.000

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	110	170	355	355	390
2023-24	120	185	385	385	425

2024-25	120	195	400	400	440
2025-26	130	205	420	420	460
2026-27	135	215	445	445	485
2027-28	140	225	465	465	510
2028-29	150	235	490	490	535
2029-30	155	250	515	515	560
2030-31	165	260	540	540	590
2031-32	170	275	565	565	615
2032-33	180	285	595	595	650
2033-34	190	300	620	620	680
2034-35	200	315	655	655	715
2035-36	210	330	685	685	750
2036-37	220	350	720	720	785
2037-38	230	365	755	755	825
2038-39	240	385	795	795	870
2039-40	255	405	835	835	915
2040-41	270	425	875	875	960
2041-42	280	445	920	920	1010
2042-43	295	470	970	970	1060
2043-44	310	490	1020	1020	1115
2044-45	325	515	1070	1070	1170
2045-46	345	545	1125	1125	1230
2046-47	360	570	1185	1185	1295
2047-48	380	600	1245	1245	1360

Table 7-4 : Toll Rates for Single Journey @ Km 243.000

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	100	160	330	330	360
2023-24	100	165	345	345	375
2024-25	105	175	360	360	395
2025-26	110	180	380	380	415
2026-27	120	190	400	400	435
2027-28	125	200	420	420	455
2028-29	130	210	440	440	480
2029-30	135	220	460	460	505
2030-31	145	230	485	485	525
2031-32	150	240	505	505	550
2032-33	155	255	530	530	580
2033-34	165	265	555	555	610
2034-35	175	280	585	585	635
2035-36	180	290	615	615	670
2036-37	190	305	645	645	700
2037-38	200	320	675	675	735
2038-39	210	340	710	710	770
2039-40	220	355	745	745	810
2040-41	230	370	780	780	850
2041-42	240	390	820	820	895
2042-43	255	410	860	860	940
2043-44	265	430	900	900	985
2044-45	280	450	950	950	1035
2045-46	295	475	995	995	1085
2046-47	310	500	1045	1045	1140
2047-48	325	525	1100	1100	1200

Table 7-5 : Toll Rates for Return journey @ Km 119.000

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	165	260	535	535	590
2023-24	185	295	605	605	660
2024-25	190	305	625	625	685
2025-26	200	320	655	655	720
2026-27	215	335	690	690	755
2027-28	225	350	725	725	795
2028-29	235	370	760	760	830
2029-30	245	385	800	800	875
2030-31	260	405	835	835	915
2031-32	270	425	880	880	960
2032-33	285	450	925	925	1010
2033-34	300	470	970	970	1060
2034-35	315	495	1020	1020	1115
2035-36	330	520	1070	1070	1170
2036-37	345	545	1125	1125	1230
2037-38	365	575	1180	1180	1290
2038-39	385	600	1240	1240	1355
2039-40	400	630	1305	1305	1425
2040-41	425	665	1370	1370	1500
2041-42	445	700	1440	1440	1575
2042-43	470	735	1515	1515	1660
2043-44	490	775	1595	1595	1745
2044-45	515	815	1675	1675	1835
2045-46	545	855	1765	1765	1930

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2046-47	575	900	1855	1855	2030
2047-48	605	945	1950	1950	2135

Table 7-6 : Toll Rates for Return Journey @ Km 184.000

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	165	255	535	535	580
2023-24	175	280	580	580	635
2024-25	185	290	605	605	660
2025-26	195	305	635	635	690
2026-27	205	320	665	665	730
2027-28	215	335	700	700	765
2028-29	225	355	735	735	800
2029-30	235	370	770	770	840
2030-31	245	390	805	805	880
2031-32	260	410	845	845	925
2032-33	270	430	890	890	970
2033-34	285	450	935	935	1020
2034-35	300	475	980	980	1070
2035-36	315	495	1030	1030	1125
2036-37	330	520	1080	1080	1180
2037-38	345	550	1135	1135	1240
2038-39	365	575	1190	1190	1305
2039-40	380	605	1250	1250	1370
2040-41	400	635	1315	1315	1440
2041-42	420	670	1385	1385	1510

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2042-43	445	700	1455	1455	1590
2043-44	465	740	1530	1530	1670
2044-45	490	775	1605	1605	1755
2045-46	515	815	1690	1690	1845
2046-47	540	860	1775	1775	1940
2047-48	570	905	1870	1870	2045

Table 7-7 : Toll Rates for Return journey @ Km 243.000

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	145	235	495	495	540
2023-24	155	245	515	515	565
2024-25	160	260	545	545	595
2025-26	170	275	570	570	625
2026-27	175	285	600	600	655
2027-28	185	300	630	630	685
2028-29	195	315	660	660	720
2029-30	205	330	690	690	755
2030-31	215	345	725	725	790
2031-32	225	365	760	760	830
2032-33	235	380	795	795	870
2033-34	245	400	835	835	910
2034-35	260	420	875	875	955
2035-36	270	440	920	920	1005
2036-37	285	460	965	965	1050
2037-38	300	485	1010	1010	1105

2038-39	315	505	1060	1060	1160
2039-40	330	530	1115	1115	1215
2040-41	345	560	1170	1170	1275
2041-42	365	585	1230	1230	1340
2042-43	380	615	1290	1290	1405
2043-44	400	645	1355	1355	1475
2044-45	420	680	1420	1420	1550
2045-46	440	715	1495	1495	1630
2046-47	465	750	1570	1570	1710
2047-48	485	785	1650	1650	1800

Table 7-8 : Toll Rates for Monthly Pass Local Car Ticket @ all Toll Plaza

Year	Car	Mini Bus /LCV
2023-24	330	330
2023-24	330	330
2024-25	345	345
2025-26	365	365
2026-27	385	385
2027-28	400	400
2028-29	420	420
2029-30	440	440
2030-31	460	460
2031-32	485	485
2032-33	510	510
2033-34	535	535
2034-35	560	560
2035-36	585	585
2036-37	615	615

2037-38	645	645
2038-39	680	680
2039-40	710	710
2040-41	745	745
2041-42	785	785
2042-43	825	825
2043-44	865	865
2044-45	905	905
2045-46	955	955
2046-47	1000	1000
2047-48	1050	1050

Table 7-9 : Toll Rates for Monthly Pass @ Km 119.000

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2023-24	3695	5795	11935	11935	13060
2023-24	4140	6515	13425	13425	14690
2024-25	4275	6725	13870	13870	15175
2025-26	4495	7070	14585	14585	15955
2026-27	4725	7435	15340	15340	16780
2027-28	4960	7805	16100	16100	17615
2028-29	5205	8190	16895	16895	18480
2029-30	5465	8600	17730	17730	19395
2030-31	5735	9025	18610	18610	20360
2031-32	6025	9475	19535	19535	21370
2032-33	6325	9945	20510	20510	22440
2033-34	6640	10445	21535	21535	23560
2034-35	6975	10970	22620	22620	24745
2035-36	7330	11525	23760	23760	25995

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2036-37	7700	12110	24960	24960	27305
2037-38	8090	12720	26225	26225	28695
2038-39	8505	13370	27560	27560	30155
2039-40	8940	14055	28970	28970	31695
2040-41	9400	14775	30450	30450	33315
2041-42	9880	15535	32015	32015	35030
2042-43	10390	16335	33665	33665	36835
2043-44	10930	17180	35405	35405	38740
2044-45	11500	18070	37245	37245	40750
2045-46	12100	19015	39180	39180	42865
2046-47	12730	20005	41220	41220	45100
2047-48	13400	21050	43375	43375	47460

Table 7-10 : Toll Rates for Monthly Pass @ Km 184.000

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2023-24	3615	5720	11835	11835	12940
2023-24	3935	6230	12900	12900	14105
2024-25	4080	6465	13390	13390	14640
2025-26	4290	6795	14080	14080	15390
2026-27	4510	7145	14800	14800	16180
2027-28	4730	7500	15530	15530	16980
2028-29	4965	7865	16290	16290	17810
2029-30	5210	8255	17095	17095	18685
2030-31	5465	8660	17935	17935	19605
2031-32	5735	9090	18820	18820	20575
2032-33	6020	9540	19755	19755	21595
2033-34	6320	10015	20735	20735	22665

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2034-35	6635	10515	21770	21770	23795
2035-36	6970	11040	22860	22860	24990
2036-37	7320	11595	24005	24005	26240
2037-38	7690	12175	25215	25215	27565
2038-39	8080	12790	26485	26485	28955
2039-40	8490	13440	27825	27825	30420
2040-41	8920	14125	29240	29240	31965
2041-42	9375	14845	30730	30730	33595
2042-43	9855	15605	32300	32300	35310
2043-44	10360	16405	33955	33955	37120
2044-45	10895	17245	35700	35700	39030
2045-46	11460	18135	37540	37540	41040
2046-47	12050	19075	39480	39480	43165
2047-48	12675	20065	41525	41525	45400

Table 7-11 : Toll Rates for Monthly Pass @ Km 243.000

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2023-24	3260	5265	11030	11030	12035
2023-24	3395	5485	11490	11490	12535
2024-25	3565	5765	12075	12075	13170
2025-26	3750	6055	12690	12690	13840
2026-27	3940	6365	13335	13335	14550
2027-28	4130	6670	13975	13975	15250
2028-29	4330	6990	14650	14650	15980
2029-30	4535	7330	15355	15355	16755
2030-31	4755	7685	16100	16100	17565
2031-32	4985	8055	16880	16880	18415

2032-33	5230	8450	17700	17700	19310
2033-34	5485	8860	18565	18565	20250
2034-35	5755	9295	19470	19470	21240
2035-36	6035	9750	20425	20425	22280
2036-37	6330	10225	21430	21430	23375
2037-38	6645	10730	22485	22485	24525
2038-39	6970	11260	23595	23595	25740
2039-40	7315	11820	24765	24765	27015
2040-41	7680	12405	25990	25990	28355
2041-42	8060	13025	27285	27285	29765
2042-43	8465	13675	28650	28650	31255
2043-44	8890	14360	30085	30085	32820
2044-45	9335	15080	31590	31590	34465
2045-46	9805	15835	33180	33180	36200
2046-47	10300	16635	34855	34855	38025
2047-48	10820	17475	36615	36615	39945

7.4 Toll Revenue

As indicated earlier, toll revenue on the Project Road has been calculated in all three scenarios based on above rates and projected traffic. The estimates of toll revenue under ***Optimistic***, ***Pessimistic*** and ***Most Likely*** growth scenarios are presented in the following section.

7.5 Toll Revenue at all toll plazas under Scenarios

Toll Revenue estimates under all scenarios at each of the toll plaza up to 2047-48 starting from the year 2023-24 are shown in tables below.

Table 7-12 : Toll Revenue Optimistic Scenario

(Rs. Crores)

Year	TP-1	TP2	TP3	Total
2023-24	32.46	63.26	61.19	**156.91**
2024-25	41.74	78.65	74.85	**195.24**
2025-26	46.87	88.91	83.87	**219.65**
2026-27	52.72	99.74	94.51	**246.96**
2027-28	59.74	111.58	106.42	**277.74**
2028-29	66.57	125.31	118.78	**310.66**
2029-30	75.04	140.12	132.66	**347.82**
2030-31	83.52	156.45	148.43	**388.39**
2031-32	93.68	174.14	165.38	**433.19**
2032-33	104.74	194.02	183.16	**481.91**
2033-34	117.10	216.58	204.48	**538.16**
2034-35	131.06	241.86	228.86	**601.78**
2035-36	146.57	269.74	253.74	**670.05**
2036-37	162.76	299.26	282.24	**744.26**
2037-38	182.71	332.52	314.36	**829.59**
2038-39	203.63	370.33	349.99	**923.95**
2039-40	228.40	414.25	390.53	**1033.18**
2040-41	253.93	461.88	432.88	**1148.69**
2041-42	283.70	512.46	482.05	**1278.21**
2042-43	317.45	573.06	537.82	**1428.33**
2043-44	357.03	640.12	599.40	**1596.56**
2044-45	397.74	712.33	667.66	**1777.73**
2045-46	445.11	794.44	742.01	**1981.55**
2046-47	495.21	881.43	826.14	**2202.78**
2047-48	552.71	982.78	917.06	**2452.55**

Table 7-13 : Toll Revenue Pessimistic Scenario

(Rs. Crores)

Year	TP-1	TP2	TP3	Total
2023-24	32.42	63.17	61.11	**156.70**
2024-25	41.37	77.87	74.16	**193.40**
2025-26	46.24	87.61	82.68	**216.53**
2026-27	51.80	97.88	92.79	**242.47**
2027-28	58.41	109.03	103.95	**271.40**
2028-29	64.82	121.89	115.45	**302.16**
2029-30	72.77	135.73	128.40	**336.90**
2030-31	80.64	150.84	142.99	**374.47**
2031-32	90.08	167.13	158.55	**415.77**
2032-33	100.29	185.31	174.84	**460.45**
2033-34	111.65	205.88	194.27	**511.80**
2034-35	124.32	228.86	216.35	**569.54**
2035-36	138.32	254.01	238.78	**631.12**
2036-37	152.84	280.46	264.36	**697.66**
2037-38	170.78	310.13	292.99	**773.89**
2038-39	189.32	343.71	324.62	**857.64**
2039-40	211.30	382.68	360.52	**954.49**
2040-41	233.85	424.62	397.68	**1056.16**
2041-42	259.98	469.01	440.92	**1169.91**
2042-43	289.58	522.02	489.62	**1301.22**
2043-44	324.17	580.32	543.04	**1447.52**
2044-45	359.34	642.64	601.99	**1603.97**
2045-46	400.29	713.28	665.83	**1779.41**
2046-47	443.26	787.61	737.96	**1968.84**
2047-48	492.39	874.11	815.43	**2181.93**

Table 7-14 : Toll Revenue Most Likely Scenario

(Rs. Crores)

Year	TP-1	TP2	TP3	Total
2023-24	32.44	63.21	61.15	**156.80**
2024-25	41.55	78.21	74.52	**194.28**
2025-26	46.57	88.23	83.32	**218.12**
2026-27	52.30	98.79	93.70	**244.78**
2027-28	59.10	110.23	105.20	**274.53**
2028-29	65.75	123.53	117.16	**306.44**
2029-30	73.99	137.83	130.55	**342.37**
2030-31	82.16	153.53	145.71	**381.40**
2031-32	92.00	170.48	161.96	**424.44**
2032-33	102.60	189.51	178.99	**471.10**
2033-34	114.47	211.02	199.36	**524.85**
2034-35	127.78	235.08	222.58	**585.44**
2035-36	142.52	261.55	246.20	**650.27**
2036-37	157.85	289.44	273.26	**720.55**
2037-38	176.78	320.80	303.56	**801.15**
2038-39	196.48	356.42	337.13	**890.03**
2039-40	219.86	397.84	375.29	**992.98**
2040-41	243.94	442.49	415.01	**1101.44**
2041-42	271.94	489.84	461.08	**1222.86**
2042-43	303.58	546.52	513.21	**1363.32**
2043-44	340.56	609.06	570.63	**1520.24**
2044-45	378.43	676.13	634.15	**1688.71**
2045-46	422.52	752.30	703.01	**1877.83**
2046-47	468.87	832.76	780.87	**2082.50**
2047-48	522.10	926.20	864.80	**2313.10**

CHAPTER 8

CONCLUSION & RECOMMENDATIONS

8.1 Conclusion & Recommendations

Project stretch of Goa/ Karnataka to Kundapur section of NH-17 in state of Karnataka from km 93.70.000 to km 183.300 is four lane. The road is in sound condition and serves healthy traffic volumes. Project corridor is a part of the busy and prominent national highway NH-17 which is main link for traffic on west coast to from Rajasthan, Gujarat, Maharashtra to Kerala. There are large number of townships, industrial corridors and other business establishment coming up along project corridor. As Indian economy is poised to grow at 6%+ post COVID-19, the project corridor is expected to pick up the same trend in terms of traffic flow. All these developments have potential to give positive impact to traffic flow on project. The following can be considered as major outcomes of the study

a) There is good amount of tollable traffic running on project

b) Project corridor has potential to witness traffic growth @ 6-8% annually in near future due to various development in area and overall development of economy

c) Project corridor has committed traffic as long route traffic and does not run a risk of traffic leakage due to quality competing road

Based on above it can be considered a stable healthy project from traffic and revenue point of view.

.

GMD Consultants
503-504, Mayuresh Chambers Premises, Plot No. 60,
Sector -11, CBD Belapur, Navi Mumbai. 400 614.
Maharashtra.
Phone : +91-22-2756 4586 / 2756 5313
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

SOLAPUR TO YEDISHI SECTION OF NH 211 IN THE STATE OF MAHARASHTRA (KM 0.000 TO KM 100.000)

APRIL 2023

TTRAFFIC STUDY & REVENUE PROJECTION REPORT (FINAL)

GMD Consultants
2, Park View Society, Sector -17,
Nerul East, Navi Mumbai. 400706. Maharashtra.
Phone : +91-22-27716391 / 27700233 / 27700991
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

SOLAPUR TO YESDISHI SECTION OF NH 211

(KM 0.000 TO KM 100.000)

IN THE STATE OF MAHARASHTRA.

TRAFIC STUDY & REVENUE PROJECTION REPORT (FINAL)

APRIL 2023

GMD CONSULTANTS ★ NAVI MUMBAI ★

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AADT	-	Annual Average Daily Traffic	**NHAI**	-	National Highway Authority of India
BOT	-	Build Operate Transfer	**NHDP**	-	National Highways Development Project
CAGR	-	Compound Annual Growth Rate	**NSDP**	-	Net State Domestic Product
CTV	-	Classified traffic volume	**O&M**	-	Operation & Maintenance
DBFOT	-	Design, Build, Finance, Operate & Transfer	**PCDP**	-	Per Capita Domestic Product
EME	-	Earth Moving Equipment	**PCI**	-	Per Capita Income
GDP	-	Gross Domestic Product	**PCU**	-	Passenger Car Unit
GSDP	-	Gross State Domestic Product	**PSC**	-	Pre-stressed Concrete
HCM	-	Heavy Construction Machinery	**RCC**	-	Reinforced cement concrete
HCV	-	Heavy Commercial Vehicle	**RHS**	-	Right Hand Side
HTMS	-	Highway Traffic Management System	**SH**	-	State Highway
IRC	-	Indian Road Congress	**TP**	-	Toll Plaza
IRR	-	Internal Rate of Return	**WPI**	-	Wholesale Price Index
LCV	-	Light Commercial Vehicle	**SIR**	-	Special Investment Region
LHS	-	Left Hand Side	**c.**	-	Circa
LGV	-	Light Goods Vehicle	**ROB**	-	Railway Over Bridge
MAV	-	Multi Axle Vehicle	**MDR**	-	Major District Road
MORTH	-	Ministry of Road Transport and Highways	**ODR**	-	Other District Road
NH	-	National Highway	**CA**	-	Concession Agreement
PCC	-	Plain Cement Concrete	**RMT**	-	Running Meter
CR	-	Coarse Rubble			

CHAPTER 1

INTRODUCTION

1.1 Background

The Government of India through National Highway Authority of India (NHAI) embarked upon a program to enhance the traffic capacity and safety for efficient transportation of goods as well as passenger traffic on National Highway Sections under various NHDP Phases.

The project under consideration, Four Laning of **Solapur** to **Yedeshi** section of NH-211 from km 0.000 to km 100.000 in the state of Maharashtrais one such road project NHAI intended to implement on a BOT basis in the DBFOT format. *M/s Solapur Yedeshi Tollway Ltd*. (Concessionaire) has been awarded the Project for a concession period of 29 years starting from appointed date of 21st January2015.COD was achieved for part length of project in 15th October 2019 and Tolling Operation on Project started for full length.

Project road section from Solapur to Yedeshi is part of important north-south connectivity. It connects Karnataka, southern parts of Maharashtra and other southern states to Solapur, Aurangabad, Dhule and then northern parts of India.

Following figure shows the project road alignment.

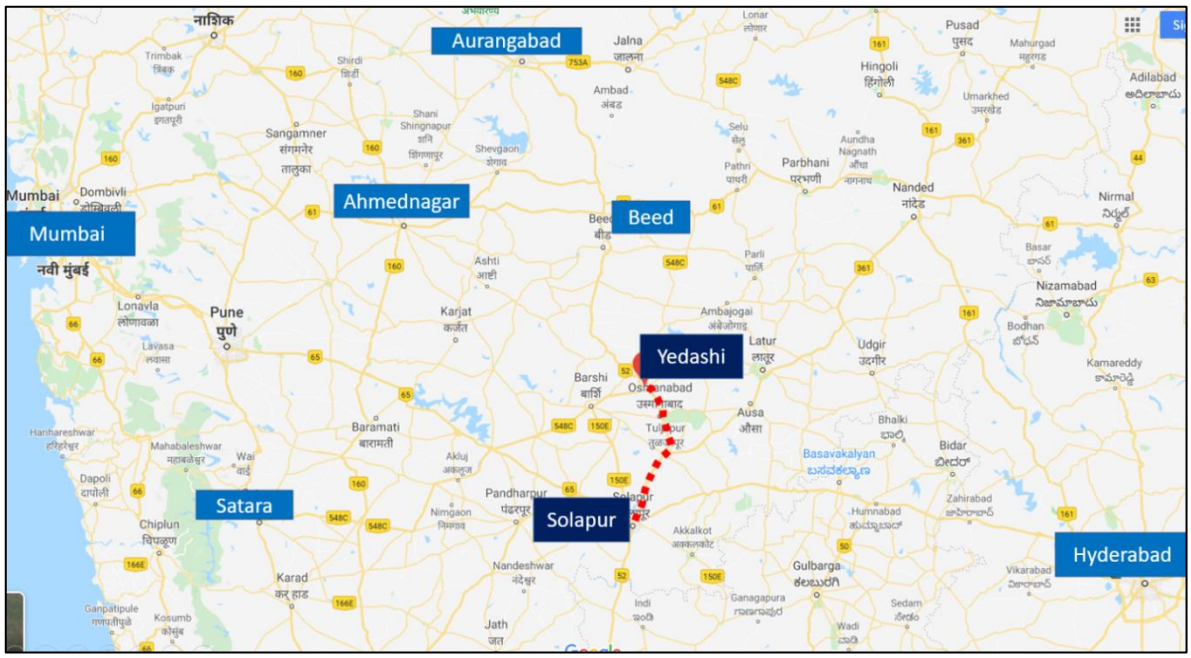


Figure 1-1: Alignment of Project Stretch

1.2 Objective of the Study

M/s IRB INFRASTRUCTURE TRUST has engaged *GMD Consultants* to assess the future traffic and toll potential of project along with related operation & maintenance expenditure involved.

This report named as **"Traffic Study &*Toll Revenue Projection Report*"** mainly focuses on traffic and revenue aspects of the project. Other parameters like competing road, area developments etc. have been considered from a traffic development point of view.

1.2.1 Scope of Services

The broad scope of work covered in the assignment is as follows

a) Analysis of Traffic Growth
b) Toll Rate Growth
c) Revenue Forecasting

The Concessionaire has provided basic traffic data and other project details on the basis of which the above analysis has been carried out.

CHAPTER 2

PROJECT DETAILS

2.1 Project Corridor

NH-211 is important national highway of Maharashtra. It connects northern Karnataka to Marathwada region of Maharashtra.

Solapur, the textile and sugar belt of Maharashtra, Jalna, India's first dry port, Aurangabad fall in project corridor. Bidkin, Shendre areas which are coming up with mega green field Industrial smart city of 10000 acre at Bidkin and Shendra in Maharashtra also fall in influence zone of project corridor.

2.2 Project Stretch Description

The Project highway from Solapur to Yedeshi border from Km 0.000 to km 100.00 has been widened to four lanes as per schedules.

Project road forms part of very important transportation corridor which works as gateway to Karnataka and rest of south India for Marathwada region of Maharashtra. Though it connects Solapur – Dhule but forms important transportation link for traffic from Vijapur, Hubli and other parts of north Karnataka to Aurangabad, Jalna, Beed and other places in Marathwada region. Project has two toll plaza at Tamamwadi and Yedeshi.

Following figure show project alignment and toll plaza locations.

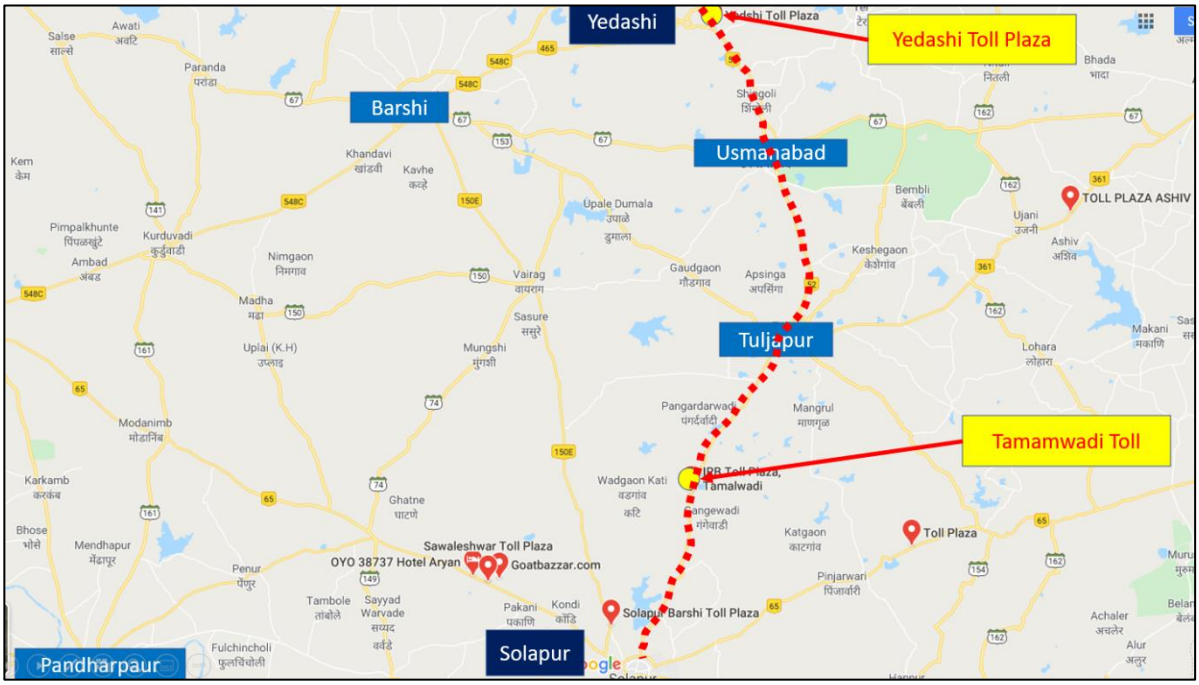


Figure 2-1: Project Alignment with Toll Plaza

2.3 Project Corridor Illustration

Four laning of project stretch is complete. Following photographs illustrate project section along the corridor.

Figure 2-2: Photographs showing Project Corridor

CHAPTER 3

TRAFFIC SURVEYS AND ANALYSIS

3.1 Traffic Surveys

The Consultants have collected the required information for project corridor to understand the general traffic and travel characteristics on the corridor.

The following traffic data has been collected from client for project.

- Classified traffic volume counts at two toll plaza locations on Solapur-Yedeshi section of NH-211 for Year 2018-19, 2019-20, 2020-21, 2021-22 & traffic data from April 2022 to March 2023.
- Local Component of traffic
- Component of Return Journey
- Component of Monthly Pass Journey

The main objective of the traffic data analysis is to:

- Determine the existing traffic movement characteristics of the project
- Establish base year traffic
- Identification of travel patterns and modal split of project traffic
- Deriving growth factors for traffic forecasting
- Estimation of corridor traffic including traffic diversion if any
- Preparation of revenue model and projection of revenue as per toll policy for various scenarios

Table 3-1below lists provides details of locations from where traffic details have been collected.

Table 3-1 : Traffic Data Details

SR. NO	LOCATION	CTV	Single Journey Traffic	Daily Return Journey	Monthly Pass	Local Pass
1	Km 19.300 Toll Plaza at Immamwadi	AADT for Period for Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Period for Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Period for Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Period for Year 2018-19, 2019-2020, 2020-21, 2021-22 &2022-23	For Period for Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23
2	Km 77.400 Toll Plaza at Yedeshi	AADT for Period for Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Period for Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Period for Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Period for Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Period for Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23

3.2 Classified Traffic Volume

The objective of conducting a Classified Traffic Volume Count is to understand the traffic flow pattern including modal split on a roadway. The Classified Traffic Volume Count survey has been provided by the concessionaire of project highway from actual traffic data gathered at toll plaza locations based on monthly data shared with NHAI.

The vehicles can broadly be classified into fast moving / motorized and slow moving / non-motorized vehicles, which can be further classified into specific categories of vehicles. The groupings of vehicles are further segregated to capture the tollable vehicle categories specifically and toll exempted vehicles are counted separately. The detailed vehicle classification system as per IRC: 64-1990 is given in table below

Table 3-2 : Vehicle Classification System

Vehicle Type	
Auto Rickshaw	
Passenger Car	Car, Jeep, Taxi & Van (Old / new technology)
Bus	Minibus

	Standard Bus
Truck	Light Goods Vehicle (LCV)
	2 – Axle Truck
	3 Axle Truck (HCV)
	Multi Axle Truck (4-6 Axle)
	Oversized Vehicles (7 or more axles)
Other Vehicles	Agriculture Tractor, Tractor & Trailer

Source - IRC: 64 – 1990

However, since project highway is currently under toll operation, the data collected is corresponding to category of tollable vehicles. Following are the type of vehicles as per concession agreement.

- Car / Jeep / van
- Minibus /LCV
- Bus
- Truck
- 3-Axle
- Multi Axle

3.3 Traffic Characteristic

Toll revenue of project highway does not solely depend on traffic volume. There are certain characteristics of traffic which have substantial potential to affect toll collection. Component of local traffic, component of passenger and commercial traffic, portion of return journey traffic, % of monthly pass traffic are some of such characteristics of traffic. These will be discussed in subsequent sections of report.

3.3.1 Traffic Data

Project concessionaire has provided Traffic data for year 2019-20,2020-21, 2021-22 & from April 2022 to March 2023 as under for both toll plazas–

Table 3-3 : Traffic Data at Immamwadi Toll Plaza at Km 19.300

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)- 2019-20	Annual Average Daily Traffic (Nos.)- 2020-21	Annual Average Daily Traffic (Nos.)- 2021-22	Annual Average Daily Traffic (Nos.)- 2022-23
1	CAR	4964	3564	6308	7840
2	Minibus/LCV	1068	782	362	442
3	Bus	675	304	343	678
4	Truck	907	835	946	1149
5	3-Axle	861	783	823	953
6	Multi Axle	934	1074	1286	1889
7	Oversized Vehicles	4	1	1	6
Total		**9413**	**7343**	**10070**	**12958**

Table 3-4 : Traffic Data at Yedeshi Toll Plaza at Km 77.400

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)- 2019-20	Annual Average Daily Traffic (Nos.)- 2020-21	Annual Average Daily Traffic (Nos.)- 2021-22	Annual Average Daily Traffic (Nos.)- 2022-23
1	CAR	2840	2132	3308	3647
2	Minibus/LCV	613	514	263	283
3	Bus	233	118	127	238
4	Truck	674	682	783	951
5	3-Axle	807	826	870	986
6	Multi Axle	1101	1343	1615	2132
7	Oversized Vehicles	0	1	1	6

Total	**6269**	**5616**	**6967**	**8245**

Pandemic of COVID-19 (Corona Virus) had impacted entire world. Taking precaution, government of India announced a complete lockdown in last of March 2020 and traffic on highways was stopped which was eased out progressively later. There after India was hit by Covid-19 second and third wave in February 21 to July -21 and December 21 to March-22. Recovering traffic pattern was somewhat again disturbed du to second and third wave of Covid-19. Traffic numbers of for period from April-2020 to March 2021 were not representative of traffic pattern at project corridor due to pandemic lockdown impact. However, for integrity of data same shown above. Traffic has almost recovered from Covid -19 impact as of now.

Adjacent road to project stretches Ahmednagar – Karmala road was in poor condition and due to which there is some additional traffic on project road in current period. Hence as correction factor is applied to average traffic of year 2022-23 to arrive at realistic yearly average traffic.

This data was then bifurcated to various components like through local, monthly, return journey etc. category. Same is discussed in detail in following section.

3.4 Data Analysis

3.4.1 Analysis of Traffic Volume Count

Understanding the character of existing traffic forms the basis of the traffic forecast. The various vehicle types having different sizes and characteristics can be converted into a single unit called Passenger Car Unit (PCU). Passenger Car equivalents for various vehicles are adopted based on recommendations of Indian Road Congress prescribed in "IRC-64-1990: Guidelines for Capacity of Roads in Rural areas". The adopted passenger car unit values (PCU) are presented in ***Table*** 3-5**.**

Table 3-5 : PCU Factors Adopted for Study

Vehicle Type	PCUs
Car	1.0
Minibus	1.5
Standard Bus	3.0

LCV/LGV	1.5
2 Axle Truck	3.0
3 – 6 Axle Truck	4.5
MAV	4.5
Auto Rickshaw	1.0
Van/Tempo	1.0
Agriculture Tractor with Trailer	4.5
Agriculture Tractor without Trailer	1.5

Source: IRC: 64-1990

Traffic volume at each toll plaza was converted to PCU and same is presented as under

Table 3-6 : Traffic in PCU at Project Stretch Base Year 2022-23

Year	Toll Plaza Location (Km)	Traffic No	PCU	PCU Index
2019-20	Tamalwadi Km 19.300	9413	18116	1.92
	Yedeshi Km 77.400	6269	13859	2.21
2020-21	Tamalwadi Km 19.300	7343	15339	2.09
	Yedeshi Km 77.400	5616	13829	2.46
2021-22	Tamalwadi Km 19.300	10070	18981	1.88
	Yedeshi Km 77.400	6967	16316	2.34
2022-23	Tamalwadi Km 19.300	12958	25377	1.96
	Yedeshi Km 77.400	8245	20222	2.45

It can be observed from above that project traffic has PCU index more than 2 which is an indicator of high proportion of commercial traffic in traffic mix in project

corridor. Following figure illustrates variation of PCU index at two toll plaza locations.

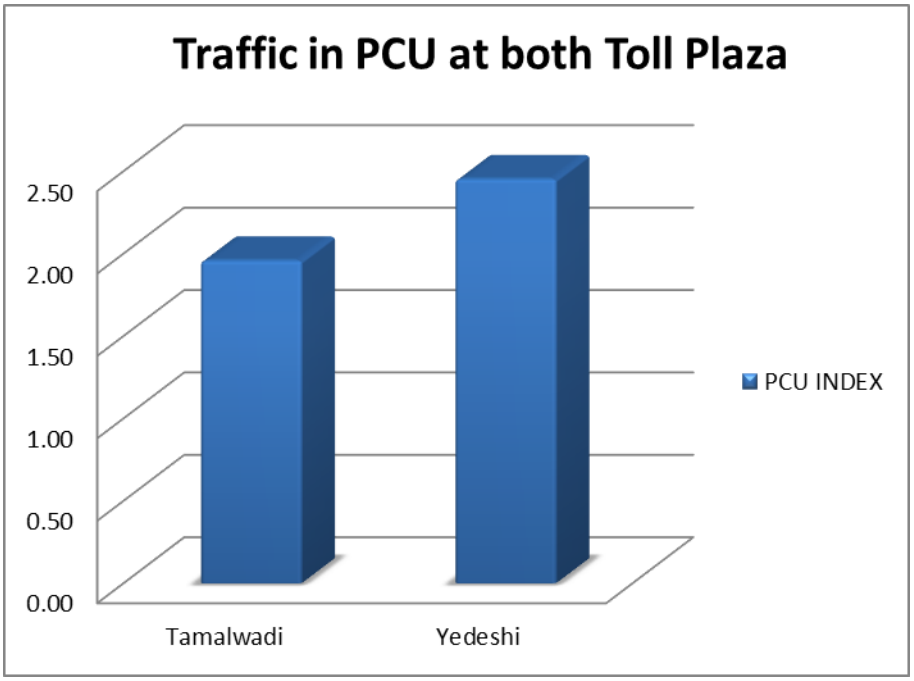


Figure 3-1: Comparison of PCU Index

It can be observed that PCU index is consistent at two toll plaza locations with commercial traffic slightly higher at Yedeshi toll plaza..

3.4.2 Components of Traffic

As discussed previously, components of traffic volume play an important role in determining project revenue. A larger component of commercial traffic with higher axle configuration adds to project revenue positively. Similarly, a larger component of local traffic affects the project revenue potential negatively.

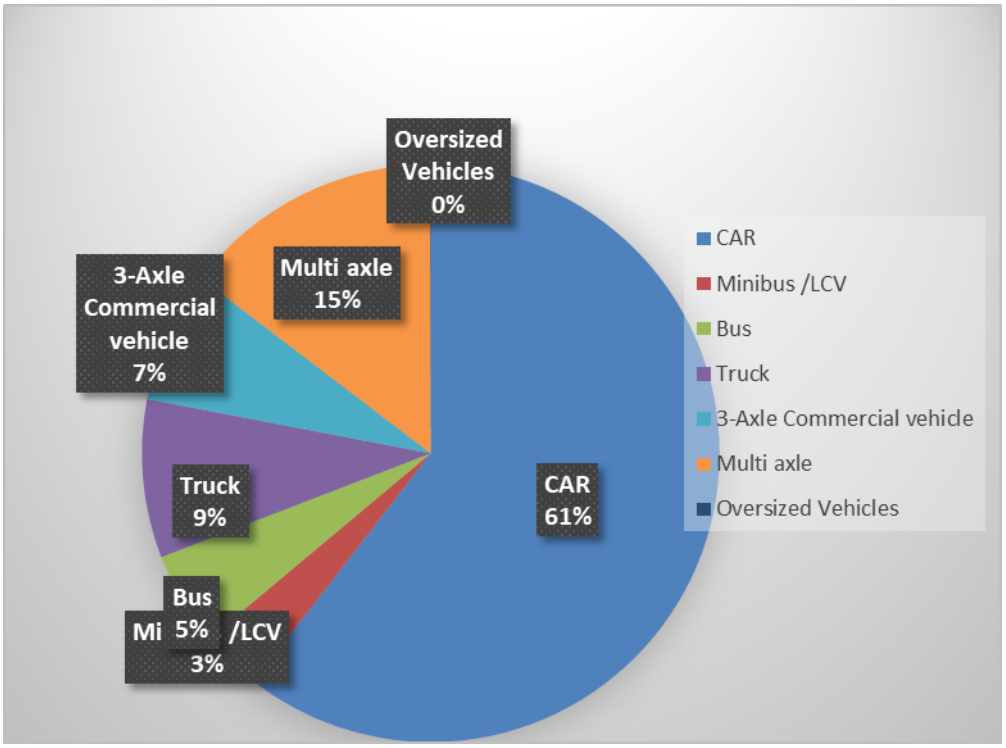


Figure 3-2 : Model Split of Tollable Vehicle @TP-1

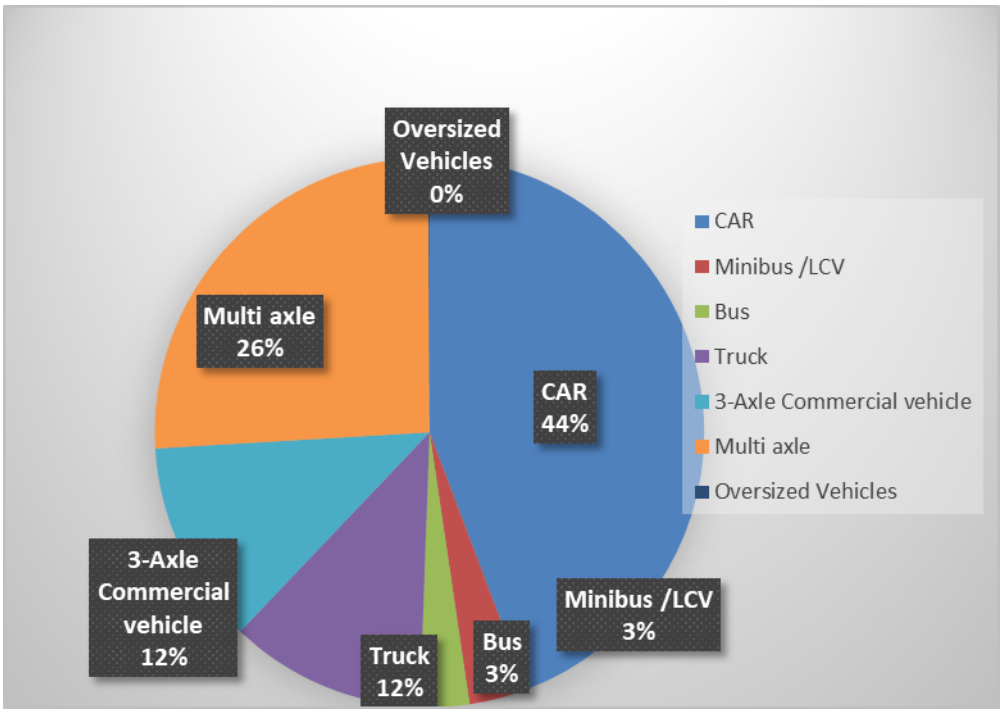


Figure 3-3 : Model Split of Tollable Vehicle @TP-2

It is observed that car traffic forms about 44%- 61% of total traffic at toll plaza locations while multi axle commercial vehicles are about 22% -38% of total traffic. Truck / Bus and LCV share about 14%-15% and 3% of traffic volume respectively.

Another important bifurcation of traffic is components of traffic with respect various type of toll ticketing like

1. Single Journey
2. Multi Journey
3. Monthly Pass (Local and General)

The following table provides numbers of vehicles falling in each of above category on base year 2022-23.

Table 3-7 : Journey Type Bifurcation of Traffic atTamalwadiTP-1 KM 19.300

Sr. No	Type	Traffic Volume (Nos.)2022-23
1	Single Journey	6980
2	Return Journey	5715
3	Local Commercial Single Journey	236
4	Monthly Pass Local	8
5	Monthly Pass	11
6	Local Monthly Pass Commercial	9

Most dominant part of the above is the single journey type followed by return journey at project stretch. Monthly pass commuters are a very low fraction of the total traffic on the project corridor.

The single journey component in total traffic numbers is a high as 54%. Return journey component is 44%. The number of monthly pass local is 0% and Local commercial Single Journey 2% at Imamwadi toll plaza.

Following tables give the detail of journey distribution at Yedeshi toll plaza at Km 77.400.

Table 3-8 : Journey Type Bifurcation of Traffic at Yedashi TP-2 KM 77.400

Sr. No	Type	Traffic Volume (Nos.)2022-23
1	Single Journey	5865
2	Return Journey	2168
3	Local Commercial Single Journey	174
4	Monthly Pass Local	14
5	Monthly Pass	14
6	Local Monthly Pass Commercial	11

It is observed that the project corridor demonstrates a similar pattern of single journey dominated mix of traffic across the entire stretch which is typical of major national highways.

3.5 Secondary Data Collection

There are several other factors which have a substantial impact on traffic pattern and growth on any project corridor. Following are some of such important factors

- Industrial development around project corridor and its catchment
- Educational infrastructure along project corridor
- Demographic pattern
- Urban area development
- Tourism potential
- Upcoming major infrastructural or Industrial projects
- Special Industry in project corridor
- Overall trends of economic growth local as well as national / regional

Hence in addition to traffic details on project site, secondary data was also collected from various other sources. Typical secondary data includes the following:

1. Vehicle registration data of regional and national level.
2. Economic Data
   a) GDP

b) NSDP

c) Population Growth

d) Per Capita Income growth

e) Industrial Growth

f) Special Industry Potential

g) Regional and National development vision / plan

h) Any other relevant data

3. Competing road network

We have collected and utilized such underlying data in the study to estimate the growth and risk factors for traffic along the project corridor.

CHAPTER 4

INFLUENCE ZONE TRANSPORT NETWORK ANALYSIS

4.1 Introduction

Highway corridors behave like integrated circuit network and more often than not every road is connected to various networks having different origin and destinations. Traffic running on these networks behave like fluid and flow on network on alignment of least friction.

Following Factors can be considered as major contributors to friction on transportation network

- Travel Speed / Travel Time
- Geometric deficiencies like blind horizontal curves and steep vertical gradients etc,
- Configuration of road
- Riding quality
- Traffic delays,
- Length of road,
- Passing through built up or Urban Area,
- Terrain,
- Facilities,

4.2 Competing / Alternate route

Project road from Solapur to Yedashi is important transportation link between Solapur and Aurangabad. It can be observed that between Solapur and Yedashi all other roads cross or meet project road alignment radially. There is no important parallel road network which can be a competing link for project road traffic. At local level there is no competing road. Moreover, after completion of four laning project road is under toll operation for last two years since 2018. In such case local diversion, if any, would have settled by now.

At regional level also project road (NH-211) is preferred route for Solapur – Aurangabad traffic. Though there could be one alternate route via Ahmednager for Solapur- Aurangabad pair origin and destination.

Following figures show the layout of competingroutes between both these Zones

Figure 4-1: Alternate route at Regional level

For this alternate route also traffic would have settled since project road is under toll operation for last two years under toll. With completion of Aurangabad – Yedashi stretch four laning last year project route has become more attractive for candidate traffic. Following table provides summary of analysis of competing or alternate routes.

Sr. No	Route Details	Designation	Length (Km)	Avg. Speed (KMPH)	Time Taken (Min)	Observations
Regional Level						
1	Solapur-Ahmednagar-Aurangabad	Alternate Route	346	64	6 Hr 50 Min	Alternate route is longer and has higher travel time. Project road has clear advantage
	Solapur-Yedeshi-Aurangabad	Project Road	310	55	5 Hr 27 Min	

Table 4-1 : Competing Roads Details

Under these circumstances it is not envisaged that commercial or passenger traffic would switch to alternate roads from the project road.

CHAPTER 5

GROWTH OF TRAFFIC ON PROJECT HIGHWAY

5.1 Introduction

Traffic growth is a function of the interplay of a number of contributory factors such as National economy, Government policy, socio-economic conditions of the people, and changes in land uses along the project corridor precincts etc. As these factors have a number of uncertainties associated with them, forecasts of traffic are dependent on the projections of other factors such as population, gross domestic product (GDP), vehicle ownership, per capita income (PCI), agricultural output, fuel consumption etc. Future pattern of change in these factors can be estimated with only a reasonable degree of accuracy and hence the resultant traffic forecast levels may not be precise.

Traffic growth forecast for project corridor Solapur–Yedeshi section of NH-211has been done taking the above factors into consideration. "**IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**" is established best practice and has been used for traffic growth forecast.

5.2 Trend Analysis

One of the methods of estimation of future rate of growth is to assume the same rate of growth as in the past. Although such a method is more suitable to projects of short durations say 5-10 years, however for long term projections it would-be erroneous to assume that the past rate of growth will continue to prevail for a long time in future. Economic conditions, which are major influencing factors, are bound to change over a long period of time. Thus, it would be necessary to modify the past trends of growth suitably.

Elasticity model of growth projection is one of the most widely acceptable methods for traffic forecast. The same is recommended in **IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**.

In this method the past trend of vehicular data is paired with an economic indicator and a regression analysis is done to yield the economic model of growth. Growth of vehicle traffic varies for different type of vehicle. It is a proven fact that the growth pattern for passenger and goods vehicle is different. Traffic growth on any highway

typically depends on number of economic parameters. Most important and direct parameters are given as under

- Per Capita Income
- Net State Domestic Product (NSDP)
- Population

It can be observed that the ownership of a car is more closely related to affordability; hence per capita is the index which closely fits the growth of car traffic among other criteria. In a similar fashion, the following can be pairs of vehicle type and independent variable for elasticity modeling of growth.

- Car / Jeep – Par Capita Income
- Bus / Minibus – Population
- Goods Vehicle – NSDP

5.3 Estimation of Traffic Demand Elasticity

Elasticity of traffic demand is defined as the rate at which traffic intensity varies due to a change in the corresponding indicator selected. Hence, In order to estimate the elasticity of traffic demand, it is necessary to establish relationship between the growth in number of given category of vehicles with the relevant economic variable considered, such as NSDP, per capita income and population growth.Latest available data for vehicle registration, per capita income, NSDP and population is used in analysis.

As per IRC: 108-1996 the model for estimating elasticity index for the project corridor is of the following form and is given as below:

$$Log\ (P) = k \times Log\ (EI) + A$$

Where,

P = *Number of Vehicles (Mode wise)*

EI = *Economic Indicator*

A = *Regression constant*

k = *Elasticity coefficient (Regression coefficient)*

The elasticity for car and bus (passenger vehicles) is calculated based on the Population and Per Capita Domestic Product (PCDP) and the elasticity for trucks is calculated based on the Net State Domestic Product (NSDP).

The project corridor is entirely in stat of Maharashtra but being at border of Karnataka there is certain of Karnataka on project traffic. In such circumstances for elasticity calculations, working data from above Maharashtra and Karnataka states has been analyzed.

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Maharashtra State.

Table 5-1 : Per Capita Income Vs Car Maharashtra

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	99564	2307841	5.00	6.36		
2013	103904	2592565	5.02	6.41	4%	
2014	109399	2834847	5.04	6.45	5%	
2015	114746	3113773	5.06	6.49	5%	
2016	122422	3406872	5.09	6.53	7%	
2017	132899	3715744	5.12	6.57	9%	5.96%

Regression analysis of same is given in figure below

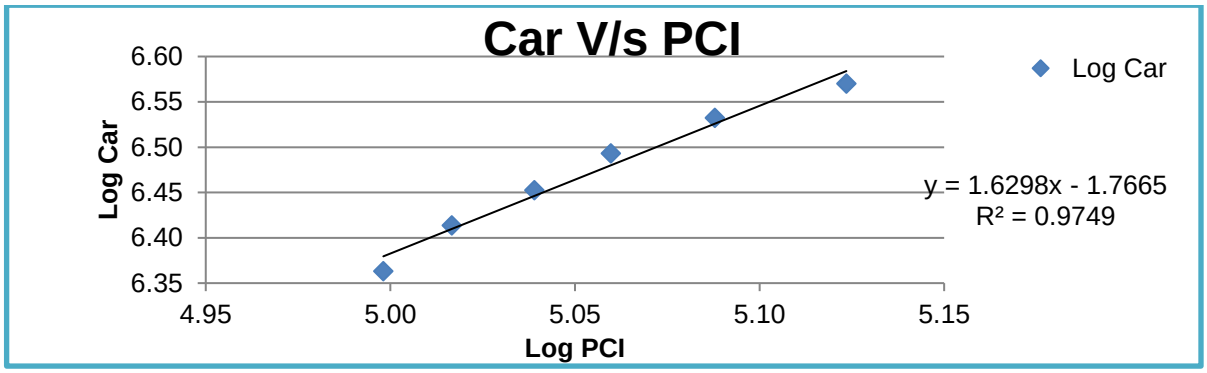


Figure 5-1: Regression and Elasticity PCI vs. Car–Extrapolation Maharashtra

Table 5-2 : Population Vs BusMaharashtra

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	112374333	119298	8.05	5.08		
2013	113807248	129535	8.06	5.11	1%	
2014	115229410	140087	8.06	5.15	1%	
2015	116640546	140102	8.07	5.15	1%	
2016	118040394	150427	8.07	5.18	1%	
2017	119428710	160042	8.08	5.20	1%	1.23%

Regression analysis of same is given in figure below

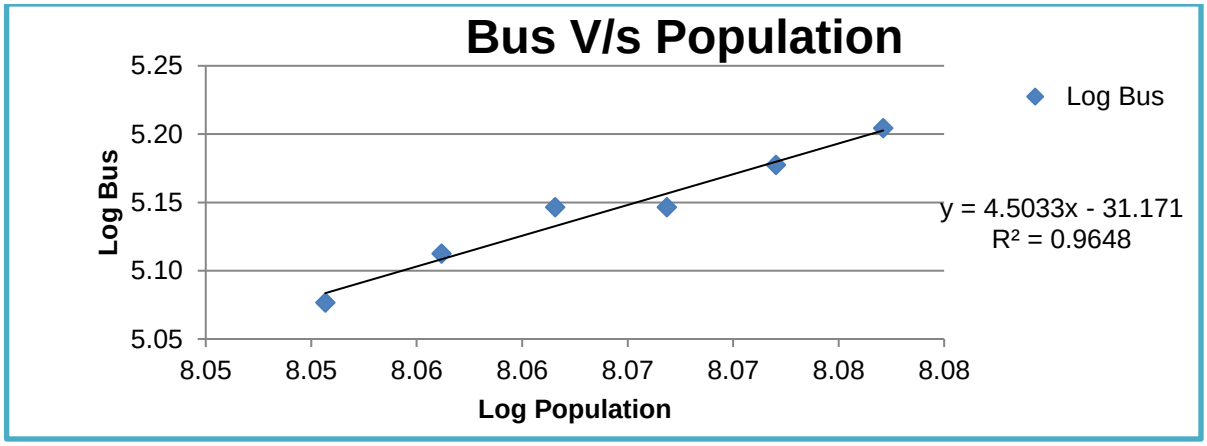


Figure 5-2: Regression and Elasticity Population vs. Bus – ExtrapolationMaharashtra

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-3 : LCV Traffic Vs NSDPMaharashtra

Year	NSDP	LCV	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	1126595	656407	6.05	5.82		
2013	1189711	739725	6.08	5.87	6%	
2014	1267551	803128	6.10	5.90	7%	
2015	1345341	868632	6.13	5.94	6%	
2016	1452439	927903	6.16	5.97	8%	6.56%

Following figure depict regression analysis and extrapolation.

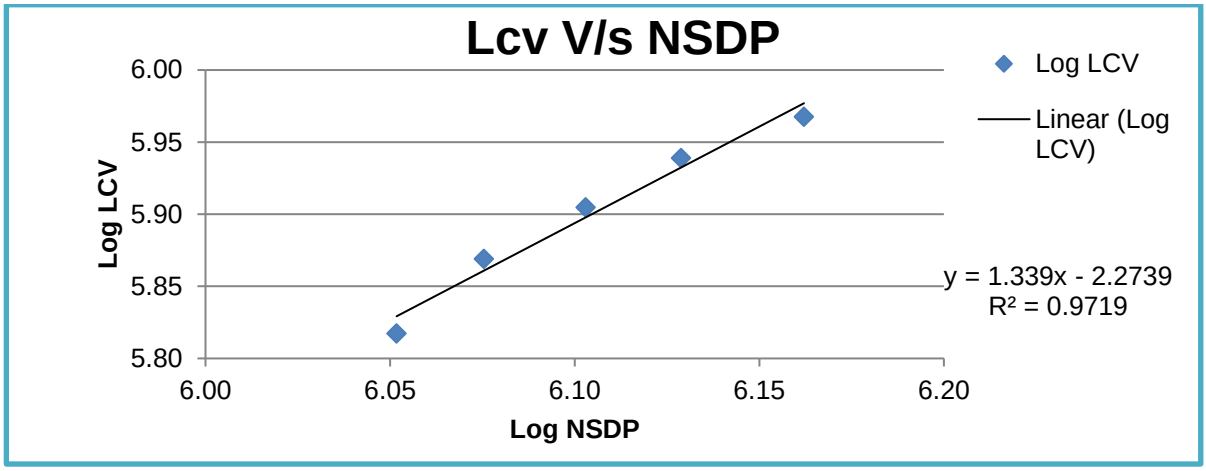


Table 5-4 : Truck Traffic Vs NSDP Maharashtra

Year	NSDP	TRUCK	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	1126595	411418	6.05	5.61		
2013	1189711	402366	6.08	5.60	6%	
2014	1267551	470128	6.10	5.67	7%	
2015	1345341	491582	6.13	5.69	6%	
2016	1452439	468810	6.16	5.67	8%	
2017	1595514	496439	6.20	5.70	10%	7.22%

Following figure depict regression analysis and extrapolation.

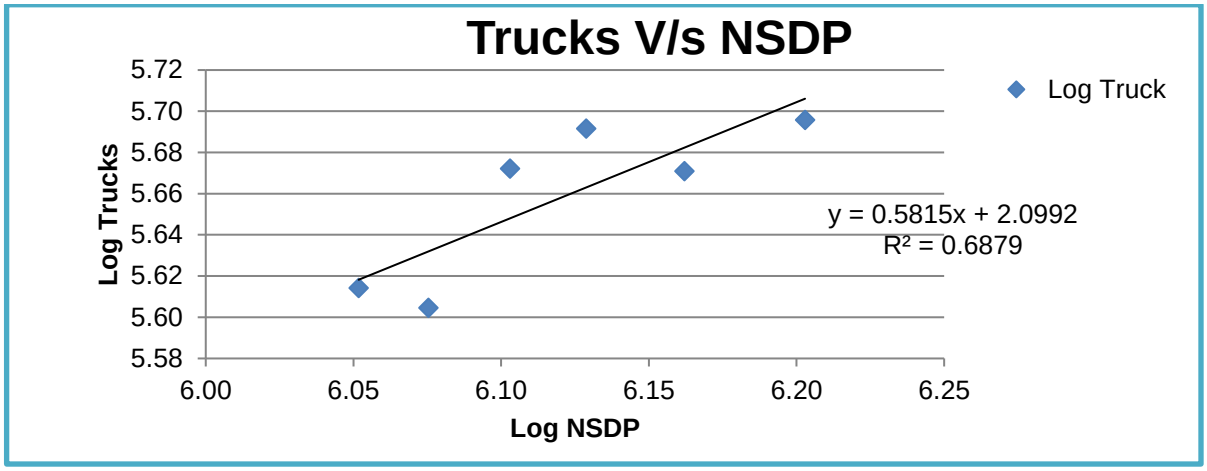


Figure 5-3: Regression and Elasticity NSDP vs. Goods Traffic – extrapolationMaharashtra

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit*regression as reflected by R^2 values are presented in the Table below

Table 5-4 : Summary Regression Analysis Maharashtra

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average Growth	Growth Elastic Model
Maharashtra	Car/Jeep	PCI	y = 1.6298x + -1.7665	R² = 0.9749	1.6298	5.96%	9.71%
	Bus	Population	y = 4.5033x - -31.1713	R² = 0.9648	4.5033	1.23%	5.52%
	LCV	NSDP	y = 1.339x - -2.2739	R² = 0.9719	1.3390	6.56%	8.78%
	Truck	NSDP	y = 0.5815x - 2.0992	R² = 0.6879	0.5815	7.22%	4.20%

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Karnataka State.

Table 5-5 : Per Capita Income Vs Car Karnataka

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	90269	1269430	4.96	6.10		
2013	94382	1420767	4.97	6.15	5%	
2014	101864	1572521	5.01	6.20	8%	
2015	105703	1741831	5.02	6.24	4%	
2016	116819	1916373	5.07	6.28	11%	
2017	131260	2110493	5.12	6.32	12%	7.83%

Regression analysis of same is given in figure below

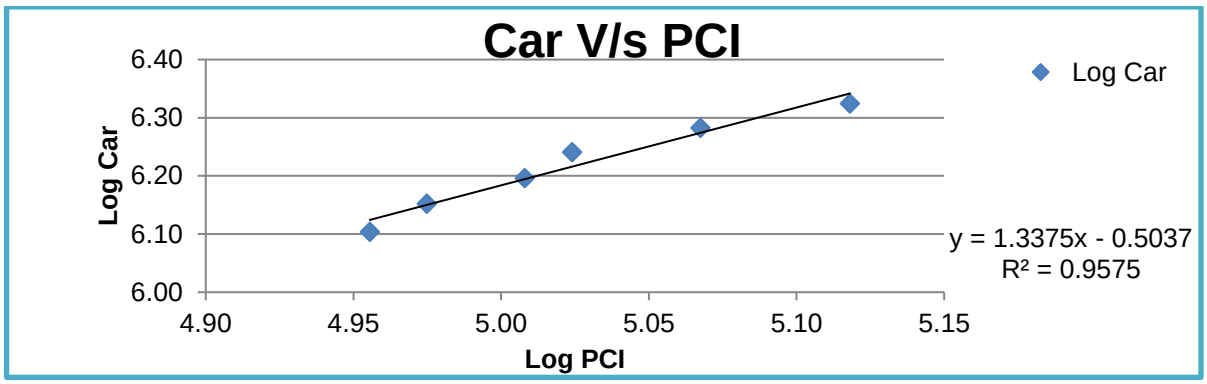


Figure 5-4: Regression and Elasticity PCI vs. Car–Extrapolation Karnataka

Table 5-6 : Population Vs Bus Karnataka

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	61095297	175705	7.79	5.24		
2013	62058777	186705	7.79	5.27	2%	
2014	63017877	195913	7.80	5.29	2%	

2015	63972322	204803	7.81	5.31	2%	
2016	64921845	213699	7.81	5.33	1%	
2017	65866188	224580	7.82	5.35	1%	1.52%

Regression analysis of same is given in figure below

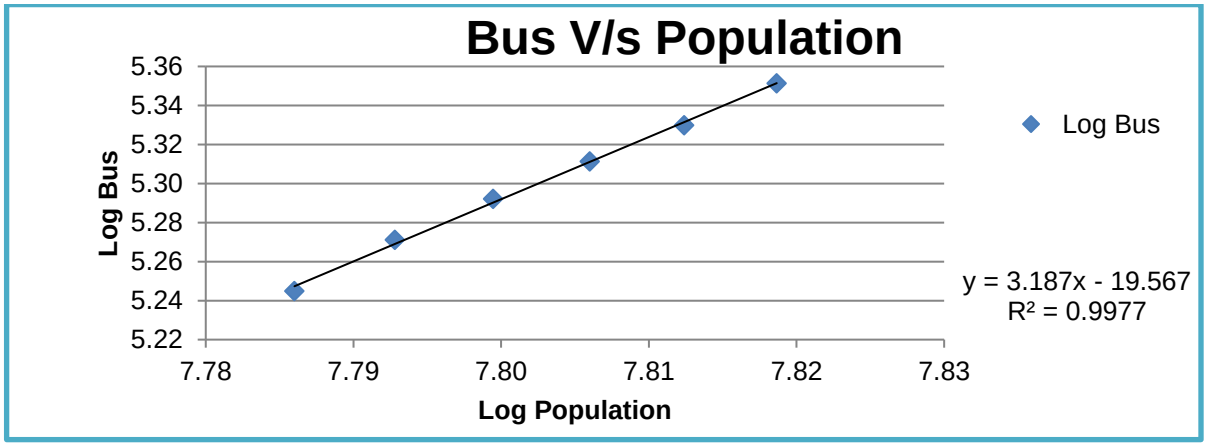


Figure 5-5: Regression and Elasticity Population vs. Bus – Extrapolation Karnataka

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-7 : LCV Traffic Vs NSDP Karnataka

Year	NSDP	LCV	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	554990	221160	5.74	5.34		
2013	586592	258701	5.77	5.41	6%	
2014	639981	294266	5.81	5.47	9%	
2015	671322	331381	5.83	5.52	5%	
2016	749990	367572	5.88	5.57	12%	7.85%

Following figure depict regression analysis and extrapolation.

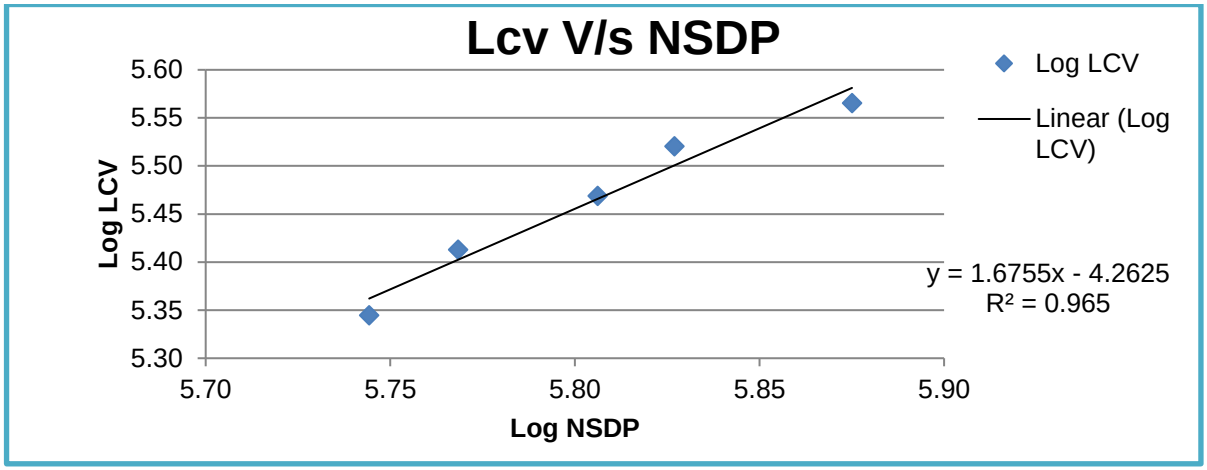


Table 5-4 : Truck Traffic Vs NSDP Karnataka

Year	NSDP	TRUCK	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	554990	233422	5.74	5.37		
2013	586592	247639	5.77	5.39	6%	
2014	639981	260989	5.81	5.42	9%	
2015	671322	274971	5.83	5.44	5%	
2016	749990	290415	5.88	5.46	12%	
2017	851880	306290	5.93	5.49	14%	9.00%

Following figure depict regression analysis and extrapolation.

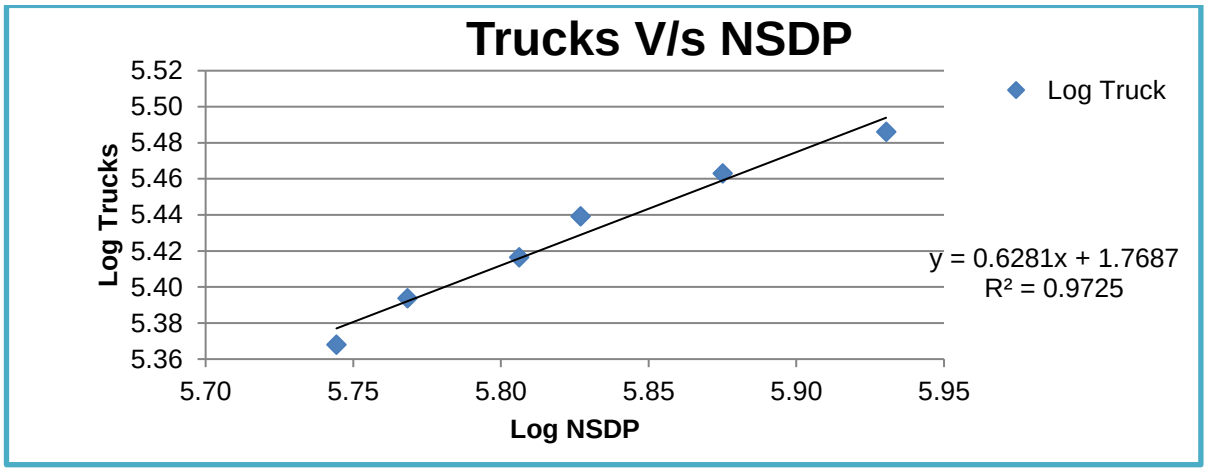


Figure 5-6: Regression and Elasticity NSDP vs. Goods Traffic – extrapolation Karnataka

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below

Table 5-8 : Summary Regression Analysis Karnataka

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average Growth	Growth Elastic Model
Karnataka	Car/Jeep	PCI	y = 1.3375x + -0.5037	R² = 0.9575	1.3375	7.83%	10.47%
	Bus	Population	y = 3.187x - -19.567	R² = 0.9977	3.1870	1.52%	4.83%
	LCV	NSDP	y = 1.6755x - -4.2625	R² = 0.965	1.6755	7.85%	13.16%
	Truck	NSDP	y = 0.6281x - 1.7687	R² = 0.9725	0.6281	9.00%	5.65%

Economical model for predicting growth is good tool, however other local, regional, national factors should also be considered before finalizing growth factors. Considering factors such as proposed developments and other influencing economic factors, moderated growth should be considered. These factors are discussed in subsequent sections.

5.4 Analysis of Historic Traffic Data

Historical traffic data forms useful information for any highway project. It provides useful information for establishing past trend of growth. Project stretch of Kaithal to Rajasthan Border is under tolling operation with current concessionaire and has only two years of tolling history from 2018-19. As traffic data available with the project concessionaires of just a year about, we do not have sufficient data points to be able to establish a reliable past trend of traffic growth. A minimum of about 5 -6 years' traffic data is required for establishing a reliable past trend.

5.5 Other Factors Influencing Growth

There are many factors which have impact on traffic growth. As discussed previously these factors can be economical, social, educational, and industrial.

Potentiality of such factors for project highway is discussed as under.

ECONOMY

After witnessing a slowdown during 2011-12, the economy recovered in 2013-14, and a high growth rate of GDP was recorded in up to 2018-19. Pandemic of COVID-19 impacted all economies of world including India. Following figure show trend of GDP growth in India.

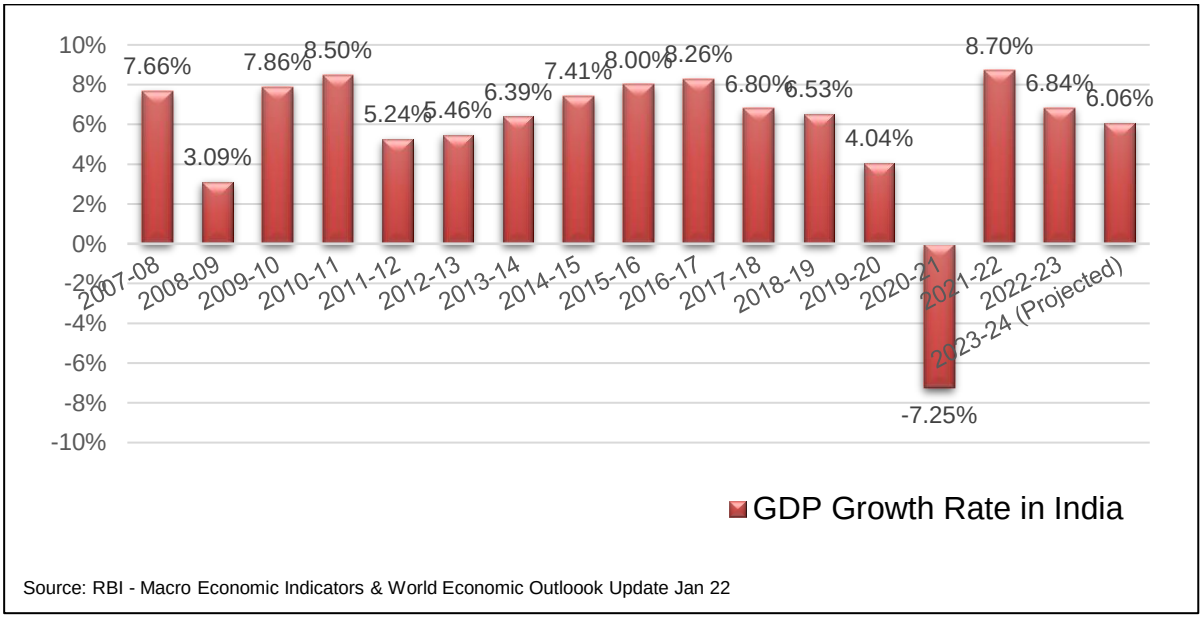


Figure 5-7 : Growth of GDP in India

FY 2017-18 recorded a growth of 6.7% which had slight impact of GST and demonetization. Indian economy appears on recovery path with estimated growth of 6.8% in FY 2018-19. Government took major policy decision including tax infrastructure reforming, banking sector improvement and ease of doing business.

Major economies of world collapsed due to pandemic COVID-19 including India. Indian economy is also registered negative growth in financial year 2020-21. After that Indian economy recovered handsomely and registered a growth of about 9% in Year 2021-22. This was partly due to low base of year 2020-21 as well.

Honorable Prime Minister has announced a major relief package of Rs. 20 lakh crores which is about 10% of GDP. This is aimed at turning this major crisis of

COVID-19 into opportunity by providing major impetus to industrial production to the limit of becoming a self-reliant economy. With major thrust of this package being on **Make -In- India** it is expected that industry in India would grow at rapid pace and recover handsomely in post COVID-19 scenario. World Economic Outlook update also has predicted a growth rate of about 7.5 % in year 2022-23.

5.6 Developments along and around the Project Corridor & State

Project stretch falls in region of good development potential. The same is discussed as under.

Solapur

Solapur is one of the major city of Karnataka which shares boundary with Karnataka. Thus, it can be called as gateway to south for this region. Solapur district has highest number of sugar factories in India.

Solapur leads Karnataka in production of Indian cigarettes or beedi.Solapuri Chadars and towels are famous in India and also at a global level, however, there has been a significant decline in their exports due to quality reasons. ***"SolapuriChadars"*** are the famous and first product in Karnataka. It has been a leading centre for cotton mills and power looms in Karnataka. Solapur had the world's second-largest and Asia's largest spinning mill. The National Research Centre on Pomegranate (NRCP) of India is located in Solapur and pomegranate farming is done on a large scale in Solapur District. MIDC (Karnataka Industrial Development Corporation) has been very successful in creating and promoting industrial hubs in various part of Karnataka. It provides businesses with infrastructure such as land (open plot or built-up spaces), roads, water supply, drainage facilities and street lights along with necessary clearances. In total MIDC has developed about 300 industrial centres which have attracted large number of domestic and international industries to set up their business and production houses in Karnataka. Solapur is one of the major Industrial cluster focusing on textile and food processing. Following are major MIDCs spread over Solapur district.

- Chincholi, Mohol
- Tembhurni, Madha
- Kurduwadi, Madha

- Akkalkot
- Mangalwedha
- Solapur, Solapur citybelow.

Pandharpur

This is a holy place of Shri.Vitthal and Shri Rukmini. It is also known as the Southern Kashi of India and Kuldaivat of Karnataka State. It is located at a distance of 72 kms by road. from Solapur District headquarters. Large number of devotees from all over Karnataka and surrounding States gather at Pandharpur mainly to celebrate the Aashadhi and Kartiki Ekadashis (in month of June and July) every year in addition to the regular rush of devotees every day. As per estimate about 8-10 lakhs of devotees visit Pandharpur during this auspicious periods.

Jalna

Government of Karnataka and JNPT are developing dry ports at Jalna and BidkinShendra which on Paithan road. Project road would work like feeder to these economic hubs for traffic from Karnataka and other southern states.

5.7 Recommended Growth Rates of Traffic

Based on the above analysis and after giving due consideration to the entire listed factors, the following overall growth rates are recommended for each category of vehicle as under. Rate of growth is moderated in light of overall regional trend. Growth of Multi-Axle is kept slightly higher as trend of technological advances in logistic industry favors multi-axle over 2/3 axle carriage. It is also expected that as the economy moves from developing to developed, rate of growth diminishes. Same growth rate is not sustainable for long. Traffic growth is suitably stepped down for future years.

Growth rates are recommended for three scenarios for sensitivity analysis namely **Optimistic, Pessimistic** and **Most Likely** with a positive and negative variation 0.5% from Most Likely case for corridor in both states.

5.7.1 Recommended Growth Rates of Traffic for Project Stretch

Table 5-9 : Recommended Growth Rates Optimistic

Category / Year	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045
Car/Jeep/Van	9.53%	8.92%	8.77%	8.47%	8.11%
Bus	5.83%	5.50%	5.47%	5.41%	5.15%
LCV	4.31%	4.02%	3.88%	3.61%	3.32%
2- Axle	5.13%	4.56%	4.43%	4.15%	3.86%
3 - Axle	6.46%	5.72%	5.55%	5.20%	4.82%
4 to6 Axle	7.12%	6.30%	6.11%	5.72%	5.30%
7 and Above Axle	7.12%	6.30%	6.11%	5.72%	5.30%

Table 5-10 : Recommended Growth Rates Pessimistic

Category / Year	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045
Car/Jeep/Van	9.03%	8.42%	8.27%	7.97%	7.61%
Bus	5.33%	5.00%	4.97%	4.91%	4.65%
LCV	3.81%	3.52%	3.38%	3.11%	2.82%
2- Axle	4.63%	4.06%	3.93%	3.65%	3.36%
3 - Axle	5.96%	5.22%	5.05%	4.70%	4.32%
4 to6 Axle	6.62%	5.80%	5.61%	5.22%	4.80%
7 and Above Axle	6.62%	5.80%	5.61%	5.22%	4.80%

Table 5-11 : Recommended Growth Rates Most Likely

Category / Year	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045
Car/Jeep/Van	9.28%	8.67%	8.52%	8.22%	7.86%
Bus	5.58%	5.25%	5.22%	5.16%	4.90%
LCV	4.06%	3.77%	3.63%	3.36%	3.07%
2- Axle	4.88%	4.31%	4.18%	3.90%	3.61%
3 - Axle	6.21%	5.47%	5.30%	4.95%	4.57%
4 to6 Axle	6.87%	6.05%	5.86%	5.47%	5.05%

7 and Above Axle	6.87%	6.05%	5.86%	5.47%	5.05%

Traffic and revenue has been worked out on the basis of above growths and same is presented in subsequent chapter of report.

5.8 COVID-19 Impact

All social and economic activities had been completely disrupted due worldwide pandemic of Corona Virus. This had affected traffic on project stretch as well. Traffic was severely affected form March-2020 due to lockdown and then in second wave and third waves.

Government has announced a mega economic stimulate and package of Rs. 20 Lakh Crore to bring the economy back on track and recover the losses. Traffic has shown impressive recovery post lockdown period and has recovered to normal level.

Taking recommended traffic growth and additional factors as discussed above into consideration traffic forecast for concession period is done and presented in next chapter.

CHAPTER 6

TRAFFIC FORECAST

6.1 Traffic Projections

Growth rates recommended in previous section of report are used to arrive at traffic projections for future years. Toll plaza wise futuristic traffic projection is given in tables below.

These projections have been done for following three cases of growth up to concession period

1. Optimistic Scenario
2. Pessimistic Scenario
3. Most Likely Scenario

Table 6-1 : Total Tollable Traffic @ Toll Plaza 1- Tamalwadi19.300 KM (Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU
2023-24	8586	461	719	1209	1015	2025	7	14022	27251
2024-25	9403	481	760	1271	1080	2169	7	15171	29250
2025-26	10242	500	801	1329	1142	2306	7	16327	31217
2026-27	11155	520	845	1390	1207	2451	7	17575	33322
2027-28	12150	540	891	1453	1276	2606	7	18923	35579
2028-29	13234	562	939	1519	1349	2769	7	20379	37990
2029-30	14414	584	990	1588	1427	2944	7	21954	40585
2030-31	15677	606	1044	1657	1506	3123	7	23620	43292
2031-32	17051	629	1101	1730	1589	3313	7	25420	46195
2032-33	18545	653	1161	1806	1676	3515	7	27363	49303
2033-34	20171	678	1224	1886	1770	3730	7	29466	52645
2034-35	21940	704	1290	1970	1868	3958	7	31737	56223
2035-36	23798	729	1360	2053	1966	4184	7	34097	59888
2036-37	25814	755	1433	2138	2068	4423	7	36638	63799
2037-38	28001	782	1510	2226	2175	4676	7	39377	67981
2038-39	30373	810	1591	2318	2288	4943	7	42330	72454
2039-40	32945	838	1677	2414	2407	5226	7	45514	77245
2040-41	35615	866	1763	2507	2523	5503	7	48784	82088

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU
2041-42	38502	894	1854	2604	2644	5795	7	52300	87258
2042-43	41623	924	1949	2704	2772	6102	7	56081	92775
2043-44	44997	954	2049	2808	2905	6426	7	60146	98663
2044-45	48644	985	2154	2917	3045	6766	7	64518	104948

Table 6-2 : Total Tollable Traffic @ Toll Plaza 2- Yedashi77.400 KM (Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU
2023-24	3995	297	253	1001	1051	2284	7	8888	21665
2024-25	4374	309	268	1052	1119	2446	7	9575	23193
2025-26	4763	321	283	1100	1183	2600	7	10257	24674
2026-27	5188	333	298	1150	1251	2763	7	10990	26250
2027-28	5651	345	314	1202	1322	2938	7	11779	27935
2028-29	6155	359	331	1257	1397	3123	7	12629	29734
2029-30	6703	373	349	1314	1477	3319	7	13542	31650
2030-31	7290	387	368	1372	1559	3521	7	14504	33644
2031-32	7929	402	388	1432	1645	3736	7	15539	35771
2032-33	8624	417	409	1495	1736	3964	7	16652	38039
2033-34	9379	433	432	1561	1831	4206	7	17849	40459
2034-35	10201	449	455	1629	1933	4463	7	19137	43041
2035-36	11065	465	479	1696	2034	4718	7	20464	45652
2036-37	12002	481	505	1767	2140	4987	7	21889	48433
2037-38	13019	498	532	1840	2250	5273	7	23419	51392
2038-39	14121	515	560	1916	2367	5574	7	25060	54537
2039-40	15316	534	590	1995	2490	5892	7	26824	57888
2040-41	16558	551	620	2071	2610	6204	7	28621	61237
2041-42	17899	568	652	2151	2735	6534	7	30546	64800
2042-43	19350	587	686	2233	2867	6880	7	32610	68580
2043-44	20918	606	721	2318	3005	7245	7	34820	72593
2044-45	22613	626	758	2407	3150	7629	7	37190	76859

Table 6-3 : Total Tollable Traffic@ Toll Plaza 1- Tamalwadi19.300 KM (Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU
2023-24	8548	459	715	1203	1011	2015	7	13958	27123
2024-25	9319	476	753	1258	1071	2149	7	15033	28981
2025-26	10103	493	791	1309	1126	2273	7	16102	30781
2026-27	10954	510	830	1363	1185	2404	7	17253	32703
2027-28	11875	528	871	1418	1247	2543	7	18489	34750
2028-29	12875	547	915	1476	1312	2691	7	19823	36946
2029-30	13959	566	960	1535	1380	2847	7	21254	39276
2030-31	15113	585	1007	1595	1449	3006	7	22762	41702
2031-32	16362	605	1057	1657	1522	3174	7	24384	44292
2032-33	17714	625	1109	1722	1599	3352	7	26128	47057
2033-34	19179	645	1163	1790	1680	3540	7	28004	50007
2034-35	20764	667	1221	1859	1765	3738	7	30021	53152
2035-36	22419	687	1280	1927	1847	3933	7	32100	56342
2036-37	24206	709	1343	1997	1933	4137	7	34332	59737
2037-38	26136	731	1408	2069	2023	4353	7	36727	63353
2038-39	28219	753	1477	2144	2118	4580	7	39298	67207
2039-40	30468	776	1549	2223	2217	4819	7	42059	71316
2040-41	32786	798	1621	2298	2313	5050	7	44873	75436
2041-42	35279	820	1695	2375	2413	5292	7	47881	79804
2042-43	37963	843	1773	2455	2517	5546	7	51104	84451
2043-44	40850	866	1855	2538	2626	5812	7	54554	89392
2044-45	43957	890	1941	2624	2739	6091	7	58249	94645

Table 6-4 : Total Tollable Traffic @ Toll Toll Plaza 2- Yedashi77.400 KM (Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU
2023-24	3976	296	251	996	1046	2273	7	8845	21559
2024-25	4334	307	264	1043	1109	2423	7	9487	22978
2025-26	4698	317	277	1085	1166	2564	7	10114	24327
2026-27	5093	328	290	1129	1227	2713	7	10787	25763
2027-28	5522	339	305	1175	1291	2870	7	11509	27290
2028-29	5987	350	320	1223	1358	3036	7	12281	28909
2029-30	6491	362	336	1273	1428	3213	7	13110	30635

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU
2030-31	7027	374	352	1323	1499	3394	7	13976	32415
2031-32	7608	386	369	1375	1575	3584	7	14904	34304
2032-33	8237	398	388	1429	1654	3784	7	15897	36307
2033-34	8917	412	407	1485	1737	3996	7	16961	38436
2034-35	9654	426	427	1543	1825	4220	7	18102	40700
2035-36	10422	438	448	1599	1910	4440	7	19264	42962
2036-37	11253	452	469	1657	2000	4672	7	20510	45365
2037-38	12149	466	492	1717	2093	4916	7	21840	47908
2038-39	13118	480	516	1780	2191	5172	7	23264	50605
2039-40	14164	495	541	1845	2294	5441	7	24787	53463
2040-41	15241	509	566	1907	2393	5702	7	26325	56293
2041-42	16400	523	593	1971	2497	5976	7	27967	59291
2042-43	17647	538	621	2037	2605	6263	7	29718	62458
2043-44	18989	553	650	2105	2717	6564	7	31585	65804
2044-45	20434	568	681	2176	2835	6878	7	33579	69345

Traffic projections for Most Likely scenario are given as under

Table 6-5 : Total Tollable Traffic @ Toll Plaza 1- Tamalwadi19.300 KM (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU
2023-24	8566	460	717	1206	1013	2019	7	13988	27181
2024-25	9360	479	757	1265	1076	2158	7	15102	29115
2025-26	10172	497	796	1320	1135	2288	7	16215	30998
2026-27	11054	516	837	1377	1197	2426	7	17414	33010
2027-28	12012	535	881	1436	1262	2573	7	18706	35162
2028-29	13054	555	927	1498	1331	2729	7	20101	37467
2029-30	14185	575	975	1562	1403	2893	7	21600	39918
2030-31	15394	595	1026	1627	1477	3062	7	23188	42487
2031-32	16705	617	1079	1695	1555	3241	7	24899	45234
2032-33	18128	639	1134	1765	1637	3431	7	26741	48166
2033-34	19672	662	1193	1838	1723	3632	7	28727	51303
2034-35	21349	686	1254	1915	1814	3845	7	30870	54661
2035-36	23103	709	1319	1990	1903	4056	7	33087	58086
2036-37	25002	732	1386	2068	1997	4278	7	35470	61736
2037-38	27057	757	1457	2149	2096	4511	7	38034	65630
2038-39	29280	782	1531	2233	2199	4758	7	40790	69785
2039-40	31687	808	1610	2320	2308	5018	7	43758	74226

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU
2040-41	34176	833	1689	2404	2413	5272	7	46794	78699
2041-42	36861	858	1771	2491	2524	5538	7	50050	83459
2042-43	39757	884	1857	2581	2639	5817	7	53542	88522
2043-44	42881	911	1948	2674	2759	6111	7	57291	93922
2044-45	46250	939	2043	2771	2885	6419	7	61314	99673

Table 6-6 : Total Tollable Traffic @ Toll Toll Plaza 2- Yedeshi 77.400 KM (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU
2023-24	3986	296	252	998	1049	2278	7	8866	21610
2024-25	4355	307	266	1047	1114	2434	7	9530	23081
2025-26	4732	318	280	1092	1175	2581	7	10185	24496
2026-27	5142	329	295	1139	1240	2737	7	10889	26006
2027-28	5588	341	310	1188	1308	2902	7	11644	27608
2028-29	6073	353	326	1239	1379	3078	7	12455	29317
2029-30	6599	365	343	1292	1454	3264	7	13324	31133
2030-31	7161	377	361	1345	1531	3455	7	14237	33017
2031-32	7770	391	380	1401	1612	3657	7	15218	35024
2032-33	8431	405	400	1459	1697	3871	7	16270	37158
2033-34	9149	420	420	1519	1787	4098	7	17400	39430
2034-35	9929	435	442	1582	1881	4338	7	18614	41849
2035-36	10745	450	465	1643	1974	4575	7	19859	44285
2036-37	11628	465	489	1707	2071	4825	7	21192	46871
2037-38	12584	480	514	1773	2174	5088	7	22620	49615
2038-39	13618	496	541	1842	2281	5366	7	24151	52533
2039-40	14737	512	569	1914	2394	5660	7	25793	55638
2040-41	15894	527	597	1982	2503	5946	7	27456	58719
2041-42	17142	543	626	2054	2617	6246	7	29235	61986
2042-43	18488	559	657	2128	2737	6561	7	31137	65449
2043-44	19940	576	689	2204	2862	6893	7	33171	69119
2044-45	21506	593	723	2284	2992	7241	7	35346	73009

6.2 Modification in Concession Period

As per Article 29 of the concession agreement, if actual traffic on the project falls short or exceeds Target Traffic on project highway on defined date, concession

period shall be modified subject to calculation stipulated therein. For Solapur-Yedeshi project, the Target Date and Target Traffic are defined as under:

Target Date - 1st October 2023

Target Traffic - 22210 in PCU

It was observed that as per traffic projections, average traffic volume falls short of target traffic in all scenarios. Probable extension of concession period is estimated according to article 29 of concession agreement which comes to about a year. Traffic forecast and revenue projections are done for probable extended period accordingly.

Most Likely

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2023	22210	24431	10%	-7%	-7%	29	-2.2

Optimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2023	22210	24493	10%	-8%	-8%	29	-2.2

Pessimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2023	22210	24373	10%	-7%	-7%	29	-2.1

CHAPTER 7

FORECAST OF TOLL REVENUE

7.1 General

This chapter presents the tolling rate calculations, categories and toll revenue of the project.

7.2 Discount Categories

As per the Toll Notification (Schedule -R) the discounts and special provisions have been considered. In addition to discounts as per Fee Notification concessionaire has declared special category rates also. Salient features of toll rate structure are given as under

1. Monthly Pass: For frequent user's monthly pass would be issued for 50 trips at 2/3rd rate as per provision of fee notification.
2. Multiple Journeys (for Return Trip): Will be charged at 1.5 times single journey.
3. Single Journey: Full single journey toll would be charged to this category of vehicles who are infrequent travelers or whose frequency does not yield any discount from the above categories.
4. Local Discounts: There are several categories of local discounts.
    a) Local Car – Rs. 275 Per Month
    b) Local Commercial Traffic at 50% rate for single trip.

Building of inflation and escalation of rate on the basis of WPI are done as per toll notification (Schedule G) as given under as extract from concession agreement.

The formula for determining the applicable rate of fee shall be as follows:-

$$\text{Applicable rate of fee} = \text{base rate} + \text{base rate} \times \left\{ \frac{\text{WPI A-WPI B}}{\text{WPI B}} \right\} \times 0.4$$

Factor of inflation / growth has been incorporated as per Schedule R. WPI numbers (2011-12 series) are available up to 2018-19. A moderate growth in Wholesale Price Index (WPI) has been assumed after that. The following graph provides historical rate of inflation (WPI) in India. Data has been sourced from the Office of Economic Advisor web site (www.eaindustry.nic.in) WPI for year 2017-18 and 2018-2019 is worked back by applying a correlation factor for 2004-05 series as 2017-18 and 2018-2019 data is available in 2011-12 series only. Ratio of WPI for year 2016-17 for both series is used for conversion of WPI in 2004-05 series

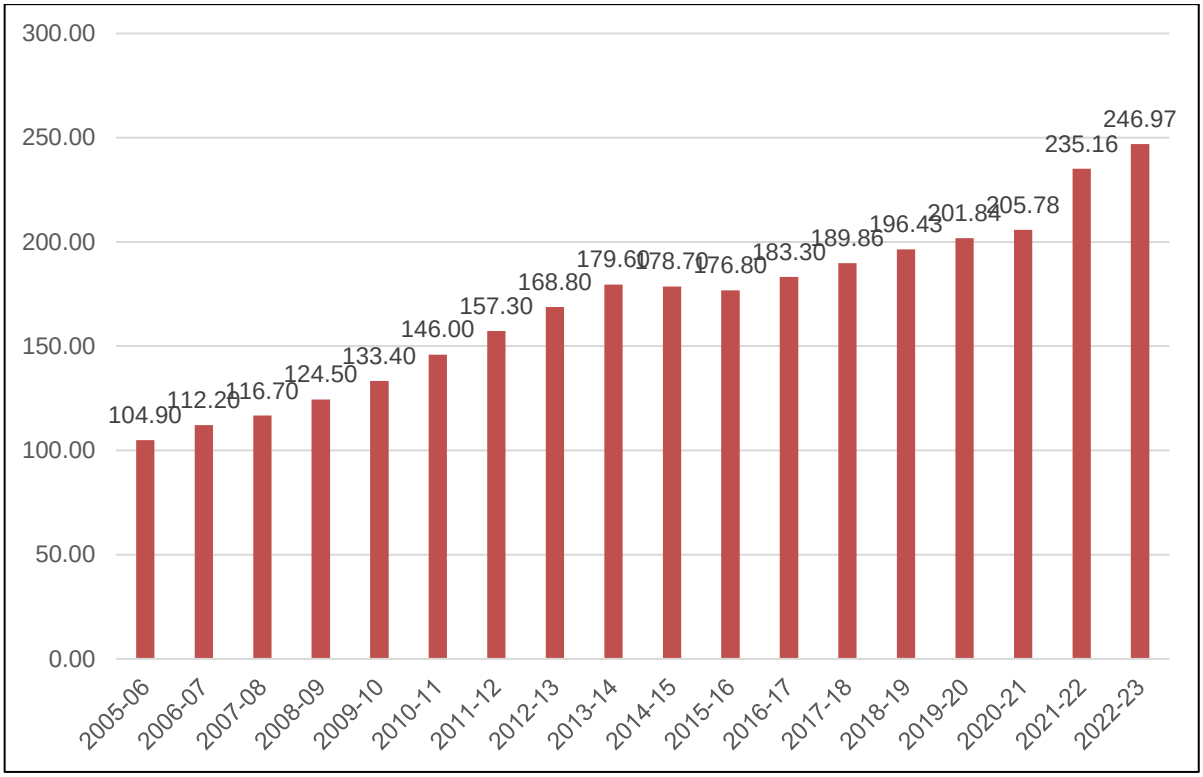


Figure 7-1 : Historical Rate of WPI Inflation in India

Average inflation in WPI in last few years is steadily growing. It grew in range of 4% - 5% in previous years. For future years initially it is takes 5% and Suitably Stepped down for future years.

7.3 Estimation of Toll Rates

As per the applicable MORTH notification and Schedule R of contract agreement, the following Base rate of fee for the categories mentioned in the table stands true in the National Highways Fee Rules applicable for contract.

Table 7-1 : Base Toll Rates June 2007-08

Type of Vehicle	Base Rate of Fee / Km (in Rs.)
Car, Jeep, Van or Light Motor Vehicle	0.65
Light Commercial Vehicle, Light Goods Vehicle or Minibus	1.05
Bus or Truck (Two Axles)	2.20
Three Axle Commercial Vehicles	2.40
Heavy Construction Machinery (HCM) or Earth Moving Equipment (EME) or Multi Axle Vehicle (MAV) (4 to 6 axles)	3.45
Oversized Vehicles (7 or more Axles)	4.20

There is no bypass or structure to be factored in for rates calculations.

Toll rates are calculated as per guidelines provided in schedule R (rounded to nearest Rs.) for the concession period and are given below.

Thus worked out rates for various categories of vehicle and discounts are given as under

Table 7-2 : Toll Rates for Single Journey@ Toll Plaza 1- Tamalwadi 19.300 KM

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	75	115	245	245	270
2024-25	75	125	260	260	280
2025-26	80	130	270	270	295
2026-27	85	135	285	285	310
2027-28	90	145	300	300	325
2028-29	90	150	315	315	340
2029-30	95	155	330	330	360
2030-31	100	165	345	345	375
2031-32	105	170	360	360	395
2032-33	110	180	380	380	415
2033-34	115	190	395	395	435
2034-35	125	200	415	415	455
2035-36	130	210	435	435	475
2036-37	135	220	460	460	500
2037-38	140	230	480	480	525
2038-39	150	240	505	505	550

2039-40	155	250	530	530	575
2040-41	165	265	555	555	605
2041-42	170	280	585	585	635
2042-43	180	290	610	610	670
2043-44	190	305	645	645	700
2044-45	200	320	675	675	735

Table 7-3 : Toll Rates for Single Journey @ Toll Plaza 2- Yedashi 77.400 KM

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	75	115	245	245	270
2024-25	75	125	260	260	280
2025-26	80	130	270	270	295
2026-27	85	135	285	285	310
2027-28	90	145	300	300	325
2028-29	95	150	315	315	340
2029-30	95	155	330	330	360
2030-31	100	165	345	345	375
2031-32	105	170	360	360	395
2032-33	110	180	380	380	415
2033-34	115	190	395	395	435
2034-35	125	200	415	415	455
2035-36	130	210	435	435	475
2036-37	135	220	460	460	500
2037-38	140	230	480	480	525
2038-39	150	240	505	505	550
2039-40	155	255	530	530	580
2040-41	165	265	555	555	605
2041-42	170	280	585	585	635
2042-43	180	290	615	615	670
2043-44	190	305	645	645	700
2044-45	200	325	675	675	735

Table 7-4 : Toll Rates for Return Journey@ Toll Plaza 1- Tamalwadi 19.300 KM

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	110	175	370	370	400
2024-25	115	185	385	385	420
2025-26	120	195	405	405	445
2026-27	125	205	425	425	465
2027-28	130	215	450	450	490

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2028-29	140	225	470	470	510
2029-30	145	235	490	490	535
2030-31	150	245	515	515	565
2031-32	160	260	540	540	590
2032-33	170	270	565	565	620
2033-34	175	285	595	595	650
2034-35	185	300	625	625	680
2035-36	195	310	655	655	715
2036-37	205	330	685	685	750
2037-38	215	345	720	720	785
2038-39	225	360	755	755	825
2039-40	235	380	795	795	865
2040-41	245	400	835	835	910
2041-42	260	415	875	875	955
2042-43	270	440	920	920	1000
2043-44	285	460	965	965	1050
2044-45	300	485	1010	1010	1105

Table 7-5 : Toll Rates for Return Journey @ Toll Plaza 2- Yedashi 77.400 KM

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	110	175	370	370	400
2024-25	115	185	385	385	425
2025-26	120	195	405	405	445
2026-27	125	205	430	430	465
2027-28	130	215	450	450	490
2028-29	140	225	470	470	515
2029-30	145	235	495	495	540
2030-31	155	245	515	515	565
2031-32	160	260	540	540	590
2032-33	170	270	570	570	620
2033-34	175	285	595	595	650
2034-35	185	300	625	625	680
2035-36	195	315	655	655	715
2036-37	205	330	690	690	750
2037-38	215	345	720	720	785
2038-39	225	360	755	755	825
2039-40	235	380	795	795	865
2040-41	245	400	835	835	910
2041-42	260	420	875	875	955
2042-43	270	440	920	920	1005
2043-44	285	460	965	965	1055
2044-45	300	485	1015	1015	1105

Table 7-6 : Toll Rates for Monthly Pass Local @ Toll Plaza 1- Tamalwadi 19.300 KM

Year	Car
2023-24	330
2024-25	345
2025-26	365
2026-27	385
2027-28	400
2028-29	420
2029-30	440
2030-31	460
2031-32	485
2032-33	510
2033-34	535
2034-35	560
2035-36	585
2036-37	615
2037-38	645
2038-39	680
2039-40	710
2040-41	745
2041-42	785
2042-43	825
2043-44	865
2044-45	905

Table 7-7 : Toll Rates for Monthly Pass Local @ Toll Plaza 2- Yedashi 77.400 KM

Year	Car
2023-24	330
2024-25	345
2025-26	365
2026-27	385
2027-28	400
2028-29	420
2029-30	440
2030-31	460
2031-32	485
2032-33	510
2033-34	535
2034-35	560
2035-36	585
2036-37	615
2037-38	645
2038-39	680
2039-40	710
2040-41	745
2041-42	785

Year	Car
2042-43	825
2043-44	865
2044-45	905

Table 7-8 : Toll Rates for Monthly Pass @ Toll Plaza 1- Tamalwadi 19.300 KM

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2023-24	2420	3905	8185	8185	8925
2024-25	2540	4105	8600	8600	9380
2025-26	2670	4310	9035	9035	9855
2026-27	2805	4535	9495	9495	10360
2027-28	2940	4750	9955	9955	10860
2028-29	3080	4980	10430	10430	11380
2029-30	3230	5220	10935	10935	11930
2030-31	3385	5470	11465	11465	12505
2031-32	3550	5735	12020	12020	13115
2032-33	3725	6015	12605	12605	13750
2033-34	3905	6310	13220	13220	14420
2034-35	4095	6615	13865	13865	15125
2035-36	4295	6940	14545	14545	15865
2036-37	4510	7285	15260	15260	16645
2037-38	4730	7640	16010	16010	17465
2038-39	4965	8020	16800	16800	18330
2039-40	5210	8415	17635	17635	19235
2040-41	5470	8835	18510	18510	20190
2041-42	5740	9275	19430	19430	21195
2042-43	6030	9735	20400	20400	22255
2043-44	6330	10225	21420	21420	23370
2044-45	6645	10735	22495	22495	24540

Table 7-9 : Toll Rates for Monthly Pass @ Toll Plaza 2- Yedashi77.400 KM

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2023-24	2420	3910	8195	8195	8940
2024-25	2545	4110	8610	8610	9390
2025-26	2675	4320	9045	9045	9870
2026-27	2810	4540	9510	9510	10375
2027-28	2945	4755	9965	9965	10870
2028-29	3085	4985	10445	10445	11395
2029-30	3235	5225	10950	10950	11945
2030-31	3390	5480	11480	11480	12525
2031-32	3555	5745	12035	12035	13130
2032-33	3730	6025	12620	12620	13770
2033-34	3910	6315	13235	13235	14440
2034-35	4100	6625	13880	13880	15145
2035-36	4305	6950	14560	14560	15885

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2036-37	4515	7290	15280	15280	16665
2037-38	4735	7650	16030	16030	17490
2038-39	4970	8030	16820	16820	18350
2039-40	5215	8425	17655	17655	19260
2040-41	5475	8845	18530	18530	20215
2041-42	5750	9285	19455	19455	21225
2042-43	6035	9750	20425	20425	22285
2043-44	6335	10235	21450	21450	23400
2044-45	6655	10750	22525	22525	24575

7.4 Toll Revenue

As indicated earlier, toll revenue on the Project Road has been calculated in all three scenarios based on above rates and projected traffic. The estimates of toll revenue under ***Optimistic***, ***Pessimistic*** and ***Most Likely*** growth scenarios are presented in the following section.

7.5 Toll Revenue at all toll plazas under Scenarios

Toll Revenue estimates under all scenarios at each of the toll plaza up to 2045-46 starting from the year 2022-23 are shown in tables below.

Table 7-10 : Toll Revenue Optimistic Scenario

(Rs. Crores)

Year	Toll Plaza Km 19.300	Toll Plaza Km 77.400	Total
2023-24	73.50	62.71	**136.21**
2024-25	81.98	70.00	**151.98**
2025-26	91.84	78.08	**169.92**
2026-27	102.79	87.17	**189.95**
2027-28	115.81	97.92	**213.73**
2028-29	128.36	108.73	**237.09**

Year	Toll Plaza Km 19.300	Toll Plaza Km 77.400	Total
2029-30	143.64	120.88	**264.52**
2030-31	160.18	134.63	**294.81**
2031-32	179.79	150.02	**329.81**
2032-33	201.19	167.33	**368.51**
2033-34	223.63	186.08	**409.71**
2034-35	251.93	208.22	**460.15**
2035-36	281.91	231.42	**513.33**
2036-37	313.79	256.91	**570.70**
2037-38	349.28	284.91	**634.20**
2038-39	391.04	317.22	**708.26**
2039-40	436.53	353.60	**790.14**
2040-41	485.40	390.86	**876.25**
2041-42	540.31	433.52	**973.83**
2042-43	601.67	481.23	**1082.90**
2043-44	674.47	536.35	**1210.82**
2044-45	750.41	593.94	**1344.35**

Table 7-11 : Toll Revenue Pessimistic Scenario

(Rs. Crores)

Year	Toll Plaza Km 19.300	Toll Plaza Km 77.400	Total
2023-24	73.19	62.43	**135.62**
2024-25	81.25	69.36	**150.61**
2025-26	90.60	77.02	**167.62**
2026-27	100.93	85.57	**186.50**
2027-28	113.14	95.67	**208.81**
2028-29	124.84	105.76	**230.61**
2029-30	139.01	117.04	**256.05**
2030-31	154.25	129.75	**284.00**
2031-32	172.33	143.93	**316.26**
2032-33	191.98	159.80	**351.79**
2033-34	212.36	176.86	**389.21**
2034-35	238.10	196.99	**435.09**
2035-36	265.16	217.90	**483.06**
2036-37	293.75	240.73	**534.48**
2037-38	325.46	265.69	**591.15**
2038-39	362.64	294.41	**657.05**
2039-40	402.94	326.63	**729.58**
2040-41	445.95	359.33	**805.29**
2041-42	494.07	396.71	**890.78**
2042-43	547.63	438.29	**985.92**
2043-44	611.02	486.19	**1097.21**
2044-45	676.66	535.81	**1212.47**

Table 7-12 : Toll Revenue Most Likely Scenario

(Rs. Crores)

Year	Toll Plaza Km 19.300	Toll Plaza Km 77.400	Total
2023-24	73.33	62.56	**135.89**
2024-25	81.59	69.66	**151.25**
2025-26	91.19	77.54	**168.73**
2026-27	101.82	86.34	**188.17**
2027-28	114.43	96.77	**211.19**
2028-29	126.56	107.23	**233.79**
2029-30	141.24	118.90	**260.14**
2030-31	157.14	132.14	**289.28**
2031-32	175.98	146.90	**322.88**
2032-33	196.50	163.49	**359.99**
2033-34	217.86	181.39	**399.25**
2034-35	244.87	202.50	**447.37**
2035-36	273.36	224.54	**497.90**
2036-37	303.54	248.65	**552.19**
2037-38	337.11	275.11	**612.22**
2038-39	376.52	305.60	**682.12**
2039-40	419.39	339.82	**759.21**
2040-41	465.23	374.68	**839.91**
2041-42	516.61	414.55	**931.16**
2042-43	573.87	459.06	**1032.94**
2043-44	641.81	510.46	**1152.27**
2044-45	712.40	563.98	**1276.38**

CHAPTER 8

CONCLUSION & RECOMMENDATIONS

8.1 Conclusion & Recommendations

Project stretch of Solapur to Yedashi section of NH-211 in state of Karnataka from km 0.000 to km 100.000has been widened to four lane. The road is in sound condition and serves healthy traffic volumes. Project corridor is main transport link for Karnataka- Marathwada traffic. There are large number of townships, industrial corridors and other business establishment coming up along project corridor. As Indian economy is poised to grow at 6%+ post COVID-19, the project corridor is expected to pick up the same trend in terms of traffic flow. All these developments have potential to give positive impact to traffic flow on project. The following can be considered as major outcomes of the study

a) There is good amount of tollable traffic running on project

b) Project corridor has potential to witness traffic growth @ 6-8% annually in near future due to various development in area and overall development of economy

c) Project corridor has committed traffic as long route traffic and does notrun a risk of traffic leakage due to quality competing road

Based on above it can be considered a stable healthy project from traffic and revenue point of view.

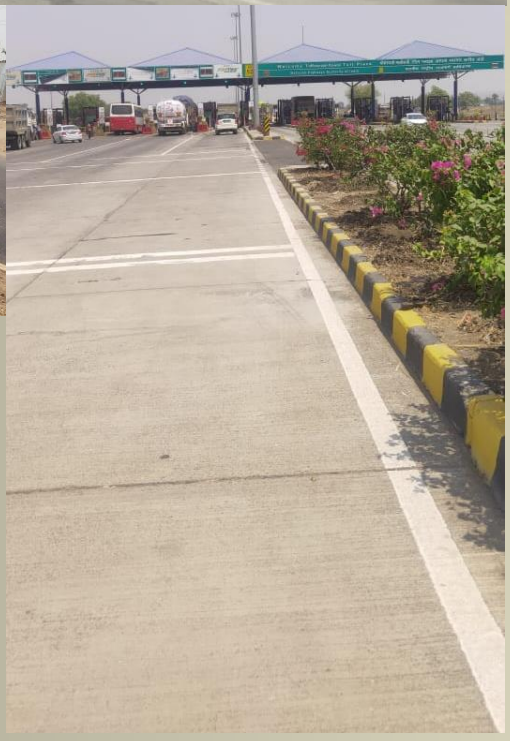
.

GMD Consultants
503-504, Mayuresh Chambers Premises, Plot No. 60,
Sector -11, CBD Belapur, Navi Mumbai. 400 614.
Maharashtra.
Phone : +91-22-2756 4586 / 2756 5313
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

YEDISHI TO AURANGABAD SECTION OF NH-211

(KM 100.000 TO KM 290.200)

IN THE STATE OF MAHARASHTRA



TRAFFIC STUDY & REVENUE PROJECTION REPORT (FINAL)

GMD CONSULTANTS NAVI MUMBAI

APRIL 2023

GMD Consultants

2, Park View Society, Sector -17,
Nerul East, Navi Mumbai. 400706. Maharashtra.
Phone : +91-22-27716391 / 27700233 / 27700991
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

YEDISHI TO AURANGABAD SECTION OF NH-211

(KM 100.000 TO KM 290.200)

IN THE STATE OF MAHARASHTRA

TRAFFIC STUDY & REVENUE

PROJECTION REPORT

(FINAL)

APRIL 2023

GMD CONSULTANTS
NAVI MUMBAI

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AADT	-	Annual Average Daily Traffic	**NHAI**	-	National Highway Authority of India
BOT	-	Build Operate Transfer	**NHDP**	-	National Highways Development Project
CAGR	-	Compound Annual Growth Rate	**NSDP**	-	Net State Domestic Product
CTV	-	Classified traffic volume	**O&M**	-	Operation & Maintenance
DBFOT	-	Design, Build, Finance, Operate & Transfer	**PCDP**	-	Per Capita Domestic Product
EME	-	Earth Moving Equipment	**PCI**	-	Per Capita Income
GDP	-	Gross Domestic Product	**PCU**	-	Passenger Car Unit
GSDP	-	Gross State Domestic Product	**PSC**	-	Pre-stressed Concrete
HCM	-	Heavy Construction Machinery	**RCC**	-	Reinforced cement concrete
HCV	-	Heavy Commercial Vehicle	**RHS**	-	Right Hand Side
HTMS	-	Highway Traffic Management System	**SH**	-	State Highway
IRC	-	Indian Road Congress	**TP**	-	Toll Plaza
IRR	-	Internal Rate of Return	**WPI**	-	Wholesale Price Index
LCV	-	Light Commercial Vehicle	**SIR**	-	Special Investment Region
LHS	-	Left Hand Side	**c.**	-	Circa
LGV	-	Light Goods Vehicle	**ROB**	-	Railway Over Bridge
MAV	-	Multi Axle Vehicle	**MDR**	-	Major District Road
MORTH	-	Ministry of Road Transport and Highways	**ODR**	-	Other District Road
NH	-	National Highway	**CA**	-	Concession Agreement
PCC	-	Plain Cement Concrete	**RMT**	-	Running Meter
CR	-	Coarse Rubble			

CHAPTER 1
INTRODUCTION

1.1 Background

The Government of India through National Highway Authority of India (NHAI) embarked upon a program to enhance the traffic capacity and safety for efficient transportation of goods as well as passenger traffic on National Highway Sections under various NHDP Phases.

The project under consideration, four laning of **Yedeshi** to **Aurangabad** section of NH-211 from km 100.000 to km 290.200 is one such road project NHAI intended to implement on a BOT basis in the DBFOT format. *M/s YA Tollway Ltd.* (Concessionaire) has been awarded the Project for a concession period of 26 years starting from 1st July 2015. Four laning of project has also been completed in September 2020.

Length of project road is 189.090 Kms. The project road is section of NH-211, is one of the important transportation link in Maharashtra which connects Solapur to Dhule and then at Dhule it can join other important highway like NH-3 (Mumbai – Agra Road) and NH-6 (east-west highway). The project road passes through the important places like Chausala, Beed, Adul, Chitegaon and then Aurangabad. The Project Road passes through the districts of Beed and Aurangabad.

Following figure shows alignment of project road section from Yedeshi to Aurangabad.

Figure 1-1 : Alignment of Project Stretch

1.2 Objective of the Study

M/s IRB INFRASTRUCTURE TRUST has engaged *GMD Consultants* to assess the future traffic and toll potential of project along with related operation & maintenance expenditure involved.

This report named as **"Traffic Study & *Toll Revenue Projection Report*"** mainly focuses on traffic and revenue aspects of the project. Other parameters like competing road, area developments etc. have been considered from a traffic development point of view.

1.2.1 Scope of Services

The broad scope of work covered in the assignment is as follows

a) Analysis of Traffic Growth
b) Toll Rate Growth
c) Revenue Forecasting

The Concessionaire has provided basic traffic data and other project details on the basis of which the above analysis has been carried out.

CHAPTER 2

PROJECT DETAILS

2.1 Project Corridor

National Highway 211 which is now part of NH-52. The national highway 52 was numbered after amalgamating many existing national highways of India.

It connects the important places like Chausala, Beed, Adul, Chitegaon and then Aurangabad. The Project Road passes through the districts of Beed and Aurangabad. Following are the major centers of development around project road.

Project Stretch Description

Like other parts of India rapid ribbon development is happening around these cities on project highway. This also contributes to sustainable traffic growth.

There are three operative toll plazas at project stretch. First is at Yedeshi at Km 134.000, second at Padalshingi at Km 194.000 and third at Bhokarwadi at Km 254.000. Following figure show project alignment and toll plaza locations.

Figure 2-1 : Project Alignment with Toll Plaza

2.2 Project Corridor Illustration

Four laning of project stretch is complete. Following photographs illustrate project section along the corridor.

Figure 2-2 : Photographs showing Project Corridor

CHAPTER 3

TRAFFIC SURVEYS AND ANALYSIS

3.1 Traffic Surveys

The Consultants have collected the required information for project corridor to understand the general traffic and travel characteristics on the corridor.

The following traffic data has been collected from client for project.

- Classified traffic volume counts at toll plaza locations on Yedeshi-Aurangabad section of NH-211 for year 2019-20, 2020-21, 2021-2022 and traffic data from April 2022 to March 2023.
- Local Component of traffic
- Component of Return Journey
- Component of Monthly Pass Journey

The main objective of the traffic data analysis is to:

- Determine the existing traffic movement characteristics of the project
- Establish base year traffic
- Identification of travel patterns and modal split of project traffic
- Deriving growth factors for traffic forecasting
- Estimation of corridor traffic including traffic diversion if any
- Preparation of revenue model and projection of revenue as per toll policy for various scenarios

Table 3-1 below lists provides details of locations from where traffic details have been collected.

Table 3-1 : Traffic Data Details

SR. NO	LOCATION	CTV	Single Journey Traffic	Daily Return Journey	Monthly Pass	Local Pass
1	Km 134.000 Toll Plaza at Pargaon	AADT for Year 2019-20, 2020-2021, 2021-22 & 2022-23	For Year 2019-20 ,2020-2021, 2021-22 & 2022-23	For Year 2019-20 ,2020-2021, 2021-22 & 2022-23	For Year 2019-20 ,2020-2021, 2021-22 & 2022-23	For Year 2019-20 ,2020-2021, 2021-22 & 2022-23
2	Km 194.000 Toll Plaza at Padalshingi	AADT for Year 2019-20, 2020-2021, 2021-22 & 2022-23	For Year 2019-20 ,2020-2021, 2021-22 & 2022-23	For Year 2019-20 ,2020-2021, 2021-22 & 2022-23	For Year 2019-20 ,2020-2021, 2021-22 & 2022-23	For Year 2019-20 ,2020-2021, 2021-22 & 2022-23
3	Km 254.000 Toll Plaza at Maliwadi	AADT for Year 2019-20, 2020-2021, 2021-22 & 2022-23	For Year 2019-20 ,2020-2021, 2021-22 & 2022-23	For Year 2019-20 ,2020-2021, 2021-22 & 2022-23	For Year 2019-20 ,2020-2021, 2021-22 & 2022-23	For Year 2019-20 ,2020-2021, 2021-22 & 2022-23

All toll plazas are located in Maharashtra.

3.2 Classified Traffic Volume

The objective of conducting a Classified Traffic Volume Count is to understand the traffic flow pattern including modal split on a roadway. The Classified Traffic Volume Count survey has been provided by the concessionaire of project highway from actual traffic data gathered at toll plaza locations based on monthly data shared with NHAI.

The vehicles can broadly be classified into fast moving / motorized and slow moving / non-motorized vehicles, which can be further classified into specific categories of vehicles. The groupings of vehicles are further segregated to capture the tollable

vehicle categories specifically and toll exempted vehicles are counted separately. The detailed vehicle classification system as per IRC: 64-1990 is given in table below .

Table 3-2 : Vehicle Classification System

Vehicle Type	
Auto Rickshaw	
Passenger Car	Car, Jeep, Taxi & Van (Old / new technology)
Bus	Minibus
	Standard Bus
Truck	Light Goods Vehicle (LCV)
	2 – Axle Truck
	3 Axle Truck (HCV)
	Multi Axle Truck (4-6 Axle)
	Oversized Vehicles (7 or more axles)
Other Vehicles	Agriculture Tractor, Tractor & Trailer

Source - IRC: 64 – 1990

However, since project highway is currently under toll operation, the data collected is corresponding to category of tollable vehicles. Following are the type of vehicles as per concession agreement.

- Car / Jeep / van
- Mini Bus /LCV
- Bus
- Truck /
- 3 Axle commercial vehicle
- Multi Axle

3.3 Traffic Characteristic

Toll revenue of project highway does not solely depend on traffic volume. There are certain characteristics of traffic which have substantial potential to affect toll collection. Component of local traffic, component of passenger and commercial

traffic, portion of return journey traffic, % of monthly pass traffic are some of such characteristics of traffic. These will be discussed in subsequent sections of report.

3.3.1 Traffic Data

Project concessionaire has provided Traffic data for base year 2019-20 ,2020-21, 2021-22 and from April 2022 to March 2023 as under for all toll plazas–

Table 3-3 : Traffic Data at Pargaon Toll Plaza at Km 134.000

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)- 2019-20	Annual Average Daily Traffic (Nos.)- 2020-21	Annual Average Daily Traffic (Nos.)- 2021-22	Annual Average Daily Traffic (Nos.)- 2022-23
1	CAR	1641	1439	2426	2863
2	Minibus /LCV	658	482	257	317
3	Bus	199	109	110	215
4	Truck	635	704	786	988
5	3-Axle Commercial vehicle	793	845	876	967
6	Multi axle	1081	1284	1567	2164
7	Oversize Vehicle	0	50	74	31
	Total	**5007**	**4913**	**6096**	**7544**

Table 3-4 : Traffic Data at Padalshingi Toll Plaza at Km 194.000

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)- 2019-20	Annual Average Daily Traffic (Nos.)- 2020-21	Annual Average Daily Traffic (Nos.)- 2021-22	Annual Average Daily Traffic (Nos.)- 2022-23
1	CAR	4114	3166	4969	5458
2	Minibus /LCV	1095	883	383	451
3	Bus	473	260	252	478
4	Truck	788	839	891	1159

5	3-Axle Commercial vehicle	944	1049	1098	1119
6	Multi axle	1134	1363	1641	2290
7	Oversize Vehicle	1	60	65	29
	Total	**8549**	**7620**	**9299**	**10985**

Table 3-5 : Traffic Data at Maliwadi Toll Plaza at Km 254.000

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)- 2019-20	Annual Average Daily Traffic (Nos.)- 2020-21	Annual Average Daily Traffic (Nos.)- 2021-22	Annual Average Daily Traffic (Nos.)- 2022-23
1	CAR	3089	2492	3992	4717
2	Minibus /LCV	687	546	192	295
3	Bus	347	177	177	341
4	Truck	547	579	567	892
5	3-Axle Commercial vehicle	679	737	718	841
6	Multi axle	866	1046	1164	1914
7	Oversize Vehicle	1	47	52	23
	Total	**6216**	**5623**	**6862**	**9023**

Pandemic of COVID-19 (Corona Virus) had impacted entire world. Taking precaution, government of India announced a complete lockdown in last of March 2020 and traffic on highways was stopped which was eased out progressively later. There after India was hit by Covid-19 second and third wave in February 21 to July - 21 and December 21 to March-22. Recovering traffic pattern was somewhat again disturbed du to second and third wave of Covid-19. Traffic numbers of for period from April-2020 to March 2021 were not representative of traffic pattern at project

corridor due to pandemic lockdown impact. However, for integrity of data same shown above. Traffic has almost recovered from Covid -19 impact as of now.

Adjacent road to project stretches Ahmednagar – Karmala road was in poor condition and due to which there is some additional traffic on project road in current period. Hence as correction factor is applied to average traffic of year 2022-23 to arrive at realistic yearly average traffic.

This data was then bifurcated to various components like through local, monthly, return journey etc. category. Same is discussed in detail in following section.

3.4 Data Analysis

3.4.1 Analysis of Traffic Volume Count

Understanding the character of existing traffic forms the basis of the traffic forecast. The various vehicle types having different sizes and characteristics can be converted into a single unit called Passenger Car Unit (PCU). Passenger Car equivalents for various vehicles are adopted based on recommendations of Indian Road Congress prescribed in "IRC-64-1990: Guidelines for Capacity of Roads in Rural areas". The adopted passenger car unit values (PCU) are presented in ***Table*** 3-6**.**

Table 3-6 : PCU Factors Adopted for Study

Vehicle Type	PCUs
Car	1.0
Minibus	1.5
Standard Bus	3.0
LCV/LGV	1.5
2 Axle Truck	3.0
3 – 6 Axle Truck	4.5
MAV	4.5
Auto Rickshaw	1.0
Van/Tempo	1.0

Agriculture Tractor with Trailer	4.5
Agriculture Tractor without Trailer	1.5

Source: IRC: 64-1990

Traffic volume at each toll plaza was converted to PCU and same is presented as under

Table 3-7 : Traffic in PCU at Project Stretch

Year	Toll Plaza Location (Km)	Traffic No	PCU	PCU Index
2019-2020	Km 134.000 Toll Plaza at Pargaon	5007	12373	2.47
	Km 194.000 Toll Plaza at Padalshingi	8549	17479	2.04
	Km 254.000 Toll Plaza at Maliwadi	6216	12740	2.05
2020-2021	Km 134.000 Toll Plaza at Pargaon	4913	13136	2.67
	Km 194.000 Toll Plaza at Padalshingi	7620	17339	2.28
	Km 254.000 Toll Plaza at Maliwadi	5623	12706	2.26
2021-2022	Km 134.000 Toll Plaza at Pargaon	6096	15511	2.54
	Km 194.000 Toll Plaza at Padalshingi	9299	19945	2.14
	Km 254.000 Toll Plaza at Maliwadi	6862	14138	2.06

Year	Toll Plaza Location (Km)	Traffic No	PCU	PCU Index
2022-2023	Km 134.000 Toll Plaza at Pargaon	7544	19724	2.61
	Km 194.000 Toll Plaza at Padalshingi	10985	24840	2.26
	Km 254.000 Toll Plaza at Maliwadi	9023	20097	2.23

It can be observed from above that project traffic has PCU index 2 to 2.6 which is an indicator of high proportion of commercial traffic in traffic mix in project corridor. Following figure illustrates variation of PCU index at three toll plaza locations.

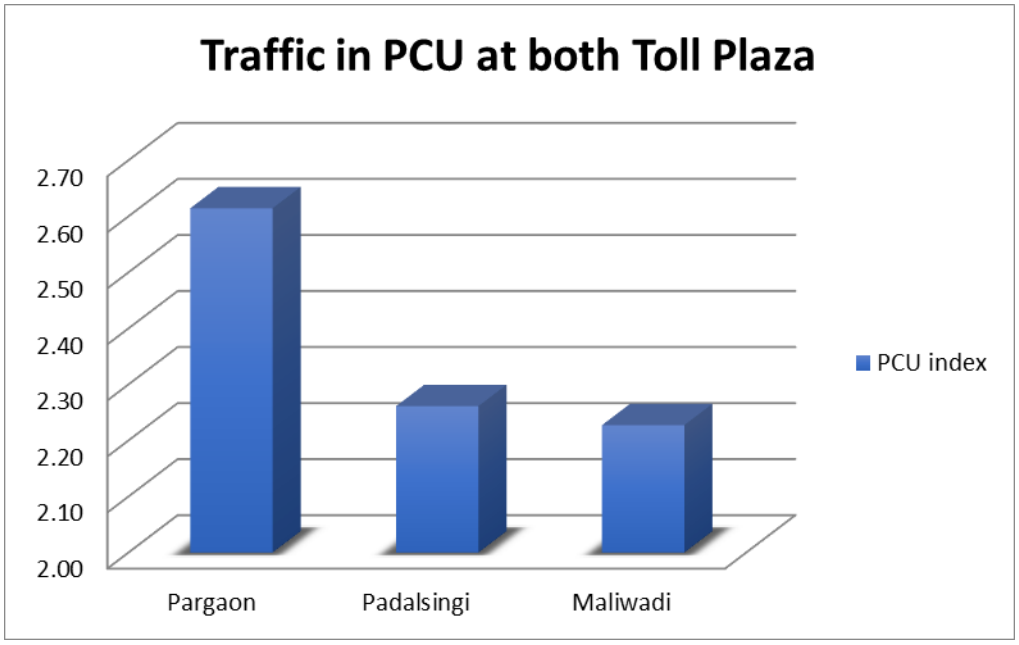


Figure 3-1 : Comparison of PCU Index

It can be observed that PCU index is consistent at all three toll plaza locations.

3.4.2 Components of Traffic

As discussed previously, components of traffic volume play an important role in determining project revenue. A larger component of commercial traffic with higher axle configuration adds to project revenue positively. Similarly, a larger component of local traffic affects the project revenue potential negatively.

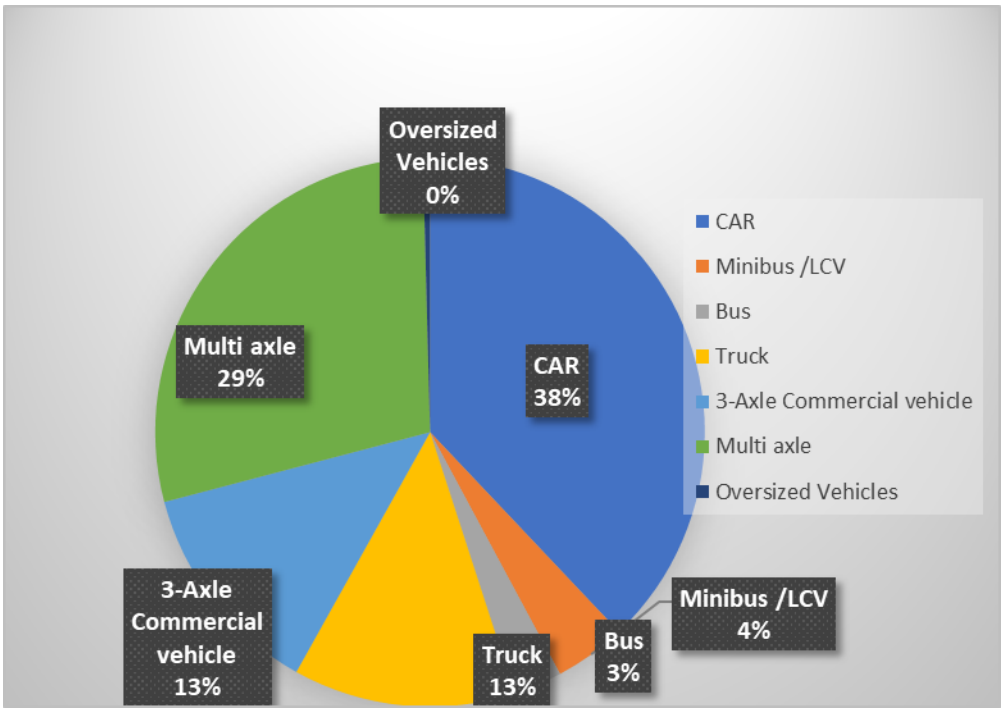


Figure 3-2: Model split of tollable vehicle @ Km 134.000

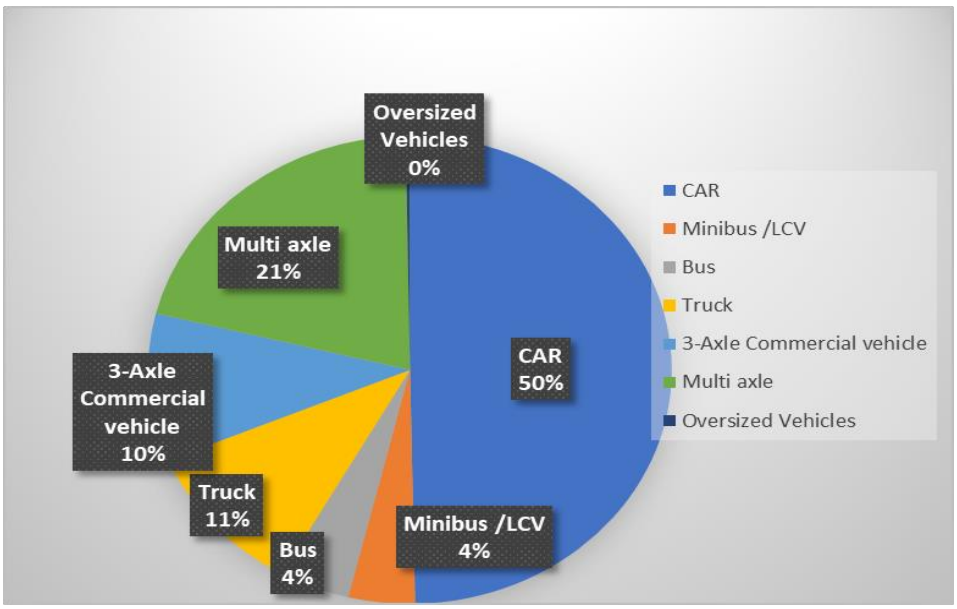


Figure 3-3: Model split of tollable vehicle @ Km 194.000

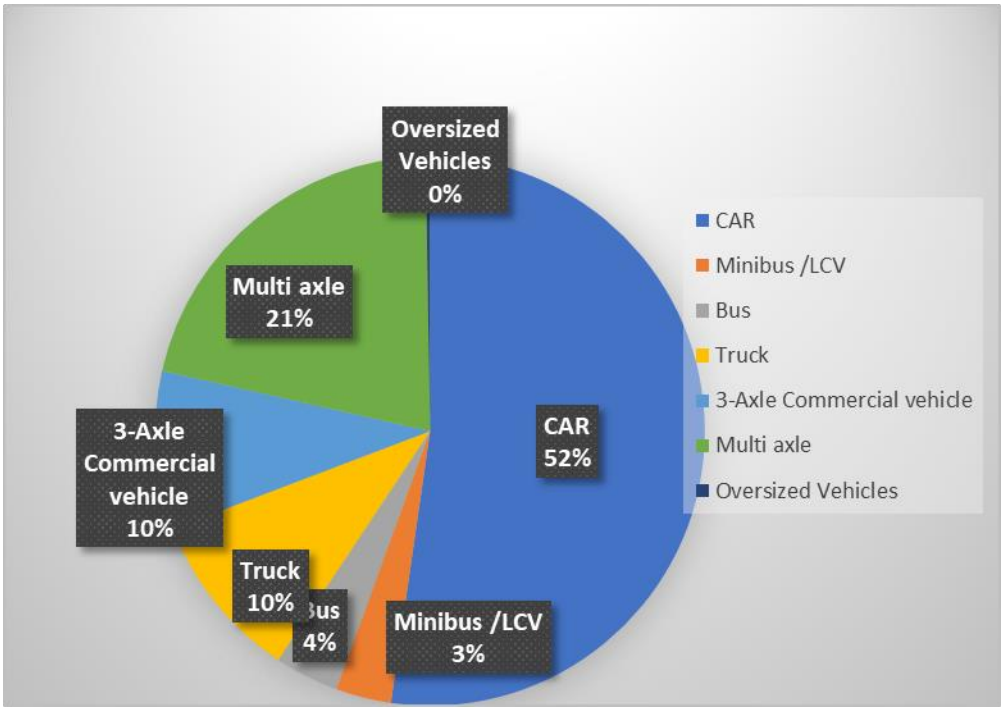


Figure 3-3: Model split of tollable vehicle @ Km 254.000

It is observed that car traffic forms about 38% of total traffic at toll plaza location KM 134.000 while multi axle commercial vehicles are about 42% of total traffic. Truck / Bus and LCV share about 16% and 4% of traffic volume respectively.

It is observed that car traffic forms about 50% of total traffic at toll plaza location KM 194.000 while multi axle commercial vehicles are about 31% of total traffic. Truck / Bus and LCV share about 15% and 4% of traffic volume respectively.

It is observed that car traffic forms about 52% of total traffic at toll plaza location KM 254.000 while multi axle commercial vehicles are about 31% of total traffic. Truck / Bus and LCV share about 14% and 3% of traffic volume respectively.

At second & third toll plaza passenger traffic component is higher due to urban settlement around.

Another important bifurcation of traffic is components of traffic with respect various type of toll ticketing like

1. Single Journey
2. Multi Journey
3. Monthly Pass (Local and General)

The following table provides numbers of vehicles falling in each of above category on base year 2022-23.

Table 3-8 : Journey Type Bifurcation of Traffic at Pargaon Toll Plaza KM 134.000

Sr. No	Type	Traffic Volume (Nos.)
		2022-23
1	Single Journey	5719
2	Return Journey	1782
3	Local Commercial Single Journey	34
4	Monthly Pass Local	8
5	Monthly Pass	2

Most dominant part of the above is the single journey type followed by return journey at project stretch. Monthly pass commuters are a very low fraction of the total traffic on the project corridor.

The single journey component in total traffic numbers is a high as 76%. Return journey component is 24%. The number of monthly pass Local is 0% and Local Commercial single Journey 0% at Pargaon toll plaza.

Following tables give the detail of journey distribution at Padalshingi toll plaza at Km 194.000 and Km 254.000.

Table 3-9 : Journey Type Bifurcation of Traffic at Padalshingi Toll Plaza KM 194.000

Sr. No	Type	Traffic Volume (Nos.)
		2022-23
1	Single Journey	6730
2	Return Journey	3896

3	Local Commercial Single Journey	284
4	Monthly Pass Local	73
5	Monthly Pass	2

Table 3-10 : Journey Type Bifurcation of Traffic at Maliwadi Toll Plaza KM 254.000

Sr. No	Type	Traffic Volume (Nos.)
		2022-23
1	Single Journey	5708
2	Return Journey	3241
3	Local Commercial Single Journey	36
4	Monthly Pass Local	29
5	Monthly Pass	8

It is observed that the project corridor demonstrates a similar pattern of single journey dominated mix of traffic across the entire stretch which is typical of major national highways.

3.5 Secondary Data Collection

There are several other factors which have a substantial impact on traffic pattern and growth on any project corridor. Following are some of such important factors

- Industrial development around project corridor and its catchment
- Educational infrastructure along project corridor
- Demographic pattern
- Urban area development
- Tourism potential
- Upcoming major infrastructural or Industrial projects
- Special Industry in project corridor
- Overall trends of economic growth local as well as national / regional

Hence in addition to traffic details on project site, secondary data was also collected from various other sources. Typical secondary data includes the following:

1. Vehicle registration data of regional and national level.
2. Economic Data
   a) GDP
   b) NSDP
   c) Population Growth
   d) Per Capita Income growth
   e) Industrial Growth
   f) Special Industry Potential
   g) Regional and National development vision / plan
   h) Any other relevant data
3. Competing road network

We have collected and utilized such underlying data in the study to estimate the growth and risk factors for traffic along the project corridor.

CHAPTER 4

INFLUENCE ZONE TRANSPORT NETWORK ANALYSIS

4.1 Introduction

Highway corridors behave like integrated circuit network and more often than not every road is connected to various networks having different origin and destinations. Traffic running on these networks behave like fluid and flow on network on alignment of least friction.

Following Factors can be considered as major contributors to friction on transportation network

- Travel Speed / Travel Time
- Geometric deficiencies like blind horizontal curves and steep vertical gradients etc.
- Configuration of road
- Riding quality
- Traffic delays,
- Length of road,
- Passing through built up or Urban Area,
- Terrain,
- Facilities,

4.2 Competing / Alternate route

In BOT projects there is always a risk factor of traffic shifting on competing roads after imposition of toll. Shifting of traffic depends on factors such as road length, type, geometry, riding quality ad capacity. Competing road network was identified around section and a speed delay analysis was conducted. In this detail of competing roads are provided and a comparison with project road is made. There can be some alternate route between Yedashi and Aurangabad. Following figure provide alignment of competing road network between Yedashi and Aurangabad.

Figure 4-1 : Alternate routes – Yedashi- Aurangabad

It can be observed that alternate routes are quire long and take more time to travel. Hence project road remains the most preferred option for travel between Yedashi and Aurangabad.

Similarly, at regional level there can be alternate via Ahmednagar for travel between Solapur and Aurangabad. Following figure show competing network in area.

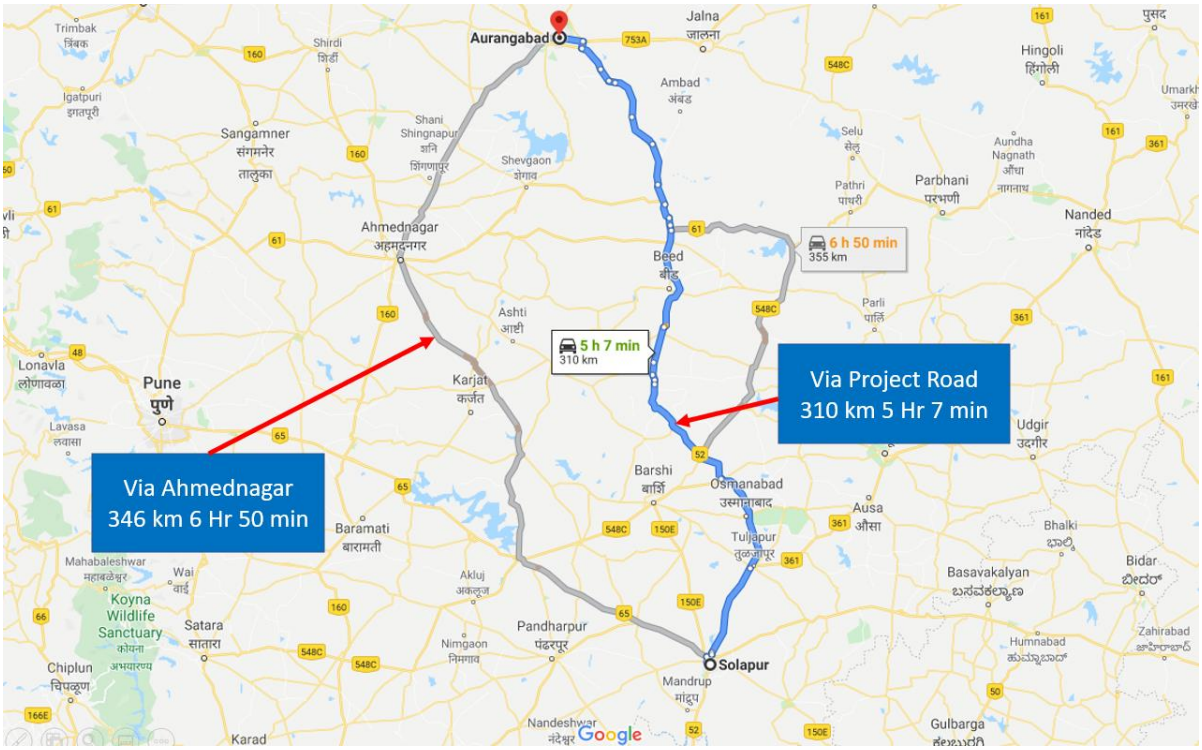


Figure 4-2 : Alternate route Between Solapur and Aurangabad

For travel between Solapur and Aurangabad as well project road is most preferred option due to shorter length and less travel time. Completion of four laning of Solapur Yedashi section has complemented travel on this route.

Following table provide summary of analysis of alternate route/ roads discussed above.

Table 4-1 : Competing Roads Details

Sr. No	Route Details	Designation	Length (Km)	Avg. Speed (KMPH)	Time Taken (Min)	Observations
Regional Level						
1	Solapur-Ahmednagar-Aurangabad	Alternate Route	346	50	6 Hr 50 Min	Project road has minimum travel time and shortest road
	Solapur- Yedashi-Aurangabad	Project Road	310	60	5 Hr 10 Min	
2	Yedashi- Kalam-Madalmoni-Aurangabad (SH-61)	Alternate Route	270	50	5 Hr 24 Min	Project road has minimum travel time and shortest road
	Yedashi-Ahmednagar-Aurangabad	Alternate Route	289	50	5 Hr 49 Min	

	Yedashi- Beed-Aurangabad	Project Road	223	57	3 Hr 54 Min	

It light of above discussion project road remains most preferred route for the traffic of influence area. Moreover, project stretch is under toll operation for last one year. Hence any shifting of traffic, if any, would have settled by now and any further shifting of traffic is not envisaged from project road.

Regional Network

Project corridor is important transportation link for the traffic between Karnataka and Rajasthan / Delhi and other northern states. Part of this traffic uses the Bijapur- Solapur- Ahmednagar- Shirdi route to join back at Dhule and proceed towards northern parts of country. The length of route between Bijapur via project road and route via Ahmednagar is almost equal. Thus, it is expected that some part traffic will come back on project road as the four laning is complete. Following figures show route between Bijapur and Dhule via Project road and via Ahmednagar for better understanding.

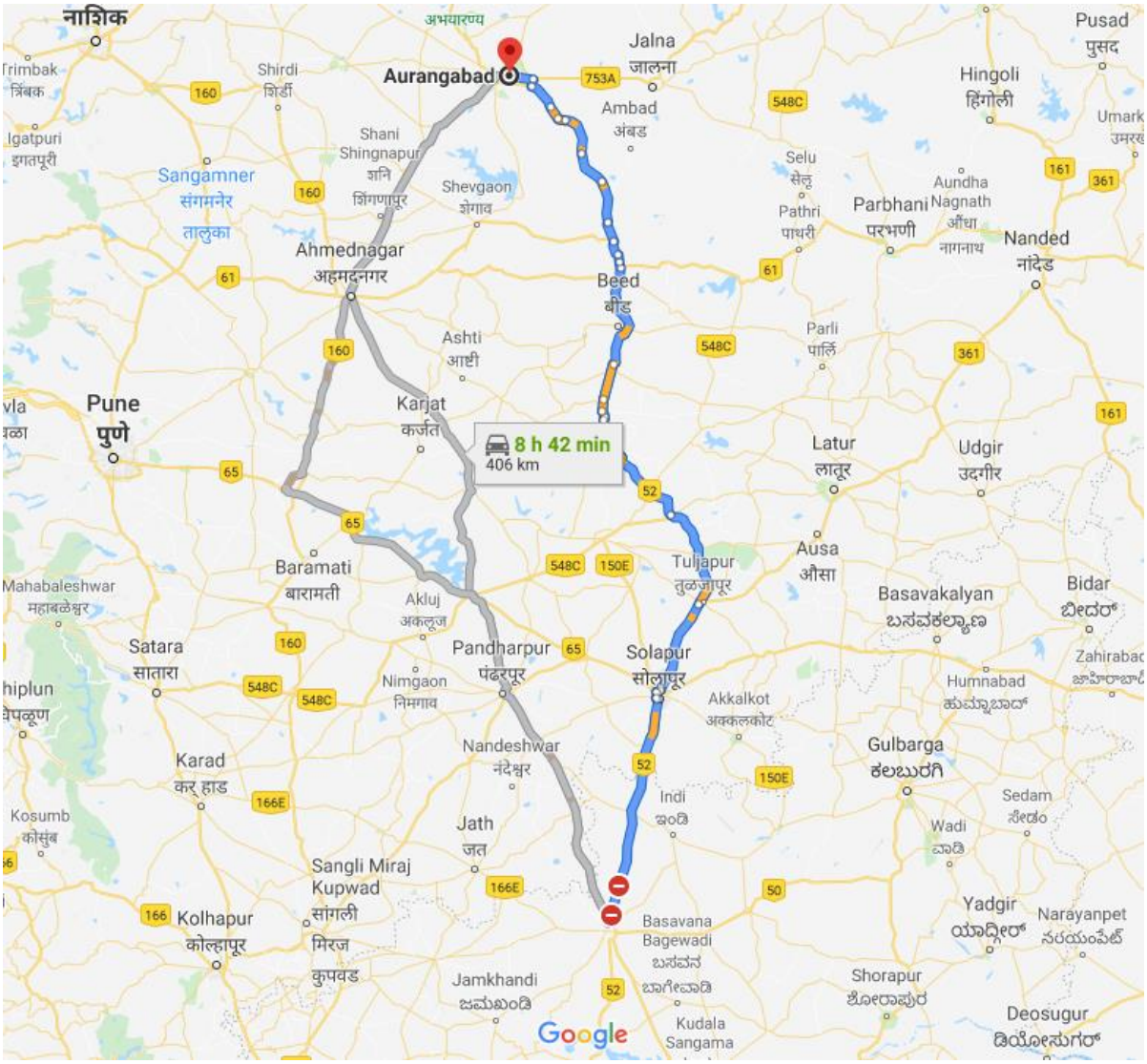


Figure 4-3 : Project Road in regional network

CHAPTER 5

GROWTH OF TRAFFIC ON PROJECT HIGHWAY

5.1 Introduction

Traffic growth is a function of the interplay of a number of contributory factors such as National economy, Government policy, socio-economic conditions of the people, and changes in land uses along the project corridor precincts etc. As these factors have a number of uncertainties associated with them, forecasts of traffic are dependent on the projections of other factors such as population, gross domestic product (GDP), vehicle ownership, per capita income (PCI), agricultural output, fuel consumption etc. Future pattern of change in these factors can be estimated with only a reasonable degree of accuracy and hence the resultant traffic forecast levels may not be precise.

Traffic growth forecast for project corridor Yedeshi - Aurangabad section of NH-8 has been done taking the above factors into consideration. "**IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**" is established best practice and has been used for traffic growth forecast.

5.2 Trend Analysis

One of the methods of estimation of future rate of growth is to assume the same rate of growth as in the past. Although such a method is more suitable to projects of short durations say 5-10 years, however for long term projections it would-be erroneous to assume that the past rate of growth will continue to prevail for a long time in future. Economic conditions, which are major influencing factors, are bound to change over a long period of time. Thus, it would be necessary to modify the past trends of growth suitably.

Elasticity model of growth projection is one of the most widely acceptable methods for traffic forecast. The same is recommended in **IRC: 108-12015-Guidelines for Traffic Prediction on Rural Highways**.

In this method the past trend of vehicular data is paired with an economic indicator and a regression analysis is done to yield the economic model of growth. Growth of vehicle traffic varies for different type of vehicle. It is a proven fact that the growth pattern for passenger and goods vehicle is different. Traffic growth on any highway

typically depends on number of economic parameters. Most important and direct parameters are given as under

- Per Capita Income
- Net State Domestic Product (NSDP)
- Population

It can be observed that the ownership of a car is more closely related to affordability; hence per capita is the index which closely fits the growth of car traffic among other criteria. In a similar fashion, the following can be pairs of vehicle type and independent variable for elasticity modeling of growth.

- Car / Jeep – Par Capita Income
- Bus / Minibus – Population
- Goods Vehicle – NSDP

5.3 Estimation of Traffic Demand Elasticity

Elasticity of traffic demand is defined as the rate at which traffic intensity varies due to a change in the corresponding indicator selected. Hence, In order to estimate the elasticity of traffic demand, it is necessary to establish relationship between the growth in number of given category of vehicles with the relevant economic variable considered, such as NSDP, per capita income and population growth. Latest available data for vehicle registration, per capita income, NSDP and population is used in analysis.

As per IRC: 108-1996 the model for estimating elasticity index for the project corridor is of the following form and is given as below:

$$Log\ (P) = k \times Log\ (EI) + A$$

Where,

P = *Number of Vehicles (Mode wise)*

EI = *Economic Indicator*

A = *Regression constant*

k = *Elasticity coefficient (Regression coefficient)*

The elasticity for car and bus (passenger vehicles) is calculated based on the Population and Per Capita Domestic Product (PCDP) and the elasticity for trucks is calculated based on the Net State Domestic Product (NSDP).

The project corridor spreads across state of Maharashtra. Toll plazas at Paragaon, Padalsingi and Bhokharwadi are in the state of Maharashtra. Project traffic share of many states like Karnataka, Gujarat & Haryana also. For elasticity calculations, working data from these states also has been analyzed.

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Maharashtra State.

Table 5-1 : Per Capita Income Vs Car Maharashtra

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	99564	2307841	5.00	6.36		
2013	103904	2592565	5.02	6.41	4%	
2014	109399	2834847	5.04	6.45	5%	
2015	114746	3113773	5.06	6.49	5%	
2016	122422	3406872	5.09	6.53	7%	
2017	132899	3715744	5.12	6.57	9%	5.96%

Regression analysis of same is given in figure below

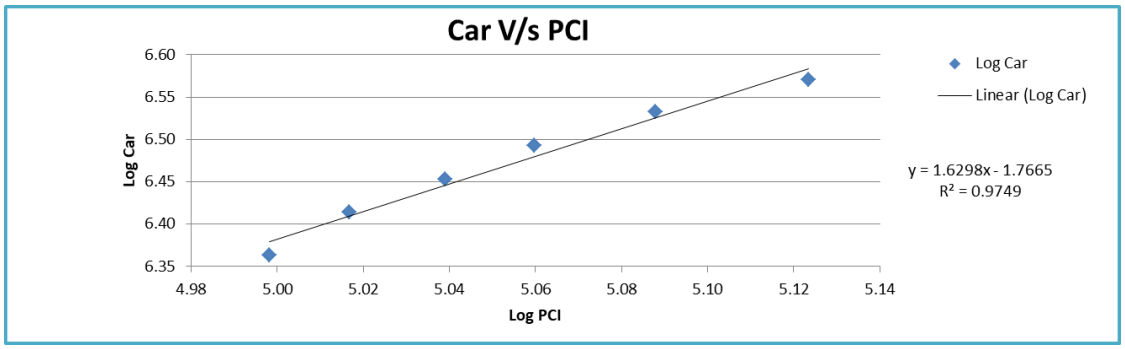


Figure 5-1 : Regression and Elasticity PCI vs. Car – Extrapolation Maharashtra

Table 5-2 : Population Vs Bus Maharashtra

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	112374333	119298	8.05	5.08		
2013	113807248	129535	8.06	5.11	1%	

2014	115229410	140087	8.06	5.15	1%	
2015	116640546	140102	8.07	5.15	1%	
2016	118040394	150427	8.07	5.18	1%	
2017	119428710	160042	8.08	5.20	1%	1.23%

Regression analysis of same is given in figure below

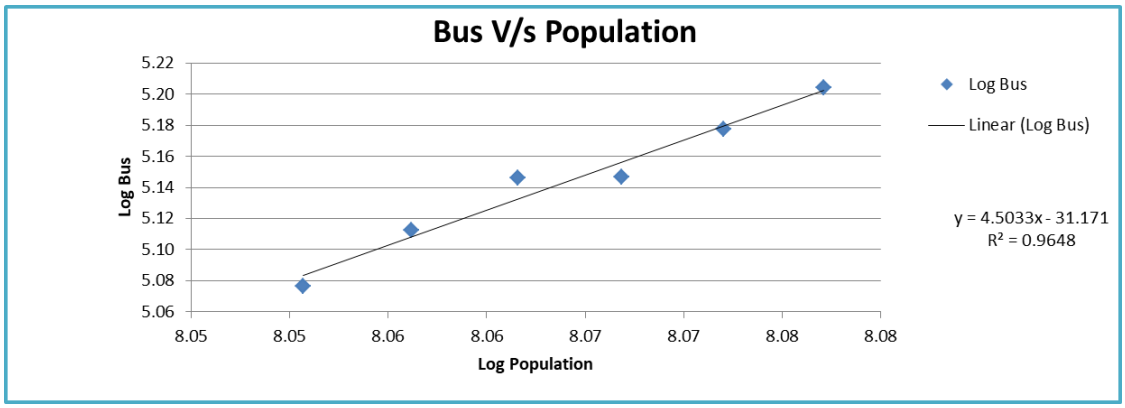


Figure 5-2 : Regression and Elasticity Population vs. Bus – Extrapolation Maharashtra

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-3 : LCV Traffic Vs NSDP Maharashtra

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth (5 Year)
2012	1126595	656407	6.05	5.82		
2013	1189711	739725	6.08	5.87	6%	
2014	1267551	803128	6.10	5.90	7%	
2015	1345341	868632	6.13	5.94	6%	
2016	1452439	927903	6.16	5.97	8%	6.56%

Following figure depict regression analysis and extrapolation.

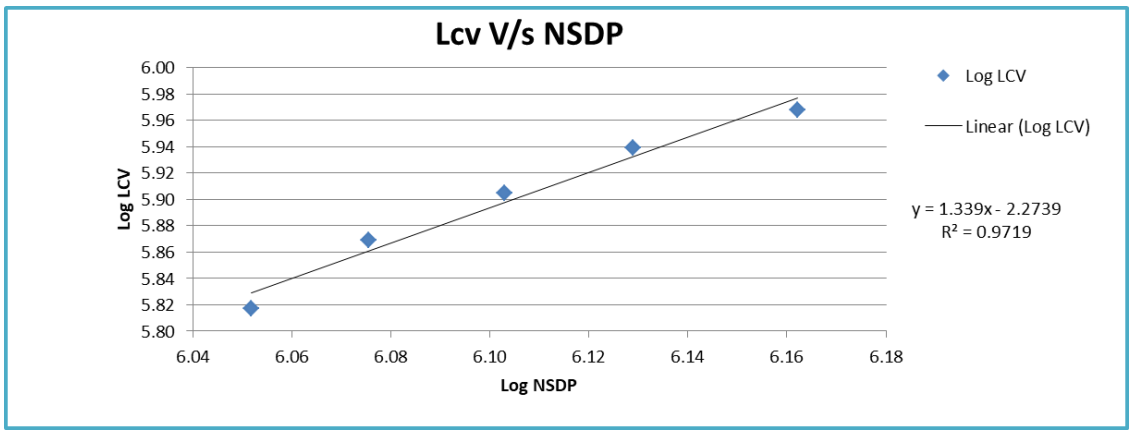


Table 5-4 : Truck Traffic Vs NSDP Maharashtra

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	1126595	411418	6.05	5.61		
2013	1189711	402366	6.08	5.60	6%	
2014	1267551	470128	6.10	5.67	7%	
2015	1345341	491582	6.13	5.69	6%	
2016	1452439	468810	6.16	5.67	8%	
2017	1595514	496439	6.20	5.70	10%	7.22%

Following figure depict regression analysis and extrapolation

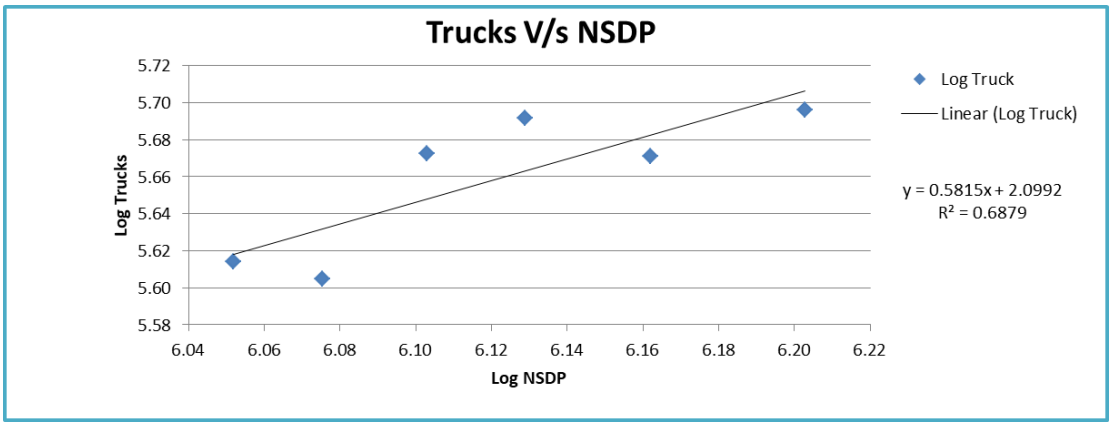


Figure 5-3 : Regression and Elasticity NSDP vs. Truck Traffic - extrapolation Maharashtra

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below.

Table 5-5 : Summary Regression Analysis Maharashtra

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average Growth	Growth Elastic Model
Maharashtra	Car/Jeep	PCI	y = 1.6298x + -1.7665	R^2 = 0.9749	1.6298	5.96%	9.71%
	Bus	Population	y = 4.5033x - -31.1713	R^2 = 0.9648	4.5033	1.23%	5.52%
	LCV	NSDP	y = 1.339x - -2.2739	R^2 = 0.9719	1.3390	6.56%	8.78%
	Truck	NSDP	y = 0.5815x - 2.0992	R^2 = 0.6879	0.5815	7.22%	4.20%

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Gujrat State.

Table 5-6 : Per Capita Income Vs Car Gujarat

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	87481	1411898	4.94	6.15		
2013	96683	1602129	4.99	6.20	11%	
2014	102589	1771298	5.01	6.25	6%	
2015	111370	2008748	5.05	6.30	9%	
2016	120683	2260084	5.08	6.35	8%	
2017	129738	2527537	5.11	6.40	8%	8.21%

Regression analysis of same is given in figure below

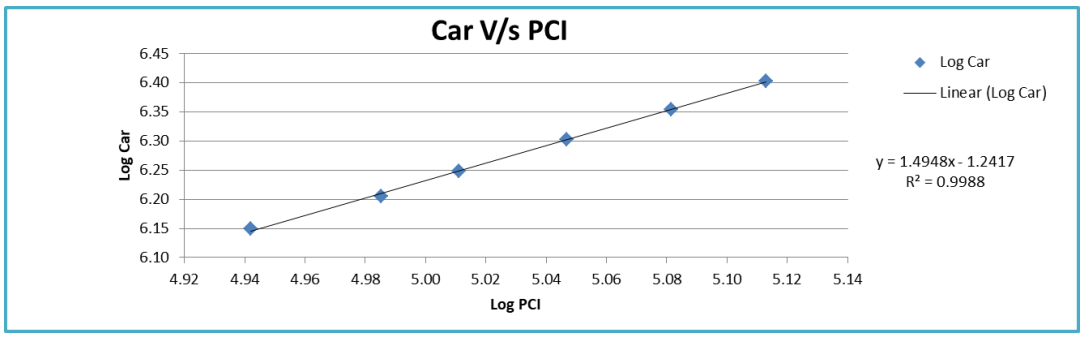


Figure 5-4 : Regression and Elasticity PCI vs. Car – Extrapolation Uttar Pradesh

Table 5-7 : Population Vs Bus Gujrat

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	60439692	67546	7.78	4.83		
2013	61563037	70615	7.79	4.85	2%	
2014	62684375	72998	7.80	4.86	2%	
2015	63803304	76435	7.80	4.88	2%	
2016	64919427	82734	7.81	4.92	2%	
2017	66032362	74855	7.82	4.87	2%	1.79%

Regression analysis of same is given in figure below

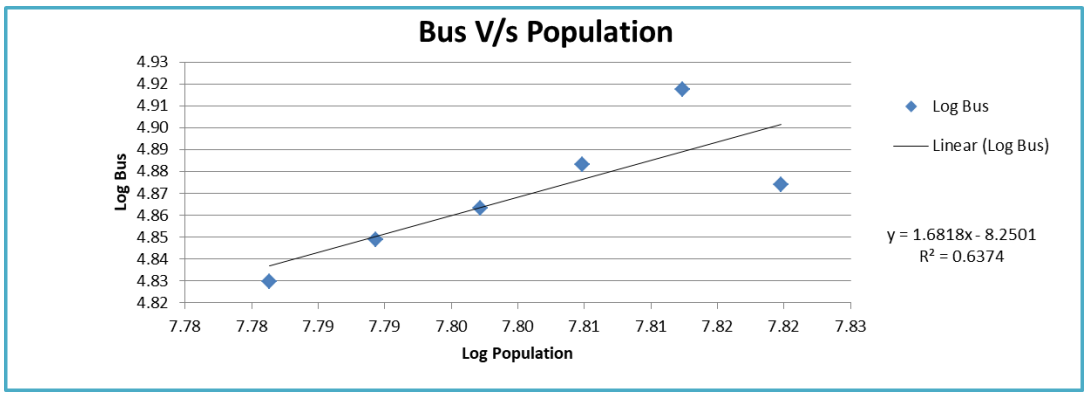


Figure 5-5 : Regression and Elasticity Population vs. Bus – Extrapolation Gujarat

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-8 : LCV Traffic Vs NSDP Gujarat

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth (5 Year)
2012	532809	448958	5.73	5.65		
2013	596659	499277	5.78	5.70	12%	
2014	641489	542918	5.81	5.73	8%	
2015	705629	589984	5.85	5.77	10%	
2016	774775	633599	5.89	5.80	10%	9.82%

Following figure depict regression analysis and extrapolation.

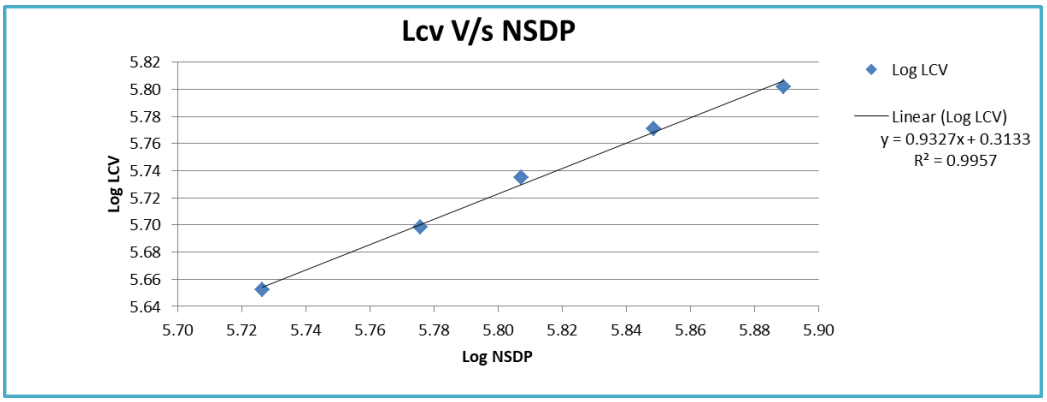


Table 5-9 : Truck Traffic Vs NSDP Gujarat

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	532809	301533	5.73	5.48		
2013	596659	319207	5.78	5.50	12%	
2014	641489	332185	5.81	5.52	8%	
2015	705629	352225	5.85	5.55	10%	
2016	774775	375265	5.89	5.57	10%	
2017	843930	396061	5.93	5.60	9%	9.64%

Following figure depict regression analysis and extrapolation

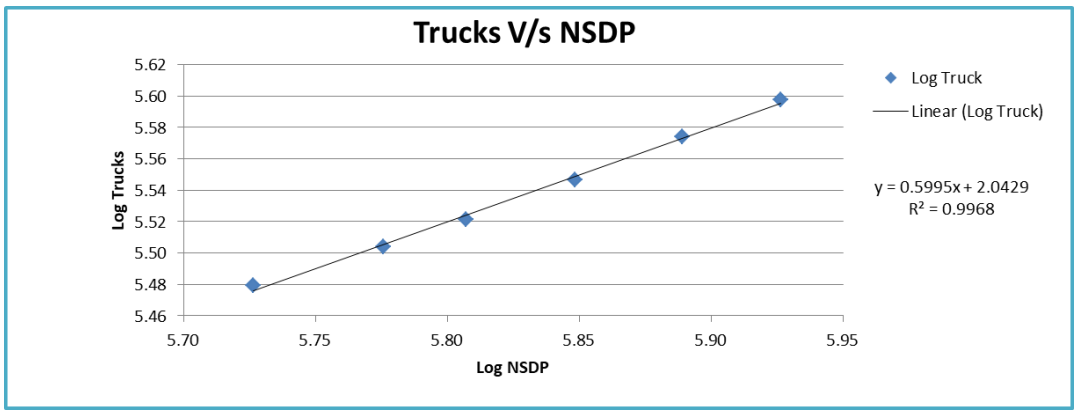


Figure 5-6 : Regression and Elasticity NSDP vs. Truck Traffic - extrapolation Gujarat

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below

Table 5-10 : Summary Regression Analysis Gujrat

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average Growth	Growth Elastic Model
Gujarat	Car/Jeep	PCI	y = 1.4948x + -1.2417	R² = 0.9988	1.4948	8.21%	12.27%
	Bus	Population	y = 1.6818x - -8.2501	R² = 0.6374	1.6818	1.79%	3.00%
	LCV	NSDP	y = 0.9327x - 0.3133	R² = 0.9957	0.9327	9.82%	9.16%
	Truck	NSDP	y = 0.5995x - 2.0429	R² = 0.9968	0.5995	9.64%	5.78%

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Haryana State.

Table 5-11 : Per Capita Income Vs Car Haryana

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	106085	1134514	5.03	6.05		
2013	111780	1293065	5.05	6.11	5%	
2014	119791	1454182	5.08	6.16	7%	
2015	125032	1609544	5.10	6.21	4%	
2016	137818	1764448	5.14	6.25	10%	
2017	150241	1879587	5.18	6.27	9%	7.23%

Regression analysis of same is given in figure below

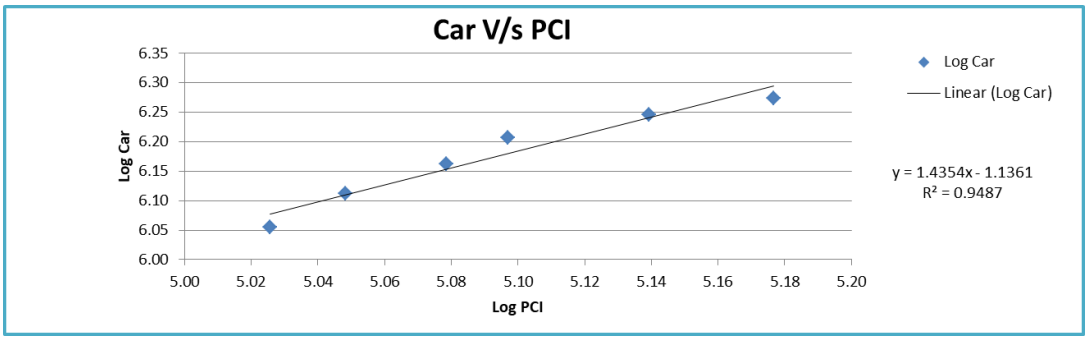


Figure 5-7 : Regression and Elasticity PCI vs. Car – Extrapolation Haryana

Table 5-12 : Population Vs Bus Haryana

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	25351462	39153	7.40	4.59		
2013	25751257	43456	7.41	4.64	2%	
2014	26149236	46558	7.42	4.67	2%	
2015	26545282	52640	7.42	4.72	2%	
2016	26939286	55781	7.43	4.75	1%	
2017	27331141	60129	7.44	4.78	1%	1.52%

Regression analysis of same is given in figure below

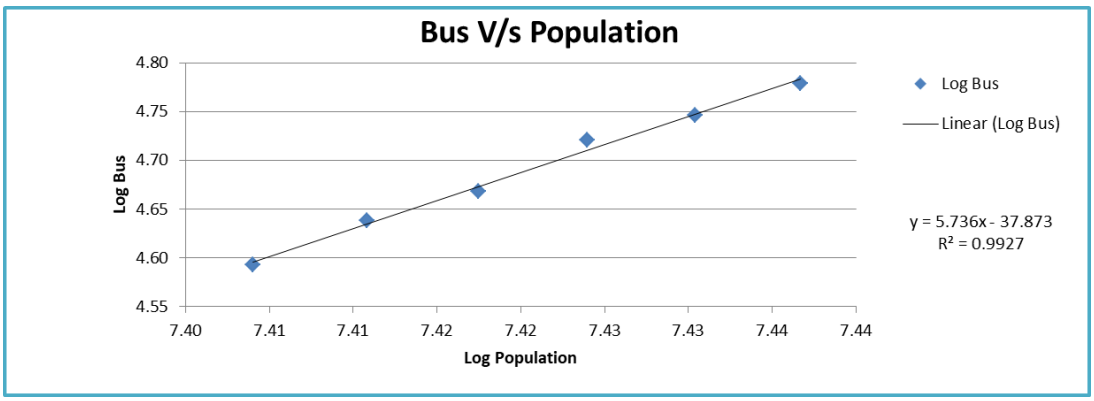


Figure 5-8 : Regression and Elasticity Population vs. Bus – Extrapolation Haryana

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-13 : LCV Traffic Vs NSDP Haryana

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth (5 Year)
2012	271152	124897	5.43	5.10		
2013	289756	137511	5.46	5.14	7%	
2014	314931	152069	5.50	5.18	9%	
2015	333359	167901	5.52	5.23	6%	
2016	372659	182776	5.57	5.26	12%	8.30%

Following figure depict regression analysis and extrapolation.

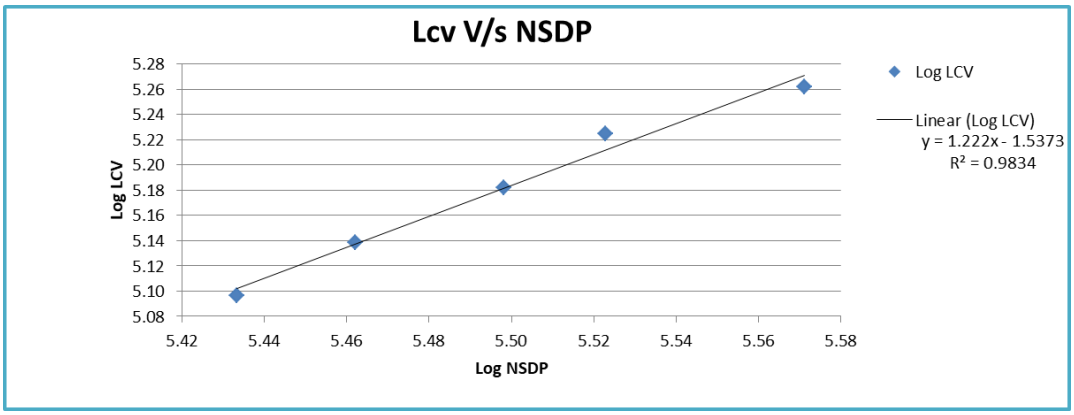


Table 5-14 : Truck Traffic Vs NSDP Haryana

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	271152	292735	5.43	5.47		
2013	289756	307509	5.46	5.49	7%	
2014	314931	327882	5.50	5.52	9%	
2015	333359	348732	5.52	5.54	6%	
2016	372659	367730	5.57	5.57	12%	
2017	412006	390321	5.61	5.59	11%	8.75%

Following figure depict regression analysis and extrapolation

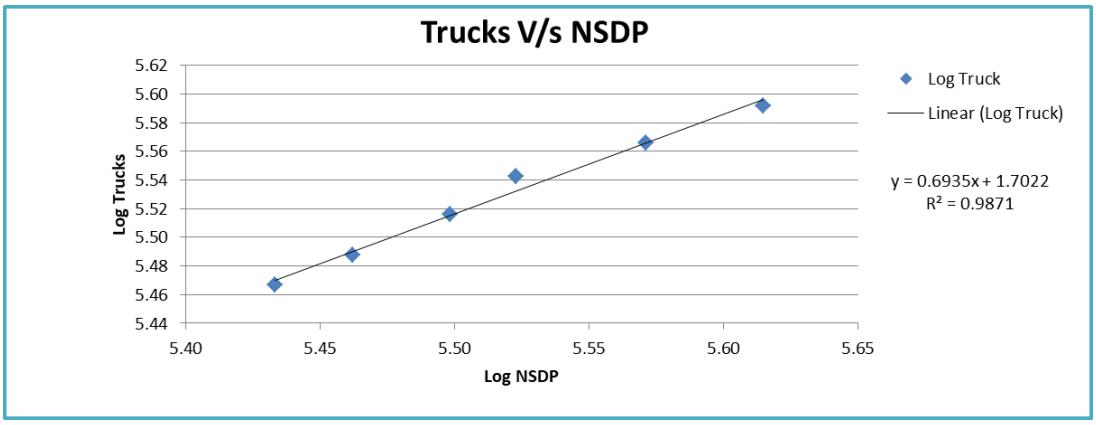


Figure 5-9 : Regression and Elasticity NSDP vs. Goods Traffic - extrapolation Haryana

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below

Table 5-15 : Summary Regression Analysis Haryana

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average Growth	Growth Elastic Model
Haryana	Car/Jeep	PCI	y = 1.4354x - -1.1361	R^2 = 0.9487	1.4354	7.23%	10.38%
	Bus	Population	y = 5.736x - - 37.8732	R^2 = 0.9927	5.7360	1.52%	8.69%
	LCV	NSDP	y = 1.222x - - 1.5373	R^2 = 0.9834	1.2220	8.30%	10.14%
	Truck	NSDP	y = 0.6935x - 1.7022	R^2 = 0.9871	0.6935	8.75%	6.07%

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Karnataka State.

Table 5-16 : Per Capita Income Vs Car Karnataka

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	90269	1454309	4.96	6.16		
2013	94382	1626924	4.97	6.21	5%	
2014	101864	1798035	5.01	6.25	8%	
2015	105703	1992262	5.02	6.30	4%	
2016	116819	2207852	5.07	6.34	11%	
2017	131260	2203562	5.12	6.34	12%	7.83%

Regression analysis of same is given in figure below

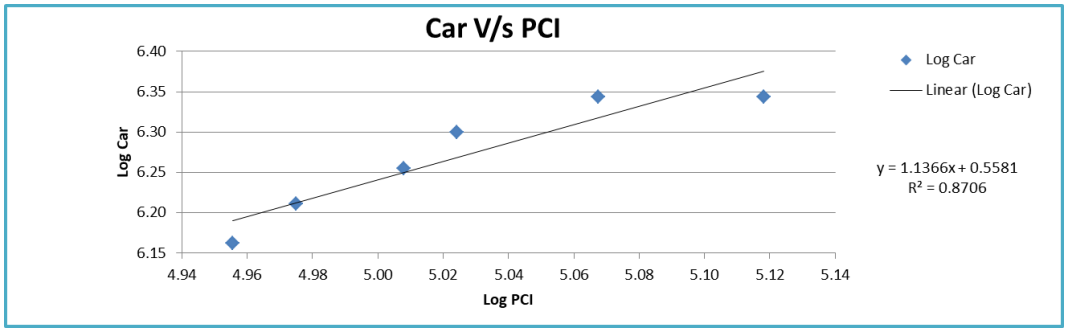


Figure 5-10 : Regression and Elasticity PCI vs. Car – Extrapolation Karnataka

Table 5-17 : Population Vs Bus Karnataka

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	61095297	175705	7.79	5.24		
2013	62058777	186705	7.79	5.27	2%	
2014	63017877	195913	7.80	5.29	2%	
2015	63972322	204803	7.81	5.31	2%	
2016	64921845	213699	7.81	5.33	1%	
2017	65866188	224580	7.82	5.35	1%	1.52%

Regression analysis of same is given in figure below

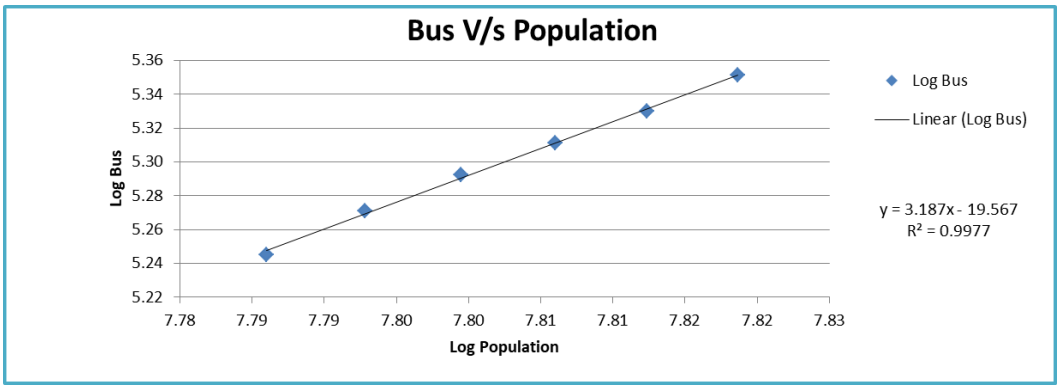


Figure 5-11 : Regression and Elasticity Population vs. Bus – Extrapolation Karnataka

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-18 : LCV Traffic Vs NSDP Karnataka

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth (5 Year)
2012	554990	221160	5.74	5.34		

2013	586592	258701	5.77	5.41	6%	
2014	639981	294266	5.81	5.47	9%	
2015	671322	331381	5.83	5.52	5%	
2016	749990	367572	5.88	5.57	12%	8%

Following figure depict regression analysis and extrapolation.

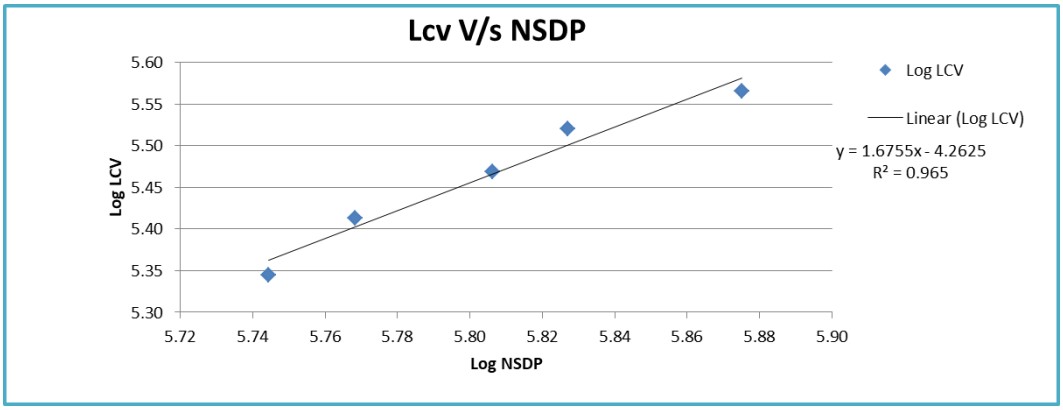


Table 5-19 : Truck Traffic Vs NSDP Karnataka

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	554990	233422	5.74	5.37		
2013	586592	247639	5.77	5.39	6%	
2014	639981	260989	5.81	5.42	9%	
2015	671322	274971	5.83	5.44	5%	
2016	749990	290415	5.88	5.46	12%	
2017	851880	306290	5.93	5.49	14%	9.00%

Following figure depict regression analysis and extrapolation

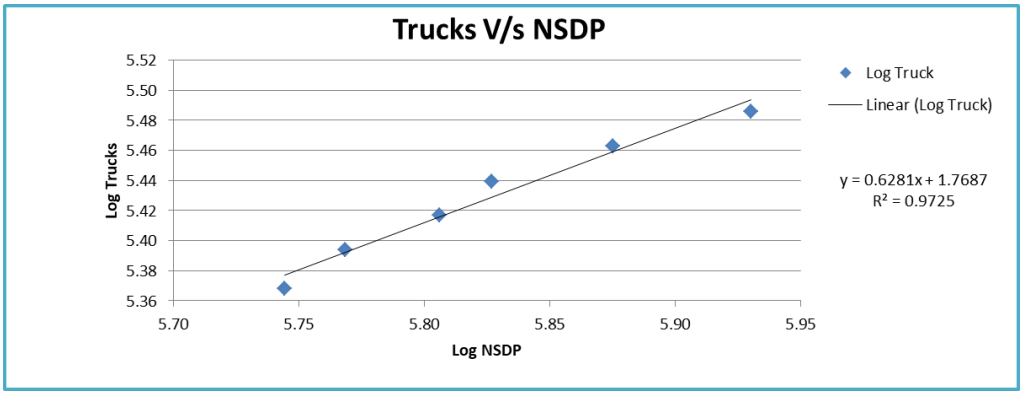


Figure 5-12 : Regression and Elasticity NSDP vs. Goods Traffic - extrapolation Karnataka

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below.

Table 5-20 : Summary Regression Analysis Karnataka

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average Growth	Growth Elastic Model
Karnataka	Car/Jeep	PCI	y = 1.1366x - 0.5581	R² = 0.8706	1.1366	7.83%	8.90%
	Bus	Population	y = 3.187x - - 19.567	R² = 0.9977	3.1870	1.52%	4.83%
	LCV	NSDP	y = 1.6755x - - 4.2625	R² = 0.965	1.6755	7.85%	13.16%
	Truck	NSDP	y = 0.6281x - 1.7687	R² = 0.9725	0.6281	9.00%	5.65%

Economical model for predicting growth is good tool, however other local, regional, national factors should also be considered before finalizing growth factors. Considering factors such as proposed developments and other influencing economic factors, moderated growth should be considered. These factors are discussed in subsequent sections.

5.4 Analysis of Historic Traffic Data

Historical traffic data forms useful information for any highway project. It provides useful information for establishing past trend of growth. Project stretch of Yedashi to Aurangabad has recently been commissioned and is under tolling operation since March 2019. As traffic data available for last two years was affected due to COVID-19 the same cannot be taken as representative. A minimum of about 5 -6 years' consistent traffic data is required for establishing a reliable past trend.

5.5 Other Factors Influencing Growth

There are many factors which have impact on traffic growth. As discussed previously these factors can be economical, social, educational, and industrial.

Potentiality of such factors for project highway is discussed as under.

ECONOMY

After witnessing a slowdown during 2011-12, the economy recovered in 2013-14, and a high growth rate of GDP was recorded in up to 2018-19. Pandemic of COVID-19 impacted all economies of world including India. Following figure show trend of GDP growth in India.

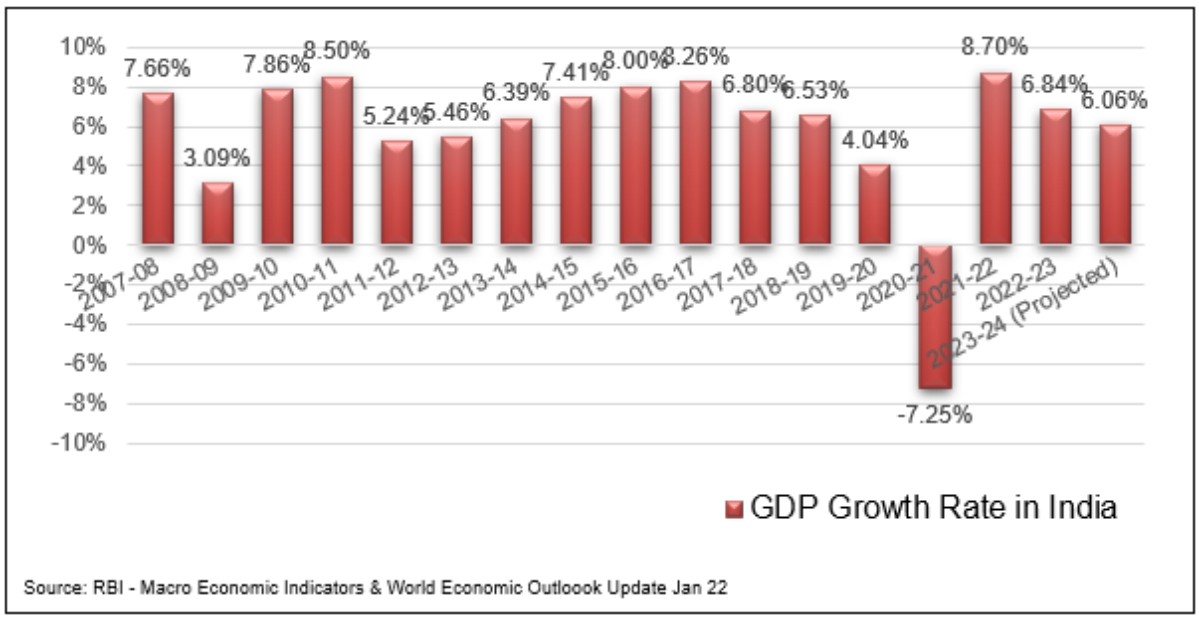


Figure 5-13 : Growth of GDP in India

FY 2017-18 recorded a growth of 6.7% which had slight impact of GST and demonetization. Indian economy appears on recovery path with estimated growth of 6.8% in FY 2018-19. Government took major policy decision including tax infrastructure reforming, banking sector improvement and ease of doing business.

Major economies of world collapsed due to pandemic COVID-19 including India. Indian economy is also registered negative growth in financial year 2020-21. After that Indian economy recovered handsomely and registered a growth of about 9% in Year 2021-22. This was partly due to low base of year 2020-21 as well.

Honorable Prime Minister has announced a major relief package of Rs. 20 lakh crores which is about 10% of GDP. This is aimed at turning this major crisis of COVID-19 into opportunity by providing major impetus to industrial production to the limit of becoming a self-reliant economy. With major thrust of this package being on **Make -In- India** it is expected that industry in India would grow at rapid pace and recover handsomely in post COVID-19 scenario. World Economic Outlook update also has predicted a growth rate of about 7.5 % in year 2022-23.

5.6 Developments along and around the Project Corridor & State

Aurangabad: is the fifth largest city in Maharashtra. It lies on a major trade route that used to connect north-west India's sea and land ports to the Deccan region. Aurangabad is administrative headquarters of the Aurangabad Division or Marathwada region.

Beed: Agriculture is the main business in Beed, and it is largely dependent on monsoon rain. Beed also is a district which provides a large number of laborers in India specially in the form of sugarcane cutters.

Jalna: is connected to major towns of the state by state highways. Road connectivity is excellent, roads connecting to Aurangabad, Pune, Ahmednagar, Nagpur, Beed, Mumbai having been upgraded to four-lane highways. A New Nagpur-Aurangabad-Mumbai highway, passing through Jalna, is being developed. There are various cotton-ginning & oil-pressing factories in Jalna.

Until 1960 Aurangabad was a undeveloped city and industrially backward area. After 1960 Growth began when the Maharashtra Industrial Development Corporation (MIDC) began acquiring land and setting up industrial estates. Aurangabad is a now

classic example of efforts of a state government towards the balanced industrialisation of the state. Major Industrial areas of Aurangabad are Chikhalthana MIDC, Shendra MIDC and Waluj MIDC. Many of the large India and multinational firms have established themselves in Industrial areas of Shendra, Waluj, Paithan.

Some of the big names include Audi, Skoda, Videocon, Siemens, Bajaj, Forbes, Goodyear, Wockhardt, Johnson & Johnson, Kenstar which have set up their production houses in Industrial areas of Aurangabad.

DMIC

Delhi Mumbai Industrial Corridor (DMIC) which is passing close to PIA envisaged to influence the pattern of development and industrialization of the region. To tap the development potential of the proposed freight corridor, an area spanning 150 kilometers wide on both sides of the freight corridor has been identified as Influence Region and is proposed to be developed as Delhi-Mumbai Industrial Corridor (DMIC). One of the Nashik Sinnar Igatpuri Investment Region's identified early bird projects is an industrial area comprising of total 40 sq. km to be developed into two parts one of 8 sq. km in Shendra and other with an area of 32 sq. km at Bidkin some 24 km from Aurangabad on the Paithan road.

The Aurangabad Industrial City (AURIC) Bidkin Industrial Area (BIA) is strategically positioned and directly connected to the major state highways which are Paithan Road, NH-211 and SH-178 (Jalna Road). Nearest major city is Aurangabad which is served by NH-211, Major State Highway (MSH) 6 and MSH-8, and SH-16, SH-60 and SH-148.

Considering the scenario, it may be assumed that the traffic growth on project highway would remain high and there are minimal risks in terms of growth.

5.7 Recommended Growth Rates of Traffic

Based on the above analysis and after giving due consideration to the entire listed factors, the following overall growth rates are recommended for each category of vehicle as under. Rate of growth is moderated in light of overall regional trend. Growth of Multi-Axle is kept slightly higher as trend of technological advances in logistic industry favors multi-axle over 2/3 axle carriage. It is also expected that as

the economy moves from developing to developed, rate of growth diminishes. Same growth rate is not sustainable for long. Traffic growth has been suitably stepped down for future years.

Growth rates are recommended for three scenarios for sensitivity analysis namely **Optimistic, Pessimistic** and **Most Likely** with a positive and negative variation 0.25% from Most Likely case for corridor in both states.

5.7.1 Recommended Growth Rates of Traffic for Maharashtra Part of Stretch

Table 5-21 : Recommended Growth Rates Optimistic

Category / Year	2021-2025	2025-2030	2031-2035	2036-2040	2041-2045
Car/Jeep/Van	9.46%	7.71%	7.08%	6.77%	6.72%
Bus	6.00%	4.79%	4.27%	4.01%	4.01%
Minibus	6.00%	4.79%	4.27%	4.01%	4.01%
LCV	5.98%	4.10%	3.41%	3.07%	3.00%
2- Axle	4.92%	3.69%	3.17%	2.91%	2.86%
3 - Axle	6.19%	4.75%	4.05%	3.71%	3.65%
4 to6 Axle	6.82%	4.75%	4.05%	3.71%	3.65%
7 and Above Axle	6.82%	4.75%	4.05%	3.71%	3.65%

Table 5-22 : Recommended Growth Rates Pessimistic

Category / Year	2021-2025	2025-2030	2031-2035	2036-2040	2041-2045
Car/Jeep/Van	8.96%	7.21%	6.58%	6.27%	6.22%
Bus	5.50%	4.29%	3.77%	3.51%	3.51%
Minibus	5.48%	3.60%	2.91%	2.57%	2.50%
LCV	4.42%	3.19%	2.67%	2.41%	2.36%
2- Axle	5.69%	4.25%	3.55%	3.21%	3.15%
3 - Axle	6.32%	4.25%	3.55%	3.21%	3.15%
4 to6 Axle	6.32%	4.25%	3.55%	3.21%	3.15%
7 and Above Axle	6.32%	4.25%	3.55%	3.21%	3.15%

Table 5-23 : Recommended Growth Rates Most Likely

Category / Year	2021-2025	2025-2030	2031-2035	2036-2040	2041-2045
Car/Jeep/Van	9.21%	7.46%	6.83%	6.52%	6.47%
Bus	5.75%	4.54%	4.02%	3.76%	3.76%
Minibus	5.75%	4.54%	4.02%	3.76%	3.76%
LCV	5.73%	3.85%	3.16%	2.82%	2.75%
2- Axle	4.67%	3.44%	2.92%	2.66%	2.61%
3 - Axle	5.94%	4.50%	3.80%	3.46%	3.40%
4 to6 Axle	6.57%	4.50%	3.80%	3.46%	3.40%
7 and Above Axle	6.57%	4.50%	3.80%	3.46%	3.40%

Traffic and revenue has been worked out on the basis of above growths and same is presented in subsequent chapter of report.

5.8 COVID -19 Impact

All All social and economic activities had been completely disrupted due worldwide pandemic of Corona Virus. This had affected traffic on project stretch as well. Traffic was severely affected form March-2020 due to lockdown and then in second wave and third waves.

Government has announced a mega economic stimulate and package of Rs. 20 Lakh Crore to bring the economy back on track and recover the losses. Traffic has shown impressive recovery post lockdown period and has recovered to normal level.

Taking recommended traffic growth and additional factors as discussed above into consideration traffic forecast for concession period is done and presented in next chapter.

CHAPTER 6

TRAFFIC FORECAST

6.1 Traffic Projections

Growth rates recommended in previous section of report are used to arrive at traffic projections for future years. Toll plaza wise futuristic traffic projection is given in tables below.

These projections have been done for following three cases of growth up to concession period

1. Optimistic Scenario
2. Pessimistic Scenario
3. Most Likely Scenario

Table 6-1 : Total Tollable Traffic @ Toll Plaza 1- Chainage 134.000 KM (Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	3134	337	228	1037	1026	2311	34	8107	21065
2024-25	3431	356	242	1088	1090	2468	36	8711	22493
2025-26	3696	370	253	1128	1142	2585	38	9212	23624
2026-27	3980	385	265	1170	1196	2708	40	9744	24817
2027-28	4286	400	277	1213	1253	2836	42	10307	26066
2028-29	4616	416	291	1258	1312	2970	44	10907	27386
2029-30	4971	433	305	1304	1375	3110	46	11544	28775
2030-31	5322	447	318	1346	1431	3236	48	12148	30056
2031-32	5698	462	332	1389	1489	3367	50	12787	31398
2032-33	6101	477	346	1433	1549	3503	52	13461	32798
2033-34	6533	493	361	1478	1612	3644	54	14175	34267
2034-35	6996	510	376	1524	1677	3792	56	14931	35808
2035-36	7470	525	391	1568	1739	3932	58	15683	37307
2036-37	7975	540	406	1613	1804	4078	60	16476	38875

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2037-38	8514	556	422	1660	1871	4230	62	17315	40521
2038-39	9090	573	439	1708	1940	4387	64	18201	42240
2039-40	9705	591	457	1758	2011	4550	66	19138	44042
2040-41	10357	609	475	1809	2085	4716	68	20119	45906
2041-42	11053	627	494	1861	2161	4888	70	21154	47853
2042-43	11795	646	513	1914	2240	5066	72	22246	49886
2043-44	12587	665	534	1969	2321	5250	75	23401	52019

Table 6-2 : Total Tollable Traffic @ Toll Plaza 2- Chainage 194.000 KM (Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	5973	478	507	1216	1188	2447	31	11840	26574
2024-25	6537	506	537	1276	1261	2614	33	12764	28430
2025-26	7041	527	562	1323	1321	2738	34	13546	29924
2026-27	7583	548	588	1372	1384	2868	36	14379	31505
2027-28	8168	571	615	1422	1450	3004	38	15268	33175
2028-29	8797	595	644	1475	1519	3146	40	16216	34941
2029-30	9475	619	675	1529	1591	3295	42	17226	36805
2030-31	10146	640	704	1577	1656	3428	44	18195	38541
2031-32	10863	662	734	1627	1724	3566	46	19222	40365
2032-33	11631	685	765	1678	1794	3711	48	20312	42285
2033-34	12454	709	797	1731	1866	3861	50	21468	44299
2034-35	13335	733	830	1786	1941	4017	52	22694	46416
2035-36	14238	756	863	1838	2013	4166	54	23928	48504
2036-37	15202	779	897	1892	2087	4320	56	25233	50691
2037-38	16231	803	933	1947	2165	4480	58	26617	52992
2038-39	17329	827	970	2003	2246	4646	60	28081	55404
2039-40	18502	852	1008	2061	2329	4818	62	29632	57934
2040-41	19745	877	1048	2119	2414	4994	64	31261	60565
2041-42	21072	903	1090	2180	2501	5176	66	32988	63329
2042-43	22487	930	1133	2242	2593	5365	68	34818	66235

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2043-44	23997	957	1178	2306	2688	5560	70	36756	69284

Table 6-3 : Total Tollable Traffic @ Toll Plaza 3- Chainage 254.000 KM

(Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	5163	313	362	936	894	2044	25	9737	21519
2024-25	5651	332	383	982	950	2183	27	10508	23039
2025-26	6087	345	401	1018	995	2287	28	11161	24264
2026-27	6557	359	420	1056	1042	2396	29	11859	25562
2027-28	7062	373	440	1095	1091	2510	30	12601	26930
2028-29	7605	388	461	1135	1142	2629	31	13391	28371
2029-30	8191	404	483	1176	1197	2753	32	14236	29898
2030-31	8770	417	503	1213	1246	2864	33	15046	31318
2031-32	9390	431	524	1251	1296	2980	34	15906	32813
2032-33	10054	445	546	1290	1349	3100	35	16819	34384
2033-34	10765	460	570	1330	1404	3225	36	17790	36042
2034-35	11527	476	595	1372	1461	3356	37	18824	37794
2035-36	12307	490	619	1412	1516	3480	38	19862	39514
2036-37	13139	505	644	1453	1572	3610	39	20962	41324
2037-38	14028	521	670	1495	1630	3744	40	22128	43223
2038-39	14978	537	697	1539	1690	3883	41	23365	45220
2039-40	15991	553	725	1584	1752	4027	42	24674	47314
2040-41	17065	569	754	1629	1816	4174	43	26050	49492
2041-42	18210	586	785	1675	1882	4326	44	27508	51780
2042-43	19434	603	817	1723	1950	4483	46	29056	54189
2043-44	20739	620	850	1772	2021	4646	48	30696	56721

Table 6-4 : Total Tollable Traffic @ Toll Plaza 1- Chainage 134.000 KM
(Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	3119	335	226	1032	1022	2300	33	8067	20960

2024-25	3398	353	238	1077	1080	2446	35	8627	22277
2025-26	3642	366	248	1111	1126	2550	36	9079	23283
2026-27	3904	379	259	1146	1173	2659	37	9557	24339
2027-28	4186	392	270	1182	1222	2772	38	10062	25441
2028-29	4487	406	281	1219	1274	2890	40	10597	26603
2029-30	4810	420	293	1257	1328	3013	42	11163	27822
2030-31	5126	432	304	1291	1375	3120	43	11691	28918
2031-32	5462	445	315	1325	1423	3231	44	12245	30056
2032-33	5820	458	327	1360	1473	3346	45	12829	31247
2033-34	6202	471	339	1396	1526	3465	47	13446	32496
2034-35	6609	484	351	1433	1580	3588	49	14094	33794
2035-36	7023	497	363	1468	1630	3703	51	14735	35045
2036-37	7464	510	375	1503	1683	3822	53	15410	36350
2037-38	7931	523	389	1539	1737	3944	55	16118	37706
2038-39	8428	536	403	1576	1793	4070	57	16863	39120
2039-40	8956	550	417	1614	1850	4200	59	17646	40590
2040-41	9512	564	432	1652	1908	4332	61	18461	42103
2041-42	10103	578	447	1691	1968	4468	63	19318	43678
2042-43	10731	592	462	1730	2029	4609	65	20218	45315
2043-44	11398	606	478	1771	2093	4754	67	21167	47028

Table 6-5 : Total Tollable Traffic @ Toll Plaza 2- Chainage 194.000 KM (Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	5947	477	505	1210	1183	2435	31	11788	26454
2024-25	6479	503	532	1264	1251	2590	33	12652	28178
2025-26	6945	521	555	1305	1304	2699	34	13363	29517
2026-27	7446	540	579	1347	1360	2814	35	14121	30935
2027-28	7983	560	604	1390	1418	2934	36	14925	32424
2028-29	8558	581	630	1435	1478	3058	37	15777	33986
2029-30	9175	602	656	1481	1541	3188	38	16681	35629
2030-31	9778	620	681	1521	1596	3301	39	17536	37132
2031-32	10421	638	706	1562	1653	3418	40	18438	38702
2032-33	11106	657	732	1604	1712	3539	41	19391	40346
2033-34	11837	677	759	1647	1772	3664	42	20398	42064
2034-35	12614	697	787	1692	1835	3794	43	21462	43868
2035-36	13405	715	814	1733	1894	3916	44	22521	45621
2036-37	14245	733	842	1775	1954	4041	45	23635	47445
2037-38	15138	752	872	1818	2017	4170	46	24813	49359
2038-39	16087	772	903	1862	2082	4303	47	26056	51361
2039-40	17094	792	935	1907	2149	4440	48	27365	53451
2040-41	18156	812	967	1953	2217	4579	49	28733	55611
2041-42	19284	833	1000	1999	2287	4723	50	30176	57870
2042-43	20484	854	1034	2046	2359	4872	52	31701	60240
2043-44	21758	875	1070	2094	2433	5025	54	33309	62717

Table 6-6 : Total Tollable Traffic @ Toll Plaza 3- Chainage 254.000 KM (Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	5139	312	361	933	889	2035	25	9694	21426
2024-25	5600	329	381	974	939	2164	26	10413	22831
2025-26	6004	341	398	1005	979	2256	27	11010	23935
2026-27	6437	353	415	1037	1021	2352	28	11643	25096
2027-28	6901	366	433	1070	1065	2452	29	12316	26319
2028-29	7398	379	452	1104	1111	2556	30	13030	27605
2029-30	7930	392	471	1140	1158	2665	31	13787	28957
2030-31	8451	403	489	1170	1200	2760	32	14505	30197
2031-32	9006	415	507	1201	1243	2858	33	15263	31491
2032-33	9598	427	526	1233	1288	2960	34	16066	32853
2033-34	10229	439	546	1265	1334	3065	35	16913	34273
2034-35	10902	452	566	1298	1381	3174	36	17809	35760
2035-36	11585	464	586	1329	1426	3276	37	18703	37213
2036-37	12312	476	606	1361	1472	3381	38	19646	38729
2037-38	13084	488	627	1393	1519	3489	39	20639	40309
2038-39	13904	501	649	1426	1568	3601	40	21689	41969
2039-40	14774	514	672	1460	1618	3716	41	22795	43702
2040-41	15694	527	696	1494	1669	3833	42	23955	45499
2041-42	16669	540	721	1530	1722	3953	43	25178	47380
2042-43	17705	553	746	1566	1776	4078	44	26468	49348
2043-44	18806	566	772	1603	1832	4207	45	27831	51410

Traffic projections for Most Likely scenario are given as under

Table 6-7 : Total Tollable Traffic @ Toll Plaza 1- Chainage 134.000 KM (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	3126	335	227	1034	1024	2306	34	8086	21014
2024-25	3414	354	240	1082	1084	2458	36	8668	22386
2025-26	3667	367	251	1119	1132	2569	38	9143	23455
2026-27	3940	381	262	1157	1182	2685	40	9647	24577
2027-28	4233	395	274	1196	1235	2806	42	10181	25757
2028-29	4548	410	286	1237	1290	2932	44	10747	26994
2029-30	4887	425	299	1280	1348	3064	46	11349	28301
2030-31	5221	438	311	1317	1399	3181	48	11915	29490
2031-32	5577	452	323	1355	1452	3302	50	12511	30729

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2032-33	5957	466	336	1394	1507	3427	52	13139	32023
2033-34	6363	480	350	1434	1564	3557	54	13802	33377
2034-35	6798	495	364	1476	1623	3692	56	14504	34796
2035-36	7241	509	378	1515	1679	3820	58	15200	36172
2036-37	7713	523	392	1555	1737	3952	60	15932	37604
2037-38	8215	537	407	1597	1797	4088	62	16703	39099
2038-39	8750	552	422	1640	1859	4229	64	17516	40660
2039-40	9320	567	437	1684	1924	4376	66	18374	42295
2040-41	9923	582	454	1728	1989	4525	68	19269	43978
2041-42	10565	597	471	1773	2056	4679	70	20211	45731
2042-43	11248	613	489	1819	2126	4838	72	21205	47565
2043-44	11975	630	507	1866	2198	5002	74	22252	49475

Table 6-8 : Total Tollable Traffic @ Toll Plaza 2- Chainage 194.000 KM (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	5960	477	506	1213	1185	2441	31	11813	26512
2024-25	6507	504	535	1269	1255	2602	33	12705	28298
2025-26	6992	524	559	1313	1312	2719	34	13453	29719
2026-27	7513	545	584	1359	1371	2841	35	14248	31215
2027-28	8073	566	610	1406	1432	2968	36	15091	32784
2028-29	8675	588	637	1454	1496	3101	38	15989	34444
2029-30	9323	611	666	1504	1564	3240	40	16948	36202
2030-31	9959	631	692	1549	1623	3363	41	17858	37816
2031-32	10639	651	719	1595	1684	3491	42	18821	39508
2032-33	11365	672	748	1642	1748	3623	44	19842	41289
2033-34	12140	693	778	1690	1815	3760	46	20922	43156
2034-35	12969	715	809	1739	1884	3902	48	22066	45113
2035-36	13813	736	839	1786	1949	4037	50	23210	47031
2036-37	14713	757	870	1834	2017	4176	52	24419	49038
2037-38	15672	778	902	1883	2087	4320	54	25696	51138
2038-39	16692	800	935	1933	2159	4470	56	27045	53340
2039-40	17780	823	970	1984	2233	4625	58	28473	55649
2040-41	18930	846	1006	2036	2308	4782	60	29968	58038
2041-42	20154	869	1043	2089	2387	4944	62	31548	60542
2042-43	21457	893	1082	2143	2468	5111	64	33218	63163
2043-44	22844	917	1122	2199	2552	5284	66	34984	65914

Table 6-9 : Total Tollable Traffic @ Toll Plaza 3- Chainage 254.000 KM (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	5151	312	361	934	891	2039	25	9713	21465
2024-25	5626	329	381	978	945	2173	27	10459	22932
2025-26	6046	342	399	1011	988	2271	28	11085	24099
2026-27	6498	355	417	1046	1033	2373	29	11751	25328
2027-28	6982	368	436	1082	1080	2480	30	12458	26623
2028-29	7502	382	456	1119	1129	2591	31	13210	27986
2029-30	8062	396	476	1157	1180	2707	32	14010	29421
2030-31	8612	409	495	1190	1225	2810	33	14774	30749
2031-32	9200	422	515	1225	1272	2917	34	15585	32149
2032-33	9827	435	535	1261	1320	3028	35	16441	33611
2033-34	10498	448	556	1298	1370	3143	36	17349	35148
2034-35	11215	462	578	1336	1422	3262	37	18312	36762
2035-36	11946	475	599	1372	1471	3375	38	19276	38343
2036-37	12725	488	621	1409	1522	3492	39	20296	40003
2037-38	13554	501	645	1446	1574	3612	40	21372	41735
2038-39	14437	515	669	1484	1629	3737	41	22512	43557
2039-40	15378	529	694	1523	1686	3867	42	23719	45471
2040-41	16372	543	720	1562	1743	3999	43	24982	47451
2041-42	17431	557	747	1602	1802	4135	44	26318	49525
2042-43	18558	573	775	1644	1863	4276	45	27734	51708
2043-44	19759	589	804	1687	1926	4421	46	29232	53995

6.2 Modification in Concession Period

As per Article 29 of the concession agreement, if actual traffic on the project falls short or exceeds Target Traffic on project highway on defined date, concession period shall be modified subject to calculation stipulated therein. For Yedeshi – Aurangabad project, the Target Date and Target Traffic are defined as under:

Target Date - 1st October 2023

Target Traffic -24407 in PCU

It was observed that as per traffic projections, average traffic volume falls short of target traffic in all scenarios. Probable extension of concession period is estimated according to article 29 of concession agreement which comes to about 4-5 years Traffic forecast and revenue projections are done for probable extended period accordingly.

Most Likely

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2023	24407	23030	-6%	8%	8%	26	2.2

Optimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2023	24407	23087	-5%	8%	8%	26	2.1

Pessimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2023	24407	22976	-6%	9%	9%	26	2.3

CHAPTER 7

FORECAST OF TOLL REVENUE

7.1 General

This chapter presents the tolling rate calculations, categories and toll revenue of the project.

7.2 Discount Categories

The fee schedule in the CA of Surat- Dahisar section of NH-8 is based on the old toll policy. As per the Toll Notification (Schedule - G) the discounts and special provisions have been considered. In addition to discounts as per Fee Notification concessionaire has declared special category rates also. Salient features of toll rate structure are given as under

1. Monthly Pass: For frequent users monthly pass would be issued at fee at 2/3rd rate for 50 single journey trips.
2. Multiple Journeys (for Return Trip): Will be charged at 1.5 times single journey.
3. Single Journey: Full single journey toll would be charged to this category of vehicles who are infrequent travellers or whose frequency does not yield any discount from the above categories.
4. Local Discounts: There are several categories of local discounts.
    a) Local Car Jeep Van - Rs. 275 per month (for locals residing within a radius of 20 kms from toll plaza)

Building of inflation and escalation of rate on the basis of WPI are done as per toll notification (Schedule G) as given under as extract from concession agreement.

The formula for determining the applicable rate of fee shall be as follows:-

$$\text{Applicable rate of fee} = \text{base rate} + \text{base rate} \times \left\{ \frac{\text{WPI A-WPI B}}{\text{WPI B}} \right\} \times 0.4$$

Factor of inflation / growth has been incorporated as per Schedule R. WPI numbers (2011-12 series) are available up to 2018-19. A moderate growth in Wholesale Price Index (WPI) has been assumed after that. The following graph provides historical rate of inflation (WPI) in India. Data has been sourced from the Office of Economic Advisor web site (www.eaindustry.nic.in) WPI for year 2017-18 and 2018-2019 is worked back by applying a correlation factor for 2004-05 series as 2017-18 and 2018-2019 data is available in 2011-12 series only. Ratio of WPI for year 2016-17 for both series is used for conversion of WPI in 2004-05 series

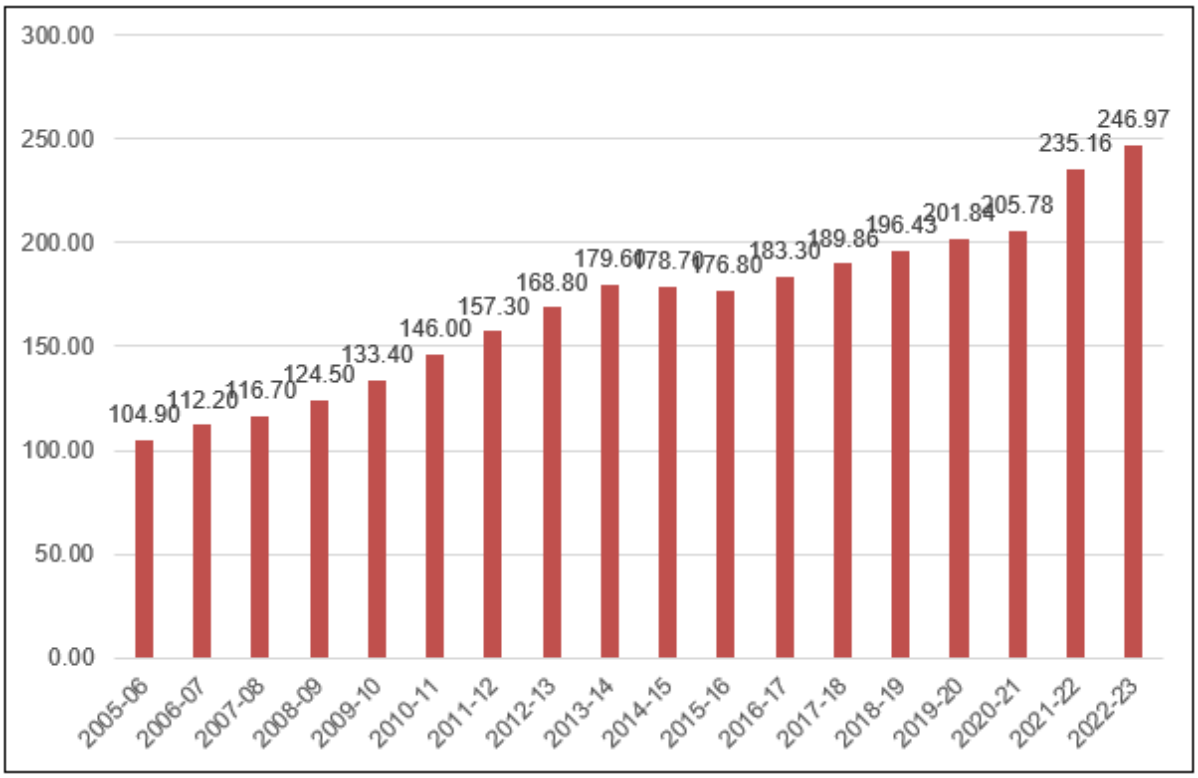


Figure 7-1 : Historical Rate of WPI Inflation in India

Average inflation in WPI in last few years is steadily growing. It grew in range of 4% - 5% in previous years. For future years initially it is takes 5% and Suitably Stepped down for future years.

7.3 Estimation of Toll Rates

As per the applicable MORTH notification and Schedule R of contract agreement, the following Base rate of fee for the categories mentioned in the table stands true in the National Highways Fee Rules applicable for contract.

Table 7-1 : Base Toll Rates June 2007-08

Type of Vehicle	Base Rate of Fee / Km (in Rs.)
Car, Jeep, Van or Light Motor Vehicle	0.65
Light Commercial Vehicle, Light Goods Vehicle or Minibus	1.05
Bus or Truck (Two Axles)	2.20
Three Axle Commercial Vehicles	2.40
Heavy Construction Machinery (HCM) or Earth Moving Equipment (EME) or Multi Axle Vehicle (MAV) (4 to 6 axles)	3.45
Oversized Vehicles (7 or more Axles)	4.20

Toll rates are calculated as per guidelines provided in schedule R (rounded to nearest Rs. five) for the concession period and are given below. Since applicable length of highway length is equal for both plazas, applicable toll rates are also same

Thus, worked out rates for various categories of vehicle and discounts are given as under.

Table 7-2 : Toll Rates for Single Journey @ Km 134.000

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	80	125	265	265	285
2024-25	80	130	275	275	300
2025-26	85	140	290	290	315
2026-27	90	145	305	305	335
2027-28	95	155	320	320	350
2028-29	100	160	335	335	365
2029-30	105	170	350	350	385
2030-31	110	175	370	370	400
2031-32	115	185	385	385	420
2032-33	120	195	405	405	440
2033-34	125	205	425	425	465
2034-35	130	215	445	445	485
2035-36	140	225	470	470	510
2036-37	145	235	490	490	535
2037-38	150	245	515	515	560
2038-39	160	260	540	540	590

2039-40	170	270	565	565	620
2040-41	175	285	595	595	650
2041-42	185	300	625	625	680
2042-43	195	315	655	655	715
2043-44	205	330	690	690	750

Table 7-3 : Toll Rates for Single Journey @ Km 194.000

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	110	175	365	365	395
2024-25	115	185	385	385	415
2025-26	120	190	400	400	440
2026-27	125	200	425	425	460
2027-28	130	210	445	445	485
2028-29	135	220	465	465	505
2029-30	145	230	485	485	530
2030-31	150	245	510	510	555
2031-32	160	255	535	535	585
2032-33	165	270	560	560	610
2033-34	175	280	590	590	640
2034-35	180	295	615	615	675
2035-36	190	310	645	645	705
2036-37	200	325	680	680	740
2037-38	210	340	715	715	775
2038-39	220	355	750	750	815
2039-40	230	375	785	785	855
2040-41	245	395	825	825	900
2041-42	255	415	865	865	945
2042-43	270	435	910	910	990
2043-44	280	455	955	955	1040

Table 7-4 : Toll Rates for Single Journey @ Km 243.00

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	105	170	355	355	390
2024-25	110	180	375	375	410
2025-26	115	190	395	395	430
2026-27	120	195	415	415	450
2027-28	130	205	435	435	475
2028-29	135	215	455	455	495

2029-30	140	225	475	475	520
2030-31	145	240	500	500	545
2031-32	155	250	525	525	570
2032-33	160	260	550	550	600
2033-34	170	275	575	575	630
2034-35	180	290	605	605	660
2035-36	185	300	635	635	690
2036-37	195	315	665	665	725
2037-38	205	335	695	695	760
2038-39	215	350	730	730	800
2039-40	225	365	765	765	835
2040-41	240	385	805	805	880
2041-42	250	405	845	845	925
2042-43	260	425	890	890	970
2043-44	275	445	930	930	1015

Table 7-5 : Toll Rates for Return Journey @ Km 134.000

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	115	190	395	395	430
2024-25	125	200	415	415	455
2025-26	130	210	435	435	475
2026-27	135	220	460	460	500
2027-28	140	230	480	480	525
2028-29	150	240	505	505	550
2029-30	155	250	530	530	575
2030-31	165	265	555	555	605
2031-32	170	275	580	580	635
2032-33	180	290	610	610	665
2033-34	190	305	640	640	695
2034-35	200	320	670	670	730
2035-36	205	335	700	700	765
2036-37	220	350	735	735	805
2037-38	230	370	775	775	845
2038-39	240	385	810	810	885
2039-40	250	405	850	850	930
2040-41	265	425	895	895	975
2041-42	275	450	940	940	1025
2042-43	290	470	985	985	1075
2043-44	305	495	1035	1035	1130

Table 7-6 : Toll Rates for Return journey @ Km 194.000

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	160	260	545	545	595
2024-25	170	275	575	575	625
2025-26	180	290	605	605	660
2026-27	185	305	635	635	690
2027-28	195	315	665	665	725
2028-29	205	330	695	695	760
2029-30	215	350	730	730	795
2030-31	225	365	765	765	835
2031-32	235	385	805	805	875
2032-33	250	400	840	840	920
2033-34	260	420	885	885	965
2034-35	275	440	925	925	1010
2035-36	285	465	970	970	1060
2036-37	300	485	1020	1020	1110
2037-38	315	510	1070	1070	1165
2038-39	330	535	1120	1120	1225
2039-40	350	560	1175	1175	1285
2040-41	365	590	1235	1235	1350
2041-42	385	620	1295	1295	1415
2042-43	400	650	1360	1360	1485
2043-44	425	685	1430	1430	1560

Table 7-7 : Toll Rates for Return journey @ Km 243.000

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	160	255	535	535	585
2024-25	165	270	560	560	610
2025-26	175	280	590	590	645
2026-27	185	295	620	620	675
2027-28	190	310	650	650	710
2028-29	200	325	680	680	745
2029-30	210	340	715	715	780
2030-31	220	355	750	750	815
2031-32	230	375	785	785	855
2032-33	245	395	825	825	900
2033-34	255	410	865	865	940
2034-35	265	430	905	905	985
2035-36	280	455	950	950	1035
2036-37	295	475	995	995	1085
2037-38	310	500	1045	1045	1140

2038-39	325	525	1095	1095	1195
2039-40	340	550	1150	1150	1255
2040-41	355	575	1210	1210	1320
2041-42	375	605	1270	1270	1385
2042-43	395	635	1330	1330	1455
2043-44	415	665	1400	1400	1525

Table 7-8 : Toll Rates for Monthly Pass Local@ all Toll Plaza

Year	Car	Mini Bus /LCV
2023-24	330	330
2024-25	345	345
2025-26	365	365
2026-27	385	385
2027-28	400	400
2028-29	420	420
2029-30	440	440
2030-31	460	460
2031-32	485	485
2032-33	510	510
2033-34	535	535
2034-35	560	560
2035-36	585	585
2036-37	615	615
2037-38	645	645
2038-39	680	680
2039-40	710	710
2040-41	745	745
2041-42	785	785
2042-43	825	825
2043-44	865	865

Table 7-9 : Toll Rates for Monthly Pass @ Km 134.000

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2023-24	2595	4190	8775	8775	9575
2024-25	2725	4400	9220	9220	10060
2025-26	2865	4625	9690	9690	10570
2026-27	3010	4860	10185	10185	11110
2027-28	3155	5095	10675	10675	11645
2028-29	3305	5340	11190	11190	12205
2029-30	3465	5600	11730	11730	12795
2030-31	3635	5870	12295	12295	13415
2031-32	3810	6155	12895	12895	14065

2032-33	3995	6455	13520	13520	14750
2033-34	4190	6765	14180	14180	15470
2034-35	4395	7100	14870	14870	16225
2035-36	4610	7445	15600	15600	17020
2036-37	4835	7810	16365	16365	17855
2037-38	5075	8195	17175	17175	18735
2038-39	5325	8600	18020	18020	19660
2039-40	5590	9025	18915	18915	20635
2040-41	5865	9475	19855	19855	21655
2041-42	6160	9945	20840	20840	22735
2042-43	6465	10445	21880	21880	23870
2043-44	6790	10965	22975	22975	25065

Table 7-10 : Toll Rates for Monthly Pass @ Km 194.000

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2023-24	3585	5795	12140	12140	13245
2024-25	3770	6090	12755	12755	13915
2025-26	3960	6400	13405	13405	14625
2026-27	4165	6725	14090	14090	15370
2027-28	4365	7050	14765	14765	16110
2028-29	4575	7385	15480	15480	16885
2029-30	4795	7745	16225	16225	17700
2030-31	5025	8120	17010	17010	18555
2031-32	5270	8510	17835	17835	19455
2032-33	5525	8925	18700	18700	20400
2033-34	5795	9360	19615	19615	21395
2034-35	6080	9820	20570	20570	22440
2035-36	6375	10300	21580	21580	23540
2036-37	6690	10805	22640	22640	24695
2037-38	7020	11335	23755	23755	25915
2038-39	7365	11895	24930	24930	27195
2039-40	7730	12485	26160	26160	28540
2040-41	8115	13105	27460	27460	29960
2041-42	8520	13760	28830	28830	31450
2042-43	8945	14445	30270	30270	33020
2043-44	9390	15170	31785	31785	34675

Table 7-11 : Toll Rates for Monthly Pass @ Km 243.000

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2023-24	3505	5665	11870	11870	12950
2024-25	3685	5955	12475	12475	13605
2025-26	3875	6255	13110	13110	14300
2026-27	4070	6575	13775	13775	15030

2027-28	4265	6890	14440	14440	15750
2028-29	4470	7225	15135	15135	16510
2029-30	4685	7570	15865	15865	17305
2030-31	4915	7940	16630	16630	18145
2031-32	5150	8325	17440	17440	19025
2032-33	5405	8725	18285	18285	19950
2033-34	5665	9155	19175	19175	20920
2034-35	5945	9600	20115	20115	21940
2035-36	6235	10070	21100	21100	23020
2036-37	6540	10565	22135	22135	24150
2037-38	6860	11085	23225	23225	25340
2038-39	7200	11635	24375	24375	26590
2039-40	7560	12210	25580	25580	27905
2040-41	7935	12815	26850	26850	29290
2041-42	8330	13455	28190	28190	30750
2042-43	8745	14125	29595	29595	32285
2043-44	9180	14830	31075	31075	33900

7.4 Toll Revenue

As indicated earlier, toll revenue on the Project Road has been calculated in all three scenarios based on above rates and projected traffic. The estimates of toll revenue under ***Optimistic***, ***Pessimistic*** and ***Most Likely*** growth scenarios are presented in the following section.

7.5 Toll Revenue at all toll plazas under Scenarios

Toll Revenue estimates under all scenarios at each of the toll plaza up to 2045-46 years starting from the year 2023-24 are shown in tables below.

Table 7-12 : Toll Revenue Optimistic Scenario

(Rs. Crores)

Year	TP-1	TP2	TP3	Total
2023-24	66.85	110.80	88.90	**266.56**
2024-25	74.39	124.39	99.20	**297.97**
2025-26	81.91	137.30	109.70	**328.91**
2026-27	90.68	151.64	121.45	**363.77**
2027-28	99.70	167.43	134.51	**401.64**
2028-29	109.57	183.86	147.45	**440.88**

Year	TP-1	TP2	TP3	Total
2029-30	120.57	203.10	162.52	**486.19**
2030-31	132.36	222.15	177.96	**532.47**
2031-32	144.59	244.94	196.28	**585.81**
2032-33	157.98	267.42	214.83	**640.24**
2033-34	172.96	293.87	235.70	**702.53**
2034-35	189.42	321.96	258.94	**770.32**
2035-36	207.89	352.49	284.15	**844.52**
2036-37	226.09	385.29	310.14	**921.52**
2037-38	246.89	422.31	340.30	**1009.49**
2038-39	270.23	462.35	372.35	**1104.94**
2039-40	295.96	507.70	409.06	**1212.71**
2040-41	322.28	555.34	448.16	**1325.77**
2041-42	351.79	608.29	490.77	**1450.85**
2042-43	384.99	666.89	537.56	**1589.44**
2043-44	422.05	732.83	591.64	**1746.52**

Table 7-13 : Toll Revenue Pessimistic Scenario

(Rs. Crores)

Year	TP-1	TP2	TP3	Total
2023-24	66.54	110.23	88.51	**265.28**
2024-25	73.71	123.14	98.30	**295.15**
2025-26	80.77	135.29	108.22	**324.28**
2026-27	88.97	148.75	119.22	**356.94**
2027-28	97.31	163.49	131.39	**392.19**
2028-29	106.39	178.69	143.34	**428.42**
2029-30	116.46	196.44	157.25	**470.15**
2030-31	127.18	213.85	171.37	**512.41**
2031-32	138.19	234.68	188.11	**560.97**
2032-33	150.21	255.04	204.95	**610.19**
2033-34	163.66	278.91	223.73	**666.30**
2034-35	178.34	304.14	244.60	**727.08**
2035-36	194.80	331.40	267.09	**793.30**
2036-37	210.86	360.51	290.14	**861.51**
2037-38	229.09	393.26	316.78	**939.14**
2038-39	249.54	428.47	344.98	**1022.99**
2039-40	271.96	468.11	377.17	**1117.24**
2040-41	294.69	509.54	411.30	**1215.54**
2041-42	320.20	555.35	448.22	**1323.77**
2042-43	348.81	605.97	488.61	**1443.39**
2043-44	380.56	662.77	535.17	**1578.50**

Table 7-14 : Toll Revenue Most Likely Scenario

(Rs. Crores)

Year	TP-1	TP2	TP3	Total
2023-24	66.71	110.47	88.69	**265.87**
2024-25	74.08	123.69	98.76	**296.53**
2025-26	81.38	136.22	108.96	**326.56**
2026-27	89.86	150.07	120.33	**360.26**
2027-28	98.54	165.28	132.92	**396.74**
2028-29	107.99	181.06	145.35	**434.41**
2029-30	118.58	199.56	159.86	**478.00**
2030-31	129.82	217.75	174.61	**522.19**
2031-32	141.42	239.48	192.10	**572.99**
2032-33	154.14	260.88	209.80	**624.81**
2033-34	168.37	286.01	229.62	**684.00**
2034-35	183.96	312.62	251.64	**748.23**
2035-36	201.46	341.52	275.46	**818.45**
2036-37	218.58	372.46	300.00	**891.04**
2037-38	238.10	407.31	328.37	**973.78**
2038-39	260.04	444.82	358.47	**1063.33**
2039-40	284.16	487.28	392.88	**1164.32**
2040-41	308.68	531.67	429.39	**1269.74**
2041-42	336.14	580.91	469.07	**1386.13**
2042-43	367.01	635.31	512.60	**1514.93**
2043-44	401.38	696.52	562.78	**1660.68**

CHAPTER 8
CONCLUSION & RECOMMENDATIONS

8.1 Conclusion & Recommendations

Project stretch of Yedeshi to Aurangabad section of NH-211 in state of Maharashtra from km 100.000 to km 290.200 is currently four lane road. The road is in sound condition and serves healthy traffic volumes. Project corridor is a part of the important regional network connecting Maharashtra with Karnataka and other southern states. There are large number of townships, industrial corridors and other business establishment coming up along project corridor. As discussed, dominant portion of traffic is long route traffic, which is more sensitive towards the growth of national economy. As Indian economy is poised to grow at 7%+ post COVID-19, the project corridor is expected to pick up the same trend in terms of traffic flow. All these developments have potential to give positive impact to traffic flow on project. The following can be considered as major outcomes of the study

a) There is good amount of tollable traffic running on project

b) Project corridor has potential to witness traffic growth @ 6-8% annually in near future due to various development in area and overall development of economy

c) Project corridor has committed traffic as long route traffic and does not run a risk of traffic leakage due to quality competing road

Based on above it can be considered a stable healthy project from traffic and revenue point of view.

GMD Consultants
503-504, Mayuresh Chambers Premises, Plot No. 60,
Sector -11, CBD Belapur, Navi Mumbai. 400 614.
Maharashtra.
Phone : +91-22-2756 4586 / 2756 5313
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

KAITHAL TO RAJASTHAN SECTION OF NH 152/65 (KM 33.250 TO KM 241.580) IN THE STATE OF HARYANA

TRAFFIC STUDY & REVENUE PROJECTION REPORT (FINAL)

APRIL 2023

GMD Consultants
503, Mayuresh Chambers, Plot No. 60, Sector -11,
CBD Belapur, Navi Mumbai. 400 614.
Maharashtra.
Phone : +91-22-2756 4586 / 2756 5313
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

KAITHAL TO RAJASTHAN SECTION OF NH-152/65

(KM 33.250 TO 241.580)

IN THE STATE OF HARYANA

TRAFFIC STUDY & REVENUE PROJECTION REPORT (FINAL)

APRIL 2023

GMD CONSULTANTS
NAVI MUMBAI

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AADT	-	Annual Average Daily Traffic	**NHAI**	-	National Highway Authority of India
BOT	-	Build Operate Transfer	**NHDP**	-	National Highways Development Project
CAGR	-	Compound Annual Growth Rate	**NSDP**	-	Net State Domestic Product
CTV	-	Classified traffic volume	**O&M**	-	Operation & Maintenance
DBFOT	-	Design, Build, Finance, Operate & Transfer	**PCDP**	-	Per Capita Domestic Product
EME	-	Earth Moving Equipment	**PCI**	-	Per Capita Income
GDP	-	Gross Domestic Product	**PCU**	-	Passenger Car Unit
GSDP	-	Gross State Domestic Product	**PSC**	-	Pre-stressed Concrete
HCM	-	Heavy Construction Machinery	**RCC**	-	Reinforced cement concrete
HCV	-	Heavy Commercial Vehicle	**RHS**	-	Right Hand Side
HTMS	-	Highway Traffic Management System	**SH**	-	State Highway
IRC	-	Indian Road Congress	**TP**	-	Toll Plaza
IRR	-	Internal Rate of Return	**WPI**	-	Wholesale Price Index
LCV	-	Light Commercial Vehicle	**SIR**	-	Special Investment Region
LHS	-	Left Hand Side	**c.**	-	Circa
LGV	-	Light Goods Vehicle	**ROB**	-	Railway Over Bridge
MAV	-	Multi Axle Vehicle	**MDR**	-	Major District Road
MORTH	-	Ministry of Road Transport and Highways	**ODR**	-	Other District Road
NH	-	National Highway	**CA**	-	Concession Agreement
PCC	-	Plain Cement Concrete	**RMT**	-	Running Meter
CR	-	Coarse Rubble			

CHAPTER 1

INTRODUCTION

1.1 Background

The Government of India through National Highway Authority of India (NHAI) embarked upon a program to enhance the traffic capacity and safety for efficient transportation of goods as well as passenger traffic on National Highway Sections under various NHDP Phases.

The project under consideration, Four Laning of **Kaithal** to **Rajasthan** section of NH-152/65 from km 33.250 to km 241.580 in the state of Haryana is one such road project NHAI intended to implement on a BOT basis in the DBFOT format. *M/s Kaithal Tollway Ltd*. (Concessionaire) has been awarded the Project for a concession period of 27 years starting from appointed date of 15th July 2015. COD was achieved for part length of project in September 2017 and Tolling Operation on Project started. Final COD for full length was achieved on 29th March-2019

Project road section from Kaithal to Rajasthan border is part of important corridor which connects part of Haryana, Punjab, Himachal Pradesh, J&K and certain part of Uttarakhand to Rajasthan, Gujarat and Costal parts of Maharashtra and then to down to south.

Project road section form Kaithal to Rajasthan border passes through three districts of Haryana namely Kaithal, Hisar and Bhiwani. Project road also passes through important towns and development areas of Narwana, Hisar and Siwani in addition to Kaithal

Following figure shows the project road alignment.

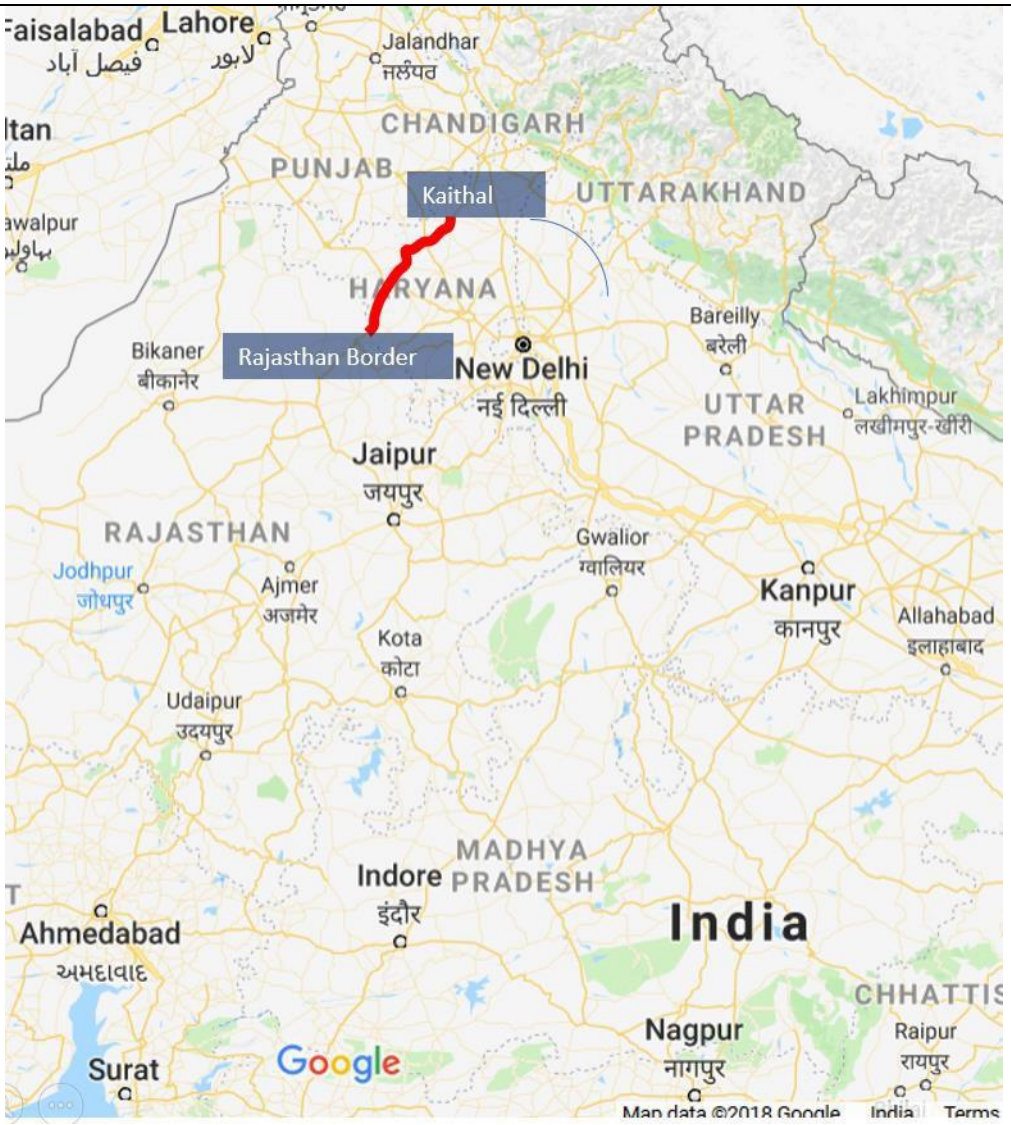


Figure 1-1 : Alignment of Project Stretch

1.2 Objective of the Study

M/s IRB INFRASTRUCTURE TRUST has engaged *GMD Consultants* to assess the future traffic and toll potential of project along with related operation & maintenance expenditure involved.

This report named as **"Traffic Study & *Toll Revenue Projection Report*"** mainly focuses on traffic and revenue aspects of the project. Other parameters like competing road, area developments etc. have been considered from a traffic development point of view.

1.2.1 Scope of Services

The broad scope of work covered in the assignment is as follows

a) Analysis of Traffic Growth

b) Toll Rate Growth

c) Revenue Forecasting

The Concessionaire has provided basic traffic data and other project details on the basis of which the above analysis has been carried out.

CHAPTER 2

PROJECT DETAILS

2.1 Project Corridor

The project road forms part of important connectivity between Northern states like Haryana,Punjab,Himachal Pradesh,J&K and states like Maharashtra,Gujarat (Kandla and Mundra),and parts of Rajasthan. It is the shortest route between Punjab / J&K, Gujarat, Rajasthan, Maharashtra, Goa, Kerala and becomes good alternate route to NH-1 and NH-8 for Gujarat, Rajasthan, Maharashtra Goa and Kerala bound traffic from Haryana, Punjab, J&K Himachal Pradesh.

Project road also caters to local intrastate traffic between districts of Ambala, Chandigarh, Kaithal, Jind, Hisar, Bhiwani in Haryana and Churu, Sikar, Nagaur and Jodhpur in Rajasthan.

2.2 Project Stretch Description

The Project Project highway from Kaithal to Rajasthan border from Km 33.250 to km 241.580 has been widened to four lanes as per schedules. The project has following bypasses which are part of project road.

Table 2-1 : Bypass Details

Sr. No	Bypass Name	Length	Toll Plaza
1	Kalyat	3.450	125.790
2	Dhanaudha	3.800	
3	Narwana	1.900	
4	Barwala	7.850	171.580
5	Hisar+Talwandi Rana		
6	Barwa	3.300	212.400
7	Siwani	6.150	

Full COD for project is achived on 29th March 2019.

Project road forms part of very important transportation corridor which connects Northern states like Haryana, Punjab, J&K, Himachal etc to Southern states and development centers especially on west coast line of India. In previous years project road from Ambala to onwards was in bad shape. There were large number of congestion points along the route in form of narrow roads inside towns, level crossings and bad riding quality. Project road from Kaithal to Rajasthan Border is almost complete which has taken up bypasses and ROBs. Also the road from Ambala to Kaithal is under four laning construction as of now. The project is awarded to M/s

Sadbhav Engineering Limited and is expected to complete in current year. This would improve the flow of traffic on project corridor to great extent

Following figure show project alignment and toll plaza locations.

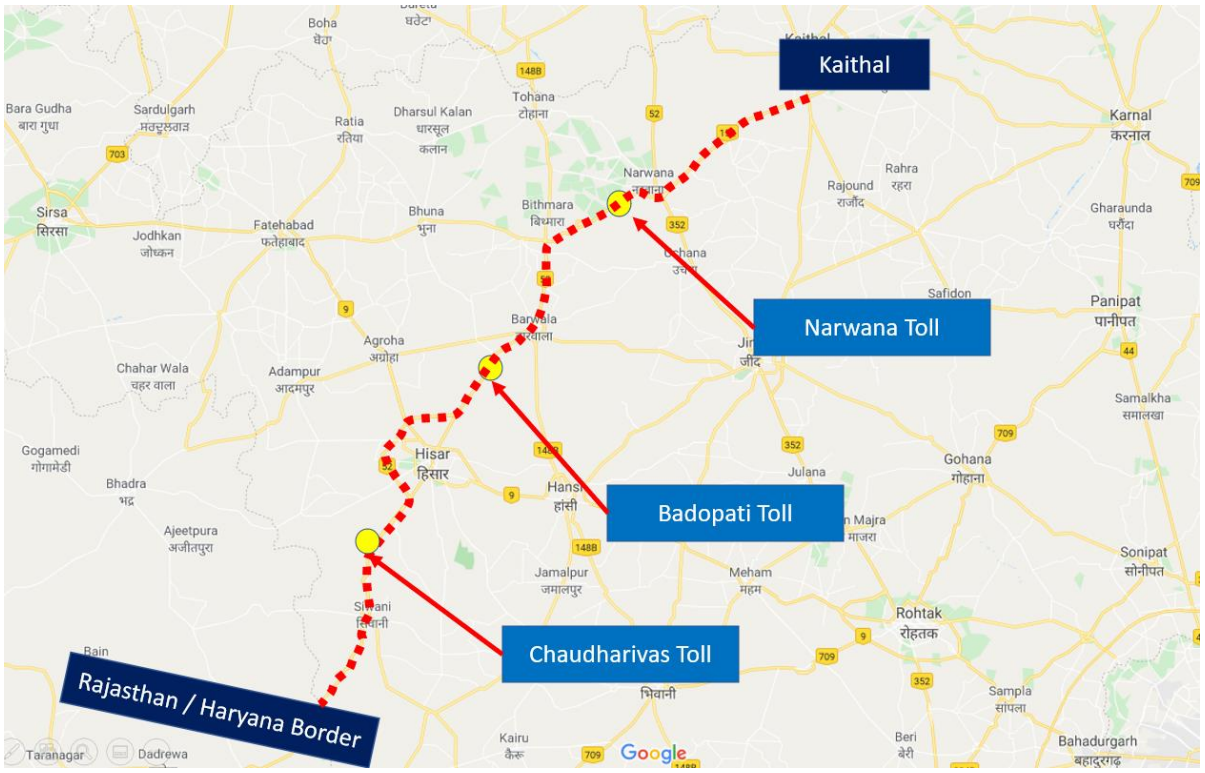


Figure 2-1 : Project Alignment with Toll Plaza

2.3 Project Corridor Illustration

Six laning of project stretch is complete. Following photographs illustrate project section along the corridor.

Figure 2-2 : Photographs showing Project Corridor

CHAPTER 3

TRAFFIC SURVEYS AND ANALYSIS

3.1 Traffic Surveys

The Consultants have collected the required information for project corridor to understand the general traffic and travel characteristics on the corridor.

The following traffic data has been collected from client for project.

- Classified traffic volume counts at three toll plaza locations on Kaithal-Rajasthan Border section of NH-152/65 for Year 2018-19,2019-20, 2020-21, 2021-22 & traffic data from April 2022 to March 2023.
- Local Component of traffic
- Component of Return Journey
- Component of Monthly Pass Journey

The main objective of the traffic data analysis is to:

- Determine the existing traffic movement characteristics of the project
- Establish base year traffic
- Identification of travel patterns and modal split of project traffic
- Deriving growth factors for traffic forecasting
- Estimation of corridor traffic including traffic diversion if any
- Preparation of revenue model and projection of revenue as per toll policy for various scenarios

Table 3-1 below lists provides details of locations from where traffic details have been collected.

Table 3-1 : Traffic Data Details

SR. NO	LOCATION	CTV	Single Journey Traffic	Daily Return Journey	Monthly Pass	Local Pass
1	Km 125 Toll Plaza at Narwana	AADT for Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23
2	Km 171 Toll Plaza at Badopatti	AADT for Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23
3	Km 212 Toll Plaza at Chaudhariwas	AADT for Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23

3.2 Classified traffic volume

The objective of conducting a Classified Traffic Volume Count is to understand the traffic flow pattern including modal split on a roadway. The Classified Traffic Volume Count survey has been provided by the concessionaire of project highway from actual traffic data gathered at toll plaza locations based on monthly data shared with NHAI.

The vehicles can broadly be classified into fast moving / motorized and slow moving / non-motorized vehicles, which can be further classified into specific categories of vehicles. The groupings of vehicles are further segregated to capture the tollable vehicle categories specifically and toll exempted vehicles are counted separately. The detailed vehicle classification system as per IRC: 64-1990 is given in table below

Table 3-2 : Vehicle Classification System

Vehicle Type	
Auto Rickshaw	
Passenger Car	Car, Jeep, Taxi & Van (Old / new technology)
Bus	Minibus
	Standard Bus
Truck	Light Goods Vehicle (LCV)
	2 – Axle Truck
	3 Axle Truck (HCV)
	Multi Axle Truck (4-6 Axle)
	Oversized Vehicles (7 or more axles)
Other Vehicles	Agriculture Tractor, Tractor & Trailer

Source - IRC: 64 – 1990

However, since project highway is currently under toll operation, the data collected is corresponding to category of tollable vehicles. Following are the type of vehicles as per concession agreement.

- Car / Jeep / van
- Min Bus /LCV
- Truck / Bus
- Multi Axle

3.3 Traffic Characteristic

Toll revenue of project highway does not solely depend on traffic volume. There are certain characteristics of traffic which have substantial potential to affect toll collection. Component of local traffic, component of passenger and commercial traffic, portion of return journey traffic, % of monthly pass traffic are some of such characteristics of traffic. These will be discussed in subsequent sections of report.

3.3.1 Traffic Data

Project concessionaire has provided Traffic data for base year 2019-20, 2020-21, 2021-22 and from April 2022 to March 2023 as under for both toll plazas–

Table 3-3 : Traffic Data at Narwana Toll Plaza at Km 125

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)- 2019-20	Annual Average Daily Traffic (Nos.)- 2020-21	Annual Average Daily Traffic (Nos.)- 2021-22	Annual Average Daily Traffic (Nos.)- 2022-23
1	CAR	2952	2657	4351	4094
2	Minibus/LCV	633	569	381	325
3	Bus	310	279	315	289
4	Truck	320	287	529	462
5	3-Axle	314	283	416	345
6	Multi Axle	771	694	1347	1343
7	Oversized Vehicles	5	5	20	47
	Total	**5305**	**4774**	**7357**	**6905**

Table 3-4 : Traffic Data at Badopatti Toll Plaza at Km 171

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)- 2019-20	Annual Average Daily Traffic (Nos.)- 2020-21	Annual Average Daily Traffic (Nos.)- 2021-22	Annual Average Daily Traffic (Nos.)- 2022-23
1	CAR	5387	4850	4915	4591
2	Minibus/LCV	630	567	374	331
3	Bus	431	387	395	384
4	Truck	327	295	577	503
5	3-Axle	376	339	505	400
6	Multi Axle	923	831	1522	1326
7	Oversized Vehicles	3	3	16	46
	Total	**8077**	**7272**	**8303**	**7581**

Table 3-5 : Traffic Data at Chaudhariwas Toll Plaza at Km 212

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)-2019-20	Annual Average Daily Traffic (Nos.)-2020-21	Annual Average Daily Traffic (Nos.)-2021-22	Annual Average Daily Traffic (Nos.)-2022-23
1	CAR	2947	2652	4371	4076
2	Minibus/LCV	592	532	335	335
3	Bus	162	147	181	159
4	Truck	367	331	629	522
5	3-Axle	470	423	630	537
6	Multi Axle	1395	1257	2121	1812
7	Oversized Vehicles	6	5	29	65
	Total	**5939**	**5347**	**8295**	**7506**

Pandemic of COVID-19 (Corona Virus) had impacted entire world. Taking precaution, government of India announced a complete lockdown in last of March 2020 and traffic on highways was stopped which was eased out progressively later. There after India was hit by Covid-19 second and third wave in February 21 to July -21 and December 21 to March-22. Recovering traffic pattern was somewhat again disturbed due to second and third wave of Covid-19. Traffic numbers of for period from April-2020 to March 2021 were not representative of traffic pattern at project corridor due to pandemic lockdown impact. However, for integrity of data same shown above. Traffic has almost recovered from Covid -19 impact as of now.

Since the traffic data is available year 2022-23 report has been updated taking this as base year traffic.

This data was then bifurcated to various components like through local, monthly, return journey etc. category. Same is discussed in detail in following section.

3.4 Data Analysis

3.4.1 Analysis of Traffic Volume Count

Understanding the character of existing traffic forms the basis of the traffic forecast. The various vehicle types having different sizes and characteristics can be converted into a single unit called Passenger Car Unit (PCU). Passenger Car equivalents for various vehicles are adopted based on recommendations of Indian Road Congress prescribed in “IRC-64-

1990: Guidelines for Capacity of Roads in Rural areas". The adopted passenger car unit values (PCU) are presented in ***Table 3-6.***

Table 3-6 : PCU Factors Adopted for Study

Vehicle Type	PCUs
Car	1.0
Mini Bus	1.5
Standard Bus	3.0
LCV/LGV	1.5
2 Axle Truck	3.0
3 – 6 Axle Truck	4.5
MAV	4.5
Auto Rickshaw	1.0
Van/Tempo	1.0
Agriculture Tractor with Trailer	4.5
Agriculture Tractor without Trailer	1.5

Source: IRC: 64-1990

Traffic volume at each toll plaza was converted to PCU and same is presented as under

Table 3-7 : Traffic in PCU at Project Stretch Base Year 2022-23

Year	Toll Plaza Location (Km)	Traffic No	PCU	PCU Index
2019-20	Narwana Km 125.79	5305	10226	1.93
	Badopatti Km 171.58	8077	13901	1.72
	Chaudhariwas Km 212.400	5939	13136	2.21
2020-21	Narwana Km 125.79	4774	9203	1.93
	Badopatti Km 171.58	7272	12516	1.72
	Chaudhariwas Km 212.400	5347	11832	2.21
2021-22	Narwana Km 125.79	7357	14849	2.02

Year	Toll Plaza Location (Km)	Traffic No	PCU	PCU Index
	Badopatti Km 171.58	8303	16824	2.03
	Chaudhariwas Km 212.400	8295	18866	2.27
2022-23	Narwana Km 125.79	6905	14124	2.05
	Badopatti Km 171.58	7581	15122	1.99
	Chaudhariwas Km 212.400	7506	16679	2.22

It can be observed from above that project traffic has PCU index ranging from 2.0 to 2.3 which is an indicator of good proportion of commercial traffic in traffic mix in project corridor. Following figure illustrates variation of PCU index at three toll plaza locations.

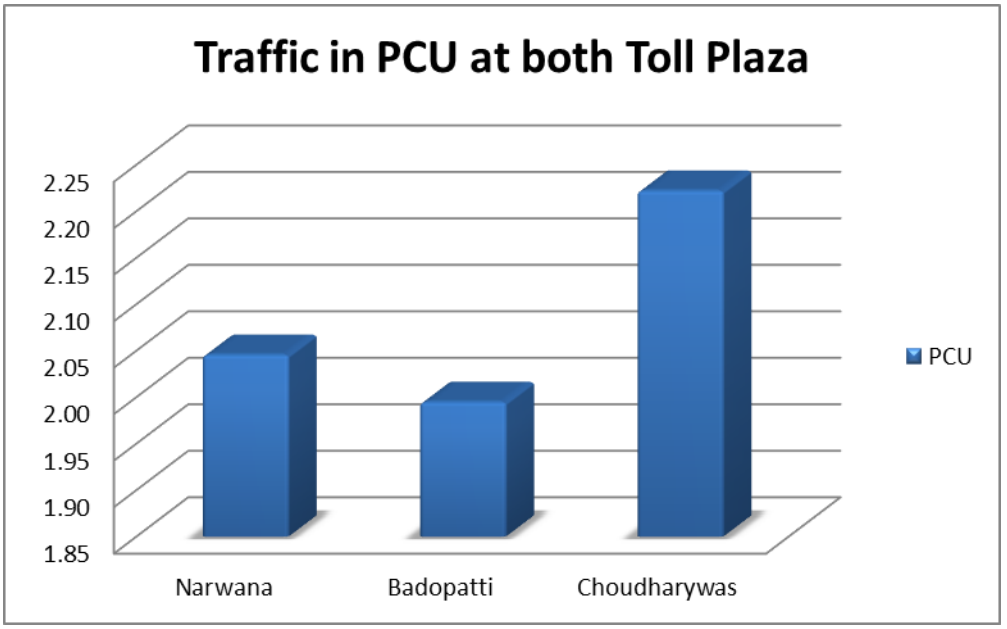


Figure 3-1 : Comparison of PCU Index

3.4.2 Components of Traffic

As discussed previously, components of traffic volume play an important role in determining project revenue. A larger component of commercial traffic with higher axle configuration adds to project revenue positively. Similarly, a larger component of local traffic affects the project revenue potential negatively.

It is observed that car traffic forms about 50%- 60% of total traffic at toll plaza locations while multi axle commercial vehicles are about 20% -35% of total traffic. Truck / Bus and LCV share about 12% and 5 % of traffic volume respectively.

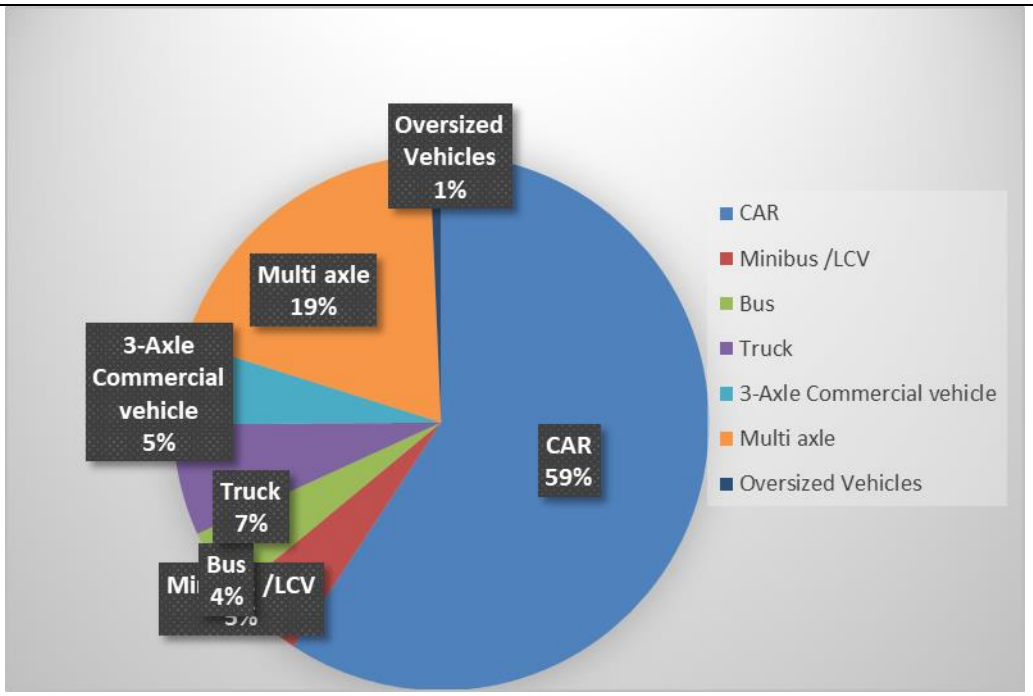


Figure 3-2 :Model Split of Tollable Vehicle-Km 125.790

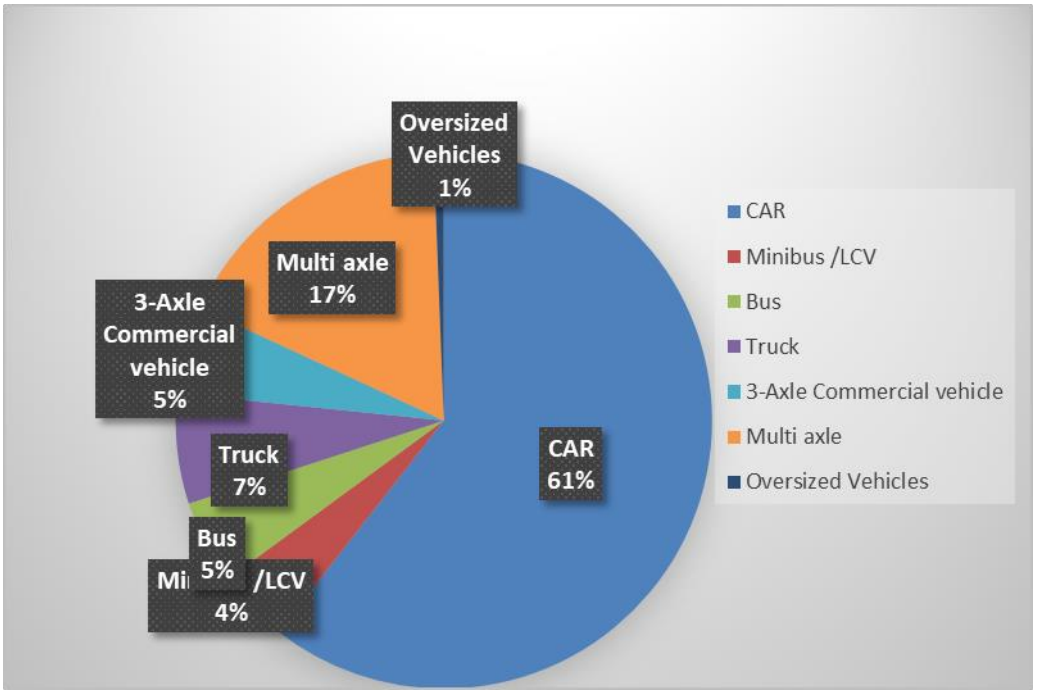


Figure 3-3 :Model Split of Tollable Vehicle-Km 171.58

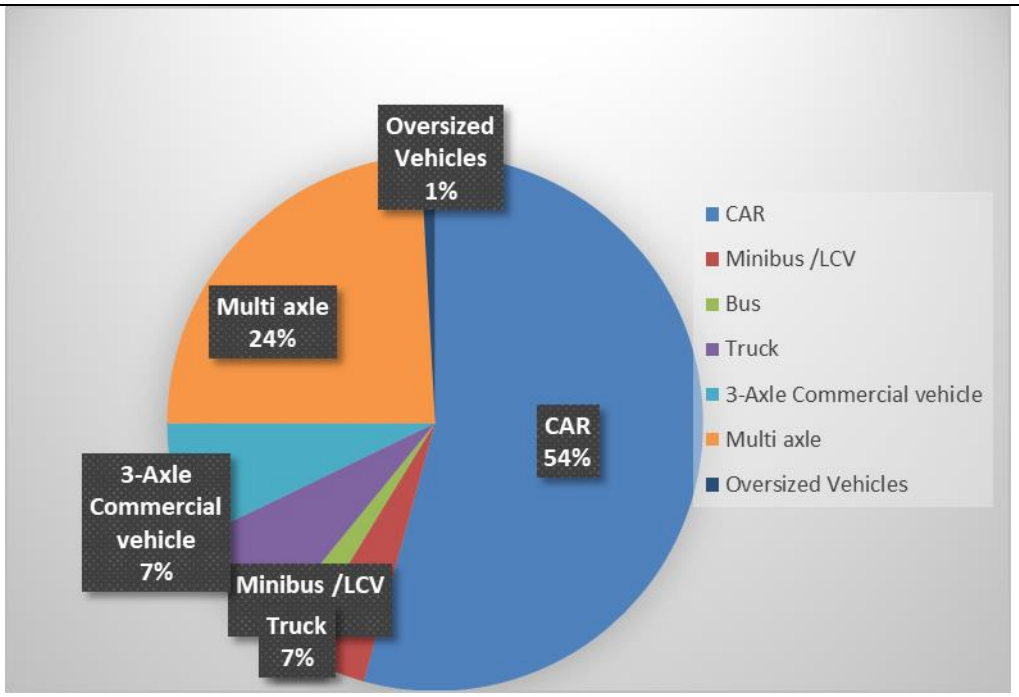


Figure 3-4 :Model Split of Tollable Vehicle-Km 212.400

Another important bifurcation of traffic is components of traffic with respect various type of toll ticketing like

1. Single Journey
2. Multi Journey
3. Monthly Pass (Local and General)

The following table provides numbers of vehicles falling in each of above category on base year 2022-23.

Table 3-8 : Journey Type Bifurcation of Traffic at Narwana TP-1 KM 125

Sr. No	Type	Traffic Volume (Nos.)2022-23
1	Single Journey	3944
2	Return Journey	2878
3	Local Commercial Single Journey	56
4	Monthly Pass Local	27
5	Monthly Pass	0

Most dominant part of the above is the single journey type followed by return journey at project stretch. Monthly pass commuters are a very low fraction of the total traffic on the project corridor.

The single journey component in total traffic numbers is a high as 57%. Return journey component is 42%. The number of monthly pass local is 0% and local commercial single Journey also 1% at Narwana toll plaza.

Following tables give the detail of journey distribution at Badopatti and Chaudhariwas toll plaza.

Table 3-9 : Journey Type Bifurcation of Traffic at Badopatti TP KM 171

Sr. No	Type	Traffic Volume (Nos.)2022-23
1	Single Journey	4089
2	Return Journey	3174
3	Local Commercial Single Journey	206
4	Monthly Pass Local	112
5	Monthly Pass	0

Table 3-10 : Journey Type Bifurcation of Traffic at Chaudhariwas TP KM 212

Sr. No	Type	Traffic Volume (Nos.)2022-23
1	Single Journey	4637
2	Return Journey	2728
3	Local Commercial Single Journey	106
4	Monthly Pass Local	35
5	Monthly Pass	0

Monthly local pass are very high in proportion at Badopatti toll plaza. At Other toll plazas single journey is dominating pattern of trip.

3.5 Secondary Data Collection

There are several other factors which have a substantial impact on traffic pattern and growth on any project corridor. Following are some of such important factors

- Industrial development around project corridor and its catchment
- Educational infrastructure along project corridor
- Demographic pattern
- Urban area development
- Tourism potential
- Upcoming major infrastructural or Industrial projects
- Special Industry in project corridor
- Overall trends of economic growth local as well as national / regional

Hence in addition to traffic details on project site, secondary data was also collected from various other sources. Typical secondary data includes the following:

1. Vehicle registration data of regional and national level.
2. Economic Data
   a) GDP
   b) NSDP
   c) Population Growth
   d) Per Capita Income growth
   e) Industrial Growth
   f) Special Industry Potential
   g) Regional and National development vision / plan
   h) Any other relevant data
3. Competing road network

We have collected and utilized such underlying data in the study to estimate the growth and risk factors for traffic along the project corridor.

CHAPTER 4

INFLUENCE ZONE TRANSPORT NETWORK ANALYSIS

4.1 Introduction

Highway corridors behave like integrated circuit network and more often than not every road is connected to various networks having different origin and destinations. Traffic running on these networks behave like fluid and flow on network on alignment of least friction.

Following Factors can be considered as major contributors to friction on transportation network

- Travel Speed / Travel Time
- Geometric deficiencies like blind horizontal curves and steep vertical gradients etc,
- Configuration of road
- Riding quality
- Traffic delays,
- Length of road,
- Passing through built up or Urban Area,
- Terrain,
- Facilities,

4.2 Competing / Alternate route

Though project road has started collecting toll form mid of year 2017-18 but it was for partial completion of project stretch. Some critical location bypasses and ROBs were pending at beginning of toll. Also stretch from Ambala to Kaithal which is just before project stretch is under four laning. In this case project traffic can be considered as under settlement. Shifting of traffic depends on factors such as road length, type, geometry, riding quality and capacity. Competing road analysis was done at two levels. First at regional level and second at local level.

Project road forms an optimal route for the traffic between following zones.

Zone-1- J&K, Punjab (Ludhiana, Amritsar parts), Haryana, Himachal, Part of Uttarakhand
Zone-2 – Rajasthan, Gujarat (Kandla, Mundra), Maharashtra (Coastal), Southern States (Coastal).

As alternate routes converge at Ajmer, the Project Influence Area (PIA) is considered between Ambala and Ajmer only.

Following figures show the layout of competing routes between both these Zones

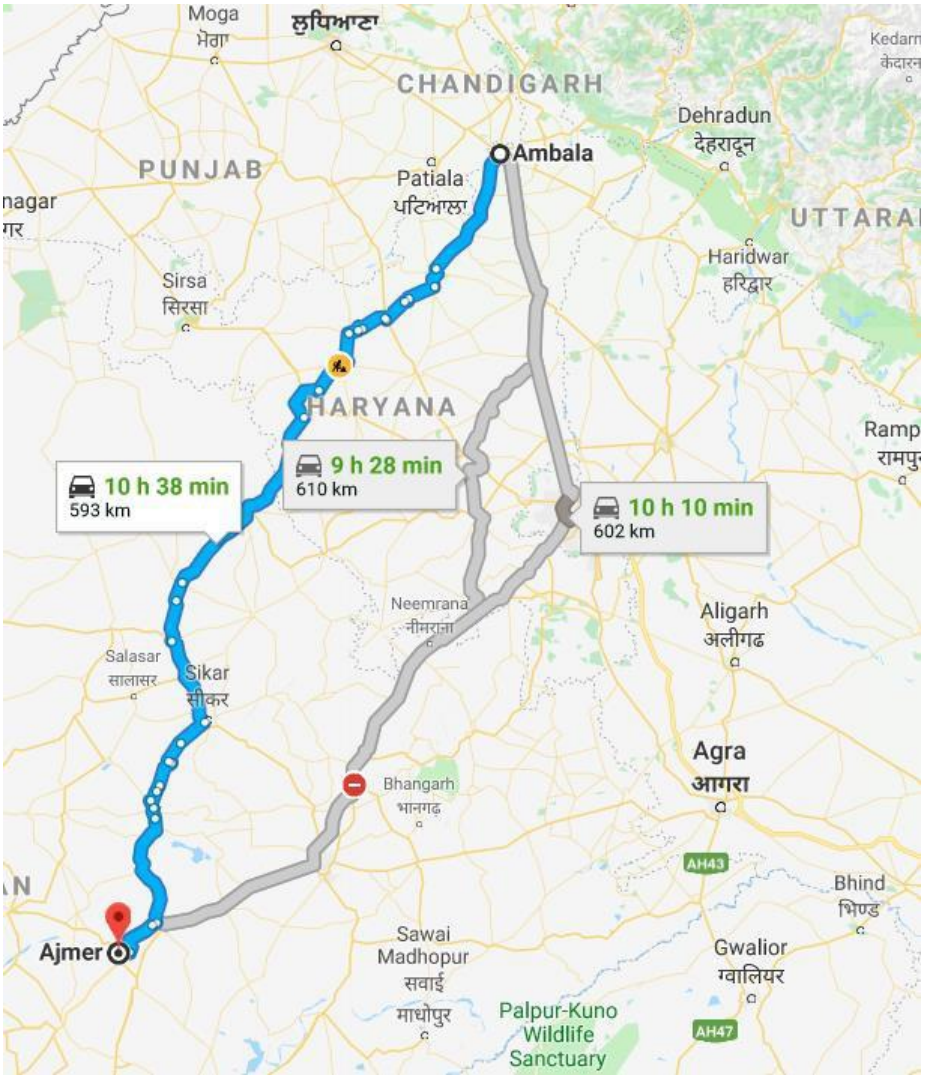


Figure 4-1 : Alternate route at regional level between Zones

Above figure depicts alternate route between Ambala and Ajmer. Following figure shows alternate routes between Ludhiana and Ajmer

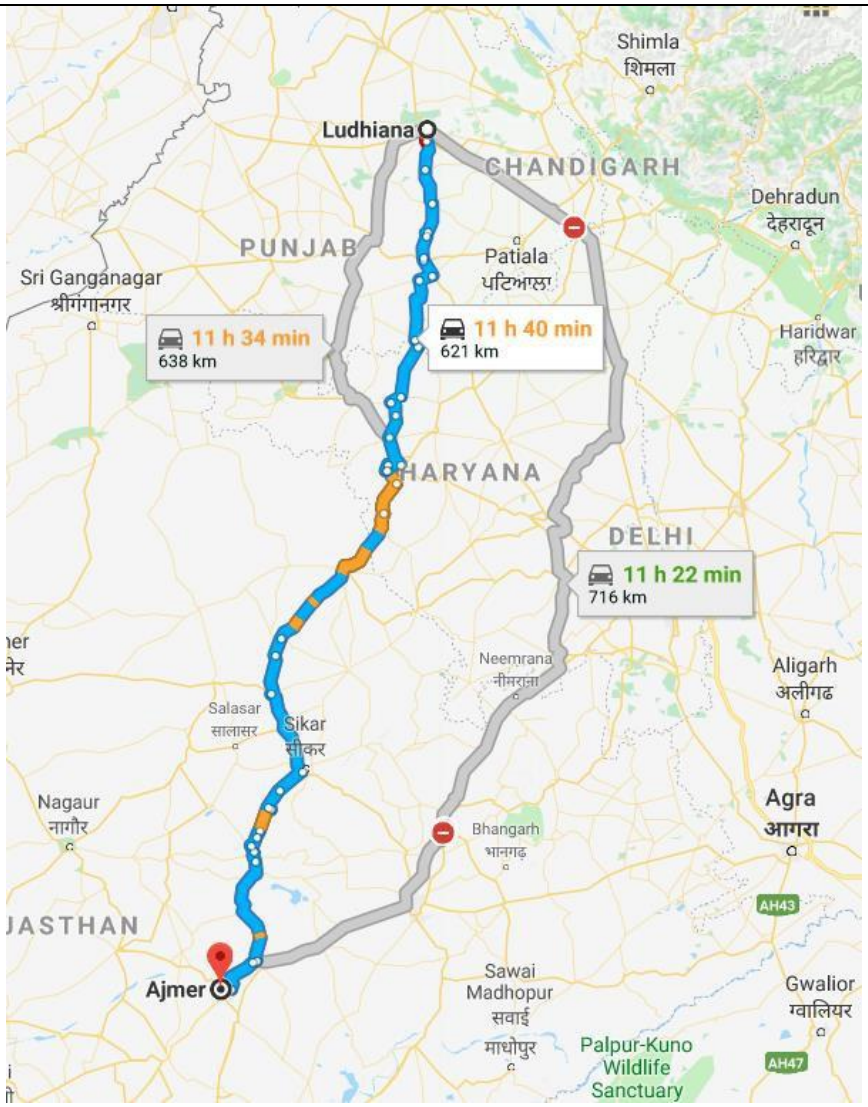


Figure 4-2 : Alternate route at regional level between Ludhiana & Ajmer

From above figures it can be seen that the route containing project alignment has least distance between these origin and destination zones.

Following facts improve probability of target traffic getting attracted to project road.

- Project corridor between Ambala to Rajasthan Border is expected to complete four laning with all bypasses and ROBs.
- Road from Ludhiana to Hisar is part of Bharatmala project and will be converted to four lanes. Currently road from Hisar to Fatehabad only in four lanes.

- Project Corridor is part of ambitious project of Bharatmala which will improve entire length of corridor in terms of capacity and traffic flow. The Government of India has identified the Ludhiana – Ajmer corridor as an optimal route which shall provide time and cost savings to traffic moving from western India to northern India. This will also allow traffic to avoid heavy traffic jams around New Delhi which it is facing on the present route.
- NH-1 and NH-8 which are currently major corridor for traffic between Zone1 and Zone2 will face capacity constraints in coming years. NH-1 for example is four lane road between Ambala and Panipat and runs about 80,000 PCU which is already above its capacity

At local level it was observed that there is no formidable local alternate route to bypass toll plaza. There can a combination of village roads to form alternate loop around toll plazas, but these are too long as compared to project road between said nodes. Thus no local diversion of traffic from project road is anticipated

Following table provide summary of analysis of alternate route/ roads discussed above.

Table 4-1 : Summary Network analysis

Sr. No	Route Details	Designation	Length (Km)	Avg. Speed (KMPH)	Time Taken (Min)	Observations
Regional Level						
1	Ambala-Panipat-Karnal-Rohtak-Ajmer	Alternate Route	610	64	9 Hr 28 Min	Alternate route is longer but has shorter travel time. With completion of Ambala - Kaithal four laning of Road induced traffic is expected onto project stretch
	Ambala-Kaithal-Hisar-Ajmer	Project Road	593	55	10 Hr 38 Min	
2	Ludhiana-Chandigarh Panipat-Karnal-Ajmer	Alternate Route	716	63	11 Hr 22 Min	Alternate route is longer but has shorted travel time. With completion of Ambala - Kaithal

	Ludhiana - Ambala- Kaithal- Hisar- Ajmer	Project Road	621	53	11 Hr 40 Min	four laning of Road induced traffic is expected onto project stretch

Table 4-2 : Competing Roads Details

Under these circumstances it is not envisaged that commercial or passenger traffic would switch to alternate roads from the project road.

CHAPTER 5

GROWTH OF TRAFFIC ON PROJECT HIGHWAY

5.1 Introduction

Traffic growth is a function of the interplay of a number of contributory factors such as National economy, Government policy, socio-economic conditions of the people, and changes in land uses along the project corridor precincts etc. As these factors have a number of uncertainties associated with them, forecasts of traffic are dependent on the projections of other factors such as population, gross domestic product (GDP), vehicle ownership, per capita income (PCI), agricultural output, fuel consumption etc. Future pattern of change in these factors can be estimated with only a reasonable degree of accuracy and hence the resultant traffic forecast levels may not be precise.

Traffic growth forecast for project corridor Kaithal – Rajasthan Border section of NH-152/65 has been done taking the above factors into consideration. "**IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**" is established best practice and has been used for traffic growth forecast.

5.2 Trend Analysis

One of the methods of estimation of future rate of growth is to assume the same rate of growth as in the past. Although such a method is more suitable to projects of short durations say 5-10 years, however for long term projections it would-be erroneous to assume that the past rate of growth will continue to prevail for a long time in future. Economic conditions, which are major influencing factors, are bound to change over a long period of time. Thus, it would be necessary to modify the past trends of growth suitably.

Elasticity model of growth projection is one of the most widely acceptable methods for traffic forecast. The same is recommended in **IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**.

In this method the past trend of vehicular data is paired with an economic indicator and a regression analysis is done to yield the economic model of growth. Growth of vehicle traffic varies for different type of vehicle. It is a proven fact that the growth pattern for passenger and goods vehicle is different. Traffic growth on any highway typically depends on number of economic parameters. Most important and direct

parameters are given as under

- Per Capita Income
- Net State Domestic Product (NSDP)
- Population

It can be observed that the ownership of a car is more closely related to affordability; hence per capita is the index which closely fits the growth of car traffic among other criteria. In a similar fashion, the following can be pairs of vehicle type and independent variable for elasticity modeling of growth.

- Car / Jeep – Par Capita Income
- Bus / Minibus – Population
- Goods Vehicle – NSDP

5.3 Estimation of Traffic Demand Elasticity

Elasticity of traffic demand is defined as the rate at which traffic intensity varies due to a change in the corresponding indicator selected. Hence, In order to estimate the elasticity of traffic demand, it is necessary to establish relationship between the growth in number of given category of vehicles with the relevant economic variable considered, such as NSDP, per capita income and population growth. Latest available data for vehicle registration, per capita income, NSDP and population is used in analysis.

As per IRC: 108-1996 the model for estimating elasticity index for the project corridor is of the following form and is given as below:

$$Log\ (P) = k \times Log\ (EI) + A$$

Where,

P = *Number of Vehicles (Mode wise)*

EI = *Economic Indicator*

A = *Regression constant*

k = *Elasticity coefficient (Regression coefficient)*

The elasticity for car and bus (passenger vehicles) is calculated based on the Population and Per Capita Domestic Product (PCDP) and the elasticity for trucks is calculated based on the Net State Domestic Product (NSDP).

The project corridor spreads across state of Haryana. Toll plazas at Narwana, Badopatti and Choudhariwas are in the state of Haryana, but project stretch is under

impact of Rajasthan state as well. In such circumstances for elasticity calculations, working data from above two states has been analyzed.

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Haryana State.

Table 5-1 : Per Capita Income Vs Car Haryana

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	106085	989519	5.03	6.00		
2013	111780	1134616	5.05	6.05	5%	
2014	119791	1278272	5.08	6.11	7%	
2015	125032	1420621	5.10	6.15	4%	
2016	137818	1711692	5.14	6.23	10%	
2017	150241	1851788	5.18	6.27	9%	7.23%

Regression analysis of same is given in figure below

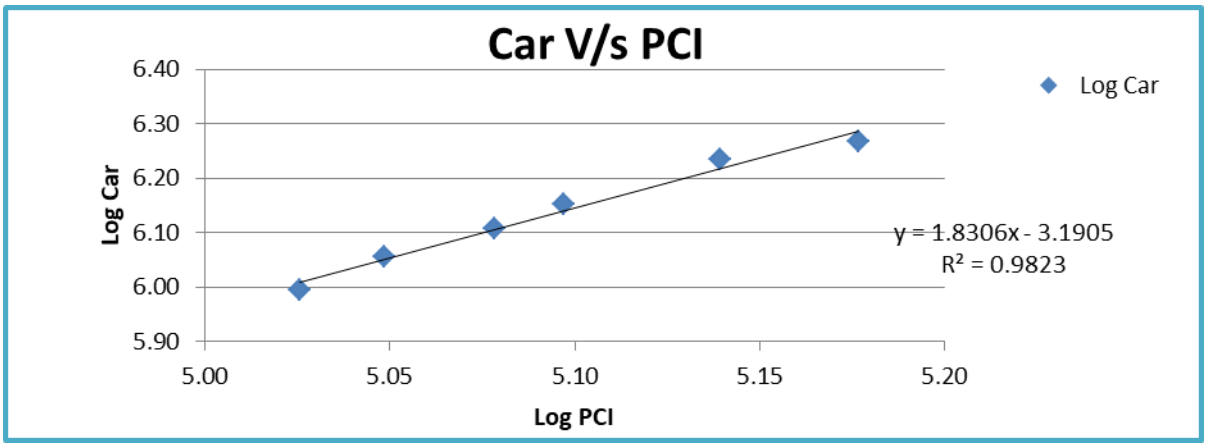


Figure 5-1 : Regression and Elasticity PCI vs. Car – Extrapolation Haryana

Table 5-2 : Population Vs Bus Haryana

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	25351462	39153	7.40	4.59		
2013	25751257	43456	7.41	4.64	2%	
2014	26149236	46558	7.42	4.67	2%	
2015	26545282	52640	7.42	4.72	2%	
2016	26939286	55781	7.43	4.75	1%	
2017	27331141	60129	7.44	4.78	1%	1.52%

Regression analysis of same is given in figure below

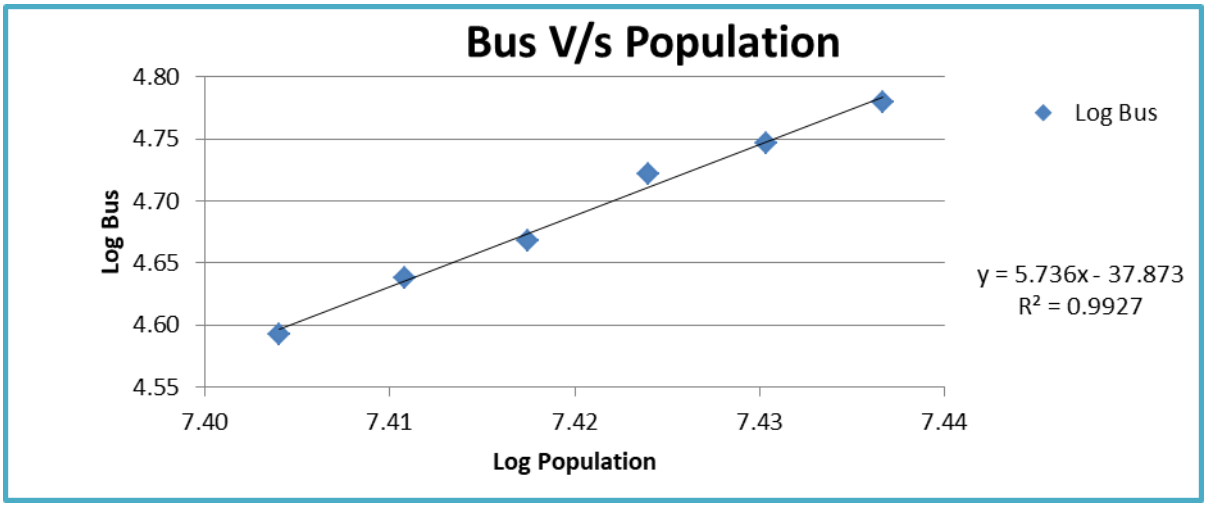


Figure 5-2 : Regression and Elasticity Population vs. Bus – Extrapolation Haryana

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-3 : LCV Traffic Vs NSDP Haryana

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth (5 Year)
2012	271152	124897	5.43	5.10		
2013	289756	137511	5.46	5.14	7%	
2014	314931	152069	5.50	5.18	9%	
2015	333359	167901	5.52	5.23	6%	
2016	372659	182776	5.57	5.26	12%	8.30%

Following figure depict regression analysis and extrapolation.

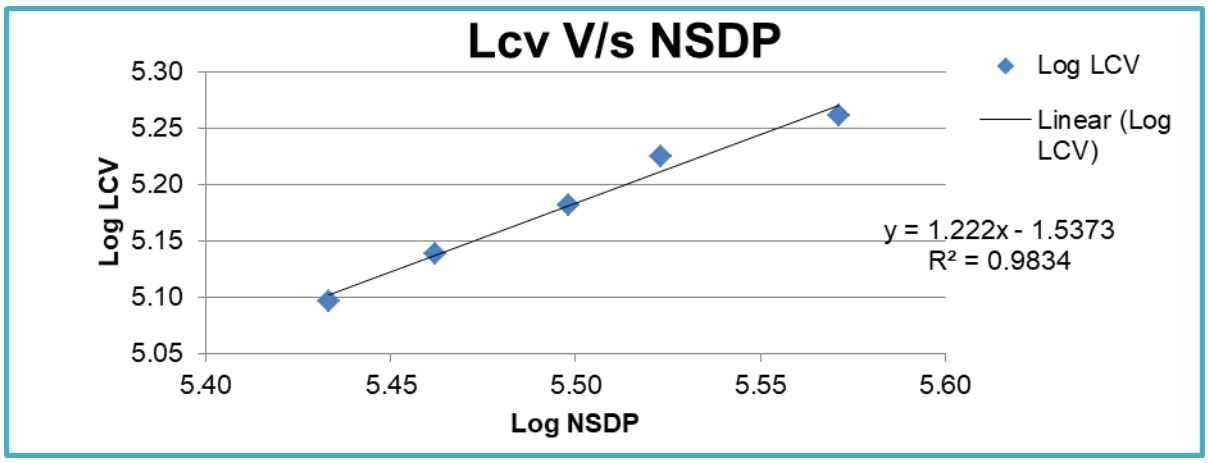


Figure 5-3 : Regression and Elasticity NSDP vs. LCV Traffic - extrapolation Haryana

Table 5-4 : Goods Traffic Vs NSDP Haryana

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	271152	292735	5.43	5.47		
2013	289756	307509	5.46	5.49	7%	
2014	314931	327882	5.50	5.52	9%	
2015	333359	348732	5.52	5.54	6%	
2016	372659	367730	5.57	5.57	12%	
2017	412006	390321	5.61	5.59	11%	8.75%

Following figure depict regression analysis and extrapolation.

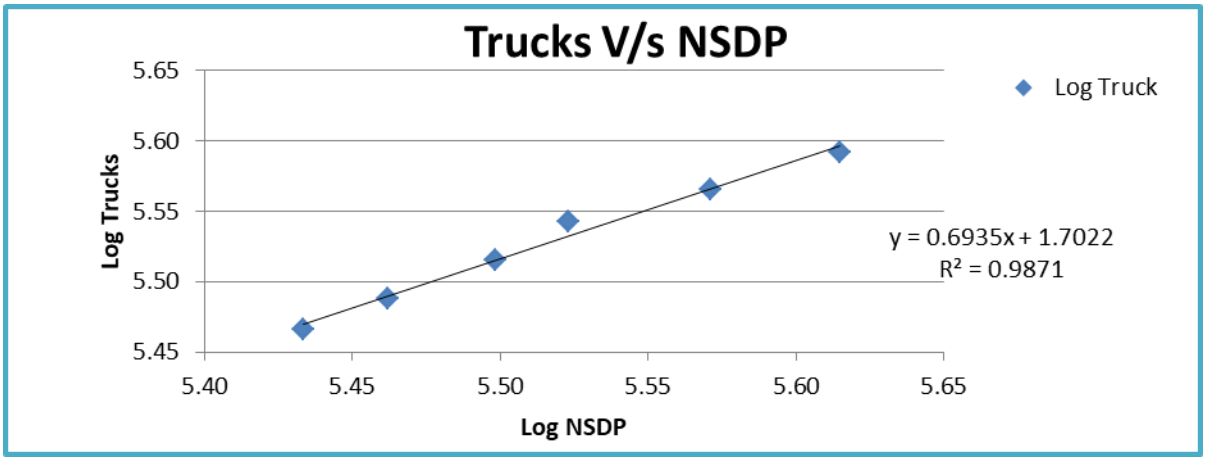


Figure 5-4 : Regression and Elasticity NSDP vs. Goods Traffic - extrapolation Haryana

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below

Table 5-5 : Summary Regression Analysis Haryana

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average IV Growth (5yrs)	Growth Elastic Model	Remarks
Haryana	Car/Jeep	PCI	y = 1.8306x + -3.1905	R^2 = 0.9823	1.8306	7.23%	13.24%	Good Regression
	Bus	Population	y = 5.736x - -37.8732	R^2 = 0.9927	5.7360	1.52%	8.69%	Good Regression
	LCV	NSDP	y = 1.222x - -1.5373	R^2 = 0.9834	1.2220	8.30%	10.14%	Good Regression
	Truck	NSDP	y = 0.6935x - 1.7022	R^2 = 0.9871	0.6935	8.75%	6.07%	Good Regression

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Rajasthan State.

Table 5-6 : Per Capita Income Vs Car Rajasthan

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	57192	591069	4.76	5.77		
2013	58441	659542	4.77	5.82	2%	
2014	61053	733916	4.79	5.87	4%	
2015	64496	814079	4.81	5.91	6%	
2016	68565	899307	4.84	5.95	6%	
2017	71394	988391	4.85	5.99	4%	4.55%

Regression analysis of same is given in figure below

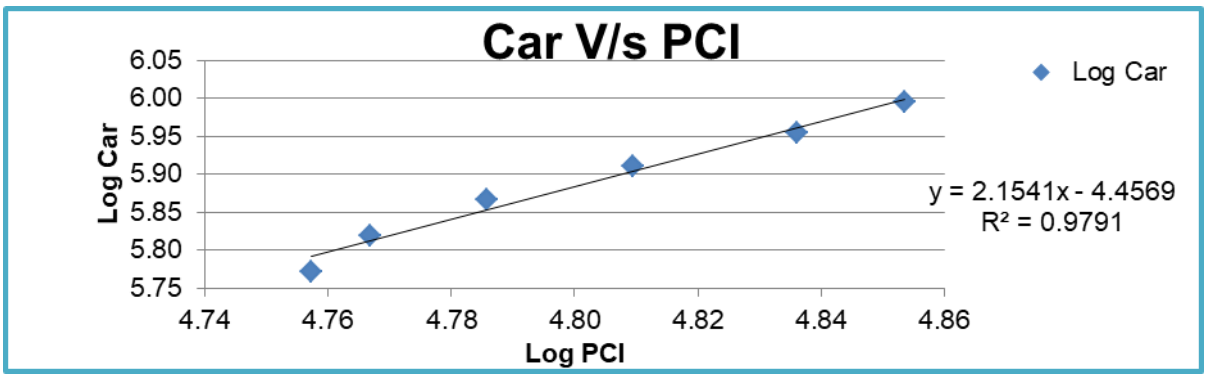


Figure 5-5 : Regression and Elasticity PCI vs. Car – Extrapolation Rajasthan

Table 5-7 : Population Vs Bus Rajasthan

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	68548437	83345	7.84	4.92		
2013	69783885	88616	7.84	4.95	2%	
2014	71016445	93892	7.85	4.97	2%	
2015	72245688	97650	7.86	4.99	2%	
2016	73471198	102818	7.87	5.01	2%	
2017	74692571	108680	7.87	5.04	2%	1.73%

Regression analysis of same is given in figure below

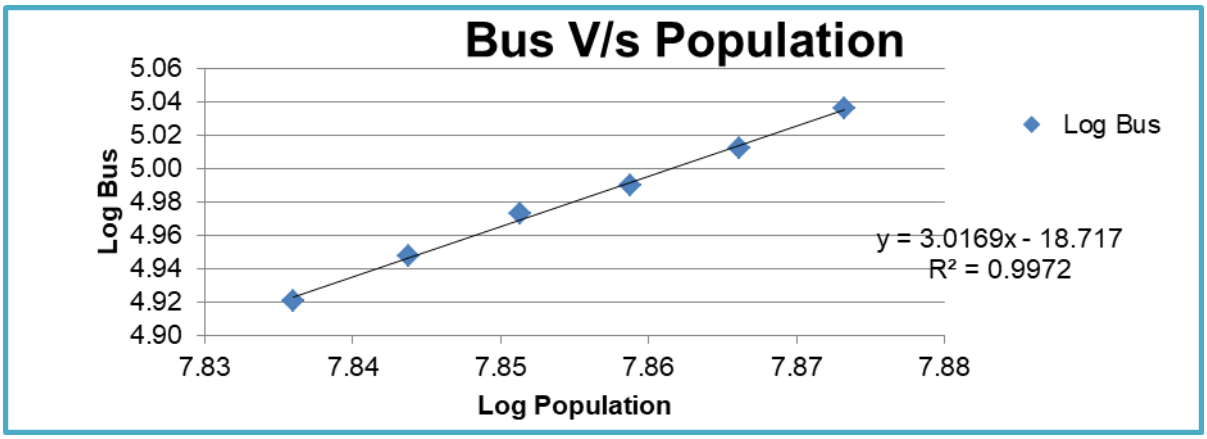


Figure 5-6 : Regression and Elasticity Population vs. Bus – Extrapolation Rajasthan

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-8 : LCV Traffic Vs NSDP Rajasthan

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth (5 Year)
2012	395331	69509	5.60	4.84		
2013	409802	76396	5.61	4.88	4%	
2014	434292	33379	5.64	4.52	6%	
2015	465408	91787	5.67	4.96	7%	
2016	501922	99763	5.70	5.00	8%	6.16%

Following figure depict regression analysis and extrapolation.

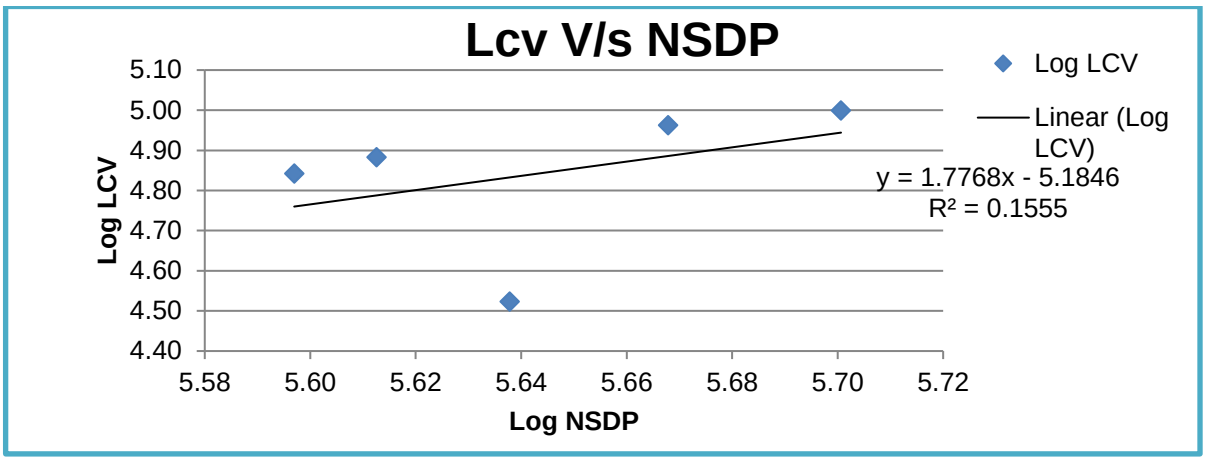


Figure 5-7 : Regression and Elasticity NSDP vs. LCV Traffic - extrapolation Rajasthan

Table 5-9 : Goods Traffic Vs NSDP Rajasthan

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	395331	362028	5.60	5.56		
2013	409802	401983	5.61	5.60	4%	
2014	434292	434379	5.64	5.64	6%	
2015	465408	472365	5.67	5.67	7%	
2016	501922	517604	5.70	5.71	8%	
2017	530172	561158	5.72	5.75	6%	6.06%

Following figure depict regression analysis and extrapolation.

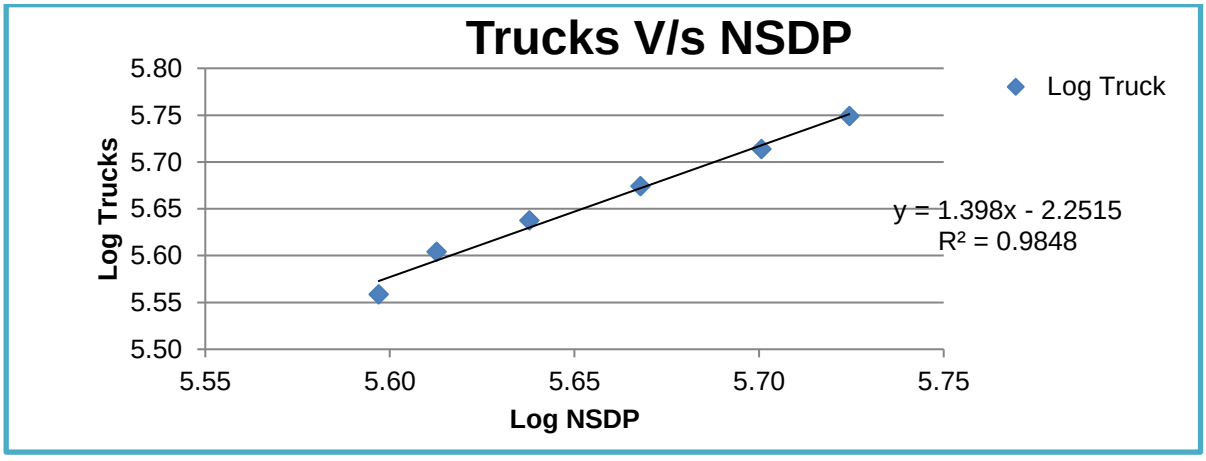


Figure 5-8 : Regression and Elasticity NSDP vs. Goods Traffic - extrapolation Rajasthan

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity

coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below

Table 5-10 : Summary Regression Analysis Rajasthan

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average IV Growth (5yrs)	Growth Elastic Model	Remarks
Rajasthan	Car/Jeep	PCI	y = 2.1541x + -4.4569	R² = 0.9791	2.1541	4.55%	9.79%	Good Regression
	Bus	Population	y = 3.0169x - -18.7174	R² = 0.9972	3.0169	1.73%	5.22%	Good Regression
	LCV	NSDP	y = 1.7768x - -5.1846	R² = 0.1555	1.7768	6.16%	10.95%	Good Regression
	Truck	NSDP	y = 1.398x - -2.2515	R² = 0.9848	1.3980	6.06%	8.46%	Good Regression

Economical model for predicting growth is good tool, however other local, regional, national factors should also be considered before finalizing growth factors. Considering factors such as proposed developments and other influencing economic factors, moderated growth should be considered. These factors are discussed in subsequent sections.

5.4 Analysis of Historic Traffic Data

Historical traffic data forms useful information for any highway project. It provides useful information for establishing past trend of growth. Project stretch of Kaithal to Rajasthan Border is under tolling operation with current concessionaire and has only two years of tolling history from 2018-19. After that traffic was affected due to COVID-19 pandemic. Thus, sufficient data points to be able to establish a reliable past trend of traffic growth are not available. A minimum of about 5 -6 years' consistent traffic data is required for establishing a reliable past trend.

5.5 Other Factors Influencing Growth

There are many factors which have impact on traffic growth. As discussed previously these factors can be economical, social, educational, and industrial.

Potentiality of such factors for project highway is discussed as under.

ECONOMY

After witnessing a slowdown during 2011-12, the economy recovered in 2013-14, and a high growth rate of GDP was recorded in up to 2018-19. Pandemic of COVID-19 impacted all economies of world including India. Following figure show trend of GDP growth in India.

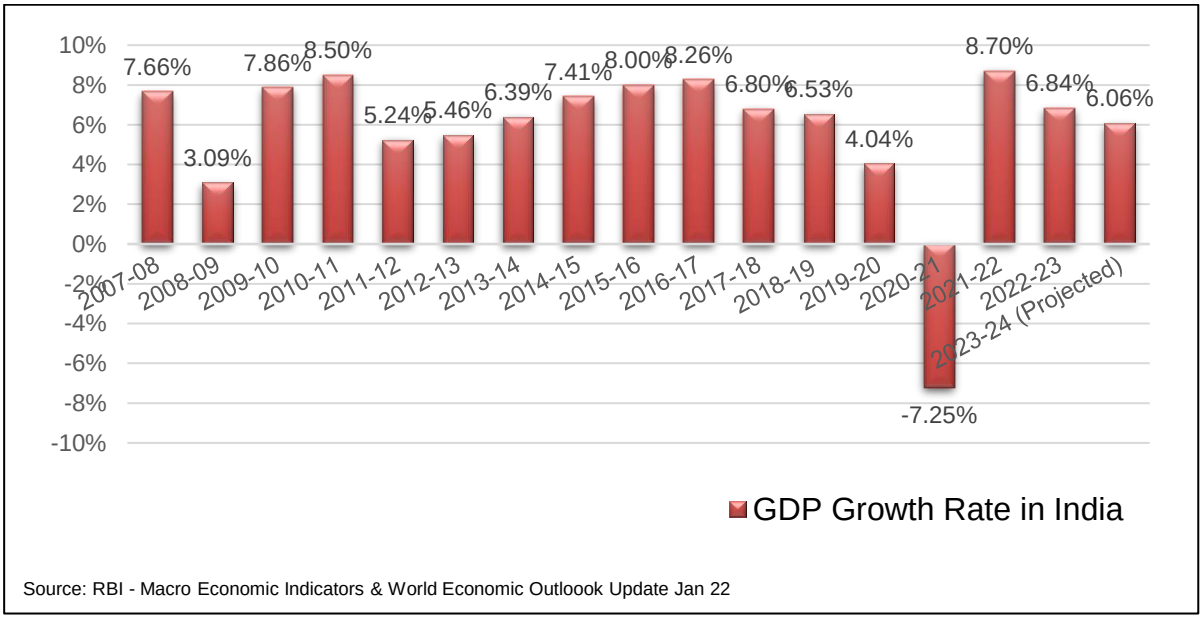


Figure 5-9 : Growth of GDP in India

FY 2017-18 recorded a growth of 6.7% which had slight impact of GST and demonetization. Indian economy appears on recovery path with estimated growth of 6.8% in FY 2018-19. Government took major policy decision including tax infrastructure reforming, banking sector improvement and ease of doing business.

Major economies of world collapsed due to pandemic COVID-19 including India. Indian economy is also registered negative growth in financial year 2020-21. After that Indian economy recovered handsomely and registered a growth of about 9% in Year 2021-22. This was partly due to low base of year 2020-21 as well.

Honorable Prime Minister has announced a major relief package of Rs. 20 lakh crores which is about 10% of GDP. This is aimed at turning this major crisis of COVID-19 into opportunity by providing major impetus to industrial production to the limit of becoming a self-reliant economy. With major thrust of this package being on **Make -In- India** it is expected that industry in India would grow at rapid pace and

recover handsomely in post COVID-19 scenario. World Economic Outlook update also has predicted a growth rate of about 7.5 % in year 2022-23.

5.6 Developments along and around the Project Corridor & State

Project stretch falls in region of good development potential. The same is discussed as under.

Haryana is the largest recipient of investment per capita since 2000 in India, and among one of the wealthiest and most economically developed regions in South Asia. Haryana has the sixth highest per capita income among Indian states and union territories. Haryana is also boosted by 30 SEZs (mainly along DMIC, ADKIC and DWPE in NCR), 7% national agricultural exports, 60% of national Basmati rice export, 67% cars, 60% motorbikes, 50% tractors and 50% refrigerators produced in India. In services. Since Haryana surrounds the country's capital Delhi on three sides (north, west and south), consequently a large area of Haryana is included in the economically-important National Capital Region for the purposes of planning and development.

Major Cities of Haryana state & their characteristics are as below.

Faridabad is one of the biggest industrial cities of Haryana as well as North India. Faridabad has been described as eighth fastest growing city in the world and third most in India by City Mayors Foundation survey. Faridabad is home to large-scale companies like Escorts Limited, India Yamaha Motor Pvt. Ltd., Havells India Limited, JCB India Limited, Indian Oil (R&D), Larsen & Toubro (L&T), Whirlpool India Ltd., ABB Group, Goodyear India Ltd., Bata India Ltd and Eicher Tractor Ltd. and Beebay Kidswear. Eyewear e-tailer Lenskart and healthcare startup Lybrate have their headquarters in Faridabad. More than
5,000 units of auto parts producers are based in Faridabad.

Many directorates of different union government ministries are headquartered in Faridabad including Central Ground Water Board, Department of Plant Quarantine and Central Insecticide Lab and Union Government Offices from Haryana including the Commissioner of Central Excise within Department of Revenue, Government of India, Department of Explosives, and Department of Labour. The Apex Central Training Institute of the Department of Revenue, Government of India, National Academy of Customs Excise & Narcotics is

located at Sector 29. The National Power Training Institute, an autonomous body under Ministry of Power, Government of India has a corporate office in Faridabad. The city also hosts the National Institute of Financial Management, which serves as training academy for accounting and financial services. Also

headquartered here is NHPC Limited which is a Central PSU under Ministry of Power, Government of India and the largest Hydro-power Company in India.

Hisar, city has been identified as a counter-magnet city for the National Capital Region to attract migrants and develop as an alternative center of growth to Delhi. With upcoming integrated industrial aerocity and aero MRO hub at Hisar Airport, it is a fast-developing city.

The city has a large steel industry and is known as the 'city of steel'. Hisar is India's largest manufacturer of galvanized iron. The Jindal Group is based in Hisar. Jindal Stainless Steel is also the world's largest producer of Stainless Steel strips for razor blades and India's largest producer of coin blanks. Textile and automobile industry is also a major contributor to the economy of the city. It also has a large number of livestock farms with the Central Livestock Farm, established in 1809 being one of the Asia's largest cattle farms.

Panipat city is famous in India by the name of "City of Weavers" and "Textile City". It is also known as the "cast-off capital" due to being "the global centre for recycling textiles. It is known for its woven modhas or round stools. Panipat has heavy industry, including a refinery operated by the Indian Oil Corporation, a urea manufacturing plant operated by National Fertilizers Limited and a National Thermal Power Corporation power plant. The IOCL refinery in Panipat is one of the major Industry in area which contributes to growth.

Gurugram : Witnessing rapid urbanisation, Gurgaon has become a leading financial and industrial hub with the third-highest per capita income in India. Gurgaon ranks number 1 in India in IT growth rate and existing technology infrastructure, and number 2 in startup ecosystem, innovation and livability.

The city's economic growth story started when the leading Indian automobile manufacturer Maruti Suzuki India Limited established a manufacturing plant in Gurgaon in the 1970s. Today, Gurgaon has local offices for more than 250 Fortune 500 companies. Various international companies, including Coca-Cola, Pepsi, BMW, Agilent Technologies, Hyundai have chosen Gurugram to be their Indian corporate headquarters.

IMT Minesar, Dundahera and Sohna are industrial and logistics hub, that also has National Security Guards, Indian Institute of Corporate Affairs, National Brain Research Centre and National Bomb Data Centre. Retail is an important industry in Gurgaon, with the presence of 26 shopping malls

Ambala is connected to all the other major cities of north India including Delhi, Panipat, Chandigarh, Ludhiana, Amritsar and Shimla. It is a big interchange for various commuters for all neighboring states. The Ambala Cantt bus stand witnesses roughly 50,000 commuters daily.

National highway NH 1 popularly known as GT road passes through Ambala and connects it to National capital Delhi, Panipat, Ludhiana and Amritsar. NH 22 connects it to state capital Chandigarh and Shimla. National Highway 52 (new NH-165) connects it to Kaithal, Narwana and Hisar.

Being located in the Indo-Gangetic Plain, the land is generally fertile and conducive to agriculture.

Small scale industries form the bulk of the industrial landscape in the district. It is one of the largest producers of scientific and surgical instruments in the country and home to a large number of scientific instrument manufacturers. It produces microscopes and other instruments used in chemistry laboratories. Manufacture of submersible pumps and mixers and grinders is another industry that has traditionally flourished.

Ambala is also an important textile trading centre, besides Delhi and Ludhiana and has a well-known cloth market, which is famous in the region especially for those seeking bridal wear. It also produces rugs, known locally as Durries, and houses many suppliers to Indian defence forces

Punjab state is one of the most fertile regions in India. The region is ideal for wheat-growing. Rice, sugar cane, fruits and vegetables are also grown. Punjab is called the "Granary of India" or "India's bread-basket". It produces 10.26% of India's cotton, 19.5% of India's wheat, and 11% of India's rice. The Firozpur and Fazilka Districts are the largest producers of wheat and rice in the state. In worldwide terms, Indian Punjab produces 2% of the world's cotton, 2% of its wheat and 1% of its rice. The largest cultivated crop is wheat. Other important crops are rice, cotton, sugarcane, pearl millet, maize, barley and fruit.

Ludhiana is one of the City in India with best business environment. The riches are brought mostly by small-scale industrial units, which produce industrial goods,

machine parts, auto parts, household appliances, hosiery, apparel, and garments. Ludhiana is Asia's largest hub for bicycle manufacturing and produces more than 50% of India's bicycle consumption of more than 10 million each year. Ludhiana produces 60% of India's tractor parts and a large portion of auto and two-wheeler parts. Many parts used in German cars are Mercedes and BMW exclusively produced in Ludhiana to satisfy the world requirement. It is one of the largest manufacturer of domestic sewing machines. Hand tools and industrial equipment are other specialties. The apparel industry of Ludhiana is famous all over India for its woollen sweaters and cotton T-shirts; most of the top Indian woollen apparel brands are based in Ludhiana. Ludhiana also has a growing IT sector with multiple software services and product companies having development centers in the city

Chandigarh has been rated as one of the "Wealthiest Towns" of India. The Reserve Bank of India ranked Chandigarh as the Third largest deposit centre and seventh largest credit centre nationwide.

Chandigarh is ranked 4th in the top 50 cities identified globally as "emerging outsourcing and IT services destinations" ahead of cities like Beijing. Chandigarh IT Park (also known as Rajiv Gandhi Chandigarh Technology Park) is the city's attempt to break into the information technology world. Major Indian firms and multinational corporations like Quark, Infosys, EVRY, Dell, IBM, TechMahindra, Airtel, Amadeus IT Group, DLF have set up base in the city and its suburbs.

Additionally, the government is a major employer in Chandigarh with three governments having their base here i.e. Chandigarh Administration, Punjab government and Haryana government.

Ordnance Cable Factory of the Ordnance Factories Board has been set up by the Government of India. There are about 15 medium to large industries including two in the Public sector. In addition Chandigarh has over 2500 units registered under small-scale sector. The important industries are paper manufacturing, basic metals and alloys and machinery. Other industries are relating to food products, sanitary ware, auto parts, machine tools, pharmaceuticals and electrical appliances.

Rajasthan state is a fast developing state. Last year Rajasthan was the leading investment destination in India after Maharashtra and Gujarat because of peaceful environment, relatively better law and order situation, excellent infrastructure, and investment friendly climate. Rajasthan is pre-eminent in quarrying and mining in India. The state is the second largest source of cement. It has rich salt deposits at Sambhar, copper mines at Khetri and zinc mines at Dariba and Zawar. Jaipur is the capital and largest city of Rajasthan. It is also

known as Pink City of India and a famous travel destination.
There is large amount of information available on open platform including internet regarding this. Relevant information is compiled as under.

Delhi Mumbai Industrial Corridor (DMIC)

Rajasthan is strategically located along the Delhi-Mumbai section of the Golden Quadrilateral highway project, the proposed Dedicated Freight Corridor (DFC) and the Delhi Mumbai Industrial Corridor (DMIC).

Rajasthan has access to 46% of DMIC. It falls within major districts of Jaipur, Alwar, Kota and Bhilwara. Over 58% area of the state falls within the influence area of DMIC. The DMIC will provide high quality environment with state of the art infrastructure for new investors.

The state of Rajasthan has a rich agricultural and mineral base. Key industrial sectors in the state include Cement, Building Stones, Gypsum, Gems & Jewellery, Chemical, Food processing and Textiles. The emerging sectors include IT/ITES, Auto Component and Knowledge Hubs. Based on the strengths of specific regions across the state, five development nodes are identified in the influence area of DMIC. It includes two investment regions and three industrial areas.

Project road would act as feeder road for traffic destined for DMIC logistic hubs from northern states.

5.7 Recommended Growth Rates of Traffic

Based on the above analysis and after giving due consideration to the entire listed factors, the following overall growth rates are recommended for each category of vehicle as under. Rate of growth is moderated in light of overall regional trend. Growth of Multi-Axle is kept slightly higher as trend of technological advances in logistic industry favors multi-axle over 2/3 axle carriage. It is also expected that as the economy moves from developing to developed, rate of growth diminishes. Same growth rate is not sustainable for long Traffic growth is suitably stepped down for future years.

Growth rates are recommended for three scenarios for sensitivity analysis namely **Optimistic, Pessimistic** and **Most Likely** with a positive and negative variation 0.5% from Most Likely case for corridor in both states.

5.7.1 Recommended Growth Rates of Traffic for Project Stretch

Table 5-11 : Recommended Growth Rates Optimistic

Category / Year	2021-2022	2022-2026	2026-2031	2031-2036	2036-2041	2041-2046	2046-2051
Car/Jeep/Van	9.91%	5.67%	5.45%	5.22%	5.00%	4.78%	4.56%
Bus	5.11%	3.21%	3.09%	2.72%	2.61%	2.50%	2.40%
LCV	4.82%	3.38%	3.17%	2.72%	2.53%	2.35%	2.17%
2- Axle	6.37%	3.96%	3.74%	3.23%	3.04%	2.86%	2.67%
3 - Axle	6.72%	3.96%	3.74%	3.23%	3.04%	2.86%	2.67%
4 to 6 Axle	7.07%	3.96%	3.74%	3.53%	3.32%	3.12%	2.91%
7 and Above Axle	7.07%	3.96%	3.74%	3.53%	3.32%	3.12%	2.91%

Table 5-12 : Recommended Growth Rates Pessimistic

Category / Year	2021-2022	2022-2026	2026-2031	2031-2036	2036-2040	2041-2046	2046-2051
Car/Jeep/Van	9.41%	5.17%	4.95%	4.72%	4.50%	4.28%	4.06%
Bus	4.61%	2.71%	2.59%	2.22%	2.11%	2.00%	1.90%
LCV	4.32%	2.88%	2.67%	2.22%	2.03%	1.85%	1.67%
2- Axle	5.87%	3.46%	3.24%	2.73%	2.54%	2.36%	2.17%
3 - Axle	6.22%	3.46%	3.24%	2.73%	2.54%	2.36%	2.17%
4 to 6 Axle	6.57%	3.46%	3.24%	3.03%	2.82%	2.62%	2.41%
7 and Above Axle	6.57%	3.46%	3.24%	3.03%	2.82%	2.62%	2.41%

Table 5-13 : Recommended Growth Rates Most Likely

Category / Year	2021-2026	2022-2026	2026-2031	2031-2036	2036-2041	2041-2046	2046-2051
Car/Jeep/Van	9.66%	5.42%	5.20%	4.97%	4.75%	4.53%	4.31%
Bus	4.86%	2.96%	2.84%	2.47%	2.36%	2.25%	2.15%
LCV	4.57%	3.13%	2.92%	2.47%	2.28%	2.10%	1.92%
2- Axle	6.12%	3.71%	3.49%	2.98%	2.79%	2.61%	2.42%
3 - Axle	6.47%	3.71%	3.49%	2.98%	2.79%	2.61%	2.42%
4 to 6 Axle	6.82%	3.71%	3.49%	3.28%	3.07%	2.87%	2.66%
7 and Above Axle	6.82%	3.71%	3.49%	3.28%	3.07%	2.87%	2.66%

Traffic and revenue has been worked out on the basis of above growths and same is presented in subsequent chapter of report.

5.8 COVID-19 Impact

All social and economic activities had been completely disrupted due worldwide pandemic of Corona Virus. This had affected traffic on project stretch as well. Traffic was severely affected form March-2020 due to lockdown and then in second wave and third waves.

Government has announced a mega economic stimulate and package of Rs. 20 Lakh Crore to bring the economy back on track and recover the losses. Traffic has shown impressive recovery post lockdown period and has recovered to normal level.

CHAPTER 6

TRAFFIC FORECAST

6.1 Traffic Projections

Growth rates recommended in previous section of report are used to arrive at traffic projections for future years. Toll plaza wise futuristic traffic projection is given in tables below.

These projections have been done for following three cases of growth up to concession period

1. Optimistic Scenario
2. Pessimistic Scenario
3. Most Likely Scenario

Table 6-1 : Total Tollable Traffic @ Toll Plaza 1- Narwana 125.00 KM (Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	4325	335	298	481	359	1396	49	7243	14744
2024-25	4570	346	307	500	373	1451	51	7598	15388
2025-26	4818	356	316	519	387	1505	53	7954	16029
2026-27	5080	367	325	538	401	1561	55	8327	16695
2027-28	5356	378	334	558	416	1620	57	8719	17394
2028-29	5646	390	344	578	431	1680	59	9128	18116
2029-30	5953	402	354	600	447	1743	61	9560	18877
2030-31	6264	412	363	619	461	1804	63	9986	19613
2031-32	6591	423	372	639	476	1868	65	10434	20385
2032-33	6935	434	382	659	491	1934	67	10902	21187
2033-34	7297	446	392	681	507	2002	69	11394	22026
2034-35	7678	458	402	703	523	2072	71	11907	22893
2035-36	8061	469	412	725	539	2141	73	12420	23756
2036-37	8464	481	422	747	555	2212	75	12956	24649
2037-38	8887	493	432	770	571	2286	77	13516	25579
2038-39	9331	505	443	793	588	2362	79	14101	26545
2039-40	9797	517	454	817	606	2441	82	14714	27557
2040-41	10265	529	465	840	623	2517	84	15323	28547
2041-42	10755	541	476	864	641	2596	87	15960	29583
2042-43	11269	553	487	889	660	2677	90	16625	30658
2043-44	11807	565	499	915	679	2761	93	17319	31777
2044-45	12371	578	511	941	699	2847	96	18043	32935
2045-46	12936	590	523	966	718	2930	99	18762	34073
2046-47	13526	602	535	992	737	3015	102	19509	35248
2047-48	14143	615	547	1018	757	3103	105	20288	36468
2048-49	14788	628	559	1045	777	3193	108	21098	37728

Table 6-2 : Total Tollable Traffic @ Toll Plaza 2- Badopatti 171.00 KM

(Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	4851	343	397	523	415	1379	48	7956	15792
2024-25	5127	355	410	543	431	1434	50	8350	16490
2025-26	5407	367	423	563	447	1488	52	8747	17187
2026-27	5701	379	437	584	463	1544	54	9162	17913
2027-28	6011	391	451	605	480	1602	56	9596	18667
2028-29	6339	404	465	627	497	1662	58	10052	19452
2029-30	6684	417	479	650	515	1725	60	10530	20274
2030-31	7032	429	492	671	531	1786	62	11003	21074
2031-32	7400	441	506	692	548	1849	64	11500	21908
2032-33	7787	453	520	714	565	1914	66	12019	22774
2033-34	8194	465	534	736	583	1981	68	12561	23671
2034-35	8622	478	549	759	601	2051	70	13130	24611
2035-36	9053	490	563	781	619	2119	72	13697	25537
2036-37	9506	503	578	804	637	2189	74	14291	26501
2037-38	9981	516	593	829	656	2262	76	14913	27510
2038-39	10481	529	608	854	675	2337	78	15562	28553
2039-40	11004	542	624	880	696	2414	80	16240	29640
2040-41	11531	555	639	905	715	2489	82	16916	30710
2041-42	12082	568	655	931	736	2566	84	17622	31825
2042-43	12660	581	671	957	757	2646	87	18359	32985
2043-44	13265	594	688	984	779	2728	90	19128	34190
2044-45	13899	608	706	1012	802	2813	93	19933	35448
2045-46	14533	621	723	1039	824	2894	96	20730	36678
2046-47	15197	634	741	1066	846	2978	99	21561	37954
2047-48	15891	647	759	1094	869	3065	102	22427	39279
2048-49	16616	661	777	1122	892	3154	105	23327	40646

Table 6-3 : Total Tollable Traffic @ Toll Plaza 3- Chainage 212.00 KM

(Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	4307	348	164	543	559	1883	67	7871	17402
2024-25	4552	360	169	565	581	1958	70	8255	18163
2025-26	4800	372	174	586	603	2031	73	8639	18915
2026-27	5062	384	179	608	626	2107	76	9042	19701
2027-28	5338	396	184	631	650	2186	79	9464	20520
2028-29	5629	408	190	654	674	2267	82	9904	21366
2029-30	5936	420	196	678	699	2352	85	10366	22252
2030-31	6246	432	201	700	722	2435	88	10824	23117
2031-32	6572	444	206	723	745	2521	91	11302	24014
2032-33	6915	456	211	746	769	2610	94	11801	24945
2033-34	7277	468	217	770	794	2702	97	12325	25918
2034-35	7657	480	223	795	820	2798	100	12873	26932
2035-36	8040	492	229	819	845	2890	103	13418	27926
2036-37	8442	504	235	844	871	2986	106	13988	28962
2037-38	8864	516	241	869	897	3085	109	14581	30032
2038-39	9307	529	247	895	924	3187	113	15202	31149
2039-40	9772	542	253	923	952	3293	117	15852	32314
2040-41	10239	554	259	949	979	3395	121	16496	33453
2041-42	10728	567	265	977	1007	3501	125	17170	34643
2042-43	11241	580	271	1005	1035	3610	129	17871	35870
2043-44	11779	593	277	1034	1064	3722	133	18602	37141
2044-45	12342	606	284	1064	1094	3838	137	19365	38465
2045-46	12905	619	290	1093	1123	3949	141	20120	39757
2046-47	13494	632	297	1122	1153	4064	145	20907	41099
2047-48	14109	645	304	1152	1183	4182	149	21724	42483
2048-49	14753	658	311	1183	1214	4303	153	22575	43916

Table 6-4 : Total Tollable Traffic @ Toll Plaza 1- Chainage 125.000 KM

(Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	4305	334	297	478	357	1389	49	7209	14673
2024-25	4528	343	305	494	369	1437	51	7527	15243
2025-26	4751	352	313	510	381	1483	53	7843	15803
2026-27	4986	361	321	526	393	1531	55	8173	16385
2027-28	5232	370	329	543	406	1581	57	8518	16992
2028-29	5490	379	337	560	419	1632	59	8876	17616
2029-30	5761	389	345	579	433	1685	61	9253	18273
2030-31	6033	398	352	595	445	1736	63	9622	18902
2031-32	6317	407	360	611	457	1789	65	10006	19555
2032-33	6615	416	368	628	470	1843	67	10407	20232
2033-34	6928	425	376	645	483	1899	69	10825	20934
2034-35	7255	434	384	662	496	1957	71	11259	21658
2035-36	7581	443	392	679	509	2012	73	11689	22368
2036-37	7923	452	400	696	522	2068	75	12136	23099

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2037-38	8279	461	408	713	535	2127	77	12600	23857
2038-39	8651	470	416	732	549	2187	79	13084	24644
2039-40	9040	479	424	751	563	2248	81	13586	25453
2040-41	9427	488	432	768	576	2307	83	14081	26242
2041-42	9830	497	440	787	589	2367	85	14595	27058
2042-43	10251	506	448	806	603	2428	87	15129	27899
2043-44	10689	515	457	825	617	2492	89	15684	28773
2044-45	11145	524	466	844	631	2557	91	16258	29670
2045-46	11597	533	475	863	645	2618	93	16824	30545
2046-47	12067	542	484	882	659	2681	95	17410	31447
2047-48	12557	551	493	901	673	2746	97	18018	32378
2048-49	13067	560	502	921	687	2812	99	18648	33337

Table 6-5 : Total Tollable Traffic @ Toll Plaza 2- Chainage 171.00 KM (Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	4829	340	395	520	414	1372	47	7917	15712
2024-25	5078	349	406	537	428	1419	49	8266	16321
2025-26	5328	358	417	554	442	1465	50	8614	16922
2026-27	5592	367	428	571	456	1513	52	8979	17550
2027-28	5869	376	439	589	470	1562	54	9359	18199
2028-29	6159	385	450	608	485	1613	56	9756	18876
2029-30	6463	394	462	628	500	1666	58	10171	19582
2030-31	6768	402	473	645	513	1717	60	10578	20261
2031-32	7087	411	484	662	527	1770	62	11003	20967
2032-33	7422	420	495	679	541	1824	64	11445	21693
2033-34	7772	429	506	697	556	1879	66	11905	22445
2034-35	8140	438	517	716	571	1936	68	12386	23227
2035-36	8506	447	528	734	585	1991	70	12861	23992
2036-37	8889	456	539	752	600	2047	72	13355	24782
2037-38	9289	465	550	771	615	2105	74	13869	25600
2038-39	9707	474	561	791	630	2164	76	14403	26444
2039-40	10143	483	573	811	646	2226	78	14960	27326
2040-41	10576	492	584	830	661	2284	80	15507	28177
2041-42	11029	501	596	850	676	2343	82	16077	29059
2042-43	11502	510	608	870	692	2405	84	16671	29978
2043-44	11995	519	620	890	708	2468	86	17286	30921
2044-45	12509	528	632	911	724	2533	88	17925	31897
2045-46	13017	537	644	931	739	2595	90	18553	32847
2046-47	13546	546	656	951	755	2658	92	19204	33826
2047-48	14096	555	668	972	771	2722	94	19878	34834
2048-49	14670	564	681	993	787	2788	96	20579	35877

Table 6-6 : Total Tollable Traffic @ Toll Plaza 3- Chainage 212.00 KM (Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	4286	345	163	540	555	1874	67	7830	17312
2024-25	4508	355	167	558	574	1939	69	8170	17974
2025-26	4732	364	171	576	592	2001	71	8507	18619
2026-27	4966	374	175	594	611	2066	73	8859	19293
2027-28	5212	384	180	614	630	2133	75	9228	19996
2028-29	5470	394	185	634	651	2202	77	9613	20727
2029-30	5741	404	190	655	672	2273	79	10014	21482
2030-31	6012	413	194	672	690	2342	81	10404	22203
2031-32	6295	422	198	690	708	2413	83	10809	22948
2032-33	6592	431	202	708	727	2486	85	11231	23719
2033-34	6903	441	207	728	746	2562	87	11674	24528
2034-35	7228	451	212	748	767	2640	90	12136	25371
2035-36	7553	460	217	767	786	2715	92	12590	26185
2036-37	7892	469	222	787	805	2792	95	13062	27029
2037-38	8247	479	227	807	825	2871	98	13554	27903
2038-39	8618	489	232	828	846	2952	101	14066	28808
2039-40	9006	499	237	849	868	3035	104	14598	29742
2040-41	9391	508	242	869	889	3114	107	15120	30648
2041-42	9793	517	247	890	910	3195	110	15662	31582
2042-43	10212	527	252	911	932	3278	113	16225	32547
2043-44	10649	537	257	933	954	3364	116	16810	33547
2044-45	11105	547	262	955	977	3452	119	17417	34577
2045-46	11557	556	267	976	999	3535	122	18012	35574
2046-47	12027	565	272	997	1021	3621	125	18628	36602
2047-48	12515	574	277	1019	1043	3709	128	19265	37660
2048-49	13024	584	282	1041	1066	3798	131	19926	38748

Traffic projections for Most Likely scenario are given as under

Table 6-7 : Total Tollable Traffic @ Toll Plaza 1- Chainage 125.000 KM (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	4315	335	297	479	358	1393	49	7226	14709
2024-25	4548	345	305	496	371	1444	51	7560	15309
2025-26	4783	354	313	513	384	1494	53	7894	15906
2026-27	5031	364	321	530	397	1546	55	8244	16526
2027-28	5292	374	330	549	411	1600	57	8613	17180
2028-29	5566	384	339	568	425	1656	59	8997	17856
2029-30	5854	395	348	588	440	1714	61	9400	18562
2030-31	6144	404	356	605	453	1770	63	9795	19241
2031-32	6448	413	364	623	466	1828	65	10207	19945
2032-33	6769	423	373	642	480	1888	67	10642	20686
2033-34	7105	433	382	661	494	1949	69	11093	21447
2034-35	7459	443	391	681	509	2013	71	11567	22245
2035-36	7813	453	400	700	523	2074	73	12036	23023

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2036-37	8184	463	409	720	537	2138	75	12526	23835
2037-38	8573	473	418	740	552	2203	77	13036	24673
2038-39	8980	483	427	760	567	2271	79	13567	25542
2039-40	9406	493	437	782	582	2341	81	14122	26448
2040-41	9832	503	446	802	597	2408	83	14671	27331
2041-42	10277	513	456	822	612	2477	85	15242	28246
2042-43	10742	523	466	844	628	2548	87	15838	29198
2043-44	11228	533	476	866	644	2621	89	16457	30181
2044-45	11735	543	486	889	660	2696	91	17100	31196
2045-46	12240	553	496	911	676	2767	93	17736	32189
2046-47	12768	563	506	933	692	2841	95	18398	33218
2047-48	13319	573	516	956	708	2916	97	19085	34277
2048-49	13894	583	527	979	725	2994	100	19802	35385

Table 6-8 : Total Tollable Traffic @ Toll Plaza 2- Chainage 171.00 KM (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	4840	341	395	521	414	1375	48	7934	15745
2024-25	5102	352	407	540	429	1427	50	8307	16405
2025-26	5367	362	418	559	444	1478	52	8680	17058
2026-27	5647	373	430	578	459	1530	54	9071	17736
2027-28	5941	384	443	598	475	1584	56	9481	18445
2028-29	6249	395	456	619	491	1639	58	9907	19176
2029-30	6573	406	469	640	508	1696	60	10352	19935
2030-31	6899	415	480	659	523	1752	62	10790	20671
2031-32	7241	425	492	679	538	1809	64	11248	21434
2032-33	7602	435	505	699	554	1868	66	11729	22232
2033-34	7980	446	518	720	570	1930	68	12232	23064
2034-35	8376	457	531	741	587	1994	70	12756	23927
2035-36	8773	467	544	761	603	2056	72	13276	24774
2036-37	9190	478	557	782	619	2119	74	13819	25650
2037-38	9626	489	571	803	636	2184	76	14385	26560
2038-39	10084	500	585	825	653	2251	78	14976	27504
2039-40	10562	511	599	847	671	2320	80	15590	28480
2040-41	11040	522	613	869	688	2386	82	16200	29439
2041-42	11540	533	627	891	706	2454	84	16835	30433
2042-43	12062	544	641	914	724	2524	86	17495	31460
2043-44	12608	555	655	938	742	2597	88	18183	32528
2044-45	13180	566	670	963	761	2672	90	18902	33640
2045-46	13749	577	684	986	779	2743	92	19610	34719
2046-47	14342	588	699	1010	797	2816	94	20346	35837
2047-48	14960	599	714	1035	816	2891	96	21111	36995
2048-49	15604	610	729	1060	835	2968	98	21904	38188

Table 6-9 : Total Tollable Traffic @ Toll Plaza 3- Chainage 212.00 KM (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	4298	346	164	542	557	1879	67	7853	17363
2024-25	4531	357	169	562	578	1948	69	8214	18070
2025-26	4767	368	174	582	599	2016	71	8577	18776
2026-27	5014	379	179	603	620	2086	73	8954	19504
2027-28	5274	390	184	624	642	2158	75	9347	20258
2028-29	5548	402	189	646	665	2234	78	9762	21055
2029-30	5836	414	194	668	688	2312	81	10193	21876
2030-31	6126	425	199	688	709	2388	84	10619	22676
2031-32	6431	436	204	709	730	2466	87	11063	23503
2032-33	6750	447	209	730	752	2547	90	11525	24360
2033-34	7085	458	214	752	775	2630	93	12007	25249
2034-35	7437	469	219	774	798	2716	96	12509	26168
2035-36	7790	480	224	796	820	2799	99	13008	27071
2036-37	8161	491	229	818	843	2885	102	13529	28009
2037-38	8548	502	234	841	867	2974	105	14071	28983
2038-39	8954	514	239	864	891	3065	108	14635	29986
2039-40	9379	526	244	888	916	3160	111	15224	31032
2040-41	9804	537	249	911	940	3250	114	15805	32048
2041-42	10248	548	254	934	964	3343	117	16408	33096
2042-43	10712	560	260	958	989	3439	120	17038	34189
2043-44	11196	572	266	983	1015	3538	123	17693	35321
2044-45	11703	584	272	1008	1041	3639	126	18373	36485
2045-46	12208	595	278	1032	1066	3736	129	19044	37621
2046-47	12735	606	284	1057	1092	3835	132	19741	38795
2047-48	13285	618	290	1082	1118	3937	135	20465	40006
2048-49	13858	630	296	1109	1145	4042	139	21219	41268

6.2 Modification in Concession Period

As per Article 29 of the concession agreement, if actual traffic on the project falls short or exceeds Target Traffic on project highway on defined date, concession period shall be modified subject to calculation stipulated therein. For Kaithal – Rajasthan Border project, the Target Date and Target Traffic are defined as under:

Target Date - 1st April 2023

Target Traffic - 21919 in PCU

It was observed that as per traffic projections, average traffic volume falls short of target traffic in all scenarios. Probable extension of concession period is estimated according to article 29 of concession agreement which comes to about 5 years.

Traffic forecast and revenue projections are done for probable extended period accordingly.

Most Likely

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2023	21919	15947	-27%	41%	20%	27	5.4

Optimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2023	21919	15989	-27%	41%	20%	27	5.4

Pessimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2023	21919	15907	-27%	41%	20%	27	5.4

CHAPTER 7

FORECAST OF TOLL REVENUE

7.1 General

This chapter presents the tolling rate calculations, categories and toll revenue of the project.

7.2 Discount Categories

As per the Toll Notification (Schedule - R) the discounts and special provisions have been considered. In addition to discounts as per Fee Notification concessionaire has declared special category rates also. Salient features of toll rate structure are given as under

1. Monthly Pass: For frequent users monthly pass would be issued at fee 50 time the single journey fee.
2. Multiple Journeys (for Return Trip): Will be charged at 1.5 times single journey.
3. Single Journey: Full single journey toll would be charged to this category of vehicles who are infrequent travelers or whose frequency does not yield any discount from the above categories.
4. Local Discounts: Local Car Jeep Van - Rs. 275 per month (for locals residing within a radius of 20 kms from toll plaza) and local commercial and 50% rate of single trip.

Building of inflation and escalation of rate on the basis of WPI are done as per toll notification (Schedule G) as given under as extract from concession agreement.

The formula for determining the applicable rate of fee shall be as follows:-

$$\text{Applicable rate of fee} = \text{base rate} + \text{base rate} \times \left\{ \frac{\text{WPI A-WPI B}}{\text{WPI B}} \right\} \times 0.4$$

Factor of inflation / growth has been incorporated as per Schedule R. WPI numbers (2011-12 series) are available up to 2018-19. A moderate growth in Wholesale Price

Index (WPI) has been assumed after that. The following graph provides historical rate of inflation (WPI) in India. Data has been sourced from the Office of Economic Advisor web site (www.eaindustry.nic.in) WPI for year 2017-18 and 2018-2019 is worked back by applying a correlation factor for 2004-05 series as 2017-18 and 2018-2019 data is available in 2011-12 series only. Ratio of WPI for year 2016-17 for both series is used for conversion of WPI in 2004-05 series

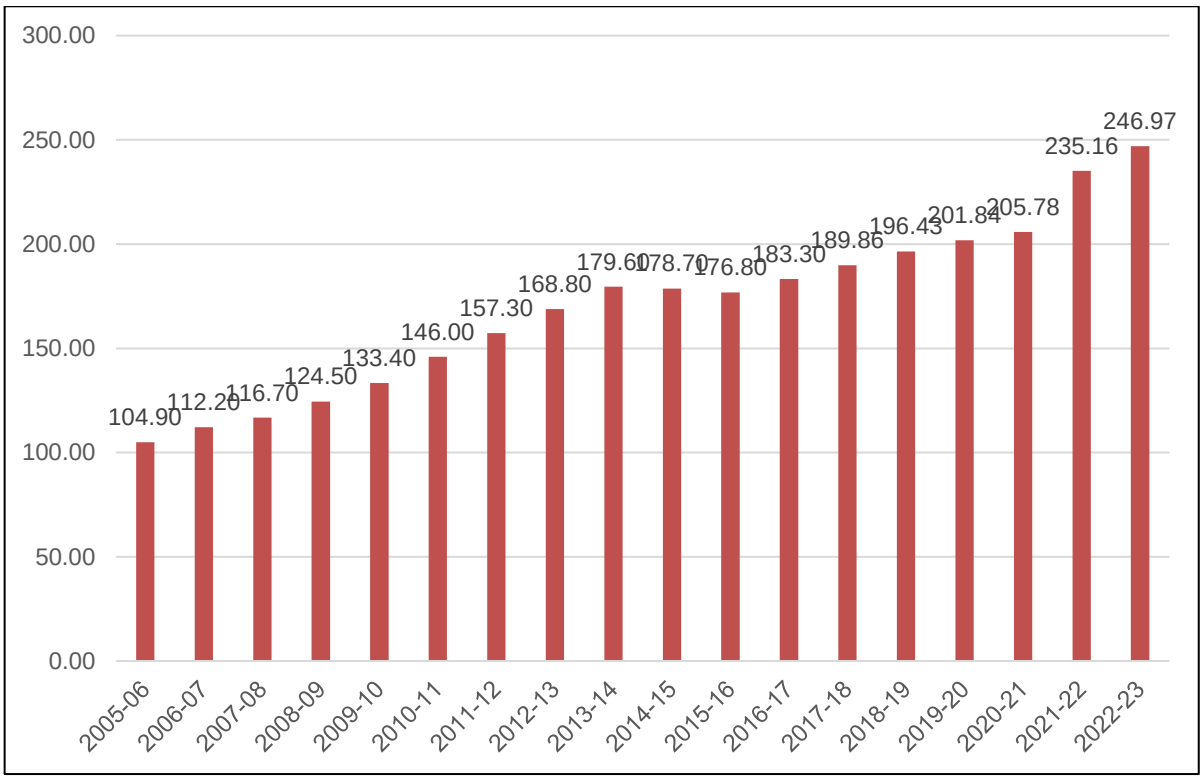


Figure 7-1 : Historical Rate of WPI Inflation in India

Average inflation in WPI in last few years is steadily growing. It grew in range of 4% - 5% in previous years. For future years initially it is takes 5% and Suitably Stepped down for future years.

7.3 Estimation of Toll Rates

As per the applicable MORTH notification and Schedule R of contract agreement, the following Base rate of fee for the categories mentioned in the table stands true in the National Highways Fee Rules applicable for contract.

Table 7-1 : Base Toll Rates June 2007-08

Type of Vehicle	Base Rate of Fee / Km (in Rs.)
Car, Jeep, Van or Light Motor Vehicle	0.65
Light Commercial Vehicle, Light Goods Vehicle or Minibus	1.05

Bus or Truck (Two Axles)	2.20
Three Axle Commercial Vehicles	2.40
Heavy Construction Machinery (HCM) or Earth Moving Equipment (EME) or Multi Axle Vehicle (MAV) (4 to 6 axles)	3.45
Oversized Vehicles (7 or more Axles)	4.20

Toll rates are calculated as per guidelines provided in schedule R (rounded to nearest Rs.) for the concession period and are given below.

Thus worked out rates for various categories of vehicle and discounts are given as under

Table 7-2 : Toll Rates for Single Journey @ Km 125.000

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	90	140	295	295	325
2024-25	90	150	310	310	340
2025-26	95	155	330	330	360
2026-27	100	165	345	345	375
2027-28	105	170	360	360	395
2028-29	110	180	380	380	415
2029-30	115	190	395	395	435
2030-31	125	200	415	415	455
2031-32	130	210	435	435	475
2032-33	135	220	460	460	500
2033-34	140	230	480	480	525
2034-35	150	240	505	505	550
2035-36	155	250	530	530	575
2036-37	165	265	555	555	605
2037-38	170	275	580	580	635
2038-39	180	290	610	610	665
2039-40	190	305	640	640	700
2040-41	200	320	670	670	735
2041-42	210	335	705	705	770
2042-43	220	355	740	740	810
2043-44	230	370	780	780	850
2044-45	240	390	815	815	890
2045-46	255	410	860	860	935
2046-47	265	430	900	900	985
2047-48	280	450	945	945	1035
2048-49	295	475	995	995	1085

Table 7-3 : Toll Rates for Single Journey @ Km 171.00

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	120	190	400	400	440
2024-25	125	200	420	420	460
2025-26	130	210	445	445	485
2026-27	140	220	465	465	510
2027-28	145	235	490	490	535
2028-29	150	245	510	510	560
2029-30	160	255	535	535	585
2030-31	165	270	565	565	615
2031-32	175	280	590	590	645
2032-33	185	295	620	620	675
2033-34	190	310	650	650	710
2034-35	200	325	680	680	740
2035-36	210	340	715	715	780
2036-37	220	355	750	750	815
2037-38	230	375	785	785	855
2038-39	245	395	825	825	900
2039-40	255	415	865	865	945
2040-41	270	435	910	910	990
2041-42	280	455	955	955	1040
2042-43	295	480	1000	1000	1090
2043-44	310	500	1050	1050	1145
2044-45	325	525	1105	1105	1205
2045-46	345	555	1160	1160	1265
2046-47	360	580	1220	1220	1330
2047-48	380	610	1280	1280	1395
2048-49	395	640	1345	1345	1465

Table 7-4 : Toll Rates for Single Journey @ Km 212.00

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	70	110	235	235	255
2024-25	70	115	245	245	265
2025-26	75	125	255	255	280
2026-27	80	130	270	270	295
2027-28	85	135	285	285	310
2028-29	90	140	295	295	325
2029-30	90	150	310	310	340
2030-31	95	155	325	325	355
2031-32	100	165	340	340	375
2032-33	105	170	360	360	390
2033-34	110	180	375	375	410
2034-35	115	190	395	395	430
2035-36	120	195	415	415	450
2036-37	130	205	435	435	475
2037-38	135	215	455	455	495
2038-39	140	230	480	480	520
2039-40	150	240	500	500	545

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2040-41	155	250	525	525	575
2041-42	165	265	555	555	605
2042-43	170	275	580	580	635
2043-44	180	290	610	610	665
2044-45	190	305	640	640	700
2045-46	200	320	670	670	735
2046-47	210	335	705	705	770
2047-48	220	355	740	740	810
2048-49	230	370	780	780	850

Table 7-5 : Toll Rates for Return Journey @ Km 125.000

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	130	215	445	445	485
2024-25	140	225	470	470	510
2025-26	145	235	490	490	535
2026-27	155	245	515	515	565
2027-28	160	260	540	540	590
2028-29	170	270	570	570	620
2029-30	175	285	595	595	650
2030-31	185	300	625	625	680
2031-32	195	310	655	655	715
2032-33	205	330	685	685	750
2033-34	215	345	720	720	785
2034-35	225	360	755	755	825
2035-36	235	380	790	790	865
2036-37	245	395	830	830	905
2037-38	260	415	870	870	950
2038-39	270	435	915	915	1000
2039-40	285	460	960	960	1050
2040-41	300	480	1010	1010	1100
2041-42	315	505	1060	1060	1155
2042-43	330	530	1110	1110	1210
2043-44	345	555	1165	1165	1275
2044-45	360	585	1225	1225	1335
2045-46	380	615	1285	1285	1405
2046-47	400	645	1350	1350	1475
2047-48	420	680	1420	1420	1550
2048-49	440	710	1490	1490	1625

Table 7-6 : Toll Rates for Return Journey @ Km 171.00

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	180	290	600	600	655
2024-25	185	300	635	635	690
2025-26	195	315	665	665	725
2026-27	205	335	700	700	765
2027-28	215	350	735	735	800
2028-29	225	365	770	770	840
2029-30	240	385	805	805	880
2030-31	250	405	845	845	920
2031-32	260	420	885	885	965
2032-33	275	445	930	930	1010
2033-34	290	465	975	975	1060
2034-35	300	485	1020	1020	1115
2035-36	315	510	1070	1070	1170
2036-37	330	535	1125	1125	1225
2037-38	350	565	1180	1180	1285
2038-39	365	590	1235	1235	1350
2039-40	385	620	1300	1300	1415
2040-41	405	650	1365	1365	1485
2041-42	425	685	1430	1430	1560
2042-43	445	715	1500	1500	1640
2043-44	465	755	1575	1575	1720
2044-45	490	790	1655	1655	1805
2045-46	515	830	1740	1740	1900
2046-47	540	870	1825	1825	1995
2047-48	565	915	1920	1920	2095
2048-49	595	965	2015	2015	2200

Table 7-7 : Toll Rates for Return Journey @ Km 212.00

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	105	165	350	350	380
2024-25	110	175	365	365	400
2025-26	115	185	385	385	420
2026-27	120	195	405	405	440
2027-28	125	205	425	425	465
2028-29	130	210	445	445	485
2029-30	140	225	465	465	510
2030-31	145	235	490	490	535
2031-32	150	245	515	515	560
2032-33	160	255	540	540	585
2033-34	165	270	565	565	615
2034-35	175	280	590	590	645
2035-36	185	295	620	620	675
2036-37	190	310	650	650	710
2037-38	200	325	685	685	745

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2038-39	210	340	715	715	780
2039-40	220	360	750	750	820
2040-41	235	375	790	790	860
2041-42	245	395	830	830	905
2042-43	255	415	870	870	950
2043-44	270	435	915	915	995
2044-45	285	460	960	960	1045
2045-46	300	480	1010	1010	1100
2046-47	315	505	1060	1060	1155
2047-48	330	530	1110	1110	1215
2048-49	345	560	1170	1170	1275

Table 7-8 : Toll Rates for Monthly Pass Local @ Km125.000

Year	Car	Mini Bus /LCV
2023-24	330	330
2024-25	345	345
2025-26	365	365
2026-27	385	385
2027-28	400	400
2028-29	420	420
2029-30	440	440
2030-31	460	460
2031-32	485	485
2032-33	510	510
2033-34	535	535
2034-35	560	560
2035-36	585	585
2036-37	615	615
2037-38	645	645
2038-39	680	680
2039-40	710	710
2040-41	745	745
2041-42	785	785
2042-43	825	825
2043-44	865	865
2044-45	905	905
2045-46	955	955
2046-47	1000	1000
2047-48	1050	1050
2048-49	1105	1105

Table 7-9 : Toll Rates for Monthly Pass Local @ Km171.000

Year	Car	Mini Bus /LCV
2023-24	330	330
2024-25	345	345
2025-26	365	365
2026-27	385	385
2027-28	400	400
2028-29	420	420
2029-30	440	440
2030-31	460	460
2031-32	485	485
2032-33	510	510
2033-34	535	535
2034-35	560	560
2035-36	585	585
2036-37	615	615
2037-38	645	645
2038-39	680	680
2039-40	710	710
2040-41	745	745
2041-42	785	785
2042-43	825	825
2043-44	865	865
2044-45	905	905
2045-46	955	955
2046-47	1000	1000
2047-48	1050	1050
2048-49	1105	1105

Table 7-10 : Toll Rates for Monthly Pass Local @ Km212.000

Year	Car	Mini Bus /LCV
2023-24	330	330
2024-25	345	345
2025-26	365	365
2026-27	385	385
2027-28	400	400
2028-29	420	420
2029-30	440	440
2030-31	460	460
2031-32	485	485
2032-33	510	510
2033-34	535	535
2034-35	560	560
2035-36	585	585
2036-37	615	615

Year	Car	Mini Bus /LCV
2037-38	645	645
2038-39	680	680
2039-40	710	710
2040-41	745	745
2041-42	785	785
2042-43	825	825
2043-44	865	865
2044-45	905	905
2045-46	955	955
2046-47	1000	1000
2047-48	1050	1050
2048-49	1105	1105

Table 7-11 : Toll Rates for Monthly Pass @ Km125.000

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2023-24	2925	4725	9900	9900	10805
2024-25	3075	4965	10405	10405	11350
2025-26	3230	5220	10935	10935	11930
2026-27	3395	5485	11490	11490	12535
2027-28	3560	5750	12045	12045	13140
2028-29	3730	6025	12625	12625	13770
2029-30	3910	6315	13235	13235	14435
2030-31	4100	6620	13875	13875	15135
2031-32	4300	6940	14545	14545	15870
2032-33	4505	7280	15255	15255	16640
2033-34	4725	7635	15995	15995	17450
2034-35	4955	8010	16780	16780	18305
2035-36	5200	8400	17600	17600	19200
2036-37	5455	8815	18465	18465	20145
2037-38	5725	9245	19375	19375	21135
2038-39	6005	9705	20330	20330	22180
2039-40	6305	10185	21340	21340	23280
2040-41	6620	10690	22400	22400	24435
2041-42	6945	11220	23515	23515	25650
2042-43	7295	11785	24685	24685	26930
2043-44	7660	12370	25925	25925	28280
2044-45	8045	12995	27225	27225	29700
2045-46	8450	13645	28595	28595	31195
2046-47	8875	14335	30035	30035	32765
2047-48	9325	15060	31555	31555	34420
2048-49	9795	15820	33150	33150	36165

Table 7-12 : Toll Rates for Monthly Pass @ Km 171.00

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2023-24	3955	6390	13390	13390	14605
2024-25	4155	6715	14065	14065	15345
2025-26	4365	7055	14780	14780	16125
2026-27	4590	7415	15535	15535	16950
2027-28	4810	7770	16285	16285	17765
2028-29	5045	8145	17065	17065	18620
2029-30	5285	8540	17890	17890	19515
2030-31	5540	8950	18755	18755	20460
2031-32	5810	9385	19665	19665	21455
2032-33	6095	9840	20620	20620	22495
2033-34	6390	10320	21625	21625	23590
2034-35	6700	10825	22685	22685	24745
2035-36	7030	11355	23795	23795	25955
2036-37	7375	11915	24965	24965	27235
2037-38	7740	12500	26195	26195	28575
2038-39	8120	13120	27485	27485	29985
2039-40	8525	13770	28850	28850	31470
2040-41	8945	14450	30280	30280	33035
2041-42	9390	15170	31790	31790	34680
2042-43	9860	15930	33375	33375	36410
2043-44	10355	16725	35045	35045	38230
2044-45	10875	17565	36805	36805	40150
2045-46	11420	18450	38655	38655	42170
2046-47	11995	19380	40605	40605	44295
2047-48	12605	20360	42660	42660	46535
2048-49	13240	21390	44820	44820	48895

Table 7-13 : Toll Rates for Monthly Pass @ Km 212.00

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2023-24	2290	3705	7760	7760	8465
2024-25	2410	3890	8150	8150	8890
2025-26	2530	4090	8565	8565	9345
2026-27	2660	4295	9005	9005	9820
2027-28	2790	4505	9435	9435	10295
2028-29	2920	4720	9890	9890	10790
2029-30	3065	4950	10370	10370	11310
2030-31	3210	5190	10870	10870	11855
2031-32	3365	5440	11395	11395	12430
2032-33	3530	5705	11950	11950	13035
2033-34	3705	5980	12530	12530	13670
2034-35	3885	6275	13145	13145	14340
2035-36	4075	6580	13790	13790	15040
2036-37	4275	6905	14465	14465	15780

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2037-38	4485	7245	15180	15180	16560
2038-39	4705	7600	15930	15930	17375
2039-40	4940	7980	16715	16715	18235
2040-41	5185	8375	17550	17550	19145
2041-42	5445	8790	18420	18420	20095
2042-43	5715	9230	19340	19340	21100
2043-44	6000	9695	20310	20310	22155
2044-45	6300	10180	21330	21330	23265
2045-46	6620	10690	22400	22400	24440
2046-47	6950	11230	23530	23530	25670
2047-48	7305	11800	24720	24720	26970
2048-49	7675	12395	25975	25975	28335

7.4 Toll Revenue

As indicated earlier, toll revenue on the Project Road has been calculated in all three scenarios based on above rates and projected traffic. The estimates of toll revenue under ***Optimistic***, ***Pessimistic*** and ***Most Likely*** growth scenarios are presented in the following section.

7.5 Toll Revenue at all toll plazas under Scenarios

Toll Revenue estimates under all scenario at each of the toll plaza up to 2048-49 starting from the year 2022-23 are shown in tables below.

Table 7-14 : Toll Revenue Optimistic Scenario

(Rs. Crores)

Year	TP-1	TP2	TP3	Total
2023-24	48.52	69.85	46.77	**165.14**
2024-25	52.90	75.97	50.83	**179.70**
2025-26	57.83	83.20	55.74	**196.76**
2026-27	63.31	91.29	61.01	**215.61**
2027-28	69.12	99.89	66.81	**235.82**
2028-29	75.55	108.60	72.48	**256.62**
2029-30	82.24	118.87	79.08	**280.19**
2030-31	90.11	129.14	85.68	**304.93**
2031-32	98.18	141.12	93.48	**332.79**
2032-33	106.70	153.69	101.57	**361.96**
2033-34	116.00	166.92	110.58	**393.50**
2034-35	126.61	181.43	120.68	**428.71**
2035-36	137.67	198.21	131.43	**467.31**
2036-37	149.60	214.83	142.59	**507.03**
2037-38	162.19	233.79	154.90	**550.88**
2038-39	176.64	255.04	168.31	**599.99**
2039-40	193.42	277.89	183.63	**654.94**
2040-41	209.83	301.79	199.09	**710.71**

Year	TP-1	TP2	TP3	Total
2041-42	227.94	327.18	216.49	**771.62**
2042-43	247.64	355.66	234.47	**837.77**
2043-44	269.81	387.64	255.93	**913.38**
2044-45	291.82	420.51	278.01	**990.34**
2045-46	317.84	457.72	301.63	**1077.20**
2046-47	344.65	496.15	326.75	**1167.55**
2047-48	375.50	538.79	304.28	**1218.56**
2048-49	406.75	584.72	330.37	**1321.84**

Table 7-15 : Toll Revenue Pessimistic Scenario

(Rs. Crores)

Year	TP-1	TP2	TP3	Total
2023-24	48.28	69.51	46.55	**164.33**
2024-25	52.37	75.24	50.33	**177.94**
2025-26	56.99	82.00	54.90	**193.89**
2026-27	62.08	89.59	59.79	**211.46**
2027-28	67.47	97.54	65.14	**230.15**
2028-29	73.42	105.51	70.34	**249.27**
2029-30	79.61	114.92	76.39	**270.92**
2030-31	86.82	124.27	82.35	**293.44**
2031-32	94.15	135.19	89.45	**318.79**
2032-33	101.82	146.53	96.73	**345.09**
2033-34	110.21	158.44	104.81	**373.47**
2034-35	119.78	171.40	113.85	**405.02**
2035-36	129.66	186.41	123.42	**439.49**
2036-37	140.24	201.12	133.27	**474.63**
2037-38	151.33	217.83	144.12	**513.28**
2038-39	164.03	236.60	155.85	**556.48**
2039-40	178.68	256.69	169.23	**604.60**
2040-41	192.89	277.54	182.59	**653.02**
2041-42	208.49	299.53	197.58	**705.59**
2042-43	225.37	324.05	212.90	**762.32**
2043-44	244.35	351.40	231.23	**826.97**
2044-45	262.95	379.31	249.93	**892.20**
2045-46	285.05	410.90	269.84	**965.78**
2046-47	307.56	443.26	290.88	**1041.69**
2047-48	333.53	478.98	269.58	**1082.09**
2048-49	359.58	517.35	291.27	**1168.20**

Table 7-16 : Toll Revenue Most Likely Scenario

(Rs. Crores)

Year	TP-1	TP2	TP3	Total
2023-24	48.43	69.66	46.65	**164.74**
2024-25	52.67	75.58	50.55	**178.81**
2025-26	57.46	82.58	55.28	**195.33**
2026-27	62.76	90.39	60.36	**213.51**
2027-28	68.36	98.64	65.92	**232.92**
2028-29	74.59	106.96	71.39	**252.94**
2029-30	81.04	116.83	77.71	**275.59**
2030-31	88.63	126.60	84.01	**299.25**
2031-32	96.33	138.03	91.47	**325.83**
2032-33	104.46	149.99	99.14	**353.60**
2033-34	113.27	162.62	107.67	**383.57**
2034-35	123.38	176.42	117.17	**416.97**
2035-36	133.84	192.35	127.32	**453.51**
2036-37	145.08	208.03	137.78	**490.88**
2037-38	156.93	225.85	149.33	**532.11**
2038-39	170.44	245.87	161.85	**578.16**
2039-40	186.09	267.33	176.18	**629.60**
2040-41	201.37	289.69	190.54	**681.60**
2041-42	218.11	313.38	206.67	**738.16**
2042-43	236.33	339.77	223.22	**799.33**
2043-44	256.81	369.30	243.04	**869.15**
2044-45	277.04	399.52	263.30	**939.85**
2045-46	301.01	433.78	284.90	**1019.69**
2046-47	325.56	468.92	307.83	**1102.32**
2047-48	353.83	507.78	285.95	**1147.56**
2048-49	382.45	549.61	309.73	**1241.80**

CHAPTER 8

CONCLUSION & RECOMMENDATIONS

8.1 Conclusion & Recommendations

Project stretch of Kaithal to Rajasthan Border section of NH-152/65 in state of Haryana from km 33.250 to km 241.580 has been widened to four lane. The road is in sound condition and serves healthy traffic volumes. Project corridor has potential to develop as main link for traffic from Punjab, Haryana, and parts of Himachal to Rajasthan and south. There are large number of townships, industrial corridors and other business establishment coming up along project corridor. As Indian economy is poised to grow at 7%+ post COVID-19, the project corridor is expected to pick up the same trend in terms of traffic flow. All these developments have potential to give positive impact to traffic flow on project. The following can be considered as major outcomes of the study

a) There is good amount of tollable traffic running on project

b) Project corridor has potential to witness traffic growth @ 6-8% annually in near future due to various development in area and overall development of economy

c) Project corridor has committed traffic as long route traffic and does not run a risk of traffic leakage due to quality competing road

Based on above it can be considered a stable healthy project from traffic and revenue point of view.

.

GMD Consultants
503-504, Mayuresh Chambers Premises, Plot No. 60,
Sector -11, CBD Belapur, Navi Mumbai. 400 614.
Maharashtra.
Phone : +91-22-2756 4586 / 2756 5313
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

AGRA TO ETAWAH (KM 199.660 TO KM 323.525) SECTION OF NH-2 IN THE STATE OF UTTAR PRADESH.

APRIL 2023

TRAFFIC STUDY & REVENUE PROJECTION REPORT (FINAL)

GMD Consultants

503, Mayuresh Chambers, Plot No. 60, Sector -11,
CBD Belapur, Navi Mumbai. 400 614. Maharashtra.
Phone : +91-22-2756 4586 / 2756 5313
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

AGRA TO ETAWAH (KM 199.660 TO KM 323.525)

SECTION OF NH-2 IN THE STATE OF

UTTAR PRADESH.

TRAFFIC STUDY & REVENUE PROJECTION REPORT (FINAL)

APRIL 2023

GMD CONSULTANTS
NAVI MUMBAI

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AADT	-	Annual Average Daily Traffic	**NHAI**	-	National Highway Authority of India
BOT	-	Build Operate Transfer	**NHDP**	-	National Highways Development Project
CAGR	-	Compound Annual Growth Rate	**NSDP**	-	Net State Domestic Product
CTV	-	Classified traffic volume	**O&M**	-	Operation & Maintenance
DBFOT	-	Design, Build, Finance, Operate & Transfer	**PCDP**	-	Per Capita Domestic Product
EME	-	Earth Moving Equipment	**PCI**	-	Per Capita Income
GDP	-	Gross Domestic Product	**PCU**	-	Passenger Car Unit
GSDP	-	Gross State Domestic Product	**PSC**	-	Pre-stressed Concrete
HCM	-	Heavy Construction Machinery	**RCC**	-	Reinforced cement concrete
HCV	-	Heavy Commercial Vehicle	**RHS**	-	Right Hand Side
HTMS	-	Highway Traffic Management System	**SH**	-	State Highway
IRC	-	Indian Road Congress	**TP**	-	Toll Plaza
IRR	-	Internal Rate of Return	**WPI**	-	Wholesale Price Index
LCV	-	Light Commercial Vehicle	**SIR**	-	Special Investment Region
LHS	-	Left Hand Side	**c.**	-	Circa
LGV	-	Light Goods Vehicle	**ROB**	-	Railway Over Bridge
MAV	-	Multi Axle Vehicle	**MDR**	-	Major District Road
MORTH	-	Ministry of Road Transport and Highways	**ODR**	-	Other District Road
NH	-	National Highway	**CA**	-	Concession Agreement
PCC	-	Plain Cement Concrete	**RMT**	-	Running Meter
CR	-	Coarse Rubble			

CHAPTER 1

INTRODUCTION

1.1 Background

The Government of India through National Highway Authority of India (NHAI) embarked upon a program to enhance the traffic capacity and safety for efficient transportation of goods as well as passenger traffic on National Highway Sections under NHDP Phase V. Under Phase V NHAI has planned to convert 6,500 km of existing 4-lane National Highways into 6-lane National Highway. Sections envisaged under 6-laning comprise the Golden Quadrilateral section (5,700 km) and some other sections which are 800 km in length.

The project under consideration, **Agra** to **Etawah** section of NH-2 from km 199.660 to km 323.525is one such road project NHAI intended to implement on a BOT basis in the DBFOT format. *M/s AE Tollway. Ltd*. (Concessionaire) has been awarded the Project for a concession period of 24 years starting from 1st August 2016. The Project has been commissioned and is currently in the operation / maintenance phase. Six Laning of project has also been completed in Nov 2020.

Length of project road is 123.865 Kms. The project road is section of NH-2, which starts from Delhi and ends at Kolkata and is a part of the Golden Quadrilateral Project. The project road section passes through the districts of Agra, Firozabad and Etawah.

Project road alignment passes through the towns/ built-up areas of Tundla, Firozabad, Shikohabad, Sirsaganj, & Jaswantnagar. Following figure shows alignment of project road section from Agra to Etawah.

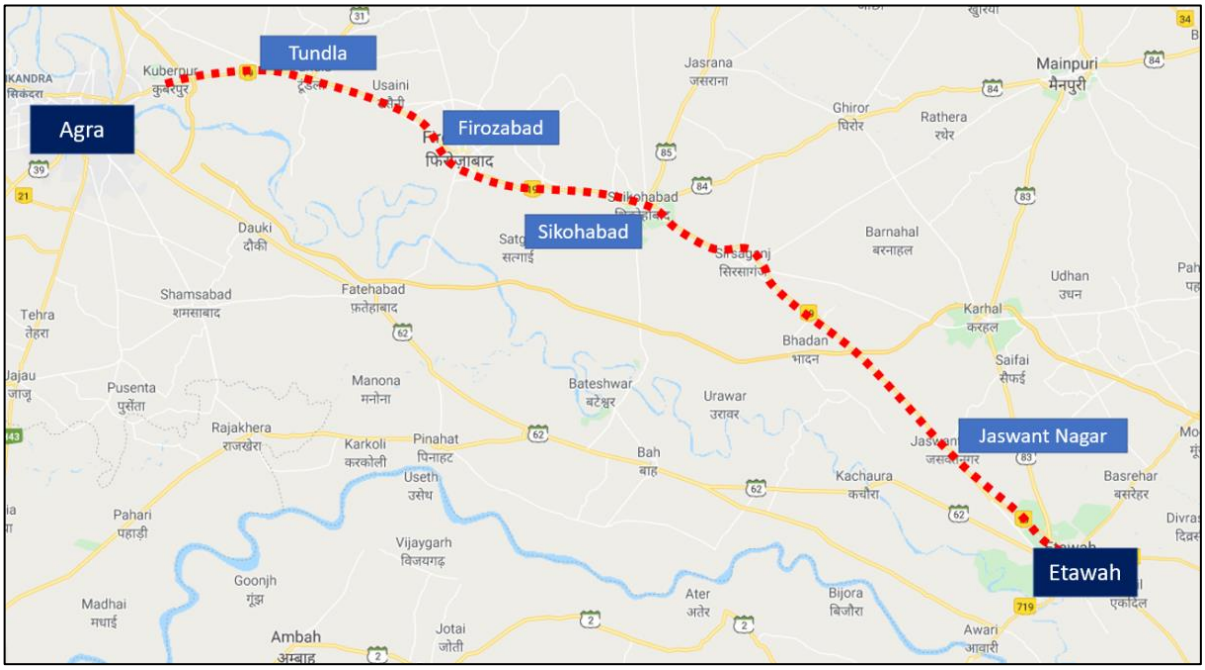


Figure 1-1: Alignment of Project Stretch

1.2 Objective of the Study

M/s IRB INFRASTRUCTURE TRUST has engaged *GMD Consultants* to assess the future traffic and toll potential of project along with related operation & maintenance expenditure involved.

This report named as **"Traffic Study &*Toll Revenue Projection Report*"** mainly focuses on traffic and revenue aspects of the project. Other parameters like competing road, area developments etc. have been considered from a traffic development point of view.

1.2.1 Scope of Services

The broad scope of work covered in the assignment is as follows

a) Analysis of Traffic Growth
b) Toll Rate Growth
c) Revenue Forecasting

The Concessionaire has provided basic traffic data and other project details on the basis of which the above analysis has been carried out.

CHAPTER 2

PROJECT DETAILS

2.1 Project Corridor

National Highway 2 (NH 2) which is now renumbered as NH-19 is oldest highway in India and connects state of Delhi, Haryana, Uttar Pradesh, Bihar, Jharkhand and West Bengal. It constitutes a major portion of historical grand truck road.

It connects the national capital Delhi to the Kolkata, as well as important cities Mathura, Agra, Kanpur, Allahabad, Varanasi, Dhanbad, Asansol, Durgapur and Bardhman. The highway is part of the Golden Quadrilateral project undertaken by National Highways Authority of India (NHAI).

The project road is a link between Agra and Kanpur in the state of Uttar Pradesh. The main project influence area of the project road consists of the three districts through which the project road passes. In addition, the project influence area includes the districts of Kanpur, Mathura and Aligarh also.

2.2 Project Stretch Description

Section of NH-2 from Agra to Etawah is part of major transportation link in the area connecting industrial cities of Agra- Kanpur and Lucknow. Important cities of Firozabad, Shikohabad, and Jaswant Nagar fall on project alignment. Firozabad has famous glass work industry. Like other parts of India rapid ribbon development is happening around these cities on project highway. This also contributes to sustainable traffic growth.

There are two operative toll plazas at project stretch. First is at Tundla at Km 224.950 and second at Gurau at Km 285.200. Following figure show project alignment and toll plaza locations.

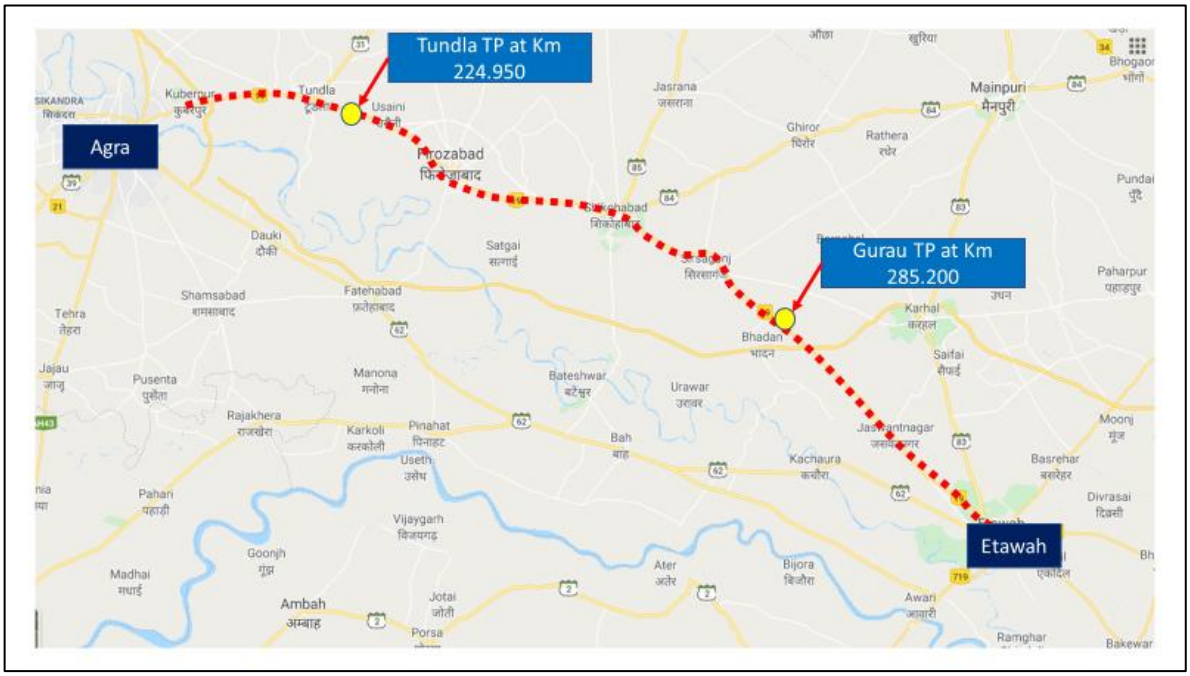


Figure 2-1: Project Alignment with Toll Plaza

2.3 Project Corridor Illustration

Six laning of project stretch is complete. Following photographs illustrate project section along the corridor.

Figure 2-2: Photographs showing Project Corridor

CHAPTER 3

TRAFFIC SURVEYS AND ANALYSIS

3.1 Traffic Surveys

The Consultants have collected the required information for project corridor to understand the general traffic and travel characteristics on the corridor.

The following traffic data has been collected from client for project.

- Classified traffic volume counts at toll plaza locations on Agra- Etawah section of NH-2 for year 2017-18, 2018-19, 2019-20, 2020-21 ,2021-22 and traffic data from April 2022 to March 2023.
- Local Component of traffic
- Component of Return Journey
- Component of Monthly Pass Journey

The main objective of the traffic data analysis is to:

- Determine the existing traffic movement characteristics of the project
- Establish base year traffic
- Identification of travel patterns and modal split of project traffic
- Deriving growth factors for traffic forecasting
- Estimation of corridor traffic including traffic diversion if any
- Preparation of revenue model and projection of revenue as per toll policy for various scenarios

Table 3-1below lists provides details of locations from where traffic details have been collected.

Table 3-1 : Traffic Data Details

SR. NO	LOCATION	CTV	Single Journey Traffic	Daily Return Journey	Monthly Pass	Local Pass
1	Km 224.950 Toll Plaza at Tundla	AADT for Year 2017-18, 2018-19, 2019-20,2020-21 ,2021-22 & 2022-2023	For Year 2017-18, 2018-19, 2019-20, 2020-21, 2021-22 & 2022-2023	For Year 2017-18, 2018-19, 2019-20, 2020-21, 2021-22 & 2022-2023	For Year 2017-18, 2018-19, 2019-20, 2020-21, 2021-22 & 2022-2023	For Year 2017-18, 2018-19, 2019-20, 2020-21, 2021-22 & 2022-2023
2	Km 285.200 Toll Plaza at Gurau	AADT for Year 2017-18, 2018-19, 2019-20,2020-21 ,2021-22 & 2022-2023	For Year 2017-18, 2018-19, 2019-20, 2020-21,2021-22 & 2022-2023	For Year 2017-18, 2018-19, 2019-20, 2020-21,2021-22 & 2022-2023	For Year 2017-18, 2018-19, 2019-20, 2020-21,2021-22 & 2022-2023	For Year 2017-18, 2018-19, 2019-20, 2020-21 ,2021-22 & 2022-2023

Toll plaza no. 1 & 2 are located in Uttar Pradesh.

3.2 Classified Traffic Volume

The objective of conducting a Classified Traffic Volume Count is to understand the traffic flow pattern including modal split on a roadway. The Classified Traffic Volume Count survey has been provided by the concessionaire of project highway from actual traffic data gathered at toll plaza locations based on monthly data shared with NHAI.

The vehicles can broadly be classified into fast moving / motorized and slow moving / non-motorized vehicles, which can be further classified into specific categories of vehicles. The groupings of vehicles are further segregated to capture the tollable vehicle categories specifically and toll exempted vehicles are counted separately. The detailed vehicle classification system as per IRC: 64-1990 is given in table below

Table 3-2 : Vehicle Classification System

Vehicle Type	
Auto Rickshaw	
Passenger Car	Car, Jeep, Taxi & Van (Old / new technology)
Bus	Minibus
	Standard Bus
Truck	Light Goods Vehicle (LCV)
	2 – Axle Truck
	3 Axle Truck (HCV)
	Multi Axle Truck (4-6 Axle)
	Oversized Vehicles (7 or more axles)
Other Vehicles	Agriculture Tractor, Tractor & Trailer

Source - IRC: 64 – 1990

However, since project highway is currently under toll operation, the data collected is corresponding to category of tollable vehicles. Following are the type of vehicles as per concession agreement.

- Car / Jeep / van
- Min Bus /LCV
- Bus
- Truck
- 3-Axle
- Multi Axle

3.3 Traffic Characteristic

Toll revenue of project highway does not solely depend on traffic volume. There are certain characteristics of traffic which have substantial potential to affect toll collection. Component of local traffic, component of passenger and commercial traffic, portion of return journey traffic, % of monthly pass traffic are some of such characteristics of traffic. These will be discussed in subsequent sections of report.

3.3.1 Traffic Data

Project concessionaire has provided Traffic data for year 2019-20 ,2020-21, 2021-22 and from April 2022 to March 2023 as under for both toll plazas–

Table 3-3 : Traffic Data at Gurau Toll Plaza at Km 285.200

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)-2019-20	Annual Average Daily Traffic (Nos.)-2020-21	Annual Average Daily Traffic (Nos.)-2021-22	Annual Average Daily Traffic (Nos.)-2022-23
1	CAR	2071	3535	5268	3371
2	LCV	1097	1286	919	748
3	BUS	494	492	635	530
4	Truck	891	1100	1351	1410
5	3-Axle	901	909	882	839
6	Multi Axle	1426	1760	2138	2386
7	Oversize Vehicle	11	8	4	10
	Total	**6892**	**9090**	**11197**	**9292**

Table 3-4 : Traffic Data at Tundla Toll Plaza at Km 224.950

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)-2019-20	Annual Average Daily Traffic (Nos.)-2020-21	Annual Average Daily Traffic (Nos.)-2021-22	Annual Average Daily Traffic (Nos.)-2022-23
1	CAR	8324	5849	7347	8954
2	LCV	1917	1514	1012	1082
3	BUS	1148	777	856	1181
4	Truck	1309	1272	1506	1775
5	3-Axle	955	948	924	887
6	Multi Axle	1255	1725	2179	2372
7	Oversize Vehicle	10	11	8	10

	Total	**14918**	**12096**	**13832**	**16260**

Pandemic of COVID-19 (Corona Virus) had impacted entire world. Taking precaution, government of India announced a complete lockdown in last of March 2020 and traffic on highways was stopped which was eased out progressively later. There after India was hit by Covid-19 second and third wave in February 21 to July - 21 and December 21 to March-22. Recovering traffic pattern was somewhat again disturbed due to second and third wave of Covid-19. Traffic numbers of for period from April-2020 to March 2021 were not representative of traffic pattern at project corridor due to pandemic lockdown impact. However, for integrity of data same shown above. Traffic has almost recovered from Covid -19 impact as of now.

Since the traffic data is available year 2022-23 report has been updated taking this as base year traffic.

3.4 Data Analysis

3.4.1 Analysis of Traffic Volume Count

Understanding the character of existing traffic forms the basis of the traffic forecast. The various vehicle types having different sizes and characteristics can be converted into a single unit called Passenger Car Unit (PCU). Passenger Car equivalents for various vehicles are adopted based on recommendations of Indian Road Congress prescribed in "IRC-64-1990: Guidelines for Capacity of Roads in Rural areas". The adopted passenger car unit values (PCU) are presented in ***Table*** 3-5**.**

Table 3-5 : PCU Factors Adopted for Study

Vehicle Type	PCUs
Car	1.0
Minibus	1.5
Standard Bus	3.0
LCV/LGV	1.5
2 Axle Truck	3.0
3 – 6 Axle Truck	4.5
MAV	4.5
Auto Rickshaw	1.0
Van/Tempo	1.0
Agriculture Tractor with Trailer	4.5
Agriculture Tractor without Trailer	1.5

Source: IRC: 64-1990

Traffic volume at each toll plaza was converted to PCU and same is presented as under

Table 3-6 : Traffic in PCU at Project Stretch Base Year 2022-23

Year	Toll Plaza Location (Km)	Traffic No	PCU	PCU Index
2019-2020	Gurau Km 285.200	6892	17043	2.47
	Tundla Km 224.950	14918	27128	1.82
2020-2021	Gurau Km 285.200	9090	20922	2.30
	Tundla Km 224.950	12096	24923	2.06
2021-2022	Gurau Km 285.200	11197	24889	2.22
	Tundla Km 224.950	13832	28565	2.07
2022-2023	Gurau Km 285.200	9292	23606	2.54

	Tundla Km 224.950	16260	32820	2.02

It can be observed from above that project traffic has PCU index close to 2.5 at Guarau which is an indicator of high proportion of commercial traffic in traffic mix. At Tundla the index is ore toward passenger traffic due to urban impact. Following figure illustrates variation of PCU index at two toll plaza locations.

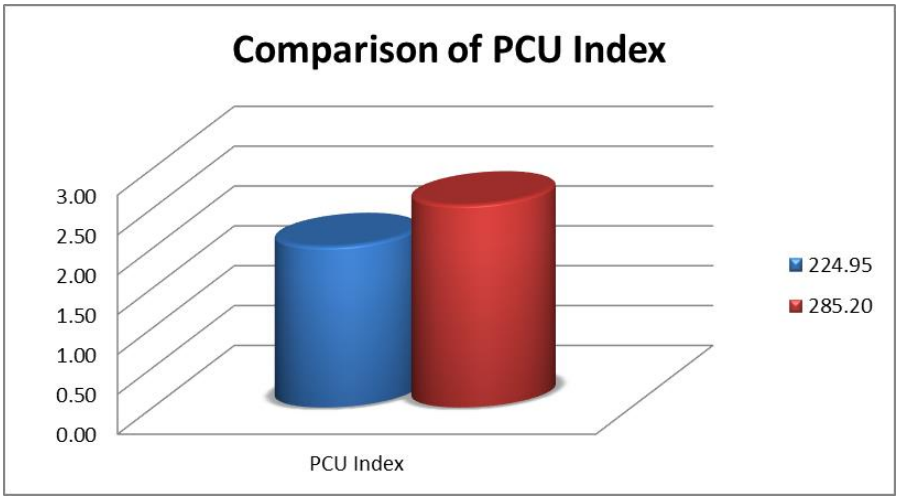


Figure 3-1: Comparison of PCU Index

3.4.2 Components of Traffic

As discussed previously, components of traffic volume play an important role in determining project revenue. A larger component of commercial traffic with higher axle configuration adds to project revenue positively. Similarly, a larger component of local traffic affects the project revenue potential negatively.

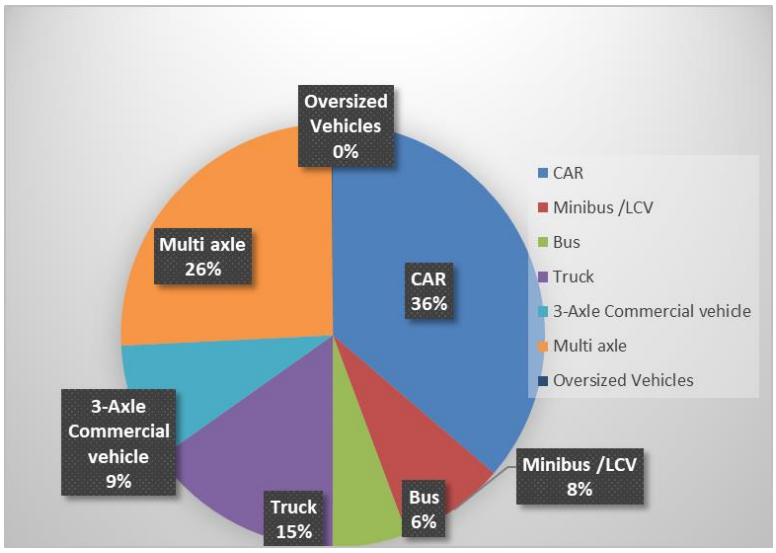


Figure 3-2 :Model Split of Tollable Vehicle-Km 285.200

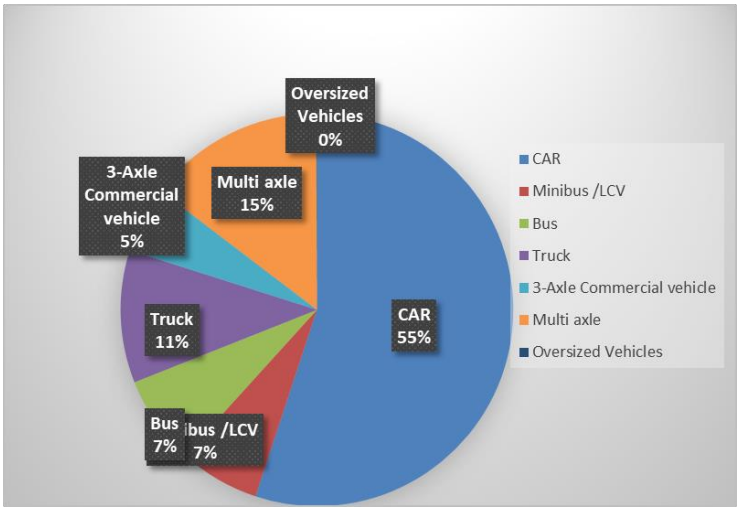


Figure 3-3 :Model Split of Tollable Vehicle-Km 224.950

It is observed that car traffic forms about 36% of total traffic at Gurau toll plaza location while multi axle commercial vehicles and trucks are about 64% of total traffic.

While at Tundla toll plaza car share rises to 55% and commercial vehicles multi axle and trucks share about 45%. This is due presence of strong urban impact of Tundla.

Another important bifurcation of traffic is components of traffic with respect various type of toll ticketing like

1. Single Journey
2. Multi Journey
3. Monthly Pass (Local and General)

The following table provides numbers of vehicles falling in each of above category on base year 2022-23

Table 3-7 : Journey Type Bifurcation of Traffic at Gurau Toll Plaza KM 285.200

Sr. No	Type	Traffic Volume (Nos.)
		2022-23
1	Single Journey	6354
2	Return Journey	2894
3	Local Commercial Single Journey	24

4	Monthly Pass Local	8
5	Monthly Pass	12

Most dominant part of the above is the single journey type followed by return journey at project stretch. Monthly pass commuters are a very low fraction of the total traffic on the project corridor.

The single journey component in total traffic numbers is a high as 69%. Return journey component is 31%. The number of monthly pass is 0% at Gurau toll plaza. This indicates higher share of long traffic.

Following tables give the detail of journey distribution at Tundla toll plaza at Km 224.950.

Table 3-8 : Journey Type Bifurcation of Traffic at Tundla Toll Plaza KM 224.950

Sr. No	Type	Traffic Volume (Nos.)
		2022-23
1	Single Journey	8021
2	Return Journey	7992
3	Local Commercial Single Journey	85
4	Monthly Pass Local	140
5	Monthly Pass	22

At Tundla toll plaza single journey share drops to 49% while return share is 49% respectively. Monthly pass is 0% and Local 2%.

It is observed that the project corridor demonstrates a similar pattern of single journey dominated mix of traffic across the entire stretch which is typical of major national highways.

3.5 Secondary Data Collection

There are several other factors which have a substantial impact on traffic pattern and growth on any project corridor. Following are some of such important factors

- Industrial development around project corridor and its catchment
- Educational infrastructure along project corridor
- Demographic pattern
- Urban area development
- Tourism potential
- Upcoming major infrastructural or Industrial projects
- Special Industry in project corridor
- Overall trends of economic growth local as well as national / regional

Hence in addition to traffic details on project site, secondary data was also collected from various other sources. Typical secondary data includes the following:

1. Vehicle registration data of regional and national level.
2. Economic Data
   a) GDP
   b) NSDP
   c) Population Growth
   d) Per Capita Income growth
   e) Industrial Growth
   f) Special Industry Potential
   g) Regional and National development vision / plan
   h) Any other relevant data
3. Competing road network

We have collected and utilized such underlying data in the study to estimate the growth and risk factors for traffic along the project corridor.

CHAPTER 4

INFLUENCE ZONE TRANSPORT NETWORK ANALYSIS

4.1 Introduction

Highway corridors behave like integrated circuit network and more often than not every road is connected to various networks having different origin and destinations. Traffic running on these networks behave like fluid and flow on network on alignment of least friction.

Following Factors can be considered as major contributors to friction on transportation network

- Travel Speed / Travel Time
- Geometric deficiencies like blind horizontal curves and steep vertical gradients etc.,
- Configuration of road
- Riding quality
- Traffic delays,
- Length of road,
- Passing through built up or Urban Area,
- Terrain,
- Facilities,

4.2 Competing / Alternate route

Project stretch has toll application history from last few years, and it can be assumed that project traffic is settled. However, for analysis point of view there can be one alternate route using Agra Lucknow Expressway at local level.

At regional level, this route connects Delhi to Kanpur and then goes towards Pryagraj and West Bengal. Most obvious alternate route is through Lucknow – Agra Expressway again.

Following maps show these routes in relation to project stretch at both local and regional level.

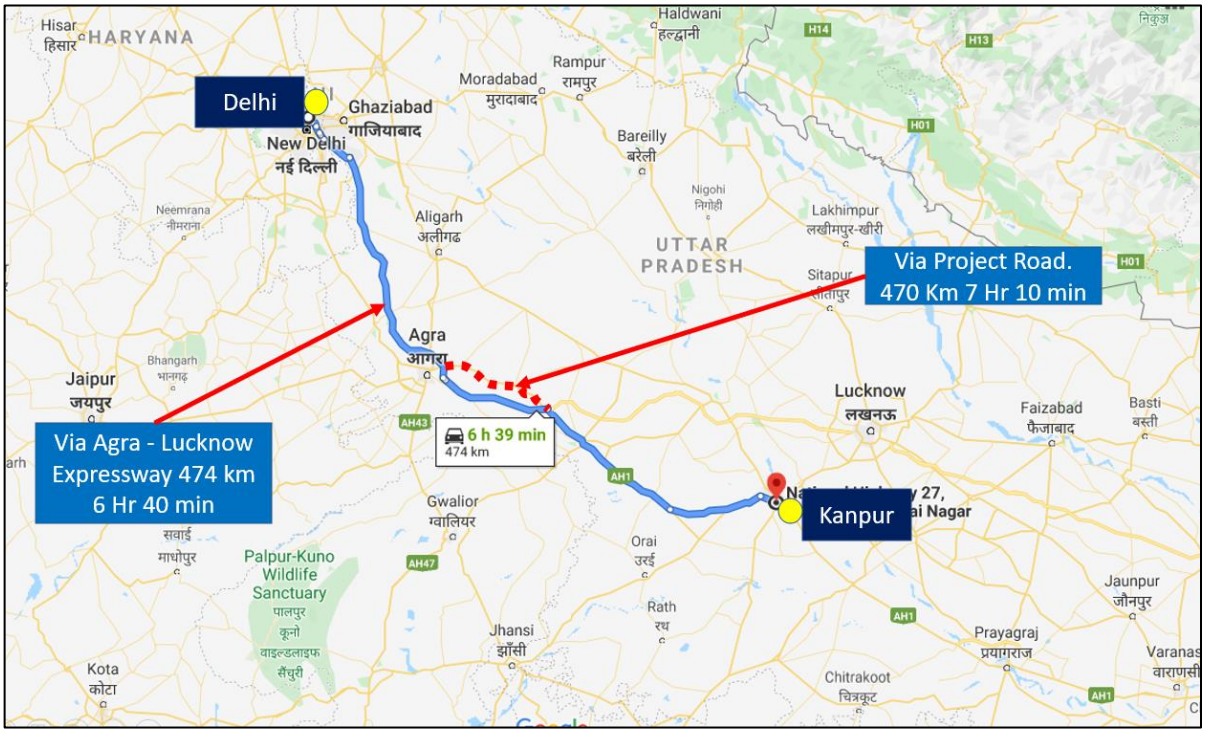


Figure 4-1: Alternate route at regional level

Figure 4-2: Alternate route at local level

It can be observed that project highway forms the one of the main spines of the corridor between Agra and Etawah. Agra – Lucknow Expressway is a faster connectivity for obvious regions. It's in operation for last few years and most of the traffic which had potential of diversion had done it so. Traffic on project road is now settled and it can be assumed as

dedicated traffic on project road for logistic obligations. With six laning now complete, project stretch has become slightly more attractive due to improved level of service.

At regional level also the difference between two alignment is only of Agra- Lucknow Expressway. Hence there too, regional level traffic is expected to have settled.

Following table provides summary of analysis of alternate route/ roads discussed above.

Table 4-1 : Competing Roads Details

Sr. No	Route Details	Designation	Length (Km)	Avg. Speed (KMPH)	Time Taken (Min)	Observations
Regional Level						
1	Delhi to Kanpur Via Agra-Lucknow Expressway	Alternate Route	474	70	6 Hr 40 Min	Alternate route running for years after toll on project road. Traffic Settled. No further diversion expected
	Delhi to Kanpur Via Project Road (NH-19)	Project Road	470	65	7 Hr 10 Min	
Local Level						
2	Agra to Etawah Via Agra-Lucknow Expressway	Alternate Route	123	65	1 Hr. 52 Min	Alternate route running for years after toll on project road. Traffic Settled. No further diversion expected
	Agra to tawah Via Project Road (NH-19)	Project Road	129	50	2 Hr. 30 Min	

Under these circumstances it is not envisaged that commercial or passenger traffic would switch to alternate roads from the project road. Further, it may be noted that during its construction phase project road had many bottlenecks like Firozabad bypass etc. Due to this part of traffic preferred Agra Lucknow expressway over project road despite higher toll tariff at Agra – Lucknow Expressway. Now as these bottlenecks are removed it is expected that some part of traffic would return to Project Corridor due to improved level of service and low toll fee as compared to Agra – Lucknow Expressway.

CHAPTER 5
GROWTH OF TRAFFIC ON PROJECT HIGHWAY

5.1 Introduction

Traffic growth is a function of the interplay of a number of contributory factors such as National economy, Government policy, socio-economic conditions of the people, and changes in land uses along the project corridor precincts etc. As these factors have a number of uncertainties associated with them, forecasts of traffic are dependent on the projections of other factors such as population, gross domestic product (GDP), vehicle ownership, per capita income (PCI), agricultural output, fuel consumption etc. Future pattern of change in these factors can be estimated with only a reasonable degree of accuracy and hence the resultant traffic forecast levels may not be precise.

Traffic growth forecast for project corridor Surat- Dahisar section of NH-8has been done taking the above factors into consideration. "**IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**" is established best practice and has been used for traffic growth forecast.

5.2 Trend Analysis

One of the methods of estimation of future rate of growth is to assume the same rate of growth as in the past. Although such a method is more suitable to projects of short durations say 5-10 years, however for long term projections it would-be erroneous to assume that the past rate of growth will continue to prevail for a long time in future. Economic conditions, which are major influencing factors, are bound to change over a long period of time. Thus, it would be necessary to modify the past trends of growth suitably.

Elasticity model of growth projection is one of the most widely acceptable methods for traffic forecast. The same is recommended in **IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**.

In this method the past trend of vehicular data is paired with an economic indicator and a regression analysis is done to yield the economic model of growth. Growth of vehicle traffic varies for different type of vehicle. It is a proven fact that the growth pattern for passenger and goods vehicle is different. Traffic growth on any highway

typically depends on number of economic parameters. Most important and direct parameters are given as under

- Per Capita Income
- Net State Domestic Product (NSDP)
- Population

It can be observed that the ownership of a car is more closely related to affordability; hence per capita is the index which closely fits the growth of car traffic among other criteria. In a similar fashion, the following can be pairs of vehicle type and independent variable for elasticity modeling of growth.

- Car / Jeep – Par Capita Income
- Bus / Minibus – Population
- Goods Vehicle – NSDP

5.3 Estimation of Traffic Demand Elasticity

Elasticity of traffic demand is defined as the rate at which traffic intensity varies due to a change in the corresponding indicator selected. Hence, in order to estimate the elasticity of traffic demand, it is necessary to establish relationship between the growth in number of given category of vehicles with the relevant economic variable considered, such as NSDP, per capita income and population growth. Latest available data for vehicle registration, per capita income, NSDP and population is used in analysis.

As per IRC: 108-1996 the model for estimating elasticity index for the project corridor is of the following form and is given as below:

$$Log\ (P) = k \times Log\ (EI) + A$$

Where,

P = *Number of Vehicles (Mode wise)*

EI = *Economic Indicator*

A = *Regression constant*

k = *Elasticity coefficient (Regression coefficient)*

The elasticity for car and bus (passenger vehicles) is calculated based on the Population and Per Capita Domestic Product (PCDP) and the elasticity for trucks is calculated based on the Net State Domestic Product (NSDP).

The project corridor spreads across state of Uttar. Toll plazas at Tunda and Gurau are in the state of Uttar Pradesh. Project corridor has certain impact of traffic from Delhi,

and Haryana also. For elasticity calculations, working data from these states has been analyzed.

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Uttar Pradesh State.

Table 5-1 : Per Capita Income Vs Car Uttar Pradesh

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	32002	1108100	4.51	6.04		
2013	32908	1205374	4.52	6.08	3%	
2014	34044	1423020	4.53	6.15	3%	
2015	34583	1572217	4.54	6.20	2%	
2016	36973	1746117	4.57	6.24	7%	
2017	40641	2027972	4.61	6.31	10%	4.94%

Regression analysis of same is given in figure below

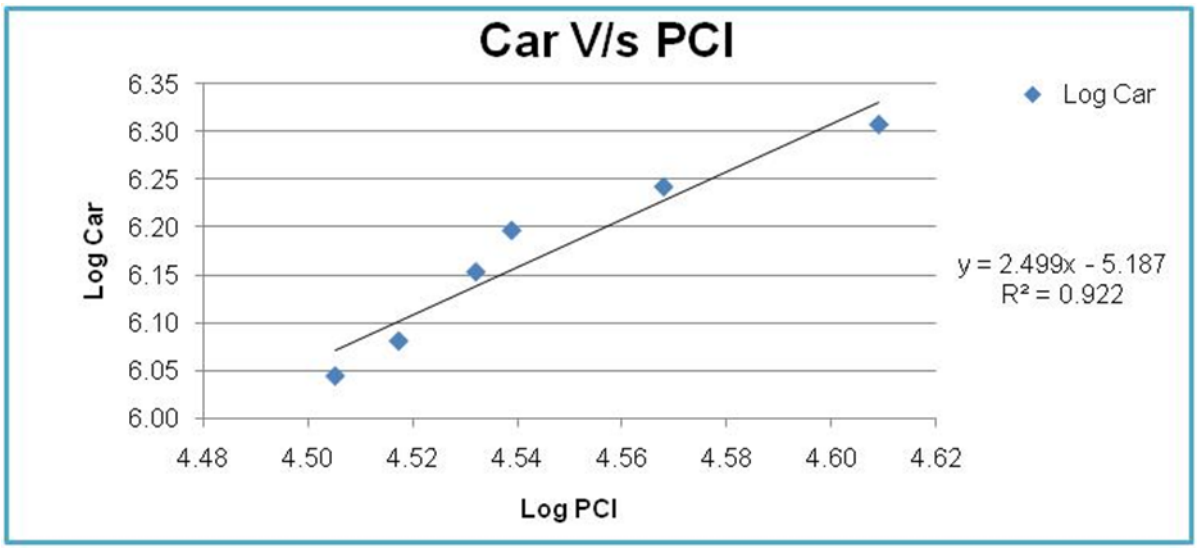


Figure 5-1: Regression and Elasticity PCI vs. Car–Extrapolation Uttar Pradesh

Table 5-2 : Population Vs Bus Uttar Pradesh

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	199812341	57901	8.30	4.76		
2013	203382046	64147	8.31	4.81	2%	
2014	206942855	74389	8.32	4.87	2%	
2015	210493544	80460	8.32	4.91	2%	
2016	214032922	89127	8.33	4.95	2%	
2017	217559836	112020	8.34	5.05	2%	1.72%

Regression analysis of same is given in figure below

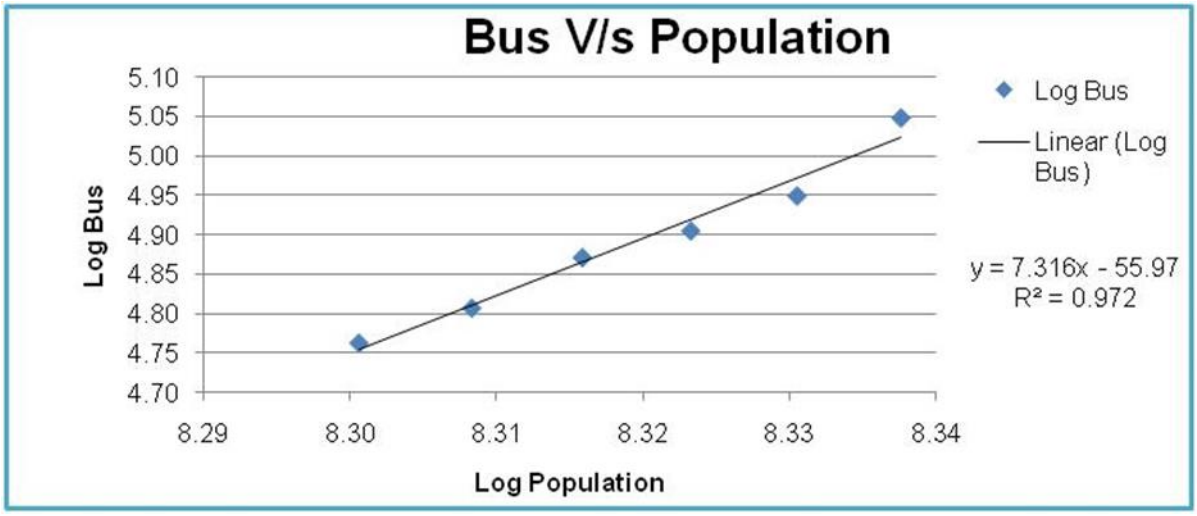


Figure 5-2: Regression and Elasticity Population vs. Bus – Extrapolation Uttar Pradesh

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-3 : LCV Traffic Vs NSDP Uttar Pradesh

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	645132	176164	5.81	5.25		
2013	673552	213657	5.83	5.33	4%	
2014	707469	265025	5.85	5.42	5%	
2015	729686	294022	5.86	5.47	3%	
2016	792049	316815	5.90	5.50	9%	5.28%

Following figure depict regression analysis and extrapolation.

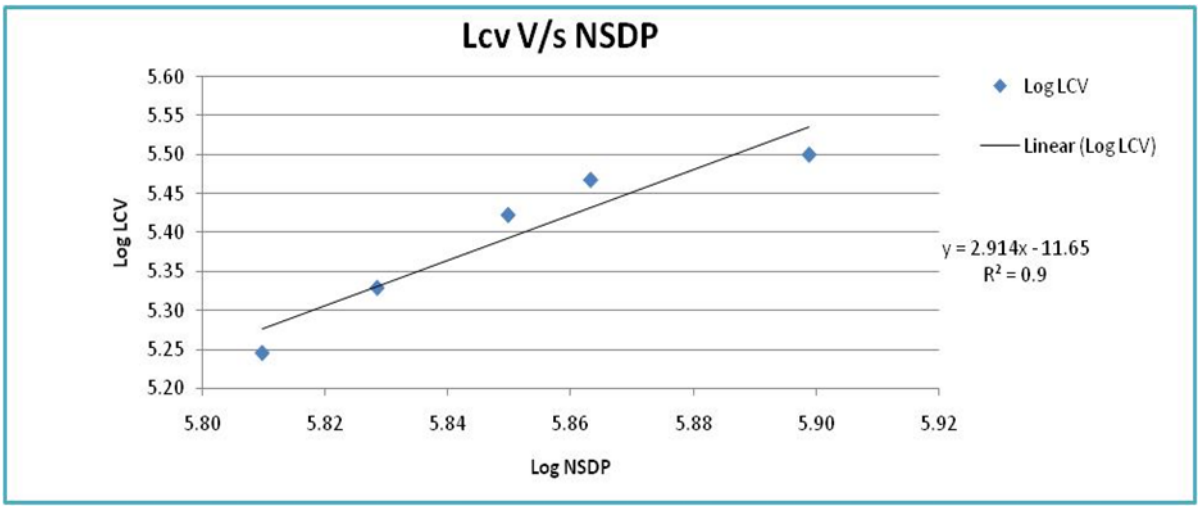


Figure 5-3: Regression and Elasticity NSDP vs. LCV Traffic – extrapolation Uttar Pradesh

Table 5-4 : Truck Traffic Vs NSDP Uttar Pradesh

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	645132	162813	5.81	5.21		
2013	673552	186404	5.83	5.27	4%	
2014	707469	202761	5.85	5.31	5%	
2015	729686	217609	5.86	5.34	3%	
2016	792049	245688	5.90	5.39	9%	
2017	883962	265167	5.95	5.42	12%	6.55%

Following figure depict regression analysis and extrapolation.

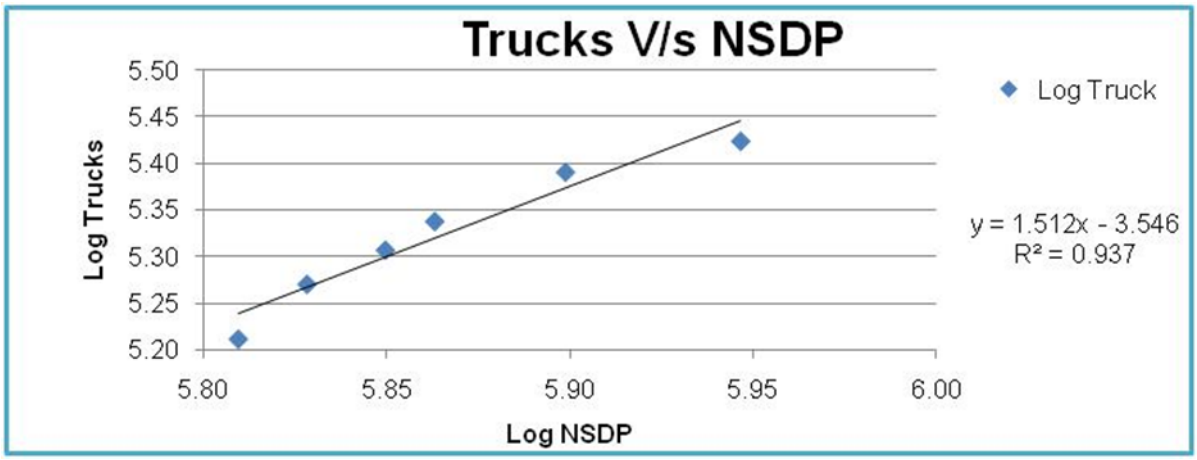


Figure 5-4: Regression and Elasticity NSDP vs. Truck Traffic – extrapolation Uttar Pradesh

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below

Table 5-5 : Summary Regression Analysis Uttar Pradesh

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average IV Growth (5yrs)	Growth Elastic Model	Remarks
Uttar Pradesh	Car/Jeep	PCI	y = 2.499x + -5.1874	R^2 = 0.922	2.4990	4.94%	12.34%	Good Regression
	Bus	Population	y = 7.3167x - -55.9791	R^2 = 0.9726	7.3167	1.72%	12.56%	Good Regression
	LCV	NSDP	y = 2.9149x - -11.6585	R^2 = 0.9	2.9149	5.28%	15.40%	Good Regression
	Truck	NSDP	y = 1.5121x - -3.5463	R^2 = 0.9373	1.5121	6.55%	9.90%	Good Regression

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Delhi State.

Table 5-6 : Per Capita Income Vs Car Delhi

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	185361	2172069	5.27	6.34		
2013	193175	2416974	5.29	6.38	4%	
2014	202216	2568380	5.31	6.41	5%	
2015	215726	2730071	5.33	6.44	7%	
2016	235737	2986579	5.37	6.48	9%	
2017	247255	3061817	5.39	6.49	5%	5.95%

Regression analysis of same is given in figure below

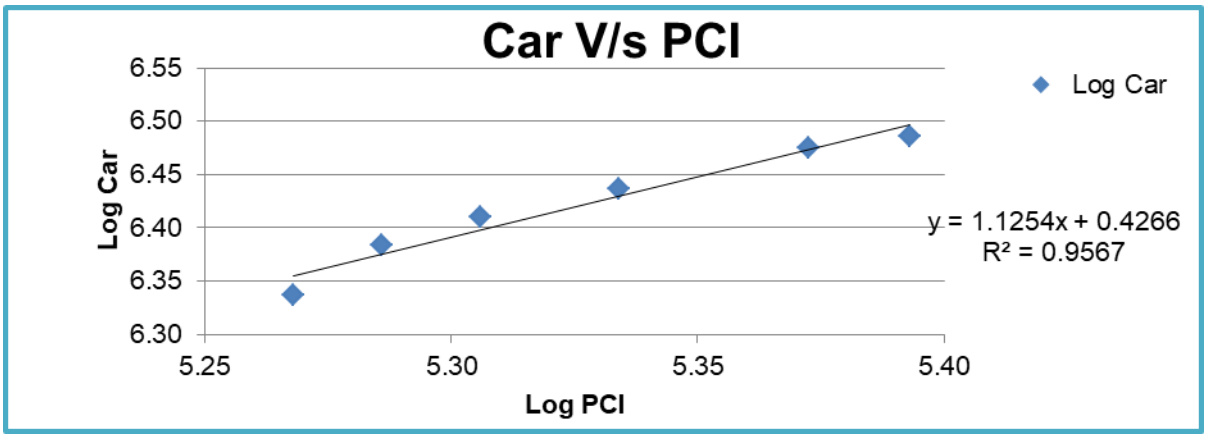


Figure 5-5: Regression and Elasticity PCI vs. Car–Extrapolation Delhi

Table 5-7 : Population Vs Bus Delhi

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	16787941	109790	7.22	5.04		
2013	17071599	19917	7.23	4.30	2%	
2014	17354281	19595	7.24	4.29	2%	
2015	17635897	19700	7.25	4.29	2%	
2016	17916359	43723	7.25	4.64	2%	
2017	18195583	41686	7.26	4.62	2%	1.62%

Regression analysis of same is given in figure below

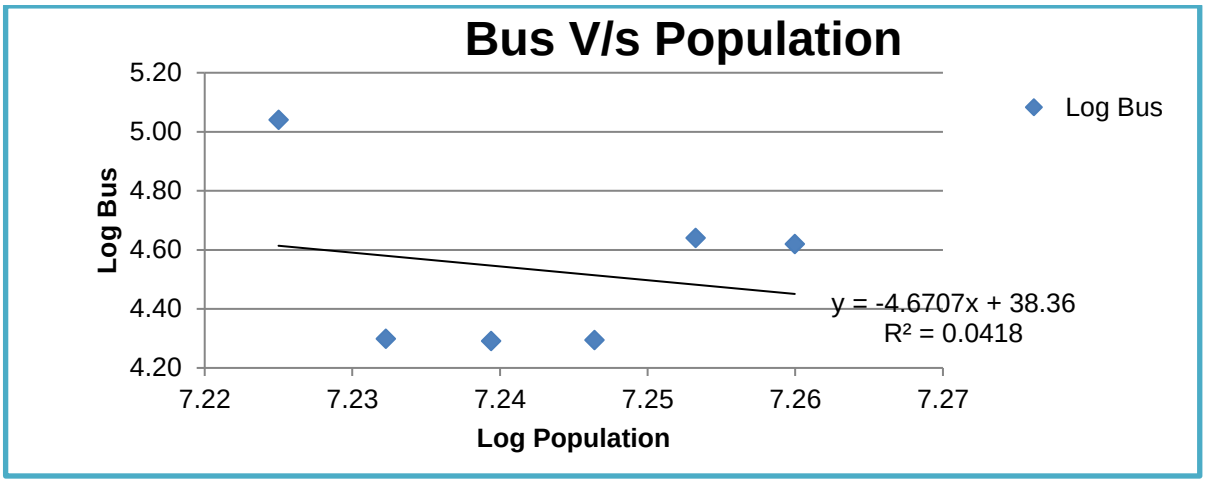


Figure 5-6: Regression and Elasticity Population vs. Bus – Extrapolation Delhi

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-8 : LCV Traffic Vs NSDP Delhi

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth (5 Year)
2012	314650	124547	5.50	5.10		
2013	334193	126539	5.52	5.10	6%	
2014	356528	136110	5.55	5.13	7%	
2015	387639	145903	5.59	5.16	9%	
2016	431730	183486	5.64	5.26	11%	
2017	461476	221068	5.66	5.34	7%	7.98%

Following figure depict regression analysis and extrapolation.

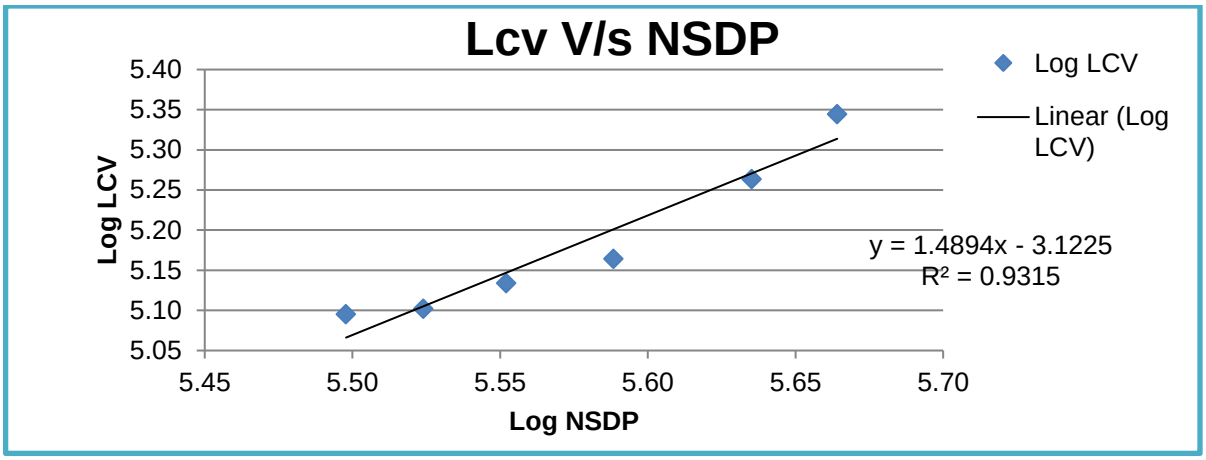


Figure 5-7: Regression and Elasticity NSDP vs. LCV Traffic – extrapolation Delhi

Table 5-9 : Truck Traffic Vs NSDP Delhi

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	314650	4792	5.50	3.68		
2013	334193	5176	5.52	3.71	6%	
2014	356528	6093	5.55	3.78	7%	
2015	387639	7503	5.59	3.88	9%	
2016	431730	8703	5.64	3.94	11%	
2017	461476	10440	5.66	4.02	7%	7.98%

Following figure depict regression analysis and extrapolation.

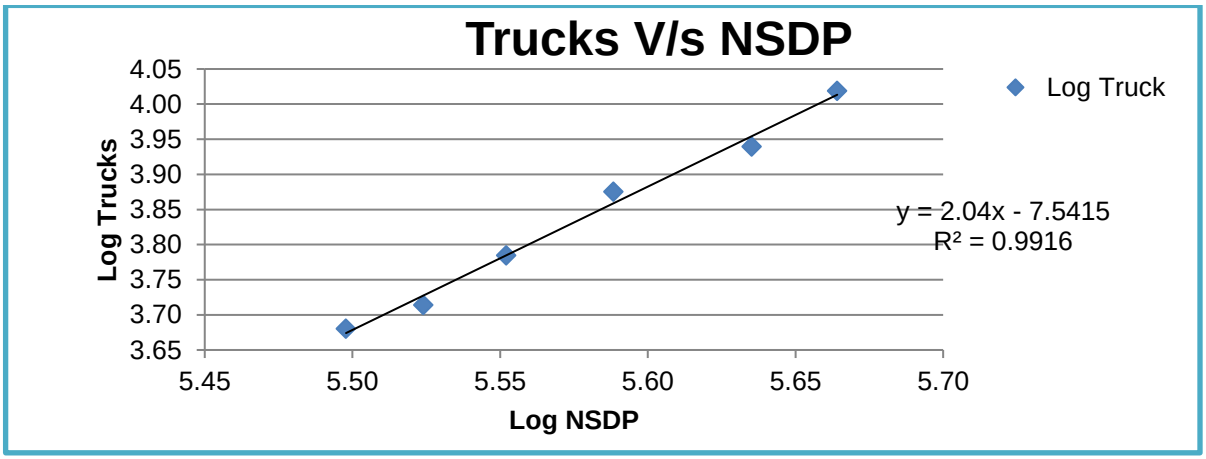


Figure 5-8: Regression and Elasticity NSDP vs. Truck Traffic – extrapolation Delhi

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below

Table 5-10 : Summary Regression Analysis Delhi

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average IV Growth (5yrs)	Growth Elastic Model	Remarks
Delhi	Car/Jeep	PCI	y = 1.1254x + 0.4266	R² = 0.9567	1.1254	5.95%	6.69%	Good Regression
	Bus	Population	y = -4.6707x - 38.36	R² = 0.0418	-4.6707	1.62%	-7.58%	Poor Regression
	LCV	NSDP	y = 1.4894x - -3.1225	R² = 0.9315	1.4894	7.98%	11.88%	Good Regression
	Truck	NSDP	y = 2.04x - -7.5415	R² = 0.9916	2.0400	7.98%	16.27%	Good Regression

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Haryana State.

Table 5-11 : Per Capita Income Vs Car Haryana

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	106085	989519	5.03	6.00		
2013	111780	1134616	5.05	6.05	5%	
2014	119791	1278272	5.08	6.11	7%	
2015	125032	1420621	5.10	6.15	4%	
2016	137818	1711692	5.14	6.23	10%	
2017	150241	1851788	5.18	6.27	9%	7.23%

Regression analysis of same is given in figure below

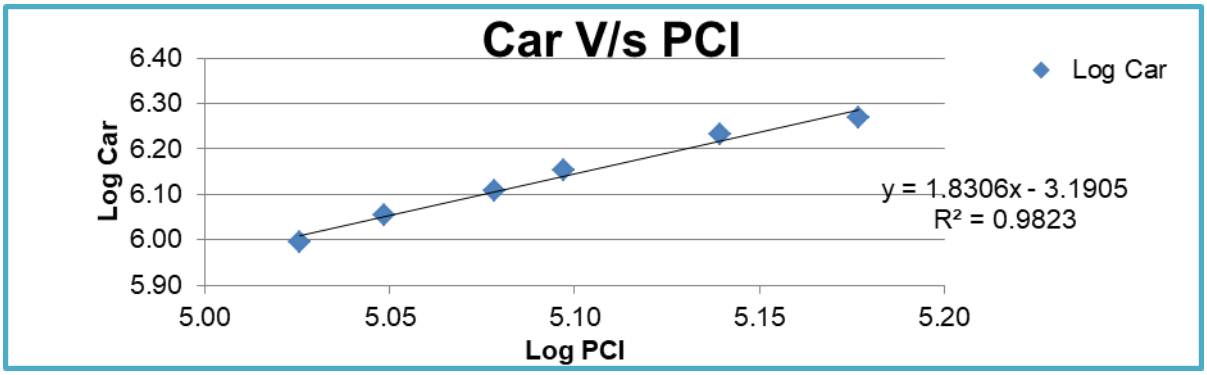


Figure 5-9: Regression and Elasticity PCI vs. Car–Extrapolation Haryana

Table 5-12 : Population Vs Bus Haryana

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	25351462	39153	7.40	4.59		
2013	25751257	43456	7.41	4.64	2%	
2014	26149236	46558	7.42	4.67	2%	
2015	26545282	52640	7.42	4.72	2%	
2016	26939286	55781	7.43	4.75	1%	
2017	27331141	60129	7.44	4.78	1%	1.52%

Regression analysis of same is given in figure below

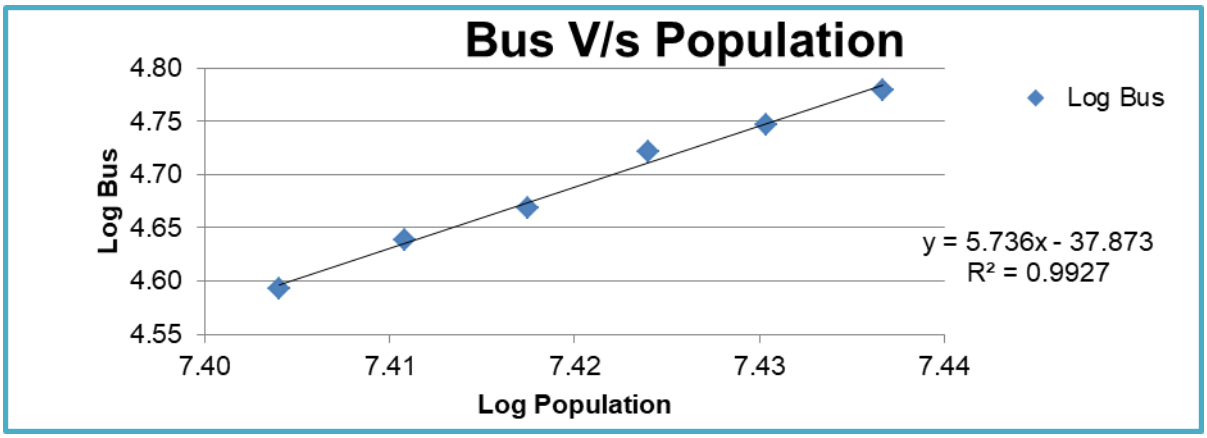


Figure 5-10: Regression and Elasticity Population vs. Bus – Extrapolation Haryana

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-13 : LCV Traffic Vs NSDP Haryana

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth (5 Year)
2012	271152	124897	5.43	5.10		
2013	289756	137511	5.46	5.14	7%	
2014	314931	152069	5.50	5.18	9%	
2015	333359	167901	5.52	5.23	6%	
2016	372659	182776	5.57	5.26	12%	

Following figure depict regression analysis and extrapolation.

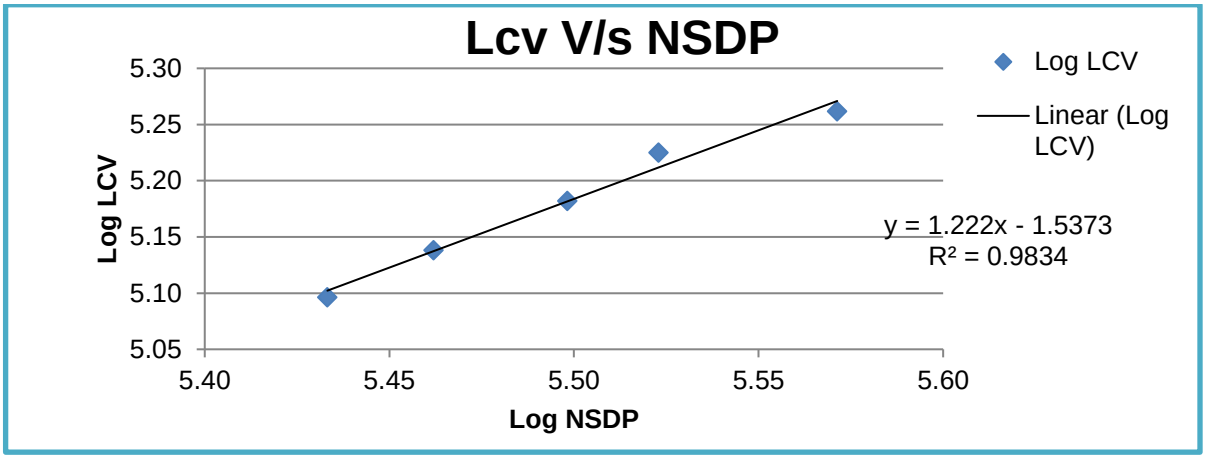


Figure 5-11: Regression and Elasticity NSDP vs. LCV Traffic – extrapolation Haryana

Table 5-14 : Truck Traffic Vs NSDP Haryana

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	271152	292735	5.43	5.47		
2013	289756	307509	5.46	5.49	7%	
2014	314931	327882	5.50	5.52	9%	
2015	333359	348732	5.52	5.54	6%	
2016	372659	367730	5.57	5.57	12%	
2017	412006	390321	5.61	5.59	11%	8.75%

Following figure depict regression analysis and extrapolation.

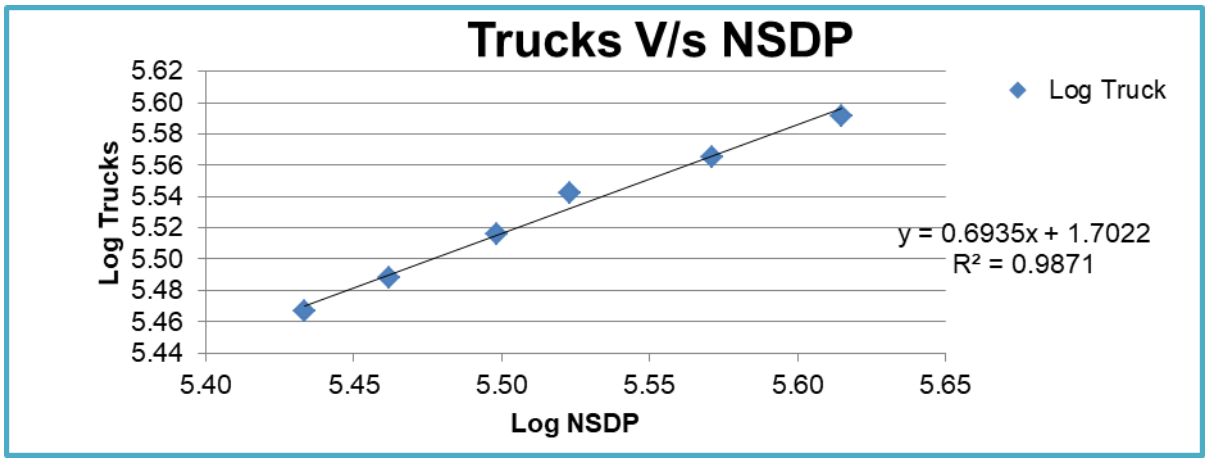


Figure 5-12: Regression and Elasticity NSDP vs. Truck Traffic – extrapolation Haryana

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below

Table 5-15 : Summary Regression Analysis Haryana

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average IV Growth (5yrs)	Growth Elastic Model	Remarks
Haryana	Car/Jeep	PCI	y = 1.8306x + -3.1905	R^2 = 0.9823	1.8306	7.23%	13.24%	Good Regression
	Bus	Population	y = 5.736x - -37.8732	R^2 = 0.9927	5.7360	1.52%	8.69%	Good Regression
	LCV	NSDP	y = 1.222x - -1.5373	R^2 = 0.9834	1.2220	8.30%	10.14%	Good Regression
	Truck	NSDP	y = 0.6935x - 1.7022	R^2 = 0.9871	0.6935	8.75%	6.07%	Good Regression

Economical model for predicting growth is good tool, however other local, regional, national factors should also be considered before finalizing growth factors. Considering factors such as proposed developments and other influencing economic factors, moderated growth should be considered. These factors are discussed in subsequent sections.

5.4 Analysis of Historic Traffic Data

Historical traffic data forms useful information for any highway project. It provides useful information for establishing past trend of growth. Project stretch of Agra to Etawah has recently been commissioned and is under tolling operation since 2016-17. As traffic data available with the project concessionaire of three years, we do not have sufficient data points to be able to establish a reliable past trend of traffic growth. Moreover part two years traffic is affected by COVID-19 impact. A minimum of about 5 -6 years' traffic data is required for establishing a reliable past trend.

5.5 Other Factors Influencing Growth

There are many factors which have impact on traffic growth. As discussed previously these factors can be economical, social, educational, and industrial.

Potentiality of such factors for project highway is discussed as under.

ECONOMY

After witnessing a slowdown during 2011-12, the economy recovered in 2013-14, and a high growth rate of GDP was recorded in up to 2018-19. Pandemic of COVID-19 impacted all economies of world including India. Following figure show trend of GDP growth in India.

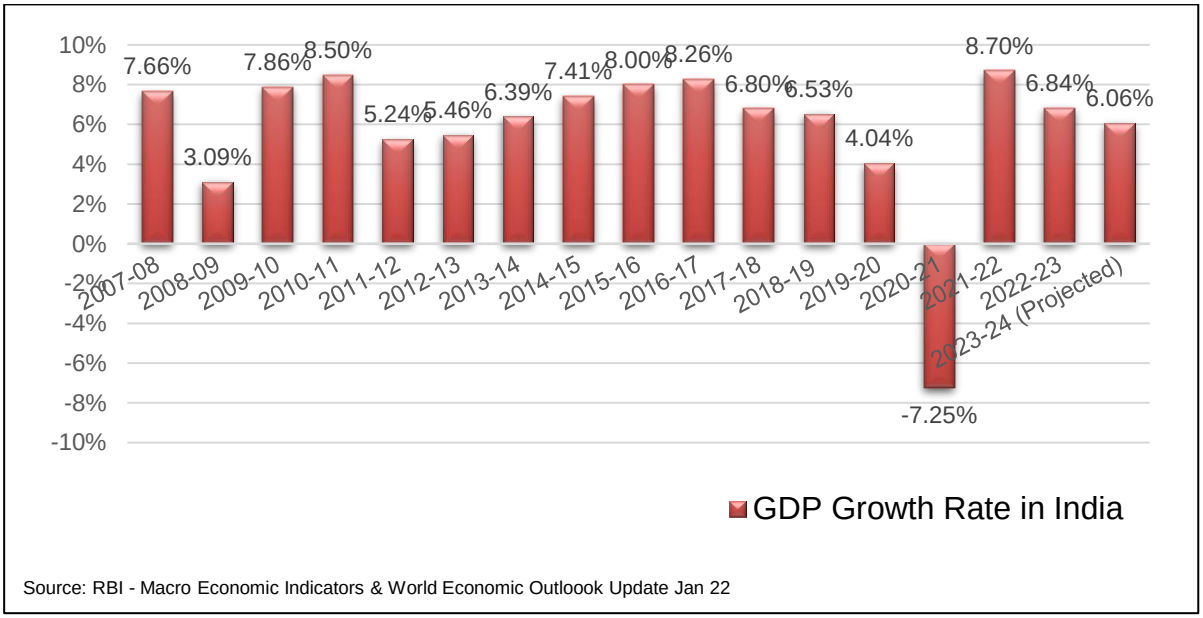


Figure 5-13 : Growth of GDP in India

FY 2017-18 recorded a growth of 6.7% which had slight impact of GST and demonetization. Indian economy appears on recovery path with estimated growth of 6.8% in FY 2018-19. Government took major policy decision including tax infrastructure reforming, banking sector improvement and ease of doing business.

Major economies of world collapsed due to pandemic COVID-19 including India. Indian economy is also registered negative growth in financial year 2020-21. After that Indian economy recovered handsomely and registered a growth of about 9% in Year 2021-22. This was partly due to low base of year 2020-21 as well.

Honorable Prime Minister has announced a major relief package of Rs. 20 lakh crores which is about 10% of GDP. This is aimed at turning this major crisis of COVID-19 into opportunity by providing major impetus to industrial production to

the limit of becoming a self-reliant economy. With major thrust of this package being on **Make -In- India** it is expected that industry in India would grow at rapid pace and recover handsomely in post COVID-19 scenario. World Economic Outlook update also has predicted a growth rate of about 7.5 % in year 2022-23.

5.6 Developments along and around the Project Corridor & State

Though growth of Delhi has been consistently below the national average economic growth, it is the largest state in terms of population and consumption driven demand for goods and services will remain significantly high. The rate of growth of NSDP also seems to be catching up with the national average over the years. Other regions in the influence area states namely Delhi, Haryana and Uttarakhand are all growing significantly faster than the national average. Considering the scenario, it may be assumed that the traffic growth on project highway would remain high and there are minimal risks in terms of growth.

Table 5-16 : GDP of India, UP and other important states

Year	India (GDP)	Bihar	Haryana	Madhya Pradesh	Maharashtra	Odisha	Punjab	Rajasthan	Uttar Pradesh	Uttarakhand	West Bengal	Delhi
1980-81	12336	514	357	623	1464	529	504	560	1631	138	830	269
1981-82	13030	543	371	639	1498	528	551	607	1670	141	808	291
1982-83	13411	548	394	668	1556	497	568	620	1800	152	840	328
1983-84	14464	601	402	702	1654	597	578	761	1871	158	939	320
1984-85	15037	658	418	668	1675	569	623	706	1900	161	964	333
1985-86	15663	672	493	726	1807	635	670	704	1975	167	1005	386
1986-87	16339	725	493	694	1832	643	694	771	2060	174	1045	411
1987-88	16917	685	484	789	1955	623	730	718	2154	182	1101	447
1988-89	18635	772	602	847	2159	754	769	1014	2434	206	1148	486
1989-90	19778	759	610	865	2515	805	834	993	2502	212	1188	531
1990-91	20824	831	674	987	2629	668	849	1149	2651	224	1251	553
1991-92	21122	784	688	916	2620	753	888	1061	2662	225	1349	638
1992-93	22254	737	688	983	3017	740	930	1220	2690	228	1389	660
1993-94	23519	755	719	1088	3349	788	970	1121	2757	233	1490	705
1994-95	25023	842	771	1107	3414	826	995	1325	2901	254	1594	790
1995-96	26846	712	787	1174	3791	864	1032	1374	2995	251	1713	804
1996-97	28987	893	879	1252	3941	804	1107	1535	3327	267	1832	915
1997-98	30234	850	887	1318	4158	920	1137	1721	3292	270	1985	1063
1998-99	32255	904	934	1405	4324	948	1203	1797	3316	274	2112	1116
1999-00	34837	950	1002	1552	4735	1008	1267	1801	3440	274	2264	1170
2000-01	36282	1106	1081	1426	4589	982	1309	1743	3511	308	2343	1215
2001-02	38236	1043	1165	1528	4751	1042	1326	1941	3575	323	2512	1262
2002-03	39719	1175	1236	1449	5079	1034	1348	1708	3690	353	2600	1359
2003-04	42883	1099	1358	1611	5471	1185	1433	2251	3885	381	2753	1433
2004-05	45906	1238	1475	1664	5948	1340	1504	2196	4079	431	2936	1588
2005-06	50257	1207	1608	1748	6810	1399	1577	2344	4317	492	3121	1752
2006-07	55066	1416	1791	1907	7748	1574	1748	2620	4660	551	3366	1969
2007-08	60199	1489	1931	1997	8650	1708	1899	2739	4959	648	3627	2191
2008-09	64248	1716	2080	2250	8786	1837	2004	2969	5336	716	3774	2464
2009-10	69769	1798	2340	2463	9634	1852	2132	3142	5668	839	4067	2667
2010-11	75987	2073	2498	2592	10732	1968	2270	3614	6120	927	4313	2888
2011-12	81069	2285	2712	2824	11222	2042	2392	3953	6451	1020	4471	3147
2012-13	85463	2369	2894	3069	11842	2163	2518	4098	6736	1095	4838	3342

Year	India (GDP)	Bihar	Haryana	Madhya Pradesh	Maharashtra	Odisha	Punjab	Rajasthan	Uttar Pradesh	Uttarakhand	West Bengal	Delhi
2013-14	90636	2469	3142	3226	12671	2331	2675	4343	7075	1178	5247	3565
2014-15	97121	2557	3314	3394	13322	2359	2777	4656	7297	1257	5633	3882
2015-16	105033	2749	3612	3597	14417	2557	2926	4981	7894	1355	-	4291
2016-17	112476	3033	3927	4129	15744	2828	3095	5352	8457	1448	-	4658
2017-18	119762	-	-	4432	-	3029	-	5736	9011	1547	-	5035
Growth 1981-2018	6.34	5.05	6.88	5.44	6.82	4.83	5.17	6.49	4.73	6.75	5.79	8.24
Growth 1994-2018	7.02	6.23	7.66	6.03	6.96	5.77	5.17	7.04	5.06	8.20	6.54	8.53
Growth 2000-2018	7.10	7.07	8.37	6.00	7.32	6.30	5.40	6.65	5.50	10.10	6.27	8.45

5.6.1 Industrial Units along Project Corridor

There are number of big and small industrial units along project corridor. Following figure show some of these along corridor.

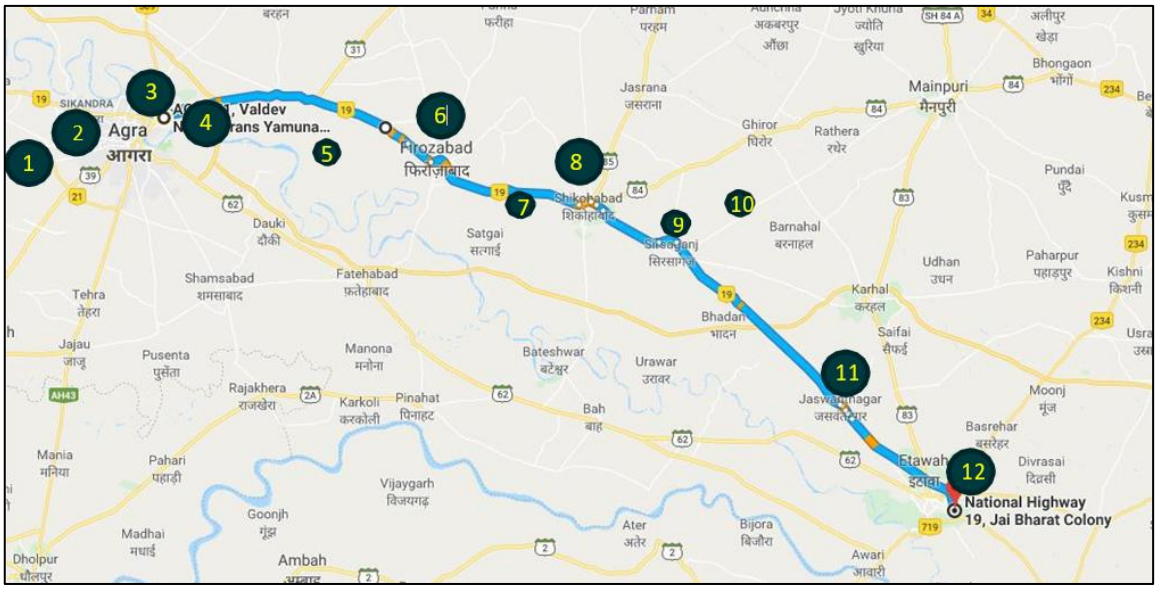


Figure 5-14 : Industrial Units along project corridor

Following is the list of industrial units along project corridor

1. Leather Park, **Agra**
2. Export Promotional Industrial Park (EPIP)
3. Foundry Nagar (BK Casting, Agricultural Industries, Paint Industries, Plastic Industries, Metal Industries), **Agra**
4. Industrial Estate, **Agra**
5. Agarbatti Industry

6. Glass Industries, **Firozabad**
7. Pipe Industries, Glass Bulb Industries
8. Agro Industries, Glass Industries, Cold Storage
9. Food Processing Industries
10. PVC Pipe Industries
11. Rural Industrial Estate, **Jaswant Nagar**
12. **Etawah**(Caplock Industries Private Limited, Rice Mills)

Such industries along project corridor and urban development around major cities of Firozabad, Tundla, Shikohabad, Jaswantnagar and Wtawah provide impetus to project traffic on corridor.

5.7 Recommended Growth Rates of Traffic

Based on the above analysis and after giving due consideration to the entire listed factors, the following overall growth rates are recommended for each category of vehicle as under. Rate of growth is moderated in light of overall regional trend. Growth of Multi-Axle is kept slightly higher as trend of technological advances in logistic industry favors multi-axle over 2/3 axle carriage. It is also expected that as the economy moves from developing to developed, rate of growth diminishes. Same growth rate is not sustainable for long. Hence growth rates have been suitably stepped down in future years.

Growth rates are recommended for three scenarios for sensitivity analysis namely **Optimistic, Pessimistic** and **Most Likely** with a positive and negative variation from Most Likely case for corridor in both states.

5.7.1 Recommended Growth Rates of Traffic for Project Stretch

Table 5-17 : Recommended Growth Rates Optimistic

Category / Year	2022-2026	2026-2031	2031-2036	2036-2041	2041-2046	2046-2051
Car/Jeep/Van	8.96%	8.75%	8.71%	7.42%	6.23%	5.15%
Bus	4.86%	4.70%	4.68%	3.29%	2.58%	1.95%
LCV	5.91%	5.71%	5.65%	4.63%	3.71%	3.16%
2- Axle	6.25%	6.07%	6.01%	5.06%	4.20%	3.42%
3 - Axle	6.59%	6.39%	6.33%	5.32%	4.41%	3.59%
4 to 6 Axle	6.93%	6.72%	6.64%	5.58%	4.62%	3.76%
7 and Above Axle	6.93%	6.72%	6.64%	5.58%	4.62%	3.76%

Table 5-18 : Recommended Growth Rates Pessimistic

Category / Year	2022-2026	2026-2031	2031-2036	2036-2041	2041-2046	2046-2051
Car/Jeep/Van	8.46%	8.25%	8.21%	6.92%	5.73%	4.65%
Bus	4.36%	4.20%	4.18%	2.79%	2.08%	1.45%
LCV	5.41%	5.21%	5.15%	4.13%	3.21%	2.66%
2- Axle	5.75%	5.57%	5.51%	4.56%	3.70%	2.92%
3 - Axle	6.09%	5.89%	5.83%	4.82%	3.91%	3.09%
4 to 6 Axle	6.43%	6.22%	6.14%	5.08%	4.12%	3.26%
7 and Above Axle	6.43%	6.22%	6.14%	5.08%	4.12%	3.26%

Table 5-19 : Recommended Growth Rates Most Likely

Category / Year	2022-2026	2026-2031	2031-2036	2036-2041	2041-2046	2046-2051
Car/Jeep/Van	8.71%	8.50%	8.46%	7.17%	5.98%	4.90%
Bus	4.61%	4.45%	4.43%	3.04%	2.33%	1.70%
LCV	5.66%	5.46%	5.40%	4.38%	3.46%	2.91%
2- Axle	6.00%	5.82%	5.76%	4.81%	3.95%	3.17%
3 - Axle	6.34%	6.14%	6.08%	5.07%	4.16%	3.34%
4 to 6 Axle	6.68%	6.47%	6.39%	5.33%	4.37%	3.51%
7 and Above Axle	6.68%	6.47%	6.39%	5.33%	4.37%	3.51%

With completion of project corridor and removal of bottlenecks as discussed in previous chapter, certain part of traffic would return to project road which had started using Agra - Lucknow Expressway as preferred route. This also has been considered while estimating future traffic and revenue on project road.

Traffic and revenue has been worked out on the basis of above growths and same is presented in subsequent chapter of report.

5.8 COVID-19 Impact

All social and economic activities had been completely disrupted due worldwide pandemic of Corona Virus. This had affected traffic on project stretch as well. Traffic was severely affected form March-2020 due to lockdown and then in second wave and third waves.

Government has announced a mega economic stimulate and package of Rs. 20 Lakh Crore to bring the economy back on track and recover the losses. Traffic has shown impressive recovery post lockdown period and has recovered to normal level.

CHAPTER 6

TRAFFIC FORECAST

6.1 Traffic Projections

Growth rates recommended in previous section of report are used to arrive at traffic projections for future years. Toll plaza wise futuristic traffic projection is given in tables below.

These projections have been done for following three cases of growth up to concession period

1. Optimistic Scenario
2. Pessimistic Scenario
3. Most Likely Scenario

Table 6-1 : Total Tollable Traffic @ Toll Plaza 1- Chainage 224.95 KM (Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	9756	1147	1238	1886	945	2536	10	17518	35141
2024-25	10631	1214	1297	2004	1007	2711	10	18874	37621
2025-26	11561	1283	1357	2125	1071	2892	10	20299	40204
2026-27	12572	1356	1420	2253	1139	3086	10	21836	42974
2027-28	13673	1433	1486	2389	1212	3294	10	23497	45952
2028-29	14870	1515	1555	2533	1289	3515	10	25287	49136
2029-30	16172	1601	1627	2686	1371	3751	10	27218	52550
2030-31	17580	1690	1703	2847	1458	4000	10	29288	56184
2031-32	19111	1785	1783	3017	1550	4265	10	31521	60076
2032-33	20776	1885	1866	3198	1648	4548	10	33931	64251
2033-34	22586	1991	1953	3390	1752	4849	10	36531	68723
2034-35	24553	2103	2044	3593	1862	5171	10	39336	73519
2035-36	26375	2200	2110	3774	1961	5459	10	41889	77821
2036-37	28330	2301	2179	3964	2065	5764	10	44613	82389
2037-38	30433	2407	2250	4165	2175	6086	10	47526	87246
2038-39	32692	2518	2324	4375	2290	6426	10	50635	92398
2039-40	35118	2635	2400	4596	2411	6785	10	53955	97869
2040-41	37308	2732	2462	4789	2517	7098	10	56916	102696
2041-42	39634	2833	2525	4990	2627	7426	10	60045	107772
2042-43	42105	2937	2590	5199	2742	7769	10	63352	113109
2043-44	44731	3045	2656	5417	2862	8128	10	66849	118725
2044-45	47519	3158	2725	5644	2988	8504	10	70548	124640
2045-46	49967	3258	2778	5837	3096	8823	10	73769	129736

Table 6-2 : Total Tollable Traffic @ Toll Plaza 2- Chainage 285.20 KM

(Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	3673	792	555	1498	895	2551	10	9974	25230
2024-25	4002	839	582	1591	954	2727	10	10705	26958
2025-26	4353	887	610	1687	1015	2910	10	11472	28760
2026-27	4734	937	638	1789	1080	3105	10	12293	30678
2027-28	5148	990	667	1898	1149	3313	10	13175	32729
2028-29	5598	1047	698	2013	1222	3535	10	14123	34920
2029-30	6087	1106	730	2135	1300	3773	10	15141	37265
2030-31	6617	1168	764	2264	1382	4024	10	16229	39752
2031-32	7193	1234	800	2400	1469	4291	10	17397	42406
2032-33	7818	1304	838	2544	1561	4576	10	18651	45240
2033-34	8499	1378	877	2697	1660	4880	10	20001	48273
2034-35	9240	1456	918	2858	1765	5204	10	21451	51510
2035-36	9925	1523	949	3003	1858	5495	10	22763	54412
2036-37	10662	1593	980	3155	1957	5801	10	24158	57477
2037-38	11453	1667	1012	3314	2061	6125	10	25642	60722
2038-39	12303	1744	1045	3481	2171	6467	10	27221	64157
2039-40	13215	1824	1080	3657	2287	6828	10	28901	67794
2040-41	14039	1891	1108	3810	2388	7144	10	30390	70987
2041-42	14913	1961	1136	3970	2494	7474	10	31958	74333
2042-43	15842	2033	1165	4136	2604	7819	10	33609	77837
2043-44	16829	2108	1194	4309	2719	8180	10	35349	81512
2044-45	17878	2186	1225	4490	2839	8558	10	37186	85375
2045-46	18798	2255	1249	4643	2941	8880	10	38776	88685

Table 6-3 : Total Tollable Traffic @ Toll Plaza 1- Chainage 224.95 KM
(Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	9712	1141	1232	1877	940	2524	10	17436	34974
2024-25	10534	1202	1285	1984	997	2686	10	18698	37267
2025-26	11403	1265	1338	2094	1055	2853	10	20018	39645
2026-27	12344	1331	1394	2210	1117	3031	10	21437	42188
2027-28	13363	1400	1452	2333	1183	3219	10	22960	44898
2028-29	14465	1473	1512	2463	1252	3419	10	24594	47786
2029-30	15658	1549	1575	2599	1325	3631	10	26347	50863
2030-31	16944	1628	1640	2742	1402	3854	10	28220	54126
2031-32	18335	1711	1708	2893	1484	4090	10	30231	57607
2032-33	19839	1799	1779	3052	1571	4341	10	32391	61323
2033-34	21468	1891	1853	3220	1663	4607	10	34712	65289
2034-35	23230	1988	1930	3397	1760	4890	10	37205	69523
2035-36	24839	2070	1983	3552	1844	5138	10	39436	73247
2036-37	26558	2155	2038	3713	1933	5398	10	41805	77179

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2037-38	28396	2243	2095	3882	2026	5673	10	44325	81343
2038-39	30360	2335	2153	4059	2124	5961	10	47002	85740
2039-40	32461	2430	2212	4244	2226	6263	10	49846	90381
2040-41	34323	2508	2258	4400	2313	6521	10	52333	94388
2041-42	36290	2588	2305	4563	2403	6790	10	54949	98585
2042-43	38371	2671	2353	4731	2497	7070	10	57703	102981
2043-44	40572	2756	2401	4906	2595	7362	10	60602	107586
2044-45	42898	2844	2451	5087	2697	7666	10	63653	112411
2045-46	44894	2920	2486	5235	2780	7916	10	66241	116444

Table 6-4 : Total Tollable Traffic @ Toll Plaza 2- Chainage 285.20KM (Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	3656	788	552	1491	890	2539	10	9926	25108
2024-25	3965	831	576	1576	944	2702	10	10604	26704
2025-26	4292	874	600	1664	1000	2870	10	11310	28355
2026-27	4647	919	625	1756	1059	3049	10	12065	30111
2027-28	5030	967	651	1854	1121	3238	10	12871	31975
2028-29	5445	1017	679	1957	1187	3439	10	13734	33960
2029-30	5894	1070	707	2066	1257	3653	10	14657	36073
2030-31	6377	1124	736	2179	1330	3878	10	15634	38294
2031-32	6900	1182	767	2299	1408	4116	10	16682	40662
2032-33	7466	1243	799	2425	1490	4369	10	17802	43178
2033-34	8079	1306	832	2558	1577	4637	10	18999	45851
2034-35	8743	1373	867	2699	1668	4922	10	20282	48699
2035-36	9348	1430	891	2822	1748	5172	10	21421	51195
2036-37	9996	1489	916	2950	1832	5435	10	22628	53826
2037-38	10688	1550	941	3084	1920	5711	10	23904	56593
2038-39	11427	1613	967	3224	2012	6001	10	25254	59505
2039-40	12218	1679	994	3371	2109	6306	10	26687	62581
2040-41	12919	1733	1015	3496	2191	6566	10	27930	65217
2041-42	13660	1789	1036	3626	2277	6837	10	29235	67972
2042-43	14444	1846	1057	3760	2366	7119	10	30602	70843
2043-44	15273	1905	1079	3899	2458	7412	10	32036	73838
2044-45	16149	1966	1101	4043	2554	7717	10	33540	76964
2045-46	16900	2018	1116	4161	2633	7968	10	34806	79558

Traffic projections for Most Likely scenario are given as under

Table 6-5 : Total Tollable Traffic @ Toll Plaza 1-Tundla- Chainage 224.95 KM (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	9735	1144	1235	1881	943	2530	10	17478	35058
2024-25	10583	1208	1292	1993	1002	2698	10	18786	37442
2025-26	11483	1274	1349	2108	1063	2872	10	20159	39923
2026-27	12459	1343	1408	2230	1128	3058	10	21636	42578
2027-28	13518	1416	1471	2359	1197	3256	10	23227	45420
2028-29	14667	1492	1536	2496	1270	3466	10	24937	48453
2029-30	15915	1573	1604	2641	1348	3690	10	26781	51704
2030-31	17261	1658	1674	2793	1430	3925	10	28751	55147
2031-32	18722	1747	1748	2953	1517	4176	10	30873	58834
2032-33	20306	1841	1825	3122	1609	4442	10	33155	62770
2033-34	22023	1939	1906	3302	1707	4725	10	35612	66984
2034-35	23885	2043	1990	3492	1810	5026	10	38256	71488
2035-36	25598	2132	2050	3660	1902	5294	10	40646	75500
2036-37	27434	2224	2112	3836	1999	5576	10	43191	79748
2037-38	29402	2321	2176	4020	2101	5874	10	45904	84253
2038-39	31510	2422	2241	4213	2208	6187	10	48791	89016
2039-40	33769	2527	2309	4415	2320	6517	10	51867	94063
2040-41	35790	2615	2362	4589	2417	6801	10	54584	98466
2041-42	37932	2706	2416	4770	2517	7099	10	57450	103091
2042-43	40202	2800	2473	4958	2621	7409	10	60473	107944
2043-44	42607	2897	2531	5154	2730	7733	10	63662	113041
2044-45	45157	2997	2590	5357	2843	8071	10	67025	118387
2045-46	47370	3084	2634	5526	2937	8354	10	69915	122925

Table 6-6 : Total Tollable Traffic @ Toll Plaza 2- Gurau - Chainage 285.20 KM (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	3664	791	554	1494	892	2545	10	9950	25168
2024-25	3983	835	579	1584	949	2714	10	10654	26830
2025-26	4322	880	604	1676	1007	2889	10	11388	28549
2026-27	4689	928	631	1773	1068	3076	10	12175	30384
2027-28	5088	978	659	1876	1134	3275	10	13020	32345
2028-29	5520	1031	688	1985	1203	3487	10	13924	34431
2029-30	5989	1087	719	2101	1276	3713	10	14895	36661
2030-31	6495	1145	751	2221	1354	3950	10	15926	39011
2031-32	7045	1207	784	2348	1436	4202	10	17032	41514
2032-33	7640	1272	819	2483	1523	4471	10	18218	44188
2033-34	8286	1340	855	2626	1615	4756	10	19488	47031
2034-35	8987	1412	893	2777	1713	5060	10	20852	50069
2035-36	9631	1474	920	2910	1800	5330	10	22075	52762
2036-37	10322	1539	948	3050	1891	5614	10	23374	55606
2037-38	11062	1606	977	3196	1987	5913	10	24751	58605
2038-39	11855	1676	1006	3350	2087	6228	10	26212	61769
2039-40	12705	1750	1037	3511	2193	6560	10	27766	65118

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2040-41	13466	1811	1061	3650	2284	6846	10	29128	68020
2041-42	14272	1873	1086	3794	2379	7145	10	30559	71056
2042-43	15126	1938	1111	3944	2478	7457	10	32064	74234
2043-44	16030	2005	1137	4099	2581	7782	10	33644	77553
2044-45	16989	2075	1163	4260	2688	8122	10	35307	81029
2045-46	17822	2136	1183	4395	2778	8407	10	36731	83971

6.2 Modification in Concession Period

As per Article 29 of the concession agreement, if actual traffic on the project falls short or exceeds Target Traffic on project highway on defined date, concession period shall be modified subject to calculation stipulated therein. For Agra-Etawah project, the Target Date and Target Traffic are defined as under:

Target Date - 1st April 2025

Target Traffic - 52995 PCU

It was observed that as per traffic projections, average traffic volume falls short of target traffic in all scenarios. Probable extension of concession period is estimated according to article 29 of concession agreement which comes to about 5 years. Traffic forecast and revenue projections are done for probable extended period accordingly.

Most Likely

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2025	52995	34284	-35%	53%	20%	24	4.8

Optimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2025	52995	34532	-35%	52%	20%	24	4.8

Pessimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2025	52995	34045	-36%	54%	20%	24	4.8

CHAPTER 7

FORECAST OF TOLL REVENUE

7.1 General

This chapter presents the tolling rate calculations, categories and toll revenue of the project.

7.2 Discount Categories

The fee schedule in the CA of Surat-Dahisar section of NH-8 is based on the old toll policy. As per the Toll Notification (Schedule -G) the discounts and special provisions have been considered. In addition to discounts as per Fee Notification concessionaire has declared special category rates also. Salient features of toll rate structure are given as under

1. Monthly Pass: For frequent user's monthly pass would be issued at fee 50 time the single journey fee at 2/3rd Rate.
2. Multiple Journeys (for Return Trip): Will be charged at 1.5 times single journey.
3. Single Journey: Full single journey toll would be charged to this category of vehicles who are infrequent travelers or whose frequency does not yield any discount from the above categories.
4. Local Discounts: Local Car Jeep Van -Rs. 275 per month (for locals residing within a radius of 20 kms from toll plaza). Additionally, local commercial vehicles are charged at 50% rate of single journey.

Building of inflation and escalation of rate on the basis of WPI are done as per toll notification (Schedule G) as given under as extract from concession agreement.

The formula for determining the applicable rate of fee shall be as follows:-

$$\text{Applicable rate of fee} = \text{base rate} + \text{base rate} \times \left\{ \frac{\text{WPI A-WPI B}}{\text{WPI B}} \right\} \times 0.4$$

Factor of inflation / growth has been incorporated as per Schedule R. WPI numbers (2011-12 series) are available up to 2021-22. A moderate growth in Wholesale Price Index (WPI) has been assumed after that. Following graph provides projection of rate of inflation (WPI) in India. Data has been taken from Office of Economic Advisor web site (www.eaindustry.nic.in). WPI for year 2017-18 and 2018-2019 is worked back by applying a correlation factor for 2004-05 series as 2017-18 and 2018-2019 data is available in 2011-12 series only. Ratio of WPI for year 2016-17 for both series is used for conversion of WPI in 2004-05 series

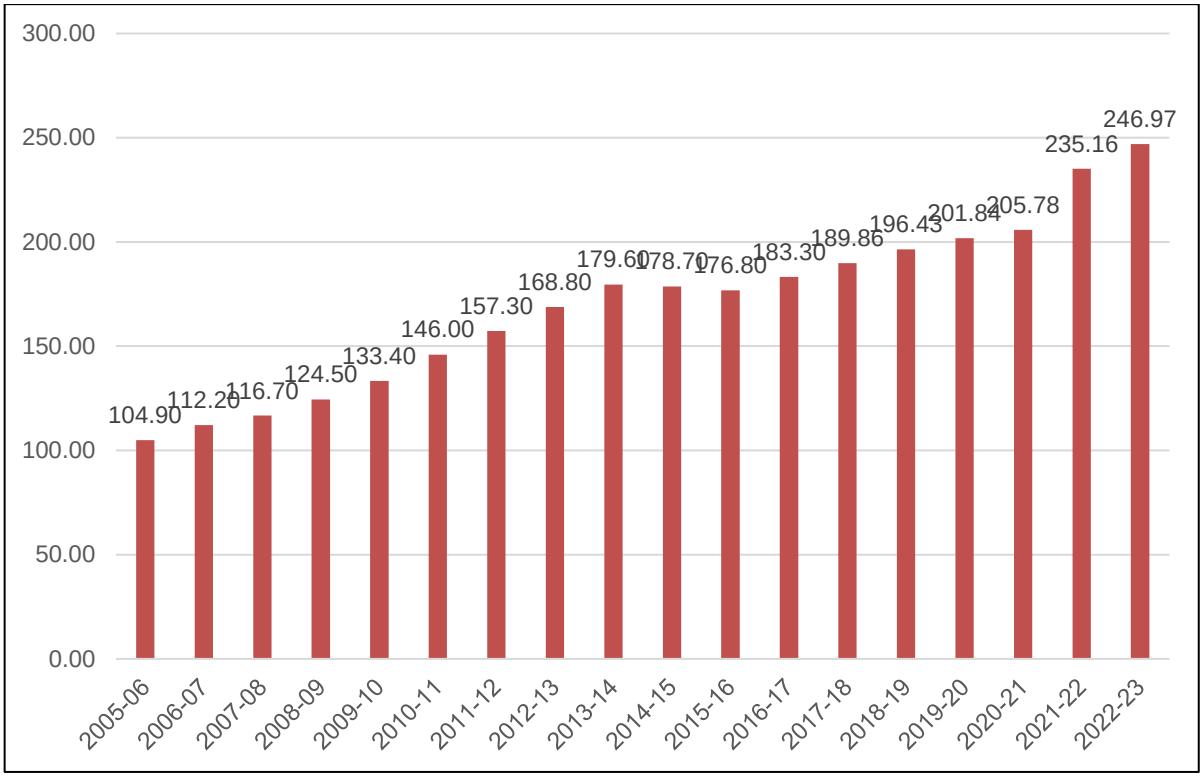


Figure 7-1 : Historical Rate of WPI Inflation in India

Average inflation in WPI in last few years is steadily growing. It grew in range of 4% - 5% in previous years. For future years initially it is takes 5% and Suitably Stepped down for future years.

7.3 Estimation of Toll Rates

As per the applicable MORTH notification and Schedule R of contract agreement, the following Base rate of fee for the categories mentioned in the table stands true in the National Highways Fee Rules applicable for contract.

Table 7-1 : Base Toll Rates June 2007-08

Type of Vehicle	Base Rate of Fee / Km (in Rs.)
Car, Jeep, Van or Light Motor Vehicle	0.65
Light Commercial Vehicle, Light Goods Vehicle or Minibus	1.05
Bus or Truck (Two Axles)	2.20
Three Axle Commercial Vehicles	2.40
Heavy Construction Machinery (HCM) or Earth Moving Equipment (EME) or Multi Axle Vehicle (MAV) (4 to 6 axles)	3.45
Oversized Vehicles (7 or more Axles)	4.20

Toll rates are calculated as per guidelines provided in schedule R (rounded to nearest Rs.) for the concession period and are given below.

Thus, worked out rates for various categories of vehicle and discounts are given as under

Table 7-2 : Toll Rates for Single Journey@ Km 224.95

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	105	170	355	355	385
2024-25	110	180	370	370	405
2025-26	115	185	390	390	425
2026-27	120	195	410	410	450
2027-28	125	205	430	430	470
2028-29	135	215	450	450	495
2029-30	140	225	475	475	515
2030-31	145	235	495	495	540
2031-32	155	250	520	520	570
2032-33	160	260	545	545	595
2033-34	170	275	570	570	625
2034-35	175	285	600	600	655
2035-36	185	300	630	630	685
2036-37	195	315	660	660	720
2037-38	205	330	695	695	755
2038-39	215	345	725	725	795
2039-40	225	365	765	765	835
2040-41	235	380	800	800	875
2041-42	250	400	840	840	920
2042-43	260	420	885	885	965
2043-44	275	445	925	925	1010

2044-45	290	465	975	975	1060
2045-46	300	490	1025	1025	1115

Table 7-3 : Toll Rates for Single Journey @ Km 285.20

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	115	180	380	380	415
2024-25	120	190	400	400	440
2025-26	125	200	420	420	460
2026-27	130	210	445	445	485
2027-28	135	220	465	465	505
2028-29	145	235	485	485	530
2029-30	150	245	510	510	555
2030-31	160	255	535	535	585
2031-32	165	270	560	560	610
2032-33	175	280	590	590	640
2033-34	180	295	615	615	675
2034-35	190	310	645	645	705
2035-36	200	325	680	680	740
2036-37	210	340	715	715	775
2037-38	220	355	750	750	815
2038-39	230	375	785	785	855
2039-40	245	395	825	825	900
2040-41	255	415	865	865	945
2041-42	270	435	905	905	990
2042-43	280	455	955	955	1040
2043-44	295	475	1000	1000	1090
2044-45	310	500	1050	1050	1145
2045-46	325	525	1105	1105	1205

Table 7-4 : Toll Rates for Return Journey @ Km 224.95

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	155	255	530	530	580
2024-25	165	265	560	560	610
2025-26	175	280	585	585	640
2026-27	180	295	615	615	675
2027-28	190	310	645	645	705
2028-29	200	325	675	675	740
2029-30	210	340	710	710	775
2030-31	220	355	745	745	810
2031-32	230	375	780	780	850
2032-33	240	390	820	820	895

2033-34	255	410	860	860	935
2034-35	265	430	900	900	980
2035-36	280	450	945	945	1030
2036-37	295	475	990	990	1080
2037-38	305	495	1040	1040	1135
2038-39	320	520	1090	1090	1190
2039-40	340	545	1145	1145	1250
2040-41	355	575	1200	1200	1310
2041-42	375	600	1260	1260	1375
2042-43	390	630	1325	1325	1445
2043-44	410	665	1390	1390	1515
2044-45	430	695	1460	1460	1595
2045-46	455	730	1535	1535	1675

Table 7-5 : Toll Rates for Return Journey @ Km 285.20

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	170	275	575	575	625
2024-25	180	285	600	600	655
2025-26	185	300	635	635	690
2026-27	195	315	665	665	725
2027-28	205	335	695	695	760
2028-29	215	350	730	730	795
2029-30	225	365	765	765	835
2030-31	235	385	805	805	875
2031-32	250	400	840	840	920
2032-33	260	420	885	885	965
2033-34	275	440	925	925	1010
2034-35	285	465	970	970	1060
2035-36	300	485	1020	1020	1110
2036-37	315	510	1070	1070	1165
2037-38	330	535	1120	1120	1225
2038-39	350	560	1175	1175	1285
2039-40	365	590	1235	1235	1345
2040-41	385	620	1295	1295	1415
2041-42	400	650	1360	1360	1485
2042-43	420	680	1430	1430	1560
2043-44	445	715	1500	1500	1635
2044-45	465	750	1575	1575	1720
2045-46	490	790	1655	1655	1805

Table 7-6 : Toll Rates for Monthly pass Local @ 224.95

Year	Car	Mini Bus /LCV
2023-24	330	330
2024-25	345	345
2025-26	365	365
2026-27	385	385
2027-28	400	400
2028-29	420	420
2029-30	440	440
2030-31	460	460
2031-32	485	485
2032-33	510	510
2033-34	535	535
2034-35	560	560
2035-36	585	585
2036-37	615	615
2037-38	645	645
2038-39	680	680
2039-40	710	710
2040-41	745	745
2041-42	785	785
2042-43	825	825
2043-44	865	865
2044-45	905	905
2045-46	955	955

Table 7-7 : Toll Rates for Monthly pass Local @ 285.20

Year	Car	Mini Bus /LCV
2023-24	330	330
2024-25	345	345
2025-26	365	365
2026-27	385	385
2027-28	400	400
2028-29	420	420
2029-30	440	440
2030-31	460	460
2031-32	485	485
2032-33	510	510
2033-34	535	535
2034-35	560	560
2035-36	585	585
2036-37	615	615
2037-38	645	645
2038-39	680	680
2039-40	710	710
2040-41	745	745

2041-42	785	785
2042-43	825	825
2043-44	865	865
2044-45	905	905
2045-46	955	955

Table 7-8 : Toll Rates for Monthly Pass @ Km 224.95

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2023-24	3490	5635	11810	11810	12880
2024-25	3665	5920	12405	12405	13535
2025-26	3850	6225	13040	13040	14225
2026-27	4050	6540	13705	13705	14950
2027-28	4245	6855	14360	14360	15670
2028-29	4450	7185	15055	15055	16420
2029-30	4660	7530	15780	15780	17215
2030-31	4890	7895	16545	16545	18045
2031-32	5125	8280	17345	17345	18925
2032-33	5375	8680	18190	18190	19840
2033-34	5635	9105	19075	19075	20810
2034-35	5910	9550	20005	20005	21825
2035-36	6200	10015	20985	20985	22895
2036-37	6505	10510	22020	22020	24020
2037-38	6825	11025	23105	23105	25205
2038-39	7165	11570	24245	24245	26450
2039-40	7520	12145	25445	25445	27760
2040-41	7890	12745	26710	26710	29135
2041-42	8285	13380	28040	28040	30590
2042-43	8700	14050	29440	29440	32115
2043-44	9135	14755	30910	30910	33720
2044-45	9590	15495	32465	32465	35415
2045-46	10075	16275	34095	34095	37195

Table 7-9 : Toll Rates for Monthly Pass @ Km 285.20

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2023-24	3765	6080	12740	12740	13895
2024-25	3955	6390	13385	13385	14600
2025-26	4155	6715	14065	14065	15345
2026-27	4370	7055	14785	14785	16125
2027-28	4580	7395	15495	15495	16900
2028-29	4800	7750	16240	16240	17715
2029-30	5030	8125	17025	17025	18570
2030-31	5275	8520	17845	17845	19470
2031-32	5530	8930	18710	18710	20415
2032-33	5795	9365	19620	19620	21405
2033-34	6080	9820	20575	20575	22450
2034-35	6375	10300	21585	21585	23545
2035-36	6690	10805	22640	22640	24700
2036-37	7020	11335	23750	23750	25910
2037-38	7365	11895	24920	24920	27190
2038-39	7725	12480	26155	26155	28530
2039-40	8110	13100	27450	27450	29945
2040-41	8515	13750	28810	28810	31430
2041-42	8935	14435	30245	30245	32995
2042-43	9385	15155	31755	31755	34645
2043-44	9850	15915	33345	33345	36380
2044-45	10345	16715	35020	35020	38205
2045-46	10865	17555	36780	36780	40125

7.4 Toll Revenue

As indicated earlier, toll revenue on the Project Road has been calculated in all three scenarios based on above rates and projected traffic. The estimates of toll revenue under ***Optimistic***, ***Pessimistic*** and ***Most Likely*** growth scenarios are presented in the following section.

7.5 Toll Revenue at all toll plazas under Scenarios

Toll Revenue estimates under all scenarios at each of the toll plaza up to 2045-46 years starting from the year 2023-24 are shown in tables below.

Table 7-10 : Toll Revenue Optimistic Scenario

(Rs. Crores)

Year	TP-1	TP2	Total
2023-24	112.02	134.95	**246.96**
2024-25	125.49	151.58	**277.07**
2025-26	140.17	170.10	**310.27**
2026-27	157.34	190.27	**347.61**
2027-28	176.19	213.62	**389.81**
2028-29	196.72	239.66	**436.38**
2029-30	219.55	267.99	**487.54**
2030-31	246.00	299.83	**545.83**
2031-32	275.32	337.39	**612.71**
2032-33	307.67	375.90	**683.57**
2033-34	343.53	422.39	**765.93**
2034-35	383.75	471.95	**855.70**
2035-36	426.85	525.99	**952.84**
2036-37	471.20	583.11	**1054.31**
2037-38	521.98	645.93	**1167.91**
2038-39	578.88	716.83	**1295.72**
2039-40	644.26	800.32	**1444.58**
2040-41	705.73	876.34	**1582.07**
2041-42	775.35	968.05	**1743.40**
2042-43	851.48	1063.00	**1914.49**
2043-44	938.64	1174.63	**2113.26**
2044-45	1029.16	1290.33	**2319.49**
2045-46	1122.27	1410.07	**2532.34**

Table 7-11 : Toll Revenue Pessimistic Scenario

(Rs. Crores)

Year	TP-1	TP2	Total
2023-24	111.48	134.28	**245.76**
2024-25	124.32	150.11	**274.44**
2025-26	138.23	167.68	**305.91**
2026-27	154.49	186.70	**341.18**
2027-28	172.18	208.65	**380.83**
2028-29	191.37	233.03	**424.40**
2029-30	212.63	259.34	**471.97**
2030-31	237.13	288.81	**525.94**
2031-32	264.16	323.47	**587.63**
2032-33	293.83	358.69	**652.52**
2033-34	326.55	401.23	**727.78**
2034-35	363.06	446.16	**809.23**
2035-36	401.88	494.93	**896.82**
2036-37	441.50	546.09	**987.59**
2037-38	486.68	602.02	**1088.71**
2038-39	537.14	664.92	**1202.07**
2039-40	595.03	738.79	**1333.82**
2040-41	648.70	805.08	**1453.78**
2041-42	709.38	885.21	**1594.59**

Year	TP-1	TP2	Total
2042-43	775.35	967.42	**1742.76**
2043-44	850.76	1063.93	**1914.69**
2044-45	928.26	1163.30	**2091.56**
2045-46	1007.27	1265.13	**2272.40**

Table 7-12 : Toll Revenue Most Likely Scenario

(Rs. Crores)

Year	TP-1	TP2	Total
2023-24	111.74	134.58	**246.33**
2024-25	124.84	150.80	**275.64**
2025-26	139.13	168.86	**307.99**
2026-27	155.82	188.44	**344.26**
2027-28	174.06	211.15	**385.21**
2028-29	193.92	236.36	**430.28**
2029-30	215.91	263.70	**479.61**
2030-31	241.35	294.36	**535.71**
2031-32	269.44	330.47	**599.91**
2032-33	300.41	367.32	**667.73**
2033-34	334.62	411.81	**746.44**
2034-35	372.91	458.98	**831.89**
2035-36	413.84	510.40	**924.24**
2036-37	455.76	564.57	**1020.34**
2037-38	503.68	623.90	**1127.58**
2038-39	557.27	690.71	**1247.98**
2039-40	618.69	769.36	**1388.05**
2040-41	676.16	840.38	**1516.54**
2041-42	741.13	926.19	**1667.32**
2042-43	811.94	1014.54	**1826.48**
2043-44	892.91	1118.39	**2011.30**
2044-45	976.58	1225.61	**2202.19**
2045-46	1062.45	1336.08	**2398.54**

CHAPTER 8

CONCLUSION & RECOMMENDATIONS

8.1 Conclusion & Recommendations

Project stretch of Agra to Etawah section of NH-2 in state of Delhi from km 199.660 to km 323.525 is currently six lane road. The road is in sound condition and serves healthy traffic volumes. Project corridor is a part of the most busy and prominent national highway NH-2 which connects political and cultural capitals of India. This is one of the most important trunk road which spreads across many states. There are large number of townships, industrial corridors and other business establishment coming up along project corridor. As discussed, dominant portion of traffic is long route traffic, which is more sensitive towards the growth of national economy. As Indian economy is poised to grow at 7%+ post COVID-19, the project corridor is expected to pick up the same trend in terms of traffic flow. All these developments have potential to give positive impact to traffic flow on project. The following can be considered as major outcomes of the study

a) There is good amount of tollable traffic running on project

b) Project corridor has potential to witness traffic growth @ 6-8% annually in near future due to various development in area and overall development of economy

c) Project corridor has committed traffic as long route traffic and does not run a risk of traffic leakage due to quality competing road

Based on above it can be considered a stable healthy project from traffic and revenue point of view.

.

GMD Consultants
503-504, Mayuresh Chambers Premises, Plot No. 60,
Sector -11, CBD Belapur, Navi Mumbai. 400 614.
Maharashtra.
Phone : +91-22-2756 4586 / 2756 5313
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

IRB INFRASTRUCTURE TRUST

UDAIPUR TO GUJARAT BORDER ON NH 8 (KM 287.400 TO KM 401.200) IN THE STATE OF RAJASTHAN

APRIL 2023

TRAFFIC STUDY & REVENUE PROJECTION REPORT (FINAL)

GMD CONSULTANTS ★ NAVI MUMBAI ★

GMD Consultants
503, Mayuresh Chambers, Plot No. 60, Sector -11,
CBD Belapur, Navi Mumbai. 400 614.
Maharashtra.
Phone : +91-22-2756 4586 / 2756 5313
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

GMD Consultants
Adding Value

UDAIPUR TO GUJARAT BORDER SECTION OF NH-8

(KM 287.400 TO 401.200)

IN THE STATE OF RAJASTHAN

TRAFFIC STUDY & REVENUE
PROJECTION REPORT
(FINAL)

APRIL 2023

GMD CONSULTANTS
NAVI MUMBAI

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AADT	-	Annual Average Daily Traffic	**NHAI**	-	National Highway Authority of India
BOT	-	Build Operate Transfer	**NHDP**	-	National Highways Development Project
CAGR	-	Compound Annual Growth Rate	**NSDP**	-	Net State Domestic Product
CTV	-	Classified traffic volume	**O&M**	-	Operation & Maintenance
DBFOT	-	Design, Build, Finance, Operate & Transfer	**PCDP**	-	Per Capita Domestic Product
EME	-	Earth Moving Equipment	**PCI**	-	Per Capita Income
GDP	-	Gross Domestic Product	**PCU**	-	Passenger Car Unit
GSDP	-	Gross State Domestic Product	**PSC**	-	Pre-stressed Concrete
HCM	-	Heavy Construction Machinery	**RCC**	-	Reinforced cement concrete
HCV	-	Heavy Commercial Vehicle	**RHS**	-	Right Hand Side
HTMS	-	Highway Traffic Management System	**SH**	-	State Highway
IRC	-	Indian Road Congress	**TP**	-	Toll Plaza
IRR	-	Internal Rate of Return	**WPI**	-	Wholesale Price Index
LCV	-	Light Commercial Vehicle	**SIR**	-	Special Investment Region
LHS	-	Left Hand Side	**c.**	-	Circa
LGV	-	Light Goods Vehicle	**ROB**	-	Railway Over Bridge
MAV	-	Multi Axle Vehicle	**MDR**	-	Major District Road
MORTH	-	Ministry of Road Transport and Highways	**ODR**	-	Other District Road
NH	-	National Highway	**CA**	-	Concession Agreement
PCC	-	Plain Cement Concrete	**RMT**	-	Running Meter
CR	-	Coarse Rubble			

CHAPTER 1

INTRODUCTION

1.1 Background

The Government of India through National Highway Authority of India (NHAI) embarked upon a program to enhance the traffic capacity and safety for efficient transportation of goods as well as passenger traffic on National Highway Sections under NHDP Phase V. Under Phase V NHAI has planned to convert 6,500 km of existing 4-lane National Highways into 6-lane National Highway. Sections envisaged under 6-laning comprise the Golden Quadrilateral section (5,700 km) and some other sections which are 800 km in length.

The project under consideration, Six Laning of section from Km 287.400 to Km 401.200 of NH-8 in state of Rajasthan and Gujarat is one such road project NHAI intended to implement on a BOT basis in the DBFOT format. *M/s Udaipur Tollway Ltd*. (Concessionaire) has been awarded the Project for a concession period of 21 years starting from 3rd September 2017. The Project has been commissioned and is currently in the operation / maintenance phase. Six laning of project has also been completed in June 2021.

The length of project road is 114.00 Km approx. The project road is section of NH-8, one of the busiest national highways of India and part of Mumbai – Delhi arm of golden quadrilateral.

Project road alignment passes through the rural area in most part of stretch. After Udaipur there is no major urban establishment other than Rishabhdeo, a famous religious place in the region. The following figure show project road in regional context.

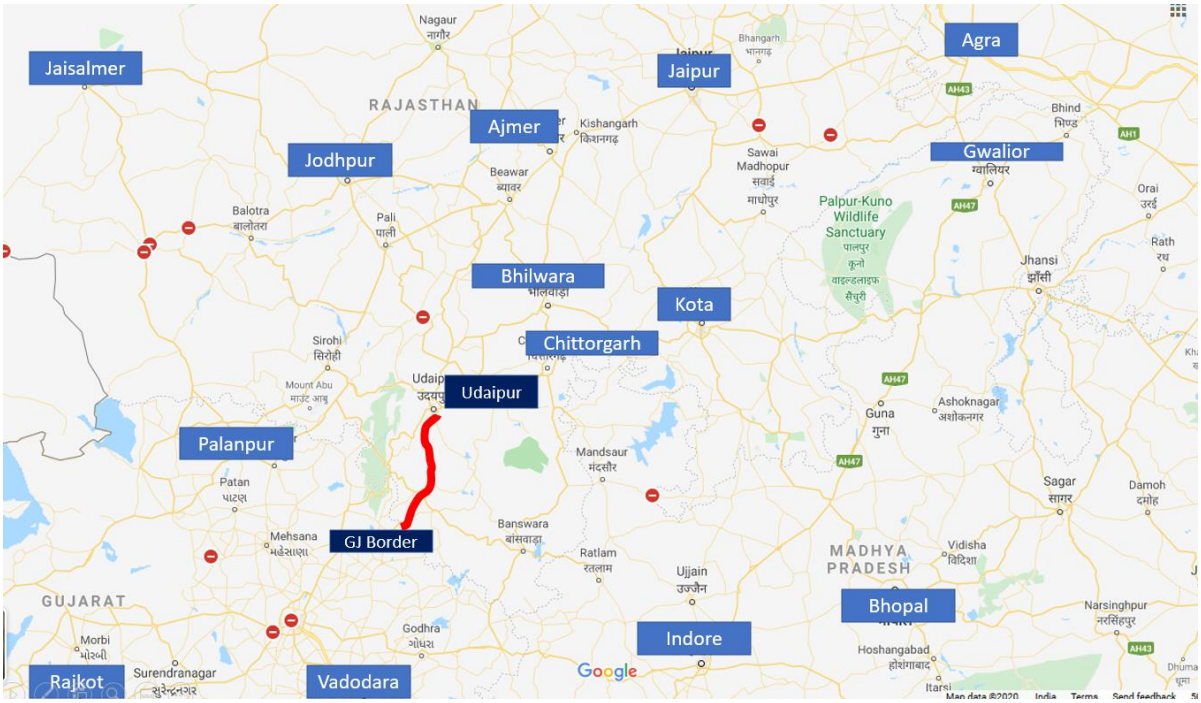


Figure 1-1 : Alignment of Project Stretch

1.2 Objective of the Study

M/s IRB INFRASTRUCTURE TRUST has engaged *GMD Consultants* to assess the future traffic and toll potential of project along with related operation & maintenance expenditure involved.

This report named as **"Traffic Study & *Toll Revenue Projection Report*"** mainly focuses on traffic and revenue aspects of the project. Other parameters like competing road, area developments etc. have been considered from a traffic development point of view.

1.2.1 Scope of Services

The broad scope of work covered in the assignment is as follows

a) Analysis of Traffic Growth
b) Toll Rate Growth
c) Revenue Forecasting

The Concessionaire has provided basic traffic data and other project details on the basis of which the above analysis has been carried out.

CHAPTER 2

PROJECT DETAILS

2.1 Project Corridor

National Highway 8 is one of the busiest national highways of India. Project stretch from Udaipur to Gujarat border on NH-8 is part of Delhi Mumbai arm of Golden quadrilateral.

Besides being part of major transport link between Mumbai and Delhi, stretch from Udaipur to Shamlaji forms major connectivity between Udaipur, Ahmedabad, Rajkot Jamnagar and Porbandar. After renumbering of all national highways by National Highway Authority of India in 2010, the current NH 48 was formed by merging the old NH 8 (Delhi-Mumbai section) and NH 4 (Mumbai-Chennai). National Highway 48 starts at Delhi and terminates at Chennai and goes through Jaipur, Udaipur, Vadodara, Mumbai, Pune and Bengaluru, traversing through six states of India.

2.2 Project Stretch Description

Section of NH-8 (New NH-48) from Udaipur to Gujarat Border is part of major transportation link in the area connecting industrial / tourist cities of Udaipur- , Ahmedabad, Vadodara, Mumbai. Project stretch would be faster connectivity to Udaipur from Gujarat border and onwards to Ahmedabad once six laning is complete.

Project stretch from Udaipur to Gujarat border as such passes through rural areas. Area has number of green marble mines and there are lot many establishments on the way. Rishabhdeo in one such area having more than 500 such units.

Major religious centres like Shamlaji and Ekling ji contribute to substantial passenger traffic on project stretch.

There is one operative toll plaza at project stretch at Khandi Obri at km 348.450.

Following figure show project alignment and toll plaza location.

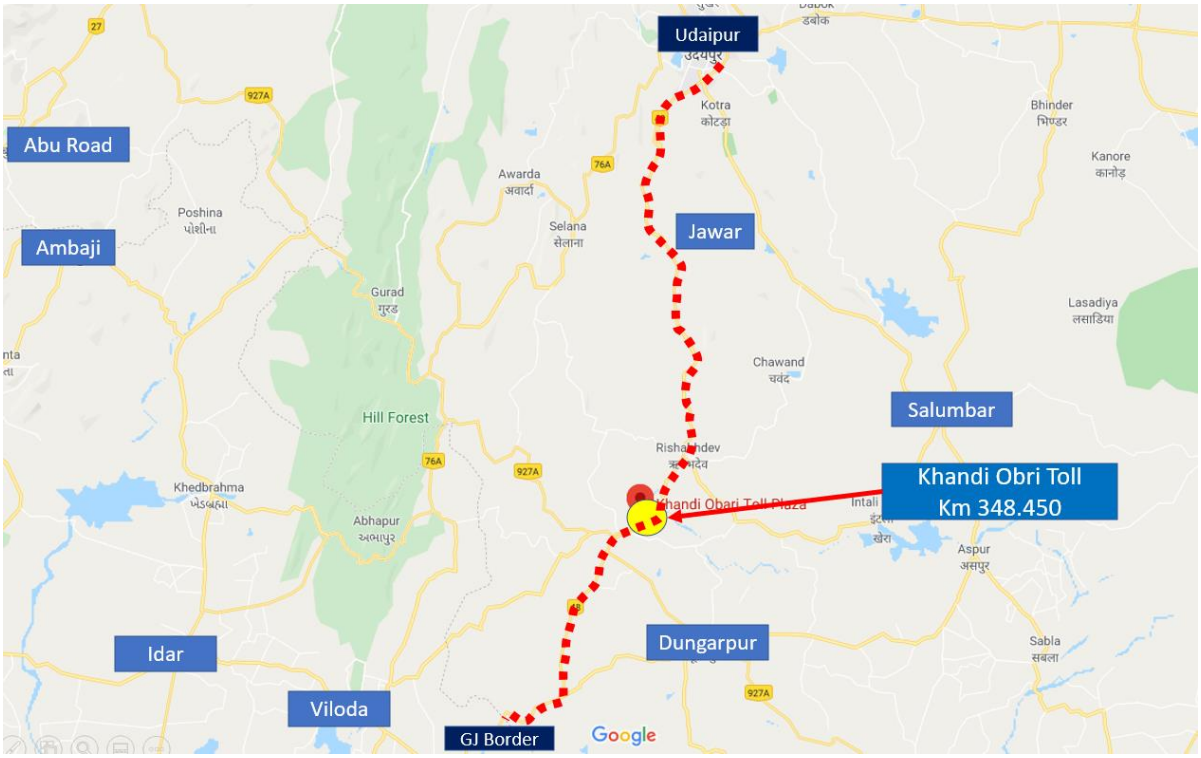


Figure 2-1 : Project Alignment with Toll Plaza

2.3 Project Corridor Illustration

Six laning of project stretch is complete underway and is expected to complete soon.

Following photographs illustrate project section along the corridor.

Figure 2-2 : Photographs showing Project Corridor

CHAPTER 3

TRAFFIC SURVEYS AND ANALYSIS

3.1 Traffic Surveys

The Consultants have collected the required information for project corridor to understand the general traffic and travel characteristics on the corridor.

The following traffic data has been collected from client for project.

- Classified traffic volume counts at toll plaza location on Udaipur – Gujarat section of NH-8 for year 2017-18 (part), 2018-2019, 2019-20, 2020-21, 2021-2022 & traffic data from April 2022 to March 2023.
- Local Component of traffic
- Component of Return Journey
- Component of Monthly Pass Journey

The main objective of the traffic data analysis is to:

- Determine the existing traffic movement characteristics of the project
- Establish base year traffic
- Identification of travel patterns and modal split of project traffic
- Deriving growth factors for traffic forecasting
- Estimation of corridor traffic including traffic diversion if any
- Preparation of revenue model and projection of revenue as per toll policy for various scenarios

Table 3-1 below lists provides details of locations from where traffic details have been collected.

Table 3-1 : Traffic Data Details

SR. NO	LOCATION	CTV	Single Journey Traffic	Daily Return Journey	Monthly Pass	Local Pass
1	Km 348.450 Toll Plaza at Khandi Obri	AADT for Year 2017-18, 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Year 2017-18, 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Year 2017-18, 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Year 2017-18, 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23	For Year 2017-18, 2018-19, 2019-2020, 2020-21, 2021-22 & 2022-23

3.2 Classified traffic Volume

The objective of conducting a Classified Traffic Volume Count is to understand the traffic flow pattern including modal split on a roadway. The Classified Traffic Volume Count survey has been provided by the concessionaire of project highway from actual traffic data gathered at toll plaza locations based on monthly data shared with NHAI.

The vehicles can broadly be classified into fast moving / motorized and slow moving / non-motorized vehicles, which can be further classified into specific categories of vehicles. The groupings of vehicles are further segregated to capture the tollable vehicle categories specifically and toll exempted vehicles are counted separately. The detailed vehicle classification system as per IRC: 64-1990 is given in table below.

Table 3-2 : Vehicle Classification System

Vehicle Type	
Auto Rickshaw	
Passenger Car	Car, Jeep, Taxi & Van (Old / new technology)
Bus	Minibus
	Standard Bus
Truck	Light Goods Vehicle (LCV)
	2 – Axle Truck
	3 Axle Truck (HCV)
	Multi Axle Truck (4-6 Axle)

	Oversized Vehicles (7 or more axles)
Other Vehicles	Agriculture Tractor, Tractor & Trailer

Source - IRC: 64 – 1990

However, since project highway is currently under toll operation, the data collected corresponds to category of tollable vehicles. The following are the type of vehicles as per concession agreement.

- Car / Jeep / van
- Min Bus /LCV
- Truck / Bus
- Multi Axle

3.3 Traffic Characteristic

Toll revenue of project highway does not solely depend on traffic volume. There are certain characteristics of traffic which have substantial potential to affect toll collection. Component of local traffic, component of passenger and commercial traffic, portion of return journey traffic, % of monthly pass traffic are some of such characteristics of traffic. These will be discussed in subsequent sections of the report.

3.3.1 Traffic Data

Project concessionaire has provided Traffic data for base year 2019-20 ,2020-21, 2021-22 and from April 2022 to March 2023 as under for both toll plazas–

Table 3-3 : Traffic Data at Khandi Obri Toll Plaza at Km 348.450

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)- 2019-20	Annual Average Daily Traffic (Nos.)- 2020-21	Annual Average Daily Traffic (Nos.)- 2021-22	Annual Average Daily Traffic (Nos.)- 2022-23
1	CAR	4532	3574	4773	5335
2	LCV	934	737	619	672
3	BUS	800	472	661	781
4	Truck	1448	1402	1703	1864
5	3-Axle	1806	1548	1691	1724

6	Multi Axle	3717	3367	3887	4157
7	Oversized Vehicle	11	13	21	13
	Total	**13248**	**11113**	**13355**	**14545**

Pandemic of COVID-19 (Corona Virus) had impacted entire world. Taking precaution, government of India announced a complete lockdown in last of March 2020 and traffic on highways was stopped which was eased out progressively later. There after India was hit by Covid-19 second and third wave in February 21 to July - 21 and December 21 to March-22. Recovering traffic pattern was somewhat again disturbed due to second and third wave of Covid-19. Traffic numbers for period from April-2020 to March 2021 were not representative of traffic pattern at project corridor due to pandemic lockdown impact. However, for integrity of data same shown above. Traffic has almost recovered from Covid -19 impact as of now.

Since the traffic data is available year 2022-23 report has been updated taking this as base year traffic.

This data was then bifurcated to various components like through local, monthly, return journey etc. category. Same is discussed in detail in following section.

3.4 Data Analysis

3.4.1 Analysis of Traffic Volume Count

Understanding the character of existing traffic forms the basis of the traffic forecast. The various vehicle types having different sizes and characteristics can be converted into a single unit called Passenger Car Unit (PCU). Passenger Car equivalents for various vehicles are adopted based on recommendations of Indian Road Congress prescribed in "IRC-64-1990: Guidelines for Capacity of Roads in Rural areas". The adopted passenger car unit values (PCU) are presented in ***Table 3-4.***

Table 3-4 : PCU Factors Adopted for Study

Vehicle Type	PCUs
Car	1.0
Minibus	1.5
Standard Bus	3.0
LCV/LGV	1.5
2 Axle Truck	3.0
3 – 6 Axle Truck	4.5
MAV	4.5
Auto Rickshaw	1.0
Van/Tempo	1.0
Agriculture Tractor with Trailer	4.5
Agriculture Tractor without Trailer	1.5

Source: IRC: 64-1990

Traffic volume at each toll plaza was converted to PCU and same is presented as under

Table 3-5 : Traffic in PCU at Project Stretch Base Year 2022-23

Year	Toll Plaza Location (Km)	Traffic No	PCU	PCU Index
2019-20	Khandi Obri at Km 348.450	13248	34871	2.63
2020-21	Khandi Obri at Km 348.450	11113	30155	2.71
2021-22	Khandi Obri at Km 348.450	13355	35453	2.65
2022-23	Khandi Obri at Km 348.450	14545	38213	2.63

It can be observed from above that project traffic has PCU index more than 2.5 which is an indicator of high proportion of commercial traffic in traffic mix in project corridor.

3.4.2 Components of Traffic

As discussed previously, components of traffic volume play an important role in determining project revenue. A larger component of commercial traffic with higher axle configuration adds to project revenue positively. Similarly, a larger component of local traffic affects the project revenue potential negatively.

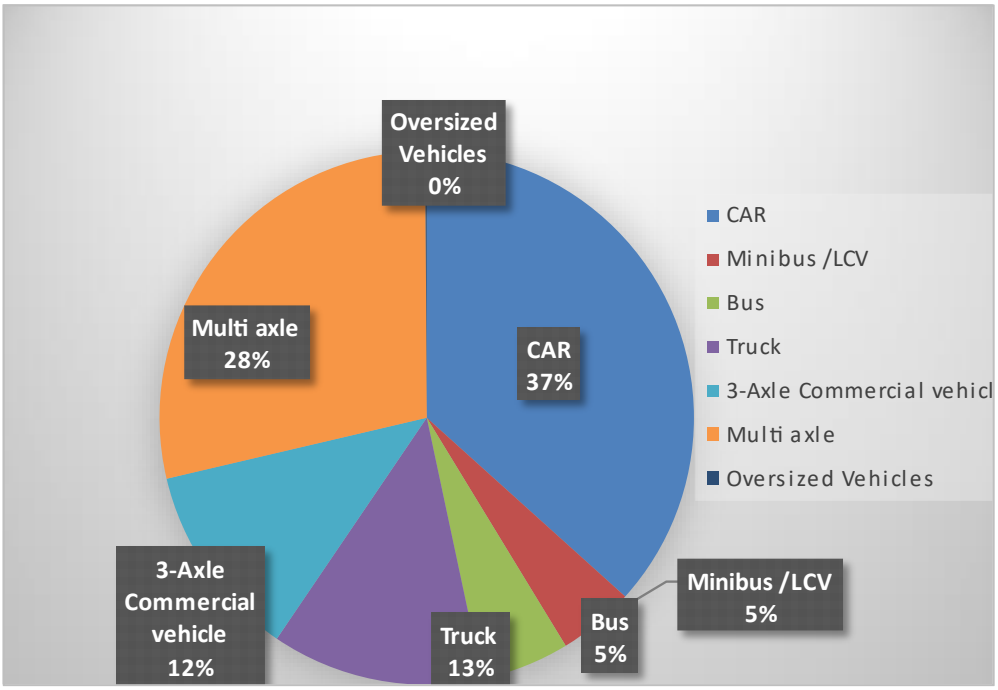


Figure 3-1 : Model Split of Tollable Vehicle

It is observed that car traffic forms about 37% of total traffic at toll plaza locations while multi axle commercial vehicles are about 40% of total traffic. Truck / Bus and LCV share about 18% and 5 % of traffic volume respectively.

Another important bifurcation of traffic is components of traffic with respect various type of toll ticketing like

1. Single Journey
2. Multi Journey
3. Monthly Pass (Local and General)

The following table provides numbers of vehicles falling in each of above category on base year 2022-23

Table 3-6 : Journey Type Bifurcation of Traffic at Khandi Obri TP KM 348.450

Sr. No	Type	Traffic Volume (Nos.)2022-23
1	Single Journey	11685
2	Return Journey	2664
3	Local Commercial Single Journey	131
4	Monthly Pass Local	60
5	Monthly Pass	0

Most dominant part of the above is the single journey type followed by return journey at project stretch. Monthly pass commuters are a very low fraction of the total traffic on the project corridor.

The single journey component in total traffic numbers is a high as 80%. Return journey component is 18%. The number of monthly pass Local is 1% and Local Commercial Single journey is 1% at Khandi Obri toll plaza.

It is observed that the project corridor demonstrates pattern of single journey dominated mix of traffic which is typical of major national highways having more long distance traffic.

3.5 Secondary Data Collection

There are several other factors which have a substantial impact on traffic pattern and growth on any project corridor. Following are some of such important factors

- Industrial development around project corridor and its catchment
- Educational infrastructure along project corridor
- Demographic pattern
- Urban area development
- Tourism potential
- Upcoming major infrastructural or Industrial projects
- Special Industry in project corridor
- Overall trends of economic growth local as well as national / regional

Hence in addition to traffic details on project site, secondary data was also collected from various other sources. Typical secondary data includes the following:

1. Vehicle registration data of regional and national level.

2. Economic Data
    a) GDP
    b) NSDP
    c) Population Growth
    d) Per Capita Income growth
    e) Industrial Growth
    f) Special Industry Potential
    g) Regional and National development vision / plan
    h) Any other relevant data
3. Competing road network

We have collected and utilized such underlying data in the study to estimate the growth and risk factors for traffic along the project corridor.

CHAPTER 4

INFLUENCE ZONE TRANSPORT NETWORK ANALYSIS

4.1 Introduction

Highway corridors behave like integrated circuit network and more often than not every road is connected to various networks having different origin and destinations. Traffic running on these networks behave like fluid and flow on network on alignment of least friction.

Following Factors can be considered as major contributors to friction on transportation network.

- Travel Speed / Travel Time
- Geometric deficiencies like blind horizontal curves and steep vertical gradients etc,
- Configuration of road
- Riding quality
- Traffic delays,
- Length of road,
- Passing through built up or Urban Area,
- Terrain,
- Facilities,

4.2 Competing / Alternate route

Project stretch is part of Delhi – Mumbai arm of golden quadrilateral transport network. Additionally, it also forms good connectivity to Ahmedabad, Rajkot, Jamnagar and other port and industrial establishments in bay of Khambat of Gujarat.

At regional level, there can be three alternates for Udaipur- Ahmedabad pair of Origin & Destination. One via project road (Udaipur – Rishabhdeo- Shamlaji- Ahemedabad), second on east side (via Himmatnagar) and third on far east side via Palanpur- Mehsana..

Following maps show these routes in relation to project stretch at regional level.

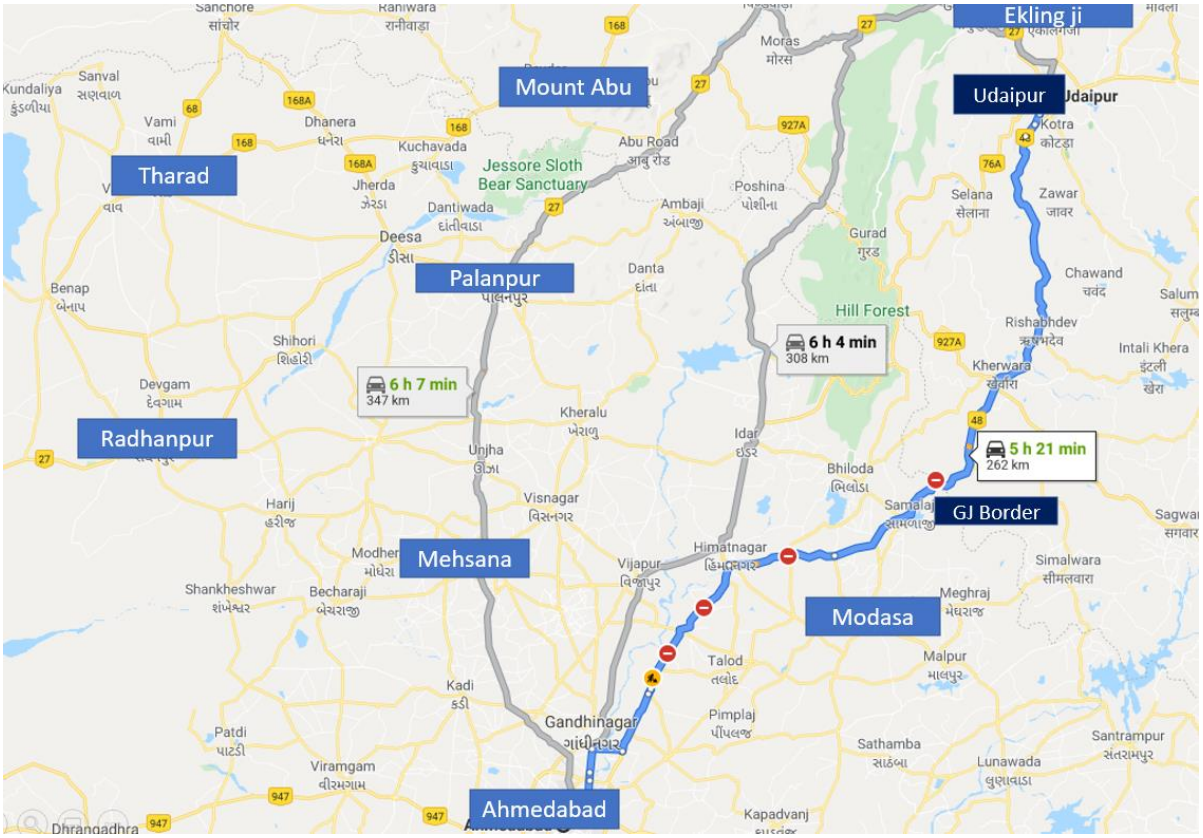


Figure 4-1 : Alternate route at regional level Udaipur - Ahmedabad

Route via project road is most preferred one due to minimum travel time and shortest length.

On a high level, between Delhi and Vadodara, there can be three alternatives. One via project road (Delhi- Jaipur- Udaipur- Shamlaji -Vadodara), second via Delhi-Sikar-Ahmedabad- Vadodara) and third via Delhi- Jaipur- Mandsauar – Banswara- Godhra-Vadodara. Following map shows these alignments.

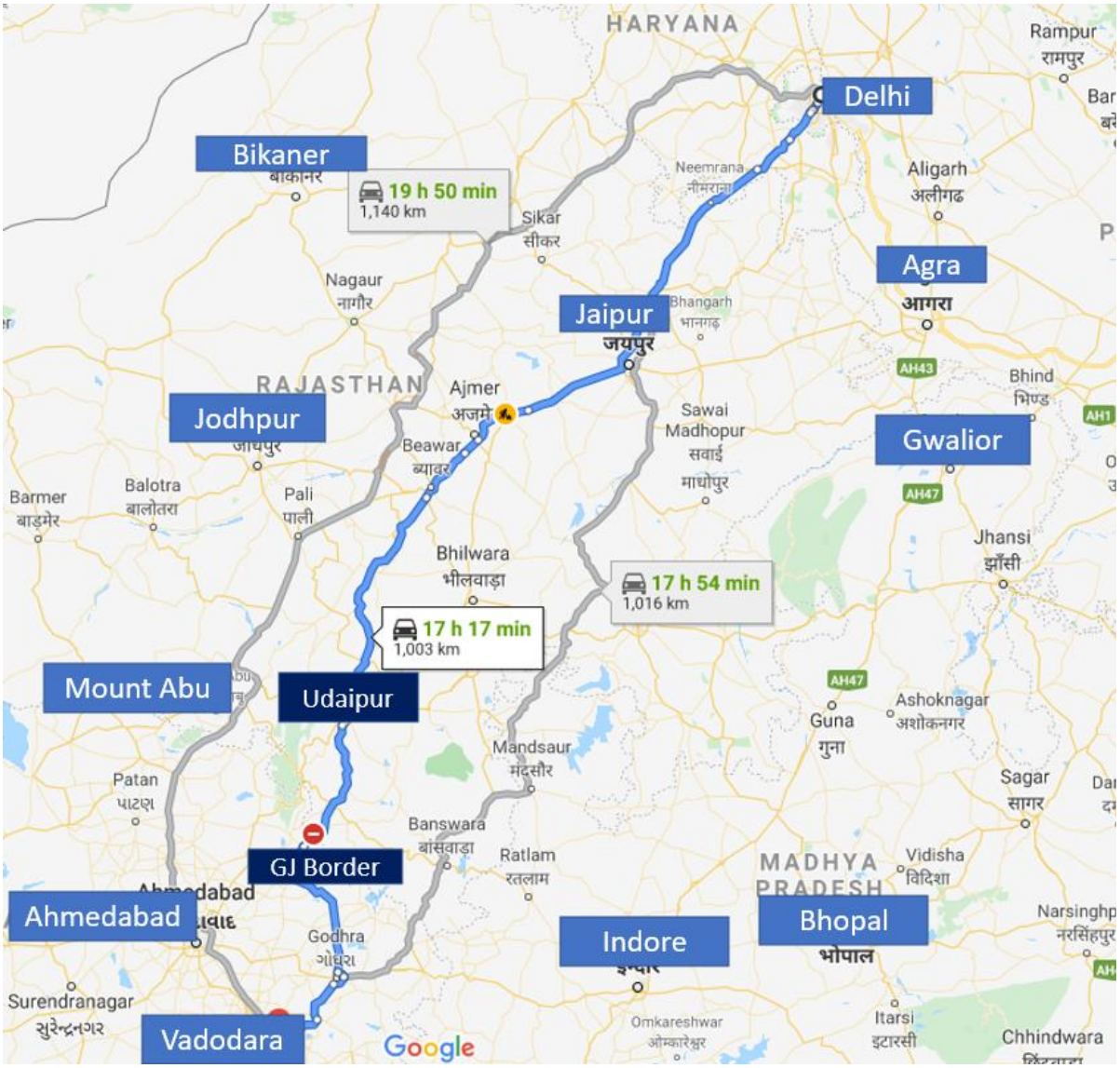


Figure 4-2 : Alternate route at regional level Delhi - Vadodara

For Delhi- Vadodara pair of origin and destination, route via project road (Udaipur – Shamlaji) is most preferred one due to minimum travel time and length of route.

Thus, at regional level project road is preferred route of long-distance traffic between Mumbai- Delhi and Udaipur- Ahmedabad. Project road is under toll operation since long hence traffic on project road is now settled and it can be assumed as dedicated traffic on project road for logistic obligations.

After six laning completion, project stretch would become slightly more attractive due to improved level of service. In such case any further diversion of traffic from project road is not envisaged. It is expected that there could be some attracted traffic on project road after completion of six laning of Kishangarh Gulabpura stretch which is connecting section for project corridor.

At local level there is no potential alternate route to bypass toll plaza.

Following table provide summary of analysis of alternate route/ roads discussed above.

Table 4-1 : Competing Roads Details

Sr. No	Route Details	Designation	Length (Km)	Avg. Speed (KMPH)	Time Taken (Min)	Observations
Regional Level						
1	Udaipur- Palanpur -Mehsana- Ahemedabad	Alternate Route	347	64	6 Hr 7 Min	Project road alternate has minimum travel time and shortest road
	Udaipur- Idar - Himmatnagar- Ahemedabad	Alternate Route	308	50	6 Hr 8 Min	
	Udaipur- Rishabhdeo- Shamlaji- Ahemedabad	Project Road	262	49	5 Hr 21 Min	
2	Delhi- Jaipur- Mandsaur - Banswara- Vadodara	Alternate Route	1140	57	19 Hr 50 Min	Project road alternate has minimum travel time and shortest road
	Delhi- Sikar- Mt. Abu - Ahemedabad- Vadodara	Alternate Route	1016	57	17 Hr 54 Min	
	Delhi- Jaipur- Udaipur - Vadodara	Project Road	1003	58	17 Hr 54 Min	

Under these circumstances it is not envisaged that commercial or passenger traffic would switch to alternate roads from the project road. Further, it may be noted that since the project highway has already been commissioned and has a tolling history, the current traffic

traversing the project corridor already factors in traffic diversion (if any) that may have taken place. Further after completion of six laning, level of service would improve on project corridor and this would create favorable conditions for traffic.

CHAPTER 5

GROWTH OF TRAFFIC ON PROJECT HIGHWAY

5.1 Introduction

Traffic growth is a function of the interplay of a number of contributory factors such as National economy, Government policy, socio-economic conditions of the people, and changes in land uses along the project corridor precincts etc. As these factors have a number of uncertainties associated with them, forecasts of traffic are dependent on the projections of other factors such as population, gross domestic product (GDP), vehicle ownership, per capita income (PCI), agricultural output, fuel consumption etc. Future pattern of change in these factors can be estimated with only a reasonable degree of accuracy and hence the resultant traffic forecast levels may not be precise.

Traffic growth forecast for project corridor Udaipur to Gujarat Border section of NH-8 has been done taking the above factors into consideration. "**IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**" is established best practice and has been used for traffic growth forecast.

5.2 Trend Analysis

One of the methods of estimation of future rate of growth is to assume the same rate of growth as in the past. Although such a method is more suitable to projects of short durations say 5-10 years, however for long term projections it would-be erroneous to assume that the past rate of growth will continue to prevail for a long time in future. Economic conditions, which are major influencing factors, are bound to change over a long period of time. Thus, it would be necessary to modify the past trends of growth suitably.

Elasticity model of growth projection is one of the most widely acceptable methods for traffic forecast. The same is recommended in **IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**.

In this method the past trend of vehicular data is paired with an economic indicator and a regression analysis is done to yield the economic model of growth. Growth of vehicle traffic varies for different type of vehicle. It is a proven fact that the growth pattern for passenger and goods vehicle is different. Traffic growth on any highway

typically depends on number of economic parameters. Most important and direct parameters are given as under

- Per Capita Income
- Net State Domestic Product (NSDP)
- Population

It can be observed that the ownership of a car is more closely related to affordability; hence per capita is the index which closely fits the growth of car traffic among other criteria. In a similar fashion, the following can be pairs of vehicle type and independent variable for elasticity modeling of growth.

- Car / Jeep – Par Capita Income
- Bus / Minibus – Population
- Goods Vehicle – NSDP

5.3 Estimation of Traffic Demand Elasticity

Elasticity of traffic demand is defined as the rate at which traffic intensity varies due to a change in the corresponding indicator selected. Hence, In order to estimate the elasticity of traffic demand, it is necessary to establish relationship between the growth in number of given category of vehicles with the relevant economic variable considered, such as NSDP, per capita income and population growth. Latest available data for vehicle registration, per capita income, NSDP and population is used in analysis.

As per IRC: 108-1996 the model for estimating elasticity index for the project corridor is of the following form and is given as below:

$$Log\ (P) = k \times Log\ (EI) + A$$

Where,

P = *Number of Vehicles (Mode wise)*

EI = *Economic Indicator*

A = *Regression constant*

k = *Elasticity coefficient (Regression coefficient)*

The elasticity for car and bus (passenger vehicles) is calculated based on the Population and Per Capita Domestic Product (PCDP) and the elasticity for trucks is calculated based on the Net State Domestic Product (NSDP).

The project corridor spreads across state of Rajasthan. Toll plazas at Khondi Obri is in the state of Rajasthan but the traffic on project stretch has certain contribution

from other states as well. For elasticity calculations, working data from such states in addition to Rajasthan has been analyzed.

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Rajasthan State.

Table 5-1 : Per Capita Income Vs Car Rajasthan

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	57192	591069	4.76	5.77		
2013	58441	659542	4.77	5.82	2%	
2014	61053	733916	4.79	5.87	4%	
2015	64496	814079	4.81	5.91	6%	
2016	68565	899307	4.84	5.95	6%	
2017	71394	988391	4.85	5.99	4%	4.55%

Regression analysis of same is given in figure below

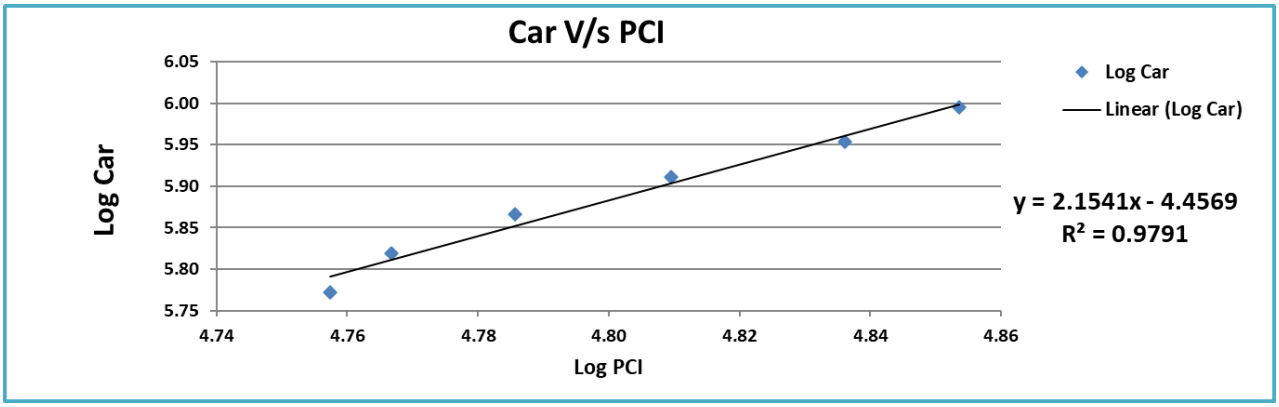


Figure 5-1 : Regression and Elasticity PCI vs. Car – Extrapolation Rajasthan

Table 5-2 : Population Vs Bus Rajasthan

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	68548437	83345	7.84	4.92		
2013	69783885	88616	7.84	4.95	2%	
2014	71016445	93892	7.85	4.97	2%	
2015	72245688	97650	7.86	4.99	2%	
2016	73471198	102818	7.87	5.01	2%	
2017	74692571	108680	7.87	5.04	2%	1.73%

Regression analysis of same is given in figure below

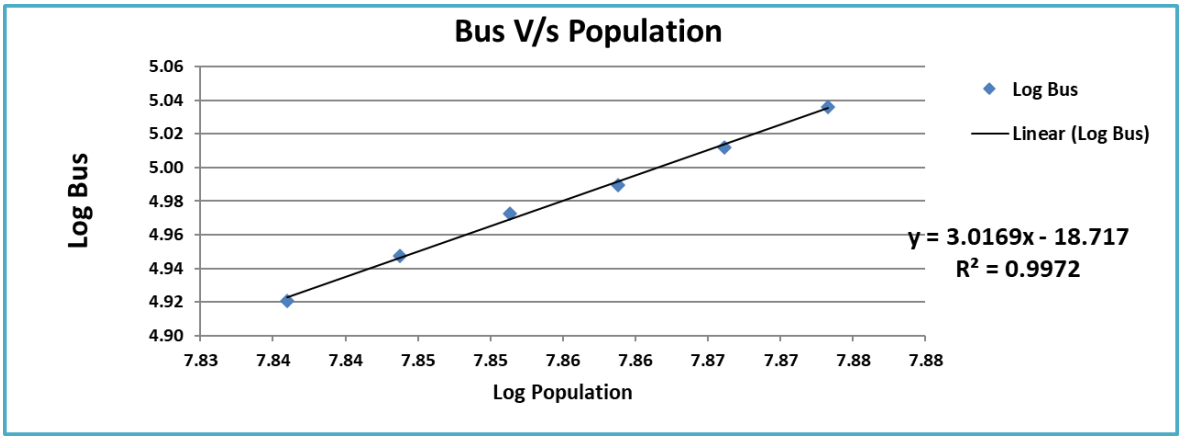


Figure 5-2 : Regression and Elasticity Population vs. Bus – Extrapolation Rajasthan

Elasticity of LCV has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-3 : LCV Vs NSDP Rajasthan

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth
2012	395331	69509	5.60	4.84		
2013	409802	76396	5.61	4.88	4%	
2014	434292	33379	5.64	4.52	6%	
2015	465408	91787	5.67	4.96	7%	
2016	501922	99763	5.70	5.00	8%	6.16%

Following figure depict regression analysis and extrapolation.

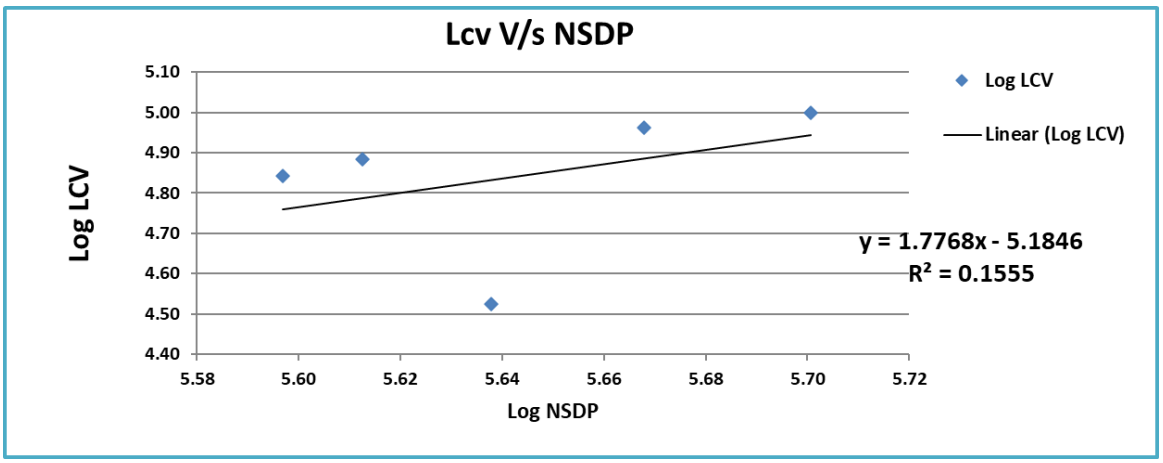


Figure 5-3 : Regression and Elasticity NSDP vs. LCV Traffic - extrapolation Rajasthan

Elasticity of Goods Traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-4 : GOODS Traffic Vs NSDP Rajasthan

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth
2012	395331	362028	5.60	5.56		
2013	409802	401983	5.61	5.60	4%	
2014	434292	434379	5.64	5.64	6%	
2015	465408	472365	5.67	5.67	7%	
2016	501922	517604	5.70	5.71	8%	
2017	530172	561158	5.72	5.75	6%	6.06%

Following figure depict regression analysis and extrapolation.

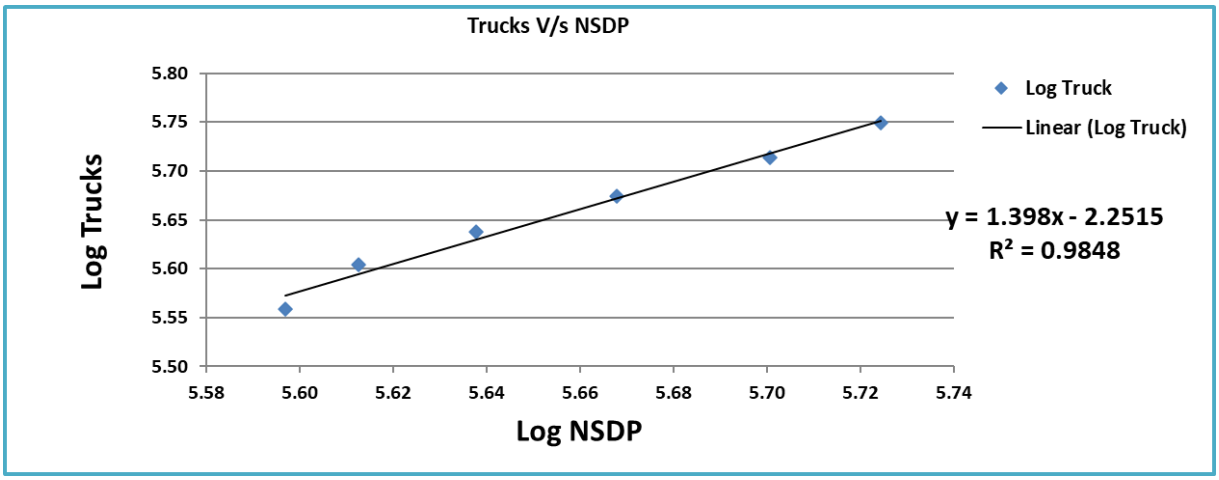


Figure 5-4 : Regression and Elasticity NSDP vs. Goods Traffic - extrapolation Rajasthan

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below

Table 5-5 : Summary Regression Analysis Rajasthan

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average IV Growth (5yrs)	Growth Elastic Model	Remarks
Rajasthan	Car/Jeep	PCI	y = 2.1541x + -4.4569	R^2 = 0.9791	2.1541	4.55%	9.79%	Good Regression
	Bus	Population	y = 3.0169x - -18.7174	R^2 = 0.9972	3.0169	1.73%	5.22%	Good Regression
	LCV	NSDP	y = 1.7768x - -5.1846	R^2 = 0.1555	1.7768	6.16%	10.95%	Poor Regression
	Truck	NSDP	y = 1.398x - -2.2515	R^2 = 0.9848	1.3980	6.06%	8.46%	Good Regression

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Rajasthan State.

Table 5-6 : Per Capita Income Vs Car Gujarat

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	87481	1411898	4.94	6.15		
2013	96683	1602129	4.99	6.20	11%	
2014	102589	1771298	5.01	6.25	6%	
2015	111370	2008748	5.05	6.30	9%	
2016	120683	2260084	5.08	6.35	8%	
2017	129738	2527537	5.11	6.40	8%	8.21%

Regression analysis of same is given in figure below

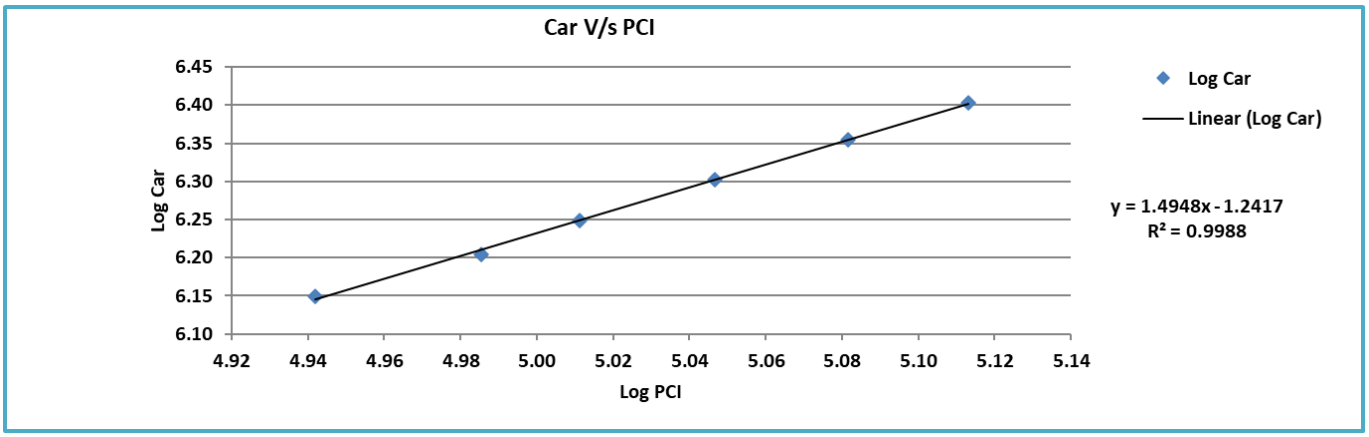


Figure 5-5 : Regression and Elasticity PCI vs. Car – Extrapolation Gujarat

Table 5-7 : Population Vs Bus Gujarat

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	60439692	67546	7.78	4.83		
2013	61563037	70615	7.79	4.85	2%	
2014	62684375	72998	7.80	4.86	2%	
2015	63803304	76435	7.80	4.88	2%	
2016	64919427	82734	7.81	4.92	2%	
2017	66032362	74855	7.82	4.87	2%	1.79%

Regression analysis of same is given in figure below

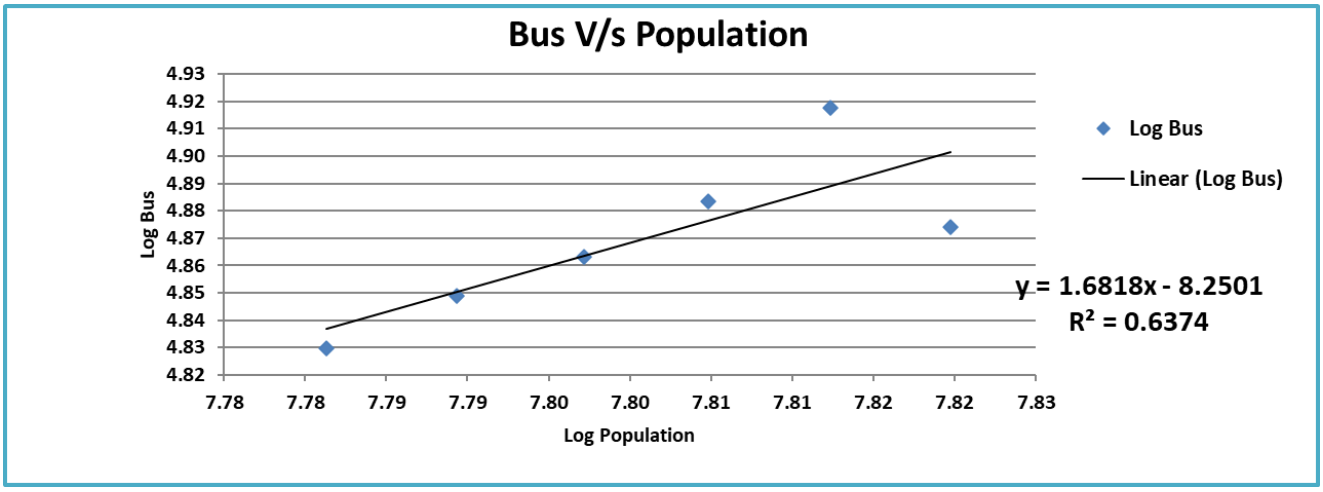


Figure 5-6 : Regression and Elasticity Population vs. Bus – Extrapolation Gujarat

Elasticity of LCV has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-8 : LCV Vs NSDP Gujarat

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth (5 Year)
2012	532809	448958	5.73	5.65		
2013	596659	499277	5.78	5.70	12%	
2014	641489	542918	5.81	5.73	8%	
2015	705629	589984	5.85	5.77	10%	
2016	774775	633599	5.89	5.80	10%	9.82%

Following figure depict regression analysis and extrapolation.

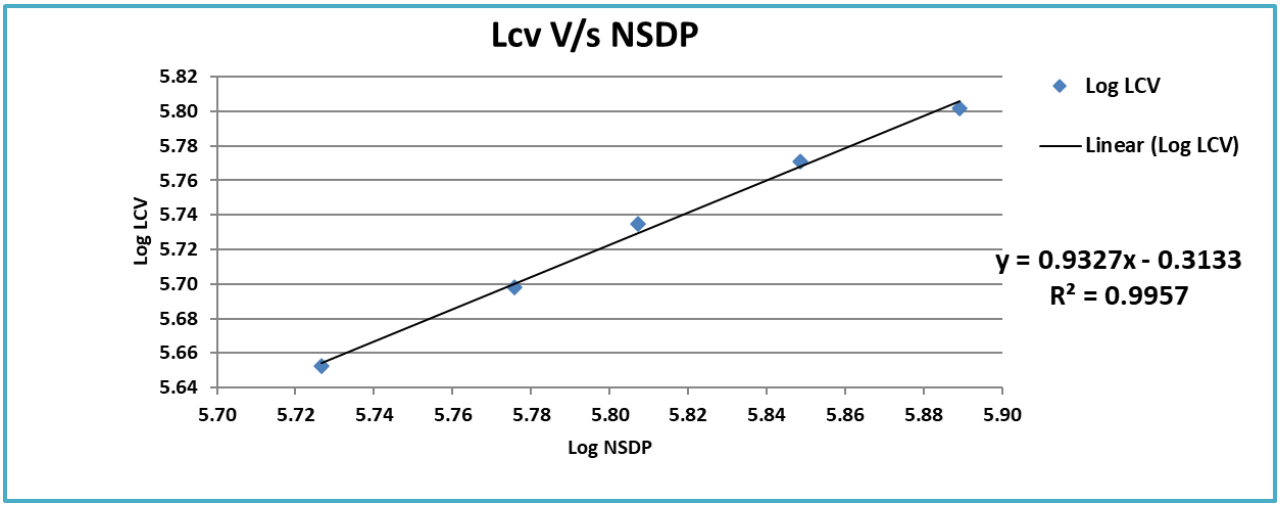


Figure 5-7 : Regression and Elasticity NSDP vs. LCV Traffic - extrapolation Gujarat

Elasticity of Goods Traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-9 : GOODS Traffic Vs NSDP Gujarat

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	532809	301533	5.73	5.48		
2013	596659	319207	5.78	5.50	12%	
2014	641489	332185	5.81	5.52	8%	
2015	705629	352225	5.85	5.55	10%	
2016	774775	375265	5.89	5.57	10%	
2017	843930	396061	5.93	5.60	9%	9.64%

Following figure depict regression analysis and extrapolation.

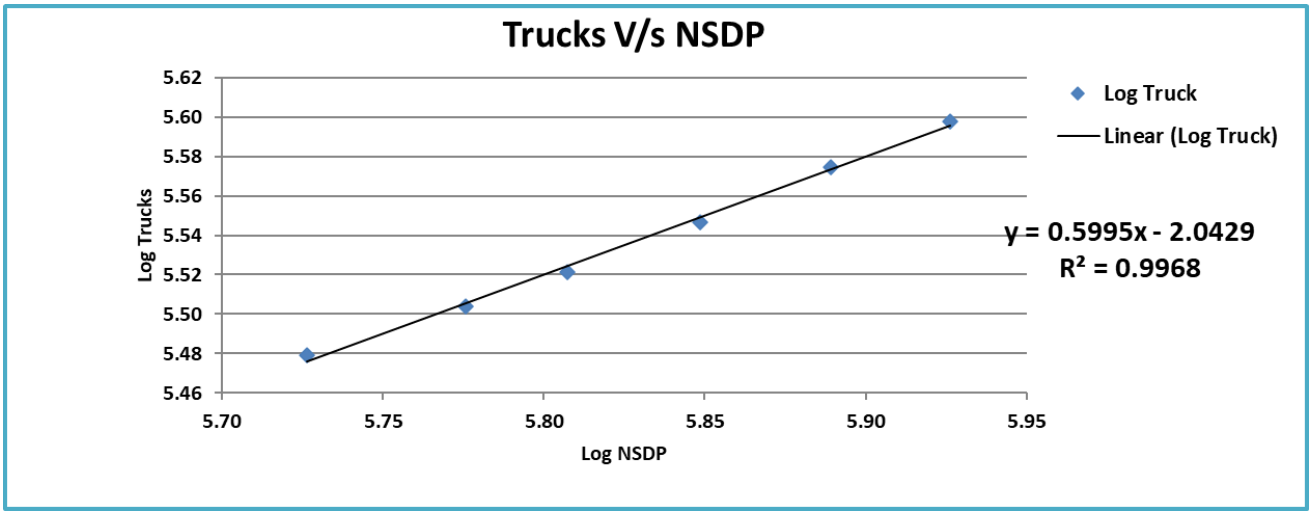


Figure 5-8 : Regression and Elasticity NSDP vs. Goods Traffic - extrapolation Gujarat

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below

Table 5-10 : Summary Regression Analysis Gujarat

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average IV Growth (5yrs)	Growth Elastic Model	Remarks
Gujarat	Car/Jeep	PCI	y = 1.4948x - -1.2417	R² = 0.9988	1.4948	8.21%	12.27%	Good Regression
	Bus	Population	y = 1.6818x - -8.2501	R² = 0.6374	1.6818	1.79%	3.00%	Fair Regression
	LCV	NSDP	y = 0.9327x - - 0.3133	R² = 0.9957	0.9327	9.82%	9.16%	Good Regression
	Truck	NSDP	y = 0.5995x - - 2.0429	R² = 0.9968	0.5995	9.64%	5.78%	Good Regression

Economical model for predicting growth is good tool, however other local, regional, national factors should also be considered before finalizing growth factors. Considering factors such as proposed developments and other influencing economic factors, moderated growth should be considered. These factors are discussed in subsequent sections.

5.4 Analysis of Historic Traffic Data

Historical traffic data forms useful information for any highway project. It provides useful information for establishing past trend of growth. Project stretch of Udaipur to Gujarat on NH-8 is under tolling operation with current concessionaire and has three year of tolling history from 2017-18 (Part year). As traffic data available with the project concessionaire is of less than three years, we do not have sufficient data points to be able to establish a reliable past trend of traffic growth. A minimum of about 5 -6 years' traffic data is required for establishing a reliable past trend.

5.5 Other Factors Influencing Growth

There are many factors which have impact on traffic growth. As discussed previously these factors can be economical, social, educational, and industrial.

Potentiality of such factors for project highway is discussed as under.

ECONOMY

After witnessing a slowdown during 2011-12, the economy recovered in 2013-14, and a high growth rate of GDP was recorded in up to 2018-19. Pandemic of COVID-19 impacted all economies of world including India. Following figure show trend of GDP growth in India.

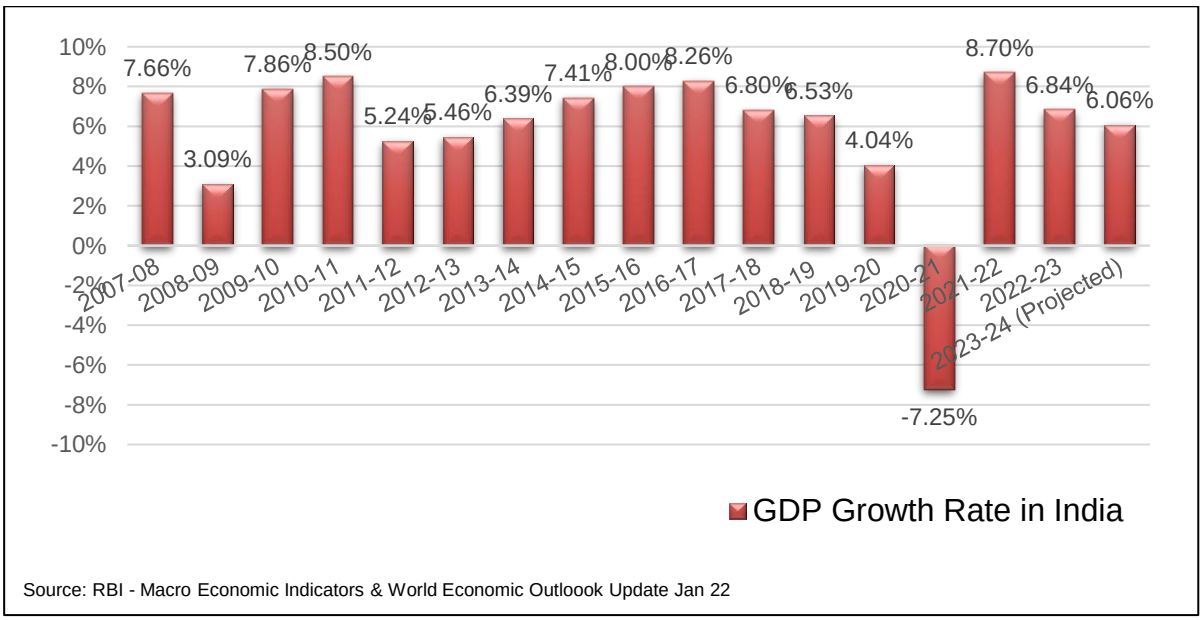


Figure 5-9 : Growth of GDP in India

FY 2017-18 recorded a growth of 6.7% which had slight impact of GST and demonetization. Indian economy appears on recovery path with estimated growth of

6.8% in FY 2018-19. Government took major policy decision including tax infrastructure reforming, banking sector improvement and ease of doing business.

Major economies of world collapsed due to pandemic COVID-19 including India. Indian economy is also registered negative growth in financial year 2020-21. After that Indian economy recovered handsomely and registered a growth of about 9% in Year 2021-22. This was partly due to low base of year 2020-21 as well.

Honorable Prime Minister has announced a major relief package of Rs. 20 lakh crores which is about 10% of GDP. This is aimed at turning this major crisis of COVID-19 into opportunity by providing major impetus to industrial production to the limit of becoming a self-reliant economy. With major thrust of this package being on **Make -In- India** it is expected that industry in India would grow at rapid pace and recover handsomely in post COVID-19 scenario. World Economic Outlook update also has predicted a growth rate of about 7.5 % in year 2022-23.

5.6 Developments along and around the Project Corridor & State

Project stretch passes through mineral rich belt of marble and minerals.

Tourism, agriculture, and mineral industries contribute to Udaipur's diverse economic base. Udaipur sees major tourist footfall throughout the year owing to its picturesque landscape, lakes, and historic palaces and architecture. Shamlaji is a major Hindu pilgrimage dedicated to God Vishnu. Each year an annual fair is held October which attracts huge crowds from surrounding region. Udaipur district is rich in lead, zinc, silver, phosphate, calcite, copper and limestone minerals. Udaipur is known for its marble which is mined, processed, and is exported across the world. Nathdwara in north of asset is one of biggest extractors of marble and limestone minerals. Hindustran Zinc, which is world's second largest zinc producer, is based out of Udaipur.

Rishbhdeo is one of the major religious and industrial settlement on project corridor. This region has more than 200 mines of green marble. Rishabhdeo is the largest miner of green marble.9 0 per-cent of green marble in the world is produced in Rishabhdev. The turnover of marble industry is more than 500 crore. It also give employment to many labourers. Beyond this the town also has spinning and weaving mill by lnjbhilwara group. Thus it gives employment to 10000 local workers. The presence of temple also leads to income of many people

Growth of Rajasthan has been comparable to the national average economic growth. Rajasthan is rich in natural resources and benefits from its strategic geographic location in India. The state is pre-eminent in quarrying, mining in India and has been a leader in crude oil extraction over the past the few years. Moreover, Rajasthan is also a relevant tourism attractor in India. Considering the scenario, it may be assumed that the traffic growth on project highway would remain high and there are minimal risks in terms of growth.

Table 5-11 : GDP of India, Rajasthan and other important states

Year	India (GDP)	Bihar	Haryana	Madhya Pradesh	Maharashtra	Odisha	Punjab	Rajasthan	Uttar Pradesh	Uttarakhand	West Bengal	Delhi
1980-81	12336	514	357	623	1464	529	504	560	1631	138	830	269
1981-82	13030	543	371	639	1498	528	551	607	1670	141	808	291
1982-83	13411	548	394	668	1556	497	568	620	1800	152	840	328
1983-84	14464	601	402	702	1654	597	578	761	1871	158	939	320
1984-85	15037	658	418	668	1675	569	623	706	1900	161	964	333
1985-86	15663	672	493	726	1807	635	670	704	1975	167	1005	386
1986-87	16339	725	493	694	1832	643	694	771	2060	174	1045	411
1987-88	16917	685	484	789	1955	623	730	718	2154	182	1101	447
1988-89	18635	772	602	847	2159	754	769	1014	2434	206	1148	486
1989-90	19778	759	610	865	2515	805	834	993	2502	212	1188	531
1990-91	20824	831	674	987	2629	668	849	1149	2651	224	1251	553
1991-92	21122	784	688	916	2620	753	888	1061	2662	225	1349	638
1992-93	22254	737	688	983	3017	740	930	1220	2690	228	1389	660
1993-94	23519	755	719	1088	3349	788	970	1121	2757	233	1490	705
1994-95	25023	842	771	1107	3414	826	995	1325	2901	254	1594	790
1995-96	26846	712	787	1174	3791	864	1032	1374	2995	251	1713	804
1996-97	28987	893	879	1252	3941	804	1107	1535	3327	267	1832	915
1997-98	30234	850	887	1318	4158	920	1137	1721	3292	270	1985	1063
1998-99	32255	904	934	1405	4324	948	1203	1797	3316	274	2112	1116
1999-00	34837	950	1002	1552	4735	1008	1267	1801	3440	274	2264	1170
2000-01	36282	1106	1081	1426	4589	982	1309	1743	3511	308	2343	1215
2001-02	38236	1043	1165	1528	4751	1042	1326	1941	3575	323	2512	1262
2002-03	39719	1175	1236	1449	5079	1034	1348	1708	3690	353	2600	1359
2003-04	42883	1099	1358	1611	5471	1185	1433	2251	3885	381	2753	1433
2004-05	45906	1238	1475	1664	5948	1340	1504	2196	4079	431	2936	1588
2005-06	50257	1207	1608	1748	6810	1399	1577	2344	4317	492	3121	1752
2006-07	55066	1416	1791	1907	7748	1574	1748	2620	4660	551	3366	1969
2007-08	60199	1489	1931	1997	8650	1708	1899	2739	4959	648	3627	2191
2008-09	64248	1716	2080	2250	8786	1837	2004	2969	5336	716	3774	2464
2009-10	69769	1798	2340	2463	9634	1852	2132	3142	5668	839	4067	2667
2010-11	75987	2073	2498	2592	10732	1968	2270	3614	6120	927	4313	2888
2011-12	81069	2285	2712	2824	11222	2042	2392	3953	6451	1020	4471	3147
2012-13	85463	2369	2894	3069	11842	2163	2518	4098	6736	1095	4838	3342
2013-14	90636	2469	3142	3226	12671	2331	2675	4343	7075	1178	5247	3565
2014-15	97121	2557	3314	3394	13322	2359	2777	4656	7297	1257	5633	3882
2015-16	105033	2749	3612	3597	14417	2557	2926	4981	7894	1355	-	4291
2016-17	112476	3033	3927	4129	15744	2828	3095	5352	8457	1448	-	4658
2017-18	119762	-	-	4432	-	3029	-	5736	9011	1547	-	5035
Growth 1981-2018	6.34	5.05	6.88	5.44	6.82	4.83	5.17	6.49	4.73	6.75	5.79	8.24
Growth 1994-2018	7.02	6.23	7.66	6.03	6.96	5.77	5.17	7.04	5.06	8.20	6.54	8.53
Growth 2000-2018	7.10	7.07	8.37	6.00	7.32	6.30	5.40	6.65	5.50	10.10	6.27	8.45

5.7 Recommended Growth Rates of Traffic

Based on the above analysis and after giving due consideration to the entire listed factors, the following overall growth rates are recommended for each category of vehicle as under. Rate of growth is moderated in light of overall regional trend. Growth of Multi-Axle is kept slightly higher as trend of technological advances in logistic industry favors multi-axle over 2/3 axle carriage. It is also expected that as the economy moves from developing to developed, rate of growth diminishes. Same growth rate is not sustainable for long. Traffic growth is suitably stepped down for future years.

Growth rates are recommended for three scenarios for sensitivity analysis namely **Optimistic, Pessimistic** and **Most Likely** with a positive and negative variation 0.5% from Most Likely case for corridor in both states.

5.7.1 Recommended Growth Rates of Traffic for Project Stretch

Table 5-12 : Recommended Growth Rates Optimistic

Category / Year	2021-2026	2026-2031	2031-2036	2036-2041	2041-2046	2046-2051
Car/Jeep/Van	9.44%	8.82%	8.21%	7.60%	7.01%	6.43%
Bus	5.26%	4.95%	4.64%	4.35%	4.07%	3.79%
LCV	3.55%	3.09%	2.64%	2.19%	1.75%	1.31%
2- Axle	3.73%	3.35%	2.96%	2.58%	2.21%	1.84%
3 - Axle	5.82%	5.20%	4.59%	3.99%	3.39%	2.80%
4 to6 Axle	6.52%	5.82%	5.13%	4.45%	3.78%	3.12%
7 and Above Axle	6.52%	5.82%	5.13%	4.45%	3.78%	3.12%

Table 5-13 : Recommended Growth Rates Pessimistic

Category / Year	2021-2026	2026-2031	2031-2036	2036-2041	2041-2046	2046-2051
Car/Jeep/Van	8.94%	8.32%	7.71%	7.10%	6.51%	5.93%
Bus	4.76%	4.45%	4.14%	3.85%	3.57%	3.29%
LCV	3.05%	2.59%	2.14%	1.69%	1.25%	0.81%
2- Axle	3.23%	2.85%	2.46%	2.08%	1.71%	1.34%
3 - Axle	5.32%	4.70%	4.09%	3.49%	2.89%	2.30%
4 to6 Axle	6.02%	5.32%	4.63%	3.95%	3.28%	2.62%
7 and Above Axle	6.02%	5.32%	4.63%	3.95%	3.28%	2.62%

Table 5-14 : Recommended Growth Rates Most Likely

Category / Year	2021-2026	2026-2031	2031-2036	2036-2041	2041-2046	2046-2051
Car/Jeep/Van	9.19%	8.57%	7.96%	7.35%	6.76%	6.18%
Bus	5.01%	4.70%	4.39%	4.10%	3.82%	3.54%
LCV	3.30%	2.84%	2.39%	1.94%	1.50%	1.06%
2- Axle	3.48%	3.10%	2.71%	2.33%	1.96%	1.59%
3 - Axle	5.57%	4.95%	4.34%	3.74%	3.14%	2.55%
4 to6 Axle	6.27%	5.57%	4.88%	4.20%	3.53%	2.87%
7 and Above Axle	6.27%	5.57%	4.88%	4.20%	3.53%	2.87%

It is expected that there will some bullet increment in traffic in year 2023-24 due to completion of Ahmedabad – Shyamalaji Road which is a feeder to project road. Hence some bullet increment is taken in year 2023-24.

Traffic and revenue have been worked out on the basis of above growths and same is presented in subsequent chapter of report.

5.8 COVID-19 Impact

All social and economic activities had been completely disrupted due worldwide pandemic of Corona Virus. This had affected traffic on project stretch as well. Traffic was severely affected form March-2020 due to lockdown and then in second wave and third waves.

Government has announced a mega economic stimulate and package of Rs. 20 Lakh Crore to bring the economy back on track and recover the losses. Traffic has shown impressive recovery post lockdown period and has recovered to normal level

Taking recommended traffic growth and additional factors as discussed above into consideration traffic forecast for concession period is done and presented in next chapter

CHAPTER 6

TRAFFIC FORECAST

6.1 Traffic Projections

Growth rates recommended in previous section of report are used to arrive at traffic projections for future years. Toll plaza wise futuristic traffic projection is given in tables below.

These projections have been done for following three cases of growth up to concession period

1. Optimistic Scenario
2. Pessimistic Scenario
3. Most Likely Scenario

Table 6-1 : Total Tollable Traffic @ Toll Plaza - 348.450 KM

(Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	6540	781	921	2165	2043	4959	16	17424	45484
2024-25	7156	808	969	2246	2162	5283	16	18640	48345
2025-26	7786	833	1018	2321	2274	5591	17	19840	51111
2026-27	8473	859	1068	2398	2392	5916	18	21124	54039
2027-28	9219	886	1121	2477	2516	6260	19	22498	57146
2028-29	10031	913	1177	2560	2647	6624	20	23972	60451
2029-30	10915	941	1236	2645	2785	7010	21	25553	63964
2030-31	11811	966	1293	2723	2912	7370	22	27097	67308
2031-32	12780	992	1353	2804	3045	7747	23	28744	70839
2032-33	13829	1018	1416	2887	3185	8145	24	30504	74581
2033-34	14963	1045	1482	2972	3331	8563	25	32381	78532
2034-35	16191	1072	1551	3059	3484	9003	26	34386	82712
2035-36	17422	1096	1618	3137	3623	9404	27	36327	86640
2036-37	18746	1121	1688	3218	3767	9823	28	38391	90776
2037-38	20171	1146	1761	3301	3918	10261	29	40587	95135
2038-39	21704	1171	1838	3386	4074	10718	30	42921	99721
2039-40	23355	1197	1918	3473	4236	11196	31	45406	104553
2040-41	24993	1217	1996	3549	4380	11619	32	47786	109023
2041-42	26746	1238	2077	3627	4528	12058	33	50307	113709
2042-43	28621	1259	2161	3706	4682	12514	34	52977	118623

Table 6-2 : Total Tollable Traffic @ Toll Plaza - Chainage 348.450 KM (Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	6508	775	916	2155	2034	4936	16	17340	45268
2024-25	7089	798	960	2225	2142	5233	16	18463	47888
2025-26	7678	818	1002	2288	2242	5511	17	19556	50377
2026-27	8316	839	1047	2353	2347	5804	18	20724	53015
2027-28	9007	860	1094	2419	2458	6113	19	21970	55804
2028-29	9755	881	1143	2487	2573	6438	20	23297	58747
2029-30	10566	903	1194	2558	2693	6780	21	24715	61860
2030-31	11380	922	1244	2621	2803	7094	22	26086	64789
2031-32	12257	941	1296	2685	2918	7422	23	27542	67868
2032-33	13201	961	1349	2751	3037	7766	24	29089	71109
2033-34	14218	981	1405	2818	3161	8126	25	30734	74521
2034-35	15313	1001	1463	2887	3290	8502	26	32482	78111
2035-36	16401	1018	1519	2947	3405	8838	27	34155	81434
2036-37	17566	1035	1578	3009	3523	9187	28	35926	84916
2037-38	18814	1053	1638	3072	3645	9550	29	37801	88564
2038-39	20150	1071	1701	3136	3771	9927	30	39786	92387
2039-40	21581	1089	1766	3201	3902	10319	31	41889	96397
2040-41	22987	1103	1829	3256	4015	10658	32	43880	100047
2041-42	24485	1117	1894	3312	4131	11007	33	45979	103852
2042-43	26080	1131	1961	3368	4250	11368	34	48192	107823

Traffic projections for Most Likely scenario are given as under

Table 6-3 : Total Tollable Traffic @ Toll Plaza - Chainage 348.450KM (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	6524	776	918	2160	2038	4948	16	17381	45377
2024-25	7123	801	964	2236	2152	5258	16	18550	48114
2025-26	7733	823	1010	2304	2258	5551	17	19696	50740
2026-27	8396	847	1058	2375	2370	5861	18	20925	53531
2027-28	9115	872	1108	2448	2487	6187	19	22236	56479
2028-29	9896	897	1160	2523	2609	6531	20	23636	59597
2029-30	10744	923	1215	2600	2737	6895	21	25135	62907
2030-31	11599	944	1268	2671	2855	7232	22	26591	66040
2031-32	12522	966	1324	2743	2978	7584	23	28140	69338
2032-33	13517	989	1382	2817	3106	7954	24	29789	72817
2033-34	14592	1013	1442	2893	3241	8342	25	31548	76491
2034-35	15752	1038	1505	2971	3381	8750	26	33423	80372
2035-36	16910	1058	1567	3040	3507	9117	27	35226	83987
2036-37	18153	1078	1631	3111	3638	9500	28	37139	87786
2037-38	19488	1098	1697	3184	3774	9899	29	39169	91776
2038-39	20921	1119	1766	3258	3914	10315	30	41323	95966

2039-40	22460	1140	1839	3334	4059	10749	31	43612	100376
2040-41	23978	1157	1909	3399	4186	11129	32	45790	104420
2041-42	25600	1175	1982	3465	4317	11522	33	48094	108652
2042-43	27332	1193	2058	3532	4452	11930	34	50531	113086

6.2 Modification in Concession Period

As per Article 29 of the concession agreement, if actual traffic on the project falls short or exceeds Target Traffic on project highway on defined date, concession period shall be modified subject to calculation stipulated therein. For Udaipur – Gujarat Border on NH-8 project stretch, the Target Date and Target Traffic are defined as under:

Target Date – 21st September 2026

Target Traffic - 61435 in PCU

It was observed that as per traffic projections, average traffic volume falls short of target traffic in all scenarios. The probable extension of concession period is estimated according to article 29 of concession agreement which comes to about a year. Traffic forecast and revenue projections are done for probable extended period accordingly.

Most Likely

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2026	61435	53583	-13%	19%	19%	21	4.0

Optimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2026	61435	54098	-12%	18%	18%	21	3.8

Pessimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2026	61435	53065	-14%	20%	20%	21	4.2

CHAPTER 7

FORECAST OF TOLL REVENUE

7.1 General

This chapter presents the tolling rate calculations, categories and toll revenue of the project.

7.2 Discount Categories

The fee schedule in the CA of Udaipur- Gujarat Border section of NH-8 is based on the old toll policy. As per the Toll Notification (Schedule - G) the discounts and special provisions have been considered. In addition to discounts as per Fee Notification concessionaire has declared special category rates also. Salient features of toll rate structure are given as under

1. Monthly Pass: For frequent users monthly pass would be issued at fee 30 time the single journey fee.
2. Multiple Journeys (for Return Trip): Will be charged at 1.5 times single journey.
3. Single Journey: Full single journey toll would be charged to this category of vehicles who are infrequent travelers or whose frequency does not yield any discount from the above categories.
4. Local Discounts: There are several categories of local discounts.
    a) Local Car Jeep Van I - Rs. 275 per month
    b) Other local Commercial at 50% of the regular single journey toll fee

Building of inflation and escalation of rate on the basis of WPI are done as per toll notification (Schedule G) as given under as extract from concession agreement.

The formula for determining the applicable rate of fee shall be as follows:-

$$\text{Applicable rate of fee} = \text{base rate} + \text{base rate} \times \left\{ \frac{\text{WPI A-WPI B}}{\text{WPI B}} \right\} \times 0.4$$

Factor of inflation / growth has been incorporated as per Schedule R. WPI numbers (2011-12 series) are available up to 2018-19. A moderate growth in Wholesale Price Index (WPI) has been assumed after that. The following graph provides historical rate of inflation (WPI) in India. Data has been sourced from the Office of Economic Advisor web site (www.eaindustry.nic.in) WPI for year 2017-18 and 2018-2019 is worked back by applying a correlation factor for 2004-05 series as 2017-18 and 2018-2019 data is available in 2011-12 series only. Ratio of WPI for year 2016-17 for both series is used for conversion of WPI in 2004-05 series

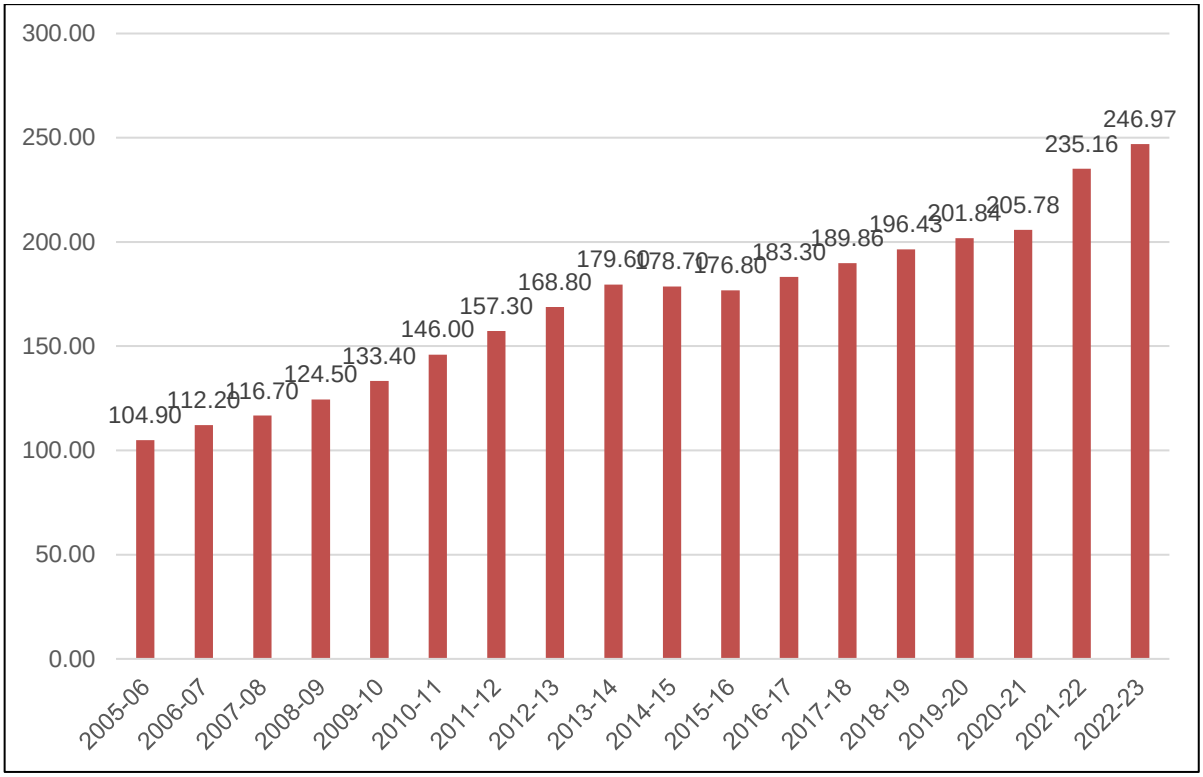


Figure 7-1 : Historical Rate of WPI Inflation in India

Average inflation in WPI in last few years is steadily growing. It grew in range of 4% - 5% in previous years. For future years initially it is takes 5% and Suitably Stepped down for future years.

7.3 Estimation of Toll Rates

As per the applicable MORTH notification and Schedule R of contract agreement, the following Base rate of fee for the categories mentioned in the table stands true in the National Highways Fee Rules applicable for contract.

Table 7-1 : Base Toll Rates June 2007-08

Type of Vehicle	Base Rate of Fee / Km (in Rs.)
Car, Jeep, Van or Light Motor Vehicle	0.65
Light Commercial Vehicle, Light Goods Vehicle or Minibus	1.05
Bus or Truck (Two Axles)	2.20
Three Axle Commercial Vehicles	2.40
Heavy Construction Machinery (HCM) or Earth Moving Equipment (EME) or Multi Axle Vehicle (MAV) (4 to 6 axles)	3.45
Oversized Vehicles (7 or more Axles)	4.20

There is no bypass or structure to be factored in for rates calculations.

Toll rates are calculated as per guidelines provided in schedule R (rounded to nearest Rs.) for the concession period and are given below.

Thus, worked out rates for various categories of vehicle and discounts are given as under

Table 7-2 : Toll Rates for Single Journey @ Km TP-348.450 KM

Year	Car	Mini Bus /LCV	Bus	Truck	3-Axle Commercial Vehicle	Multi Axle	Oversized Vehicle
2023-24	175	280	585	585	635	915	1115
2024-25	180	295	615	615	670	960	1170
2025-26	190	310	645	645	705	1010	1230
2026-27	200	325	680	680	740	1065	1295
2027-28	210	340	710	710	775	1115	1355
2028-29	220	355	745	745	810	1170	1420
2029-30	230	375	780	780	850	1225	1490
2030-31	240	390	820	820	895	1285	1560
2031-32	255	410	860	860	935	1345	1640
2032-33	265	430	900	900	980	1410	1720
2033-34	280	450	945	945	1030	1480	1800
2034-35	290	470	990	990	1080	1550	1890
2035-36	305	495	1040	1040	1130	1630	1980
2036-37	320	520	1090	1090	1190	1710	2080
2037-38	340	545	1145	1145	1245	1790	2180
2038-39	355	570	1200	1200	1310	1880	2290
2039-40	370	600	1260	1260	1375	1975	2405
2040-41	390	630	1320	1320	1440	2070	2520
2041-42	410	660	1385	1385	1515	2175	2650
2042-43	430	695	1455	1455	1590	2285	2780

Table 7-3 : Toll Rates for Return Journey @ TP-348.450 KM

Year	Car	Mini Bus /LCV	Bus	Truck	3-Axle Commercial Vehicle	Multi Axle	Oversized Vehicle
2023-24	260	420	875	875	955	1375	1675
2024-25	270	440	920	920	1005	1445	1755
2025-26	285	460	965	965	1055	1515	1845
2026-27	300	485	1015	1015	1110	1595	1940
2027-28	315	510	1065	1065	1160	1670	2035
2028-29	330	535	1115	1115	1220	1750	2130
2029-30	345	560	1170	1170	1275	1835	2235
2030-31	365	585	1225	1225	1340	1925	2345
2031-32	380	615	1285	1285	1405	2020	2455
2032-33	400	645	1350	1350	1470	2115	2575
2033-34	420	675	1415	1415	1545	2220	2700
2034-35	440	710	1485	1485	1620	2330	2835
2035-36	460	745	1555	1555	1700	2440	2975
2036-37	485	780	1635	1635	1780	2560	3120
2037-38	505	820	1715	1715	1870	2690	3270
2038-39	530	860	1800	1800	1960	2820	3435
2039-40	560	900	1890	1890	2060	2960	3605
2040-41	585	945	1980	1980	2160	3110	3785
2041-42	615	995	2080	2080	2270	3260	3970
2042-43	645	1040	2185	2185	2385	3425	4170

Table 7-4 : Toll Rates for Monthly Pass Local @ TP-348.450 KM

Year	Car	Mini Bus /LCV
2023-24	330	330
2024-25	345	345
2025-26	365	365
2026-27	385	385
2027-28	400	400
2028-29	420	420
2029-30	440	440
2030-31	460	460
2031-32	485	485
2032-33	510	510
2033-34	535	535
2034-35	560	560
2035-36	585	585
2036-37	615	615
2037-38	645	645
2038-39	680	675
2039-40	710	710
2040-41	745	745
2041-42	785	785
2042-43	825	825

Table 7-5 : Toll Rates for Monthly Pass @ TP-348.450 KM

Year	Car	Mini Bus /LCV	Bus	Truck	3-Axle Commercial Vehicle	Multi Axle	Oversized Vehicle
2023-24	5750	9290	19470	19470	21240	30530	37170
2024-25	6045	9765	20455	20455	22315	32080	39050
2025-26	6350	10260	21495	21495	23450	33710	41040
2026-27	6675	10785	22595	22595	24650	35430	43135
2027-28	6995	11300	23680	23680	25830	37135	45205
2028-29	7335	11845	24820	24820	27075	38920	47385
2029-30	7685	12415	26020	26020	28385	40800	49670
2030-31	8060	13020	27275	27275	29755	42775	52070
2031-32	8450	13650	28600	28600	31200	44845	54595
2032-33	8860	14315	29990	29990	32715	47025	57250
2033-34	9290	15010	31450	31450	34310	49320	60040
2034-35	9745	15745	32985	32985	35985	51730	62975
2035-36	10225	16515	34605	34605	37750	54265	66060
2036-37	10725	17325	36305	36305	39605	56930	69305
2037-38	11255	18180	38090	38090	41555	59735	72720
2038-39	11810	19080	39970	39970	43605	62685	76310
2039-40	12395	20025	41950	41950	45765	65790	80090
2040-41	13010	21015	44035	44035	48040	69055	84070
2041-42	13660	22065	46230	46230	50430	72495	88255
2042-43	14340	23165	48535	48535	52950	76115	92660

7.4 Toll Revenue

As indicated earlier, toll revenue on the Project Road has been calculated in all three scenarios based on above rates and projected traffic. The estimates of toll revenue under ***Optimistic***, ***Pessimistic*** and ***Most Likely*** growth scenarios are presented in the following section.

7.5 Toll Revenue at all toll plazas under Scenarios

Toll Revenue estimates under all scenarios at each of the toll plaza up to 2042-43 years starting from the year 2023-24 are shown in tables below.

Table 7-6 : Toll Revenue Optimistic Scenario

(Rs. Crores)

Year	TP-1	Total
2023-24	317.77	**317.77**
2024-25	352.95	**352.95**
2025-26	392.17	**392.17**
2026-27	436.46	**436.46**
2027-28	484.30	**484.30**
2028-29	535.23	**535.23**
2029-30	592.73	**592.73**
2030-31	653.88	**653.88**
2031-32	722.93	**722.93**
2032-33	794.12	**794.12**
2033-34	877.80	**877.80**
2034-35	966.36	**966.36**
2035-36	1064.97	**1064.97**
2036-37	1167.05	**1167.05**
2037-38	1281.88	**1281.88**
2038-39	1408.37	**1408.37**
2039-40	1552.21	**1552.21**
2040-41	1690.83	**1690.83**
2041-42	1850.84	**1850.84**
2042-43	2025.08	**2025.08**

Table 7-7 : Toll Revenue Pessimistic Scenario

(Rs. Crores)

Year	TP-1	Total
2023-24	316.21	**316.21**
2024-25	349.52	**349.52**

2025-26	386.49	**386.49**
2026-27	428.11	**428.11**
2027-28	472.84	**472.84**
2028-29	520.10	**520.10**
2029-30	573.22	**573.22**
2030-31	629.39	**629.39**
2031-32	692.62	**692.62**
2032-33	757.26	**757.26**
2033-34	833.03	**833.03**
2034-35	912.79	**912.79**
2035-36	1001.21	**1001.21**
2036-37	1091.86	**1091.86**
2037-38	1193.46	**1193.46**
2038-39	1304.95	**1304.95**
2039-40	1431.20	**1431.20**
2040-41	1551.61	**1551.61**
2041-42	1690.38	**1690.38**
2042-43	1840.63	**1840.63**

Table 7-8 : Toll Revenue Most Likely Scenario

(Rs. Crores)

Year	TP-1	Total
2023-24	316.88	**316.88**
2024-25	351.03	**351.03**
2025-26	389.16	**389.16**
2026-27	432.12	**432.12**
2027-28	478.41	**478.41**
2028-29	527.44	**527.44**
2029-30	582.64	**582.64**
2030-31	641.32	**641.32**
2031-32	707.38	**707.38**
2032-33	775.29	**775.29**
2033-34	854.90	**854.90**
2034-35	938.83	**938.83**
2035-36	1032.21	**1032.21**
2036-37	1128.41	**1128.41**
2037-38	1236.44	**1236.44**
2038-39	1355.15	**1355.15**
2039-40	1490.04	**1490.04**
2040-41	1619.18	**1619.18**
2041-42	1768.22	**1768.22**
2042-43	1930.15	**1930.15**

CHAPTER 8

CONCLUSION & RECOMMENDATIONS

8.1 Conclusion & Recommendations

Project stretch of Udaipur to Gujarat Border section of NH-8 in state of Rajasthan is nearing completion of six laning. The road is in sound condition and serves healthy traffic volumes. Project corridor is a part of the busy and prominent national highway NH-8 which connects Mumbai to Delhi and is part of golden quadrilateral. There are large number of townships, industrial corridors and other business establishment coming up along project corridor. As discussed, dominant portion of traffic is long route traffic, which is more sensitive towards the growth of national economy. As Indian economy is poised to grow at 7%+ post COVID-19, the project corridor is expected to pick up the same trend in terms of traffic flow. All these developments have potential to give positive impact to traffic flow on project. The following can be considered as major outcomes of the study

a) There is good amount of tollable traffic running on project

b) Project corridor has potential to witness traffic growth @ 6-8% annually in near future due to various development in area and overall development of economy

c) Project corridor has committed traffic as long route traffic and does not run a risk of traffic leakage due to quality competing road

Based on above it can be considered a stable healthy project from traffic and revenue point of view.

GMD Consultants
503-504, Mayuresh Chambers Premises, Plot No. 60,
Sector -11, CBD Belapur, Navi Mumbai. 400 614.
Maharashtra.
Phone : +91-22-2756 4586 / 2756 5313
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

GULABPURA TO CHITTORGARH SECTION OF NH 79 (KM 90.000 TO KM 214.870) IN THE STATE OF RAJASTHAN

TRAFFIC STUDY & REVENUE PROJECTION REPORT (FINAL)

APRIL 2023

GMD CONSULTANTS ★ NAVI MUMBAI ★

GMD Consultants
503, Mayuresh Chambers, Plot No. 60, Sector -11,
CBD Belapur, Navi Mumbai. 400 614.
Maharashtra.
Phone : +91-22-2756 4586 / 2756 5313
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

GMD Consultants
Adding Value

GULABPURA TO CHITTORGARH SECTION OF NH-79

(KM 90.000 TO KM 214.870)

IN THE STATE OF RAJASTHAN

TRAFFIC STUDY & REVENUE PROJECTION REPORT (FINAL)

APRIL 2023

GMD CONSULTANTS ★ NAVI MUMBAI ★

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AADT	-	Annual Average Daily Traffic	**NHAI**	-	National Highway Authority of India
BOT	-	Build Operate Transfer	**NHDP**	-	National Highways Development Project
CAGR	-	Compound Annual Growth Rate	**NSDP**	-	Net State Domestic Product
CTV	-	Classified traffic volume	**O&M**	-	Operation & Maintenance
DBFOT	-	Design, Build, Finance, Operate & Transfer	**PCDP**	-	Per Capita Domestic Product
EME	-	Earth Moving Equipment	**PCI**	-	Per Capita Income
GDP	-	Gross Domestic Product	**PCU**	-	Passenger Car Unit
GSDP	-	Gross State Domestic Product	**PSC**	-	Pre-stressed Concrete
HCM	-	Heavy Construction Machinery	**RCC**	-	Reinforced cement concrete
HCV	-	Heavy Commercial Vehicle	**RHS**	-	Right Hand Side
HTMS	-	Highway Traffic Management System	**SH**	-	State Highway
IRC	-	Indian Road Congress	**TP**	-	Toll Plaza
IRR	-	Internal Rate of Return	**WPI**	-	Wholesale Price Index
LCV	-	Light Commercial Vehicle	**SIR**	-	Special Investment Region
LHS	-	Left Hand Side	**c.**	-	Circa
LGV	-	Light Goods Vehicle	**ROB**	-	Railway Over Bridge
MAV	-	Multi Axle Vehicle	**MDR**	-	Major District Road
MORTH	-	Ministry of Road Transport and Highways	**ODR**	-	Other District Road
NH	-	National Highway	**CA**	-	Concession Agreement
PCC	-	Plain Cement Concrete	**RMT**	-	Running Meter
CR	-	Coarse Rubble			

CHAPTER 1

INTRODUCTION

1.1 Background

The Government of India through National Highway Authority of India (NHAI) embarked upon a program to enhance the traffic capacity and safety for efficient transportation of goods as well as passenger traffic on National Highway Sections under NHDP Phase V. Under Phase V NHAI has planned to convert 6,500 km of existing 4-lane National Highways into 6-lane National Highway. Sections envisaged under 6-laning comprise the Golden Quadrilateral section (5,700 km) and some other sections which are 800 km in length.

The project under consideration, Six Laning of **Gulabpura** to **Chittorgarh** section of NH-79 from km 90.000 to km 214.870is one such road project NHAI intended to implement on a BOT basis in the DBFOT format. *M/s CG Tollway Ltd.* (Concessionaire) has been awarded the Project for a concession period of 20 years starting from 4th November 2017. The Project has been commissioned and is currently in the operation / maintenance phase for four laning. Six laning of project has also been completed in August 2021.

Length ofprojectroadis124.870Kms. The project road is section of NH-79, which connects Ajmer to Ghat Bilod. Project section of NH-79 passes through district of Bhiwara and Chittorgarh. Project road connects to Udaipur via NH-76.

Project road alignment passes through the towns/ built-up areas Fakirabad, Bhilwara, Gulabpura, & Chittorgarh. Following figure shows alignment of project road section from Gulabpura to Chittorgarh

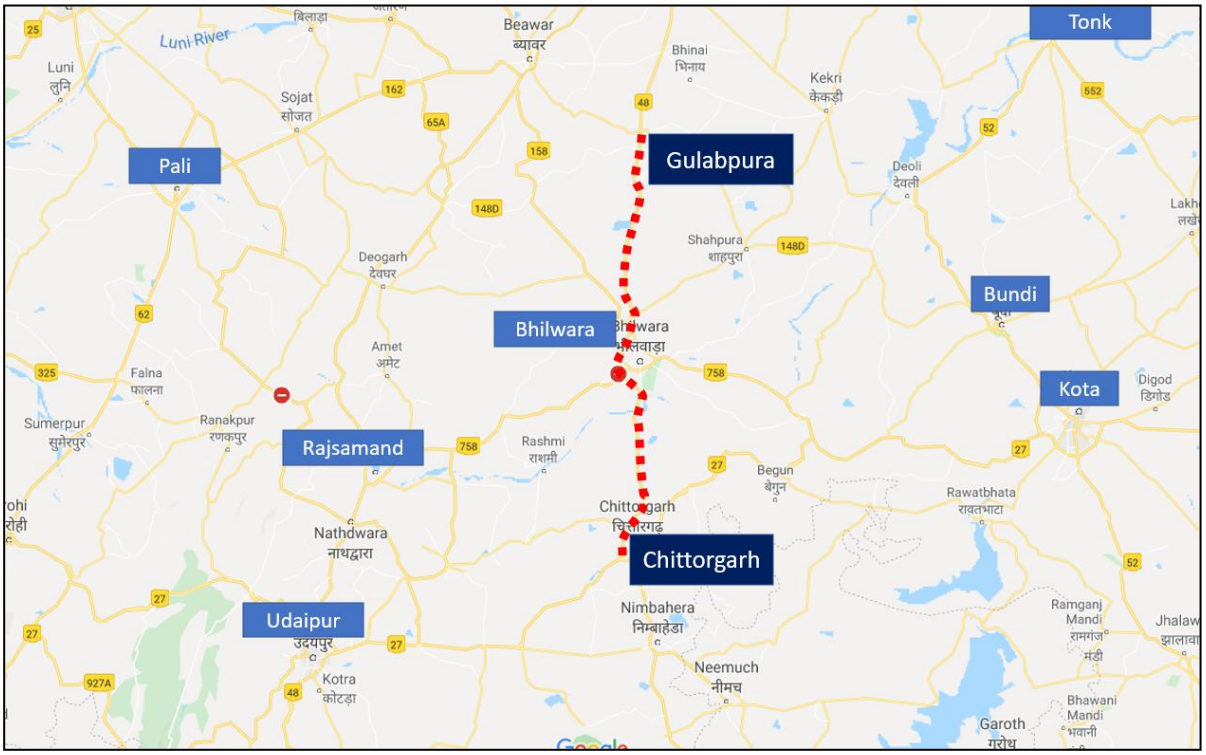


Figure 1-1: Alignment of Project Stretch

1.2 Objective of the Study

M/s IRB INFRASTRUCTURE TRUST has engaged *GMD Consultants* to assess the future traffic and toll potential of project along with related operation & maintenance expenditure involved.

This report named as **"Traffic Study &*Toll Revenue Projection Report*"** mainly focuses on traffic and revenue aspects of the project. Other parameters like competing road, area developments etc. have been considered from a traffic development point of view.

1.2.1 Scope of Services

The broad scope of work covered in the assignment is as follows

a) Analysis of Traffic Growth
b) Toll Rate Growth
c) Revenue Forecasting

The Concessionaire has provided basic traffic data and other project details on the basis of which the above analysis has been carried out.

CHAPTER 2
PROJECT DETAILS

2.1 Project Corridor

National Highway 79 (NH 79) is important link for traffic connecting Delhi, Jaipur to Udaipur, Chittorgarh and down south.

It is one of the major north-south road connectivity for the traffic from northern states of Haryana, Punjab and Delhi to Industrial and tourist areas of Rajasthan like Jaipur, Chittorgarh, Udaipur and then to Dahod, Ratlam and other parts of Madhya Pradesh.

2.2 Project Stretch Description

Section of NH-79 from Gulabpura to Chittorgarh is part of major transportation link in the area connecting industrial / tourist cities of Jaipur, Bhilwara, Chitttorgar and Udaipur. Important cities of Firozabad, Shikohabad, and Jaswant Nagar fall on project alignment. Major mining industries of marble, Zink, felspar, quarts of Udaipur and textile industry of Bhiwara provide are major contributor of commercial traffic on project corridor. Additionally, Udaipur, Chittorgarh and Bhilwara major tourist centers of India. This adds substantial value for passenger traffic on project corridor section.

Like other parts of India rapid ribbon development is happening around these cities on project highway. This also contributes to sustainable traffic growth.

There are two operative toll plazas at project stretch. First is at Lambia Kalan at Km 121.020 and second at Jojro ka Khera at Km 184.020. Following figure show project alignment and toll plaza locations.

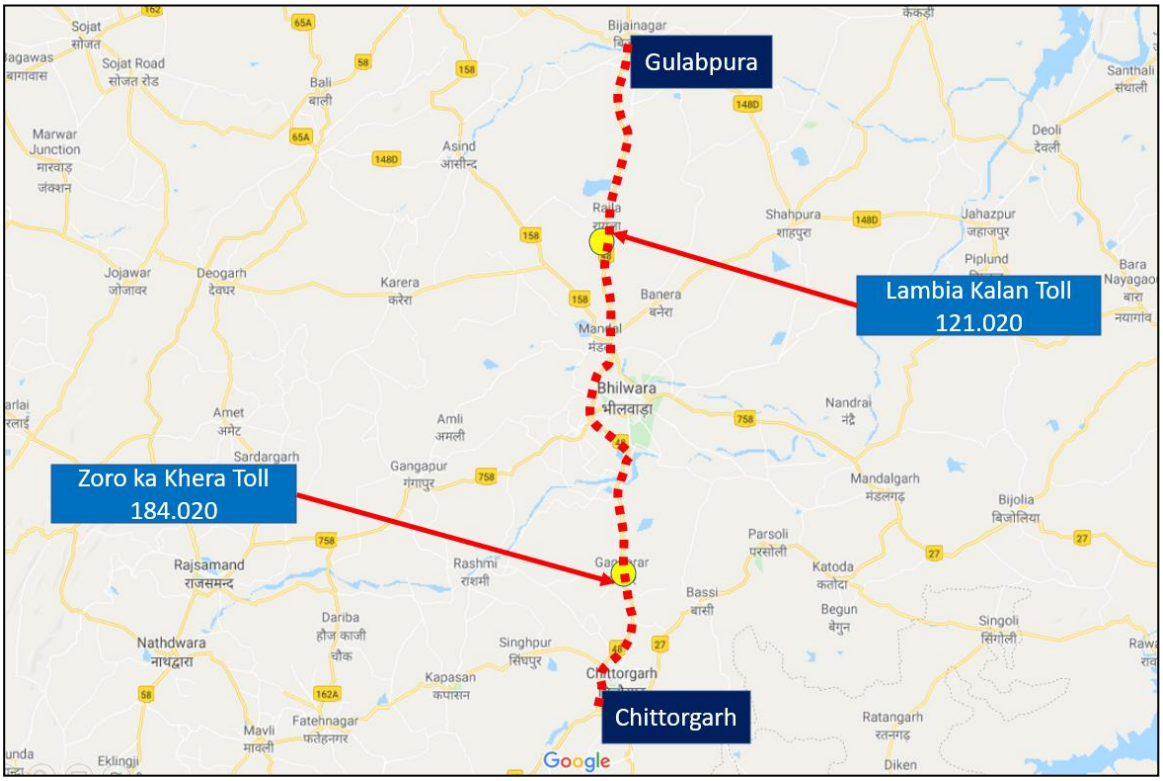


Figure 2-1: Project Alignment with Toll Plaza

2.3 Project Corridor Illustration

Six laning of project stretch is in progress and soon would be completed. Following photographs illustrate project section along the corridor.

Figure 2-2: Photographs showing Project Corridor

CHAPTER 3
TRAFFIC SURVEYS AND ANALYSIS

3.1 Traffic Surveys

The Consultants have collected the required information for project corridor to understand the general traffic and travel characteristics on the corridor.

The following traffic data has been collected from client for project.

- Classified traffic volume counts at toll plaza locations on Gulabpura-Chittorgarh section of NH-79 for year 2018-19, 2019-20, 2020-21, 2021-22 and traffic data from April 2022 to March 2023.
- Local Component of traffic
- Component of Return Journey
- Component of Monthly Pass Journey

The main objective of the traffic data analysis is to:

- Determine the existing traffic movement characteristics of the project
- Establish base year traffic
- Identification of travel patterns and modal split of project traffic
- Deriving growth factors for traffic forecasting
- Estimation of corridor traffic including traffic diversion if any
- Preparation of revenue model and projection of revenue as per toll policy for various scenarios

Table 3-1below lists provides details of locations from where traffic details have been collected.

Table 3-1 : Traffic Data Details

SR. NO	LOCATION	CTV	Single Journey Traffic	Daily Return Journey	Monthly Pass	Local Pass
1	**Km 121.020 Toll Plaza at Lambia Kalan**	AADT for Year 2018-19, 2019-20, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-20, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-20, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-20, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-20, 2020-21, 2021-22 & 2022-23
2	**Km 184.020 Toll Plaza at Jojro ka Khera**	AADT for Year 2018-19, 2019-20, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-20, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-20, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-20, 2020-21, 2021-22 & 2022-23	For Year 2018-19, 2019-20, 2020-21, 2021-22 & 2022-23

3.2 Classified Traffic Volume

The objective of conducting a Classified Traffic Volume Count is to understand the traffic flow pattern including modal split on a roadway. The Classified Traffic Volume Count survey has been provided by the concessionaire of project highway from actual traffic data gathered at toll plaza locations based on monthly data shared with NHAI.

The vehicles can broadly be classified into fast moving / motorized and slow moving / non-motorized vehicles, which can be further classified into specific categories of vehicles. The groupings of vehicles are further segregated to capture the tollable vehicle categories specifically and toll exempted vehicles are counted separately. The detailed vehicle classification system as per IRC: 64-1990 is given in table below.

Table 3-2 : Vehicle Classification System

Vehicle Type	
Auto Rickshaw	
Passenger Car	Car, Jeep, Taxi & Van (Old / new technology)
Bus	Minibus

	Standard Bus
Truck	Light Goods Vehicle (LCV)
	2 – Axle Truck
	3 Axle Truck (HCV)
	Multi Axle Truck (4-6 Axle)
	Oversized Vehicles (7 or more axles)
Other Vehicles	Agriculture Tractor, Tractor & Trailer

Source - IRC: 64 – 1990

However, since project highway is currently under toll operation, the data collected is corresponding to category of tollable vehicles. Following are the type of vehicles as per concession agreement.

- Car / Jeep / van
- Min Bus /LCV
- Bus
- Truck
- 3-Axle
- Multi Axle

3.3 Traffic Characteristic

Toll revenue of project highway does not solely depend on traffic volume. There are certain characteristics of traffic which have substantial potential to affect toll collection. Component of local traffic, component of passenger and commercial traffic, portion of return journey traffic, % of monthly pass traffic are some of such characteristics of traffic. These will be discussed in subsequent sections of report.

3.3.1 Traffic Data

Project concessionaire has provided Traffic data for year 2019-20,2020-21, 2021-22 and from April 2022 to March 2023 as under for both toll plazas–

Table 3-3 : Traffic Data at Lambial Kalan Toll Plaza at Km 121.020

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)-2019-20	Annual Average Daily Traffic (Nos.)-2020-21	Annual Average Daily Traffic (Nos.)-2021-22	Annual Average Daily Traffic (Nos.)-2022-23
1	CAR	3563	3366	4812	6301
2	Minibus /LCV	1266	933	585	768
3	Bus	428	270	376	446
4	Truck	1587	1321	1788	2455
5	3-Axle Commercial vehicle	2139	1591	1771	2006
6	Multi axle	4606	4011	4587	5086
7	Oversized Vehicle	23	19	30	11
Total		**13612**	**11511**	**13949**	**17072**

Table 3-4 : Traffic Data at Jojro ka Khera Toll Plaza at Km 184.0200

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)-2019-20	Annual Average Daily Traffic (Nos.)-2020-21	Annual Average Daily Traffic (Nos.)-2021-22	Annual Average Daily Traffic (Nos.)-2022-23
1	CAR	3042	3077	4440	5603
2	Minibus /LCV	1081	824	549	716
3	Bus	423	265	347	408
4	Truck	1285	1164	1634	2306
5	3-Axle Commercial vehicle	1568	1344	1666	1950

6	Multi axle	4360	4201	4934	5536
7	Oversized Vehicle	21	21	21	14
Total		**11781**	**10896**	**13592**	**16532**

Pandemic of COVID-19 (Corona Virus) had impacted entire world. Taking precaution, government of India announced a complete lockdown in last of March 2020 and traffic on highways was stopped which was eased out progressively later. There after India was hit by Covid-19 second and third wave in February 21 to July - 21 and December 21 to March-22. Recovering traffic pattern was somewhat again disturbed du to second and third wave of Covid-19. Traffic numbers of for period from April-2020 to March 2021 were not representative of traffic pattern at project corridor due to pandemic lockdown impact. However, for integrity of data same shown above. Traffic has almost recovered from Covid -19 impact as of now.

Since the traffic data is available year 2022-23 report has been updated taking this as base year traffic.

This data was then bifurcated to various components like through local, monthly, return journey etc. category. Same is discussed in detail in following section.

3.4 Data Analysis

3.4.1 Analysis of Traffic Volume Count

Understanding the character of existing traffic forms the basis of the traffic forecast. The various vehicle types having different sizes and characteristics can be converted into a single unit called Passenger Car Unit (PCU). Passenger Car equivalents for various vehicles are adopted based on recommendations of Indian Road Congress prescribed in "IRC-64-1990: Guidelines for Capacity of Roads in Rural areas". The adopted passenger car unit values (PCU) are presented in ***Table*** 3-5**.**

Table 3-5 : PCU Factors Adopted for Study

Vehicle Type	PCUs
Car	1.0
Minibus	1.5
Standard Bus	3.0

LCV/LGV	1.5
2 Axle Truck	3.0
3 – 6 Axle Truck	4.5
MAV	4.5
Auto Rickshaw	1.0
Van/Tempo	1.0
Agriculture Tractor with Trailer	4.5
Agriculture Tractor without Trailer	1.5

Source: IRC: 64-1990

Traffic volume at each toll plaza was converted to PCU and same is presented as under.

Table 3-6 : Traffic in PCU at Project Stretch Base Year 2022-23

Year	Toll Plaza Location (Km)	Traffic No	PCU	PCU Index
2019-2020	Lambia Kalan Km 121.020	13612	38754	2.85
	Jojro ka Khera Km 184.020	11781	34208	2.90
2020-2021	Lambia Kalan Km 121.020	11511	32446	2.82
	Jojro ka Khera Km 184.020	10896	31630	2.90
2021-2022	Lambia Kalan Km 121.020	13949	38721	2.74
	Jojro ka Khera Km 184.020	13592	38503	2.83
2022-23	Lambia Kalan Km 121.020	17072	45107	2.64
	Jojro ka Khera Km 184.020	16532	45642	2.76

It can be observed from above that project traffic has PCU index close to 3 which is an indicator of high proportion of commercial traffic in traffic mix in project corridor. The following figure illustrates variation of PCU index at four toll plaza locations.

It can be observed that PCU index is consistent at both toll plaza locations.

3.4.2 Components of Traffic

As discussed previously, components of traffic volume play an important role in determining project revenue. A larger component of commercial traffic with higher axle configuration adds to project revenue positively. Similarly, a larger component of local traffic affects the project revenue potential negatively.

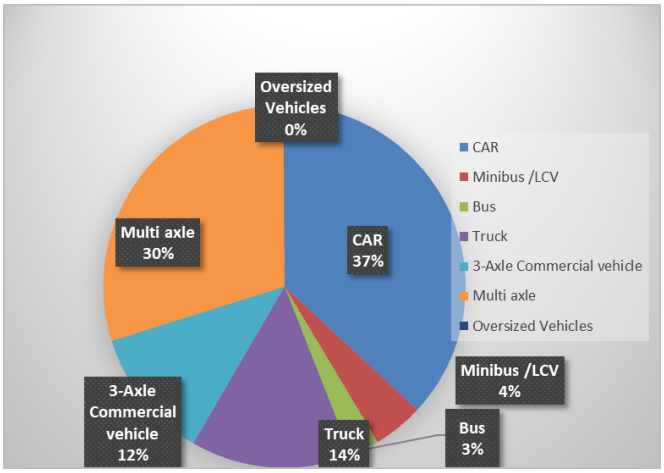


Figure 3-1 :Model Split of Tollable Vehicle-Km 121.020

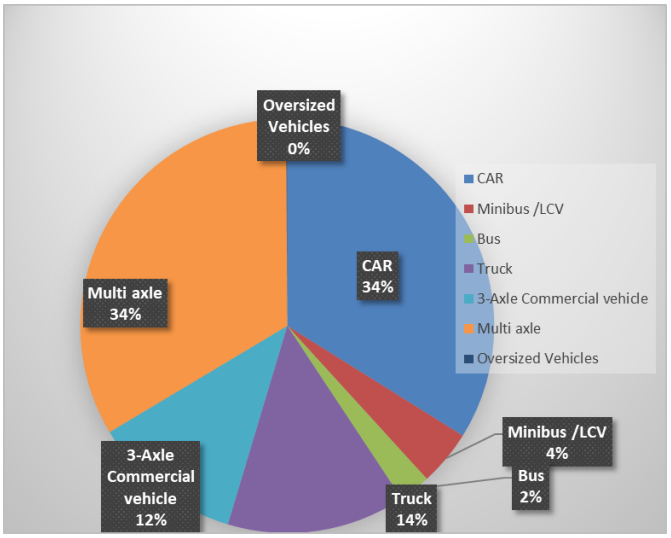


Figure 3-2 :Model Split of Tollable Vehicle- Km 184.020

It is observed that car traffic forms about 37% & 34% of total traffic at toll plaza locations while multi axle commercial vehicles are about 42% & 46% of total traffic. Truck / Bus and LCV share about 14% and 7 % of traffic volume respectively.

Another important bifurcation of traffic is components of traffic with respect various type of toll ticketing like

1. Single Journey
2. Multi Journey
3. Monthly Pass (Local and General)

The following table provides numbers of vehicles falling in each of above category for year 2022-23

Table 3-7 : Journey Type Bifurcation of Traffic at Lambia Kalan TP KM121.020

Sr. No	Type	Traffic Volume (Nos.)
		2022-2023
1	Single Journey	12110
2	Return Journey	4664
3	Local Commercial Single Journey	260
4	Monthly Pass Local	35
5	Monthly Pass	12

Most dominant part of the above is the single journey type followed by return journey at project stretch. Monthly pass commuters are a very low fraction of the total traffic on the project corridor.

The single journey component in total traffic numbers is as high as 71%. Return journey component is 27%. The number of monthly pass Local is 0% and Local commercial Single Journey 2% at Lambia Kalan toll plaza.

The following tables give the detail of journey distribution at Jojro ka Khera toll plaza at Km 184.020.

Table 3-8 : Journey Type Bifurcation of Traffic at Jojro ka KheraTPKm 184.020

Sr. No	Type	Traffic Volume (Nos.)
		2022-2023
1	Single Journey	11440
2	Return Journey	4774
3	Local Commercial Single Journey	280
4	Monthly Pass Local	30
5	Monthly Pass	13

It is observed that the project corridor demonstrates a similar pattern of single journey dominated mix of traffic across the entire stretch which is typical of major national highways.

3.5 Secondary Data Collection

There are several other factors which have a substantial impact on traffic pattern and growth on any project corridor. Following are some of such important factors

- Industrial development around project corridor and its catchment
- Educational infrastructure along project corridor
- Demographic pattern
- Urban area development
- Tourism potential
- Upcoming major infrastructural or Industrial projects
- Special Industry in project corridor
- Overall trends of economic growth local as well as national / regional

Hence in addition to traffic details on project site, secondary data was also collected from various other sources. Typical secondary data includes the following:

1. Vehicle registration data of regional and national level.
2. Economic Data
   a) GDP
   b) NSDP
   c) Population Growth

d) Per Capita Income growth

e) Industrial Growth

f) Special Industry Potential

g) Regional and National development vision / plan

h) Any other relevant data

3. Competing road network

We have collected and utilized such underlying data in the study to estimate the growth and risk factors for traffic along the project corridor.

CHAPTER 4

INFLUENCE ZONE TRANSPORT NETWORK ANALYSIS

4.1 Introduction

Highway corridors behave like integrated circuit network and more often than not every road is connected to various networks having different origin and destinations. Traffic running on these networks behave like fluid and flow on network on alignment of least friction.

Following Factors can be considered as major contributors to friction on transportation network

- Travel Speed / Travel Time
- Geometric deficiencies like blind horizontal curves and steep vertical gradients etc.
- Configuration of road
- Riding quality
- Traffic delays,
- Length of road,
- Passing through built up or Urban Area,
- Terrain,
- Facilities,

4.2 Competing / Alternate route

Project stretch has toll application history from last few years, and it can be assumed that project traffic is settled. However, for analysis point of view there can be two alternate routes at local level. One using Ajmer road to go from Kishangarh to Chittorgarh and other on east side via Shapur.

At regional level, there can be two alternates for Udaipur traffic after Kishangarh. One via project road (Kishangarh – Bhiwara- Chittorgarh- Udaipur)

Following maps show these routes in relation to project stretch at both local and regional level.

Figure 4-1: Alternate route at regional level

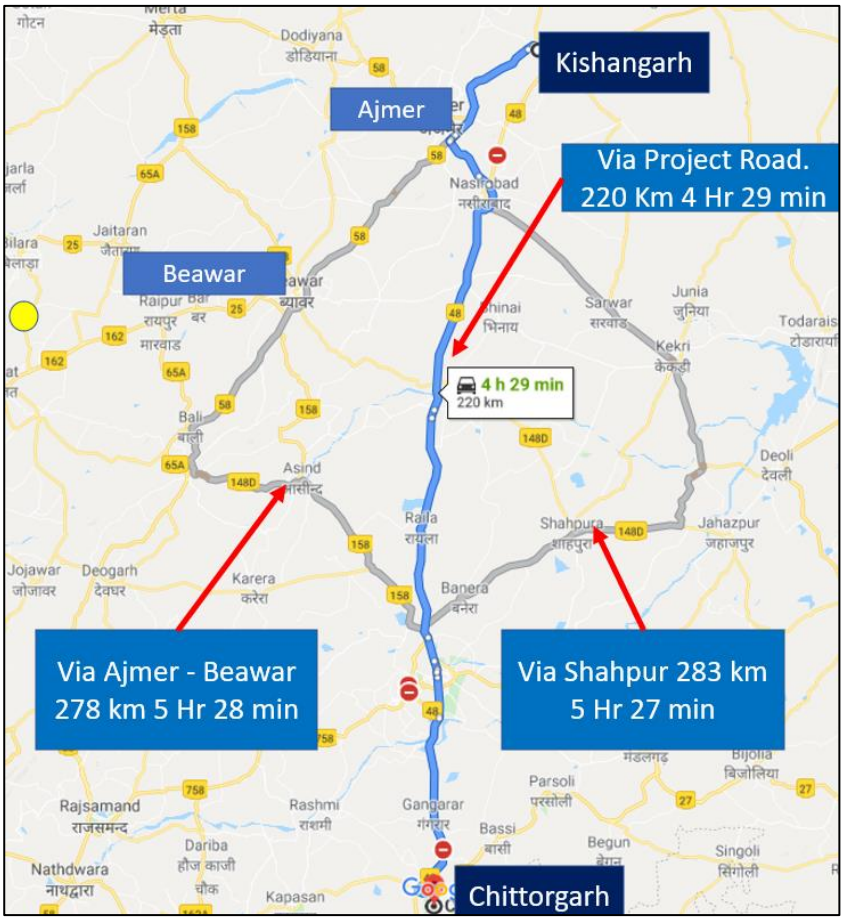


Figure 4-2: Alternate route at local level

It can be observed that project highway forms the one of the main spines of the corridor between Kishangarh / Jaipurand Chittorgarh. Traffic on project road is now settled and it can be assumed as dedicated traffic on project road for logistic obligations.

At regional level for Udaipur traffic alternate route is faster and traffic is already using this alternate.

With six laning now nearing completion, project stretch would become slightly more attractive due to improved level of service. In such case further diversion of traffic from project road is not envisaged.

Following table provides summary of analysis of alternate route/ roads discussed above.

Table 4-1 : Competing Roads Details

Sr. No	Route Details	Designation	Length (Km)	Avg. Speed (KMPH)	Time Taken (Min)	Observations
Regional Level						
1	Kishangarh – Ajmer-Udaipur	Alternate Route	299	58	5 Hr 8 Min	Alternate route has clear advantage for this pair of destination. Traffic Settled. No further diversion expected
	Kishangarh- Chittorgarh-Udaipur	Project Road	330	51	6 Hr 127 Min	
Local Level						
2	Kishangarh – Ajmer-Chittorgarh (West)	Alternate Route	278	50	5 Hr. 28 Min	Project Road has advantage. Alternate route running for years after toll on project road. Traffic Settled. No further diversion expected
	Kishangarh – Shahpur-Chittorgarh (East)	Alternate Route	283	51	5 Hr. 28 Min	
	Kishangarh – Bhilwara-Chittorgarh	Project Road	220	50	4 Hr. 29 Min	

Under these circumstances it is not envisaged that commercial or passenger traffic would switch to alternate roads from the project road. Further, it may be noted that since the project highway has already been commissioned and has a tolling history, the current traffic traversing the project corridor already factors in traffic diversion (if any) that may have taken place.

CHAPTER 5
GROWTH OF TRAFFIC ON PROJECT HIGHWAY

5.1 Introduction

Traffic growth is a function of the interplay of a number of contributory factors such as National economy, Government policy, socio-economic conditions of the people, and changes in land uses along the project corridor precincts etc. As these factors have a number of uncertainties associated with them, forecasts of traffic are dependent on the projectionsof other factors such as population, gross domestic product (GDP), vehicle ownership, per capita income (PCI), agricultural output, fuel consumption etc. Future pattern of change in these factors can be estimated with only a reasonable degree of accuracy and hence the resultant traffic forecast levels may not be precise.

Traffic growth forecast for project corridor Gulabpur- Chittorgarh section of NH-79has been done taking the above factors into consideration. "**IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**" is established best practice and has been used for traffic growth forecast.

5.2 Trend Analysis

One of the methods of estimation of future rate of growth is to assume the same rate of growth as in the past. Although such a method is more suitable to projects of short durations say 5-10 years, however for long term projections it would-be erroneous to assume that the past rate of growth will continue to prevail for a long time in future. Economic conditions, which are major influencing factors, are bound to change over a long period of time. Thus, it would be necessary to modify the past trends of growth suitably.

Elasticity model of growth projection is one of the most widely acceptable methods for traffic forecast. The same is recommended in **IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**.

In this method the past trend of vehicular data is paired with an economic indicator and a regression analysis is done to yield the economic model of growth. Growth of vehicle traffic varies for different type of vehicle. It is a proven fact that the growth pattern for passenger and goods vehicle is different. Traffic growth on any highway

typically depends on number of economic parameters. Most important and direct parameters are given as under

- Per Capita Income
- Net State Domestic Product (NSDP)
- Population

It can be observed that the ownership of a car is more closely related to affordability; hence per capita is the index which closely fits the growth of car traffic among other criteria. In a similar fashion, the following can be pairs of vehicle type and independent variable for elasticity modeling of growth.

- Car / Jeep – Par Capita Income
- Bus / Minibus – Population
- Goods Vehicle – NSDP

5.3 Estimation of Traffic Demand Elasticity

Elasticity of traffic demand is defined as the rate at which traffic intensity varies due to a change in the corresponding indicator selected. Hence, in order to estimate the elasticity of traffic demand, it is necessary to establish relationship between the growth in number of given category of vehicles with the relevant economic variable considered, such as NSDP, per capita income and population growth. Latest available data for vehicle registration, per capita income, NSDP and population is used in analysis.

As per IRC: 108-1996 the model for estimating elasticity index for the project corridor is of the following form and is given as below:

$$Log\ (P) = k \times Log\ (EI) + A$$

Where,

P = *Number of Vehicles (Mode wise)*

EI = *Economic Indicator*

A = *Regression constant*

k = *Elasticity coefficient (Regression coefficient)*

The elasticity for car and bus (passenger vehicles) is calculated based on the Population and Per Capita Domestic Product (PCDP) and the elasticity for trucks is calculated based on the Net State Domestic Product (NSDP).

The project corridor spreads across state of Rajasthan. Toll plazas at Lambia Kalan and Jojro ka Khera are in the state of Rajasthan. For elasticity calculations, working

data from Rajasthan has been analyzed. Additionally, data of Gujarat is also analyzed as project corridor has close transportation link with Gujarat also.

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Rajasthan State.

Table 5-1 : Per Capita Income Vs Car Rajasthan

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	57192	591069	4.76	5.77		
2013	58441	659542	4.77	5.82	2%	
2014	61053	733916	4.79	5.87	4%	
2015	64496	814079	4.81	5.91	6%	
2016	68565	899307	4.84	5.95	6%	
2017	71394	988391	4.85	5.99	4%	4.55%

Regression analysis of same is given in figure below

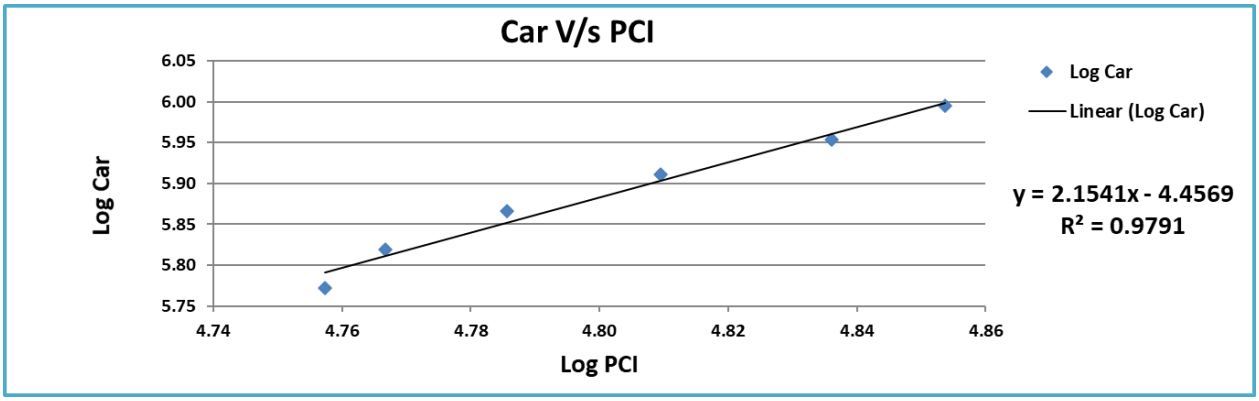


Figure 5-1: Regression and Elasticity PCI vs. Car – Extrapolation Rajasthan

Table 5-2 : Population Vs Bus Rajasthan

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	68548437	83345	7.84	4.92		
2013	69783885	88616	7.84	4.95	2%	
2014	71016445	93892	7.85	4.97	2%	
2015	72245688	97650	7.86	4.99	2%	
2016	73471198	102818	7.87	5.01	2%	
2017	74692571	108680	7.87	5.04	2%	1.73%

Regression analysis of same is given in figure below

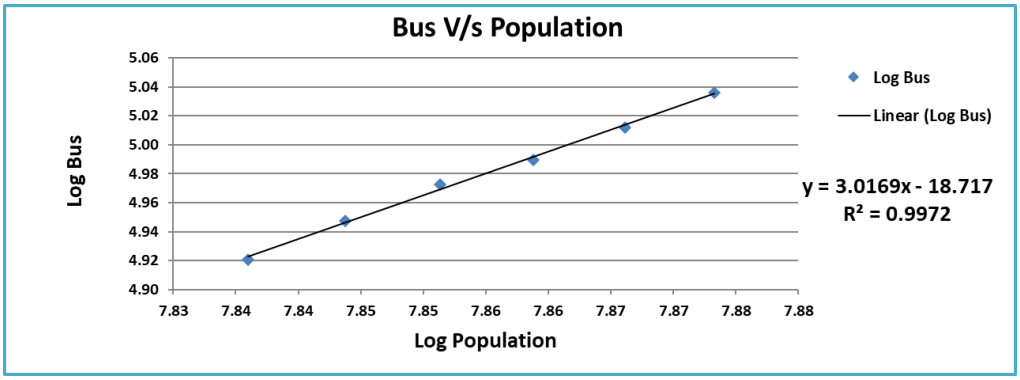


Figure 5-2: Regression and Elasticity Population vs. Bus – Extrapolation Rajasthan

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-3 : LCV Traffic Vs NSDP Rajasthan

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth
2012	395331	69509	5.60	4.84		
2013	409802	76396	5.61	4.88	4%	
2014	434292	33379	5.64	4.52	6%	
2015	465408	91787	5.67	4.96	7%	
2016	501922	99763	5.70	5.00	8%	6.16%

Following figure depict regression analysis and extrapolation.

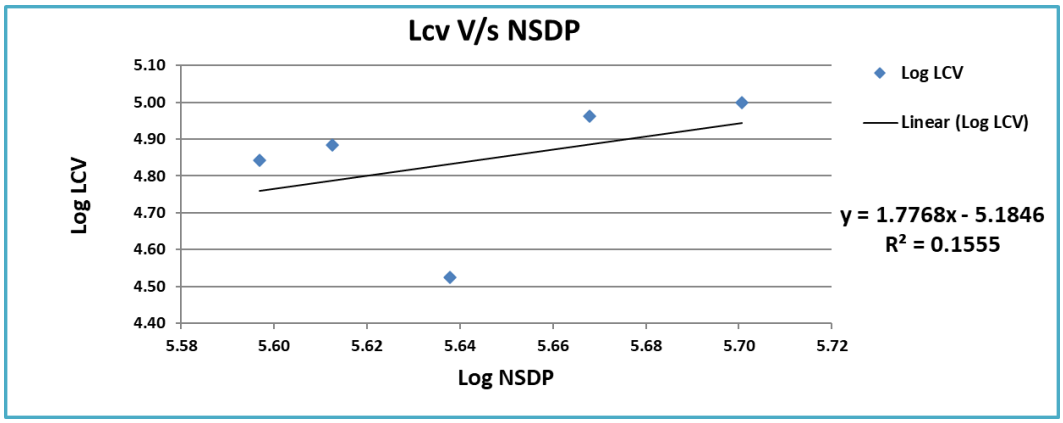


Figure 5-3: Regression and Elasticity NSDP vs. LCV Traffic - extrapolation Rajasthan

Following figure depict regression analysis and extrapolation.

Table 5-4 : Truck Traffic Vs NSDP Rajasthan

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth
2012	395331	362028	5.60	5.56		
2013	409802	401983	5.61	5.60	4%	
2014	434292	434379	5.64	5.64	6%	
2015	465408	472365	5.67	5.67	7%	
2016	501922	517604	5.70	5.71	8%	
2017	530172	561158	5.72	5.75	6%	6.06%

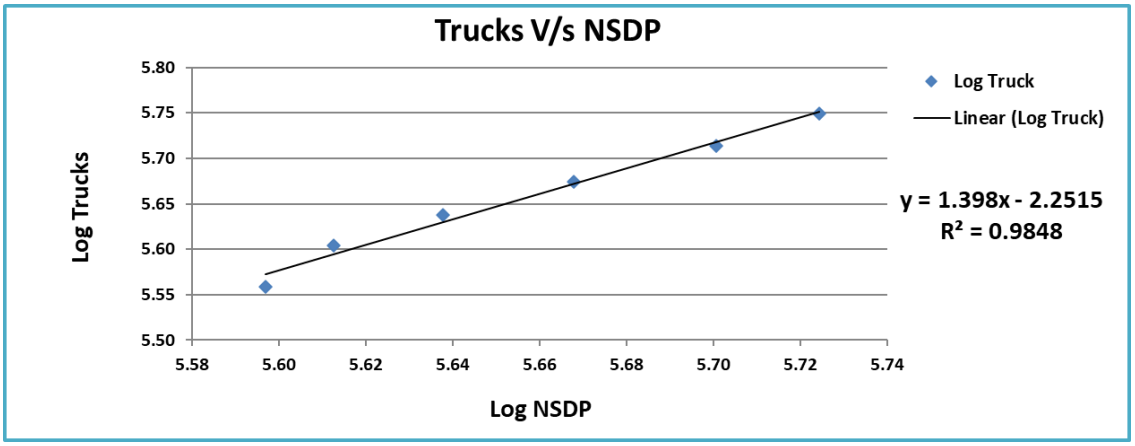


Figure 5-4: Regression and Elasticity NSDP vs. Truck Traffic - extrapolation Rajasthan

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below

Table 5-5 : Summary Regression Analysis Rajasthan

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average IV Growth (5yrs)	Growth Elastic Model	Remarks
Rajasthan	Car/Jeep	PCI	y = 2.1541x + -4.4569	R^2 = 0.9791	2.1541	4.55%	9.79%	Good Regression
	Bus	Population	y = 3.0169x - -18.7174	R^2 = 0.9972	3.0169	1.73%	5.22%	Good Regression
	LCV	NSDP	y = 1.7768x - -5.1846	R^2 = 0.1555	1.7768	6.16%	10.95%	Poor Regression
	Truck	NSDP	y = 1.398x - -2.2515	R^2 = 0.9848	1.3980	6.06%	8.46%	Good Regression

Table 5-6 : Per Capita Income Vs Car Gujarat

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	87481	1411898	4.94	6.15		
2013	96683	1602129	4.99	6.20	11%	
2014	102589	1771298	5.01	6.25	6%	
2015	111370	2008748	5.05	6.30	9%	
2016	120683	2260084	5.08	6.35	8%	
2017	129738	2527537	5.11	6.40	8%	8.21%

Regression analysis of same is given in figure below

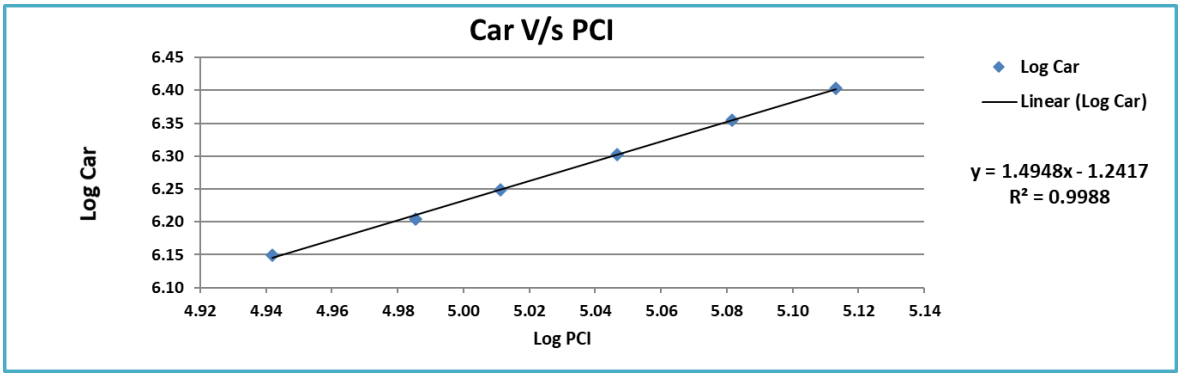


Figure 5-5: Regression and Elasticity PCI vs. Car – Extrapolation Gujarat

Table 5-7 : Population Vs Bus Gujarat

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	60439692	67546	7.78	4.83		
2013	61563037	70615	7.79	4.85	2%	
2014	62684375	72998	7.80	4.86	2%	
2015	63803304	76435	7.80	4.88	2%	

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2016	64919427	82734	7.81	4.92	2%	
2017	66032362	74855	7.82	4.87	2%	1.79%

Regression analysis of same is given in figure below

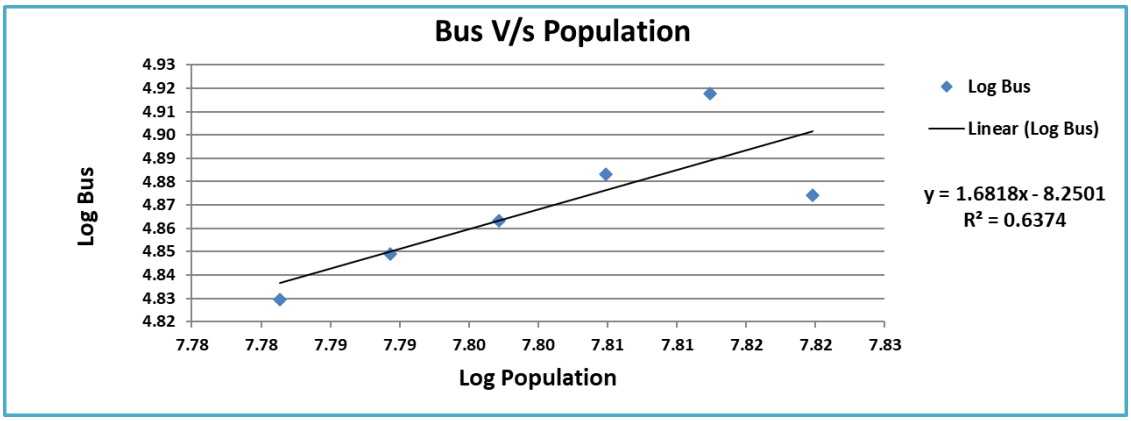


Figure 5-6: Regression and Elasticity Population vs. Bus – Extrapolation Gujarat

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-8 : LCV Traffic Vs NSDP Gujarat

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth
2012	532809	448958	5.73	5.65		
2013	596659	499277	5.78	5.70	12%	
2014	641489	542918	5.81	5.73	8%	
2015	705629	589984	5.85	5.77	10%	
2016	774775	633599	5.89	5.80	10%	9.82%

Following figure depict regression analysis and extrapolation.

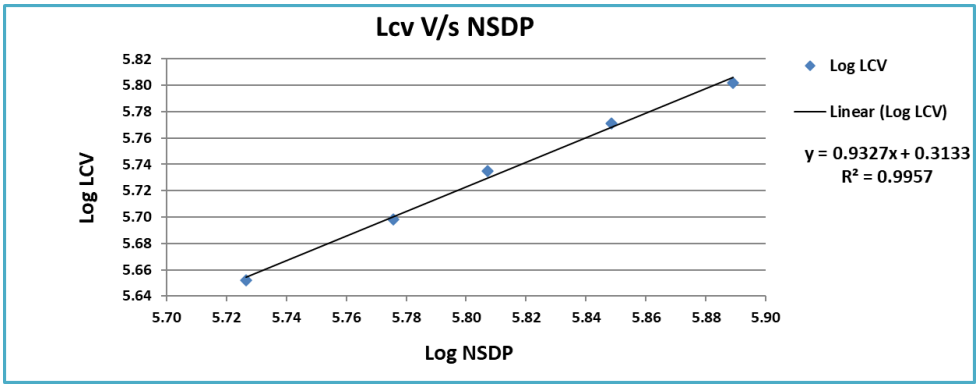


Figure 5-7: Regression and Elasticity NSDP vs. LCV Traffic - extrapolation Gujarat

Following figure depict regression analysis and extrapolation.

Table 5-9 : Truck Traffic Vs NSDP Gujarat

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth
2012	532809	301533	5.73	5.48		
2013	596659	319207	5.78	5.50	12%	
2014	641489	332185	5.81	5.52	8%	
2015	705629	352225	5.85	5.55	10%	
2016	774775	375265	5.89	5.57	10%	
2017	843930	396061	5.93	5.60	9%	9.64%

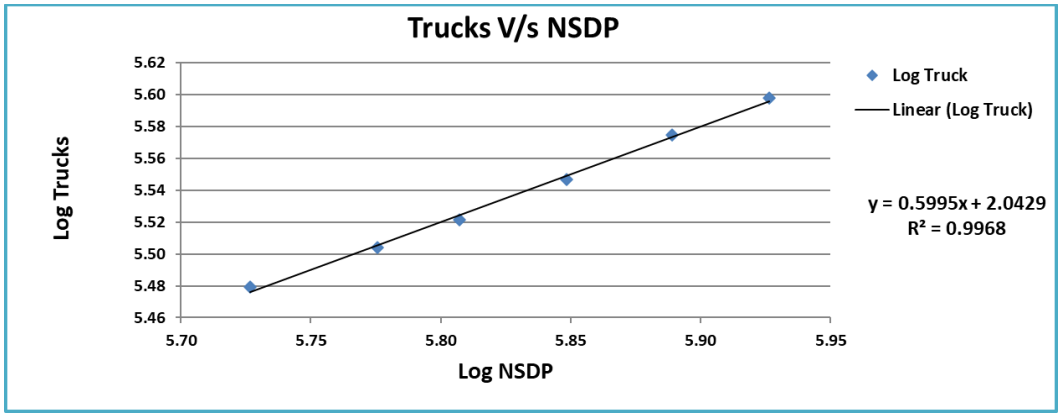


Figure 5-8: Regression and Elasticity NSDP vs. Truck Traffic - extrapolation Gujarat

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below.

Table 5-10 : Summary Regression Analysis Gujarat

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average IV Growth (5yrs)	Growth Elastic Model	Remarks
Gujarat	Car/Jeep	PCI	y = 1.4948x + -1.2417	R^2 = 0.9988	1.4948	8.21%	12.27%	Good Regression
	Bus	Population	y = 1.6818x - -8.2501	R^2 = 0.6374	1.6818	1.79%	3.00%	Fair Regression
	LCV	NSDP	y = 0.9327x - 0.3133	R^2 = 0.9957	0.9327	9.82%	9.16%	Good Regression
	Truck	NSDP	y = 0.5995x - 2.0429	R^2 = 0.9968	0.5995	9.64%	5.78%	Good Regression

Economical model for predicting growth is good tool, however other local, regional, national factors should also be considered before finalizing growth factors. Considering factors such as proposed developments and other influencing economic factors, moderated growth should be considered. These factors are discussed in subsequent sections.

5.4 Analysis of Historic Traffic Data

Historical traffic data forms useful information for any highway project. It provides useful information for establishing past trend of growth. Project stretch of Gulabpura to Chittorgarh is under tolling operation with current concessionaire and has two year of tolling history from 2018-19. As traffic data available with the project concessionaire is of year two years and that too affected by COVI-19, hence we do not have sufficient data points to be able to establish a reliable past trend of traffic growth. A minimum of about 5 -6 years' consistent traffic data is required for establishing a reliable past trend.

5.5 Other Factors Influencing Growth

There are many factors which have impact on traffic growth. As discussed previously these factors can be economic, social, educational, and industrial.

Potentiality of such factors for project highway is discussed as under.

ECONOMY

After witnessing a slowdown during 2011-12, the economy recovered in 2013-14, and a high growth rate of GDP was recorded in up to 2018-19. Pandemic of COVID-

19 impacted all economies of world including India. Following figure show trend of GDP growth in India.

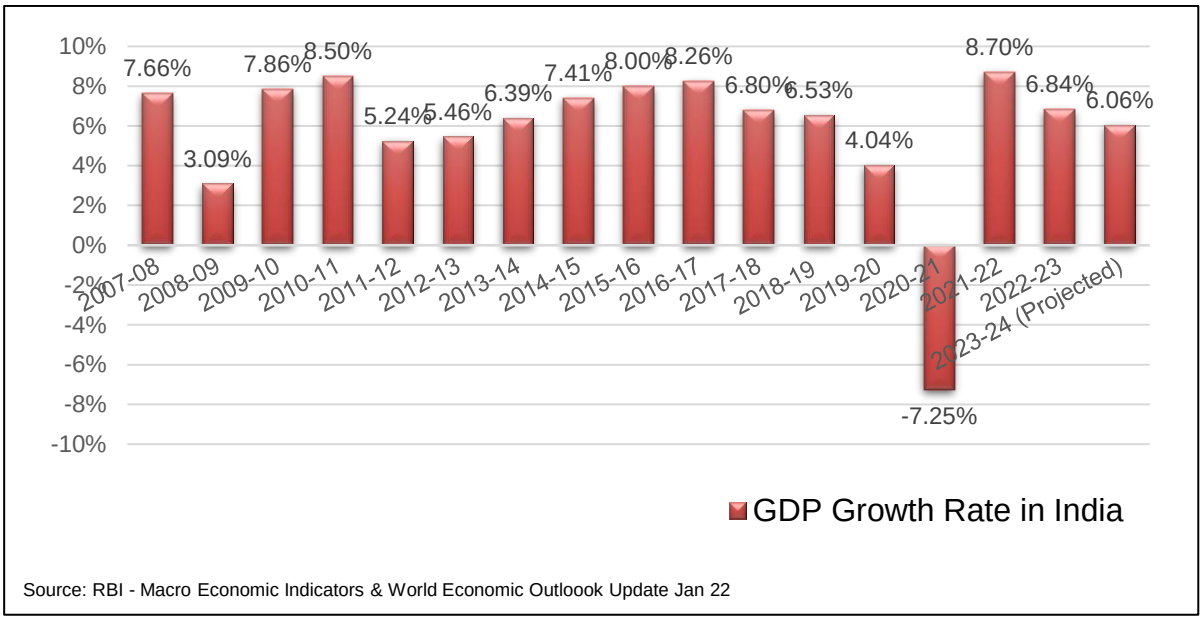


Figure 5-9 : Growth of GDP in India

FY 2017-18 recorded a growth of 6.7% which had slight impact of GST and demonetization. Indian economy appears on recovery path with estimated growth of 6.8% in FY 2018-19. Government took major policy decision including tax infrastructure reforming, banking sector improvement and ease of doing business.

Major economies of world collapsed due to pandemic COVID-19 including India. Indian economy is also registered negative growth in financial year 2020-21. After that Indian economy recovered handsomely and registered a growth of about 9% in Year 2021-22. This was partly due to low base of year 2020-21 as well.

Honorable Prime Minister has announced a major relief package of Rs. 20 lakh crores which is about 10% of GDP. This is aimed at turning this major crisis of COVID-19 into opportunity by providing major impetus to industrial production to the limit of becoming a self-reliant economy. With major thrust of this package being on **Make -In- India** it is expected that industry in India would grow at rapid pace and recover handsomely in post COVID-19 scenario. World Economic Outlook update also has predicted a growth rate of about 7.5 % in year 2022-23.

5.6 Developments along and around the Project Corridor & State

This Asset primarily serves traffic travelling between Delhi, Rajasthan, Gujarat and Maharashtra. It is observed that the vehicle distribution to be dominated by heavy

vehicles. We further noticed several textile industries and marble/granite industries bordering the Asset. Udaipur serves as a big tourism hub as well as a consumption centre which also result in traffic feeding into the demand being generated.

In addition, Chittorgarh has 4 major cement plants located in Chanderiya and Nimbahera villages. There is a regular movement of Cement bulkers to and from these locations along asset. Chanderiya Lead-Zinc Smelter, is the one of the largest zinc-lead smelting complexes in the world, is also located in Chittorgarh. Bhilwara is home to textiles industry and only centre in the country producing insulation bricks. Mining is another major sector for large scale mining of sandstone, soapstone feldspar, quartz, mica China clay and granite. Also, Iron Ore, Led, and Zinc is mined and processed in Bhilwara

Rajasthan is rich in natural resources and benefits from its strategic geographic location in India. The state is pre-eminent in quarrying, mining in India and has been a leader in crude oil extraction over the past few years. Moreover, Rajasthan is also major tourism attractor in India. Considering the scenario, it may be assumed that the traffic growth on project highway would remain high and there are minimal risks in terms of growth.

5.6.1 Industrial Units along Project Corridor

Bhilwara district occupies and important place in the mineral map of Rajasthan. The main minerals are lead Zinc, Soap Stone, China Clay, Feldspar, Quartz, Mica, Asbestos and Garnet.

Besides being a major tourist attraction in India Chittorgarh has a very rich profile in industrial mineral extraction. Lime stone (Cement Grade), Red Occur, Silica sand, China Clay and Quartz are major minerals which are in abundance. There are large number of cement plants in area. Chanderiya Lead-Zinc Smelter is one of the largest zinc-lead smelting complexes in the world.

5.7 Recommended Growth Rates of Traffic

Based on the above analysis and after giving due consideration to the entire listed factors, the following overall growth rates are recommended for each category of vehicle as under. Rate of growth is moderated in light of overall regional trend. Growth of Multi-Axle is kept slightly higher as trend of technological advances in logistic industry favors multi-axle over 2/3 axle carriage. It is also expected that as the economy moves from developing to developed, rate of growth diminishes. Same growth rate is not sustainable for long. Traffic growth is suitably stepped down fro future years.

Growth rates are recommended for three scenarios for sensitivity analysis namely **Optimistic, Pessimistic** and **Most Likely** with a positive and negative variation 0.5% from Most Likely case for corridor in both states.

5.7.1 Recommended Growth Rates of Traffic for Project Stretch

Table 5-11 : Recommended Growth Rates Optimistic

Category / Year	2021-2022	2022-2026	2026-2031	2031-2036	2036-2041	2041-2046	2046-2051
Car/Jeep/Van	9.51%	8.61%	8.31%	7.01%	6.58%	6.33%	6.09%
Bus	5.71%	4.93%	4.73%	3.77%	3.56%	3.41%	3.26%
LCV	5.19%	5.19%	4.89%	3.83%	3.34%	3.08%	2.83%
2- Axle	5.68%	5.68%	5.38%	4.55%	4.05%	3.78%	3.53%
3 – Axle	6.02%	6.02%	5.71%	4.55%	4.05%	3.78%	3.53%
4 to 6 Axle	6.71%	6.37%	6.03%	4.55%	4.05%	3.78%	3.53%
7 and Above Axle	6.71%	6.02%	5.71%	4.55%	4.05%	3.78%	3.53%

Table 5-12 : Recommended Growth Rates Pessimistic

Category / Year	2021-2022	2022-2026	2026-2031	2031-2036	2036-2041	2041-2046	2046-2051
Car/Jeep/Van	9.01%	8.11%	7.81%	6.51%	6.08%	5.83%	5.59%
Bus	5.21%	4.43%	4.23%	3.27%	3.06%	2.91%	2.76%
LCV	4.69%	4.69%	4.39%	3.33%	2.84%	2.58%	2.33%
2- Axle	5.18%	5.18%	4.88%	4.05%	3.55%	3.28%	3.03%
3 – Axle	5.52%	5.52%	5.21%	4.05%	3.55%	3.28%	3.03%
4 to 6 Axle	6.21%	5.87%	5.53%	4.05%	3.55%	3.28%	3.03%
7 and Above Axle	6.21%	5.52%	5.21%	4.05%	3.55%	3.28%	3.03%

Table 5-13 : Recommended Growth Rates Most Likely

Category / Year	2021-2022	2022-2026	2026-2031	2031-2036	2036-2041	2041-2046	2046-2051
Car/Jeep/Van	9.26%	8.36%	8.06%	6.76%	6.33%	6.08%	5.84%
Bus	5.46%	4.68%	4.48%	3.52%	3.31%	3.16%	3.01%
LCV	4.94%	4.94%	4.64%	3.58%	3.09%	2.83%	2.58%
2- Axle	5.43%	5.43%	5.13%	4.30%	3.80%	3.53%	3.28%
3 - Axle	5.77%	5.77%	5.46%	4.30%	3.80%	3.53%	3.28%
4 to 6 Axle	6.46%	6.12%	5.78%	4.30%	3.80%	3.53%	3.28%
7 and Above Axle	6.46%	5.77%	5.46%	4.30%	3.80%	3.53%	3.28%

Traffic and revenue has been worked out on the basis of above growths and same is presented in subsequent chapter of report.

5.8 COVID Impact

All All social and economic activities had been completely disrupted due worldwide pandemic of Corona Virus. This had affected traffic on project stretch as well. Traffic was severely affected form March-2020 due to lockdown and then in second wave and third waves.

Government has announced a mega economic stimulate and package of Rs. 20 Lakh Crore to bring the economy back on track and recover the losses. Traffic has shown impressive recovery post lockdown period and has recovered to normal level.

Taking recommended traffic growth and additional factors as discussed above into consideration traffic forecast for concession period is done and presented in next chapter

CHAPTER 6

TRAFFIC FORECAST

6.1 Traffic Projections

Growth rates recommended in previous section of report are used to arrive at traffic projections for future years. Toll plaza wise futuristic traffic projection is given in tables below.

These projections have been done for following three cases of growth up to concession period

1. Optimistic Scenario
2. Pessimistic Scenario
3. Most Likely Scenario

Table 6-1 : Total Tollable Traffic @ Toll Plaza 1- Lambia Kalan121.020 KM (Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU
2023-24	6725	830	410	2627	2114	5386	11	18103	47710
2024-25	7393	848	487	2740	2251	5745	11	19475	51001
2025-26	7877	913	449	2921	2367	6068	11	20606	53813
2026-27	8629	930	530	3040	2511	6451	11	22102	57346
2027-28	9205	1001	490	3239	2642	6814	11	23402	60532
2028-29	10076	1020	575	3374	2801	7242	11	25099	64495
2029-30	10761	1097	534	3594	2948	7652	11	26597	68118
2030-31	11628	1107	620	3716	3091	8019	11	28192	71705
2031-32	12287	1179	573	3926	3220	8357	11	29553	74869
2032-33	13269	1192	663	4062	3375	8757	11	31329	78813
2033-34	14032	1267	615	4290	3515	9128	11	32858	82318
2034-35	15145	1282	709	4440	3684	9564	11	34835	86655
2035-36	15964	1356	658	4664	3821	9923	11	36397	90130
2036-37	17155	1367	756	4806	3985	10347	11	38427	94458
2037-38	18095	1444	703	5047	4134	10736	11	40170	98275
2038-39	19436	1457	805	5202	4310	11193	11	42414	102991
2039-40	20514	1538	752	5461	4472	11616	11	44364	107198
2040-41	21973	1550	859	5616	4650	12079	11	46738	112078
2041-42	23152	1632	803	5879	4813	12505	11	48795	116407

Table 6-2 : Total Tollable Traffic @ Toll Plaza 2- Jojro ka Khera184.020 KM

(Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU
2023-24	6085	752	429	2437	2068	5888	14	17673	48574
2024-25	6608	790	449	2575	2192	6262	14	18890	51683
2025-26	7156	828	469	2713	2317	6639	14	20136	54834
2026-27	7751	867	490	2859	2448	7040	14	21469	58186
2027-28	8396	908	513	3012	2586	7465	14	22894	61747
2028-29	9094	953	537	3174	2733	7914	14	24419	65532
2029-30	9848	999	562	3344	2888	8391	14	26046	69551
2030-31	10537	1036	583	3495	3019	8772	14	27456	72919
2031-32	11274	1074	604	3654	3155	9170	14	28945	76452
2032-33	12064	1114	625	3820	3297	9587	14	30521	80166
2033-34	12909	1156	648	3993	3447	10022	14	32189	84069
2034-35	13813	1200	673	4174	3603	10478	14	33955	88177
2035-36	14721	1239	697	4343	3749	10902	14	35665	92069
2036-37	15687	1279	722	4518	3901	11342	14	37463	96131
2037-38	16718	1321	747	4700	4058	11802	14	39360	100387
2038-39	17817	1365	773	4890	4222	12279	14	41360	104838
2039-40	18988	1410	799	5087	4392	12775	14	43465	109488
2040-41	20190	1452	825	5279	4558	13258	14	45576	114078
2041-42	21469	1496	853	5478	4729	13759	14	47798	118872

Table 6-3 : Total Tollable Traffic @ Toll Plaza 1- Lambia Kalan121.020 KM
(Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU
2023-24	6692	826	407	2614	2105	5362	11	18017	47488
2024-25	7326	841	481	2714	2231	5693	11	19297	50534
2025-26	7769	899	440	2881	2335	5984	11	20319	53063
2026-27	8476	913	518	2985	2466	6333	11	21702	56301
2027-28	8997	976	476	3167	2582	6658	11	22867	59147
2028-29	9807	993	559	3282	2725	7045	11	24422	62747
2029-30	10423	1060	515	3480	2855	7408	11	25752	65949
2030-31	11216	1069	596	3580	2979	7727	11	27178	69106
2031-32	11792	1130	547	3765	3089	8015	11	28349	71807
2032-33	12681	1140	631	3874	3223	8359	11	29919	75240
2033-34	13343	1204	581	4074	3342	8672	11	31227	78214
2034-35	14340	1215	669	4193	3485	9043	11	32956	81947
2035-36	15039	1277	617	4386	3598	9338	11	34266	84828
2036-37	16092	1284	707	4494	3733	9690	11	36011	88475
2037-38	16887	1348	654	4700	3855	10007	11	37462	91617

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU
2038-39	18062	1356	747	4818	3999	10383	11	39376	95561
2039-40	18966	1424	693	5037	4131	10724	11	40986	98993
2040-41	20228	1429	788	5151	4273	11098	11	42978	102998
2041-42	21204	1497	733	5370	4405	11435	11	44655	106481

Table 6-4 : Total Tollable Traffic @Toll Plaza 2- Jojro ka Khera184.020 KM (Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU
2023-24	6058	749	427	2425	2058	5859	14	17590	48340
2024-25	6548	783	446	2549	2171	6203	14	18714	51197
2025-26	7059	817	465	2672	2283	6546	14	19856	54065
2026-27	7609	852	485	2801	2401	6908	14	21070	57097
2027-28	8203	889	505	2937	2526	7290	14	22364	60309
2028-29	8842	927	526	3080	2657	7693	14	23739	63703
2029-30	9532	966	547	3229	2794	8119	14	25201	67290
2030-31	10151	998	566	3358	2906	8446	14	26439	70208
2031-32	10811	1031	585	3493	3023	8788	14	27745	73270
2032-33	11514	1065	604	3633	3146	9144	14	29120	76472
2033-34	12262	1100	624	3779	3273	9514	14	30566	79816
2034-35	13059	1136	644	3931	3405	9899	14	32088	83312
2035-36	13853	1168	664	4069	3525	10250	14	33543	86567
2036-37	14695	1201	684	4213	3650	10613	14	35070	89959
2037-38	15587	1235	704	4361	3779	10989	14	36669	93485
2038-39	16533	1269	725	4515	3912	11378	14	38346	97157
2039-40	17538	1305	746	4674	4049	11781	14	40107	100980
2040-41	18560	1338	767	4826	4181	12167	14	41853	104704
2041-42	19643	1372	788	4984	4317	12567	14	43685	108583

Traffic projections for Most Likely scenario are given as under

Table 6-5 : Total Tollable Traffic @ Toll Plaza 1- Lambia Kalan121.020 KM (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU
2023-24	6709	828	408	2621	2110	5373	11	18060	47596
2024-25	7359	844	484	2728	2241	5718	11	19385	50765
2025-26	7821	905	445	2903	2351	6023	11	20459	53429
2026-27	8550	921	525	3014	2489	6389	11	21899	56816
2027-28	9098	988	484	3205	2612	6733	11	23131	59831
2028-29	9939	1006	568	3329	2764	7140	11	24757	63611
2029-30	10588	1078	526	3539	2902	7526	11	26170	67023
2030-31	11419	1088	610	3650	3037	7867	11	27682	70393
2031-32	12036	1154	563	3848	3156	8181	11	28949	73332
2032-33	12971	1165	650	3969	3301	8551	11	30618	77008
2033-34	13681	1235	602	4183	3431	8894	11	32037	80254
2034-35	14735	1248	693	4318	3587	9295	11	33887	84278
2035-36	15491	1316	642	4526	3711	9623	11	35320	87455
2036-37	16613	1325	735	4651	3862	10008	11	37205	91430
2037-38	17477	1396	683	4875	3996	10362	11	38800	94912
2038-39	18731	1406	780	5011	4156	10775	11	40870	99218
2039-40	19719	1480	727	5250	4302	11158	11	42647	103037
2040-41	21076	1488	827	5385	4463	11572	11	44822	107457
2041-42	22150	1563	771	5626	4609	11955	11	46685	111360

Table 6-6 : Total Tollable Traffic @ Toll Plaza 2- Jojro ka Khera184.020 KM (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU
2023-24	6071	750	427	2431	2063	5875	14	17631	48460
2024-25	6577	786	447	2562	2182	6233	14	18801	51441
2025-26	7106	822	467	2693	2301	6593	14	19996	54454
2026-27	7679	859	487	2830	2426	6974	14	21269	57643
2027-28	8297	897	508	2974	2557	7377	14	22624	61019
2028-29	8965	937	529	3125	2695	7803	14	24068	64594
2029-30	9687	979	553	3284	2842	8254	14	25613	68399
2030-31	10341	1013	573	3424	2963	8609	14	26937	71544
2031-32	11038	1049	593	3570	3090	8979	14	28333	74839
2032-33	11783	1086	613	3722	3222	9365	14	29805	78289
2033-34	12579	1124	634	3881	3359	9767	14	31358	81902
2034-35	13429	1163	655	4047	3502	10187	14	32997	85690
2035-36	14278	1199	676	4200	3634	10573	14	34574	89248
2036-37	15181	1236	697	4359	3771	10974	14	36232	92962
2037-38	16141	1273	720	4524	3913	11391	14	37976	96844
2038-39	17162	1311	743	4695	4061	11823	14	39809	100892

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU
2039-40	18247	1350	768	4873	4215	12271	14	41738	105123
2040-41	19357	1388	792	5044	4364	12705	14	43664	109275
2041-42	20534	1426	817	5222	4518	13153	14	45684	113596

6.2 Modification in Concession Period

As per Article 29 of the concession agreement, if actual traffic on the project falls short or exceeds Target Traffic on project highway on defined date, concession period shall be modified subject to calculation stipulated therein. For Gulabpura-Chittorgarh project, the Target Date and Target Traffic are defined as under:

Target Date - 1stJune 2026

Target Traffic - 76316 in PCU

It was observed that as per traffic projections, average traffic volume falls short of target traffic in all scenarios. Probable extension of concession period is estimated according to article 29 of concession agreement which comes to about 3-4 years Traffic forecast and revenue projections are done for probable extended period accordingly.

Most Likely

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2026	76316	57198	-25%	38%	20%	20	4

Optimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2026	76316	57743	-24%	37%	20%	20	4

Pessimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2026	76316	56663	-26%	39%	20%	20	4

CHAPTER 7

FORECAST OF TOLL REVENUE

7.1 General

This chapter presents the tolling rate calculations, categories and toll revenue of the project.

7.2 Discount Categories

The fee schedule in the CA of Gulabpura-Chittorgarh section of NH-19 is based on the old toll policy. As per the Toll Notification (Schedule -G) the discounts and special provisions have been considered. In addition to discounts as per Fee Notification concessionaire has declared special category rates also. Salient features of toll rate structure are given as under

1. Monthly Pass: For frequent user's monthly pass would be issued for 50 trips in month at 2/3d rate. Additionally, concessionaire has announced special monthly passes for local commercial cars at Rs. 670.
2. Multiple Journeys (for Return Trip): Will be charged at 1.5 times single journey.
3. Single Journey: Full single journey toll would be charged to this category of vehicles who are infrequent travelers or whose frequency does not yield any discount from the above categories.
4. Local Discounts: There are several categories of local discounts.
    a) Local Car Jeep Van I - Rs. 275 per
    b) Local LCV - Rs. 1200 per trip
    c) Local Commercial Vehicles at 50% rate for single journey

Building of inflation and escalation of rate on the basis of WPI are done as per toll notification (Schedule G) as given under as extract from concession agreement.

The formula for determining the applicable rate of fee shall be as follows:-

$$\text{Applicable rate of fee} = \text{base rate} + \text{base rate} \times \left\{ \frac{\text{WPI A-WPI B}}{\text{WPI B}} \right\} \times 0.4$$

Factor of inflation / growth has been incorporated as per Schedule R. WPI numbers (2011-12 series) are available up to 2018-19. A moderate growth in Wholesale Price Index (WPI) has been assumed after that. The following graph provides historical rate of inflation (WPI) in India. Data has been sourced from the Office of Economic Advisor web site (www.eaindustry.nic.in) WPI for year 2017-18 and 2018-2019 is worked back by applying a correlation factor for 2004-05 series as 2017-18 and 2018-2019 data is available in 2011-12 series only. Ratio of WPI for year 2016-17 for both series is used for conversion of WPI in 2004-05 series

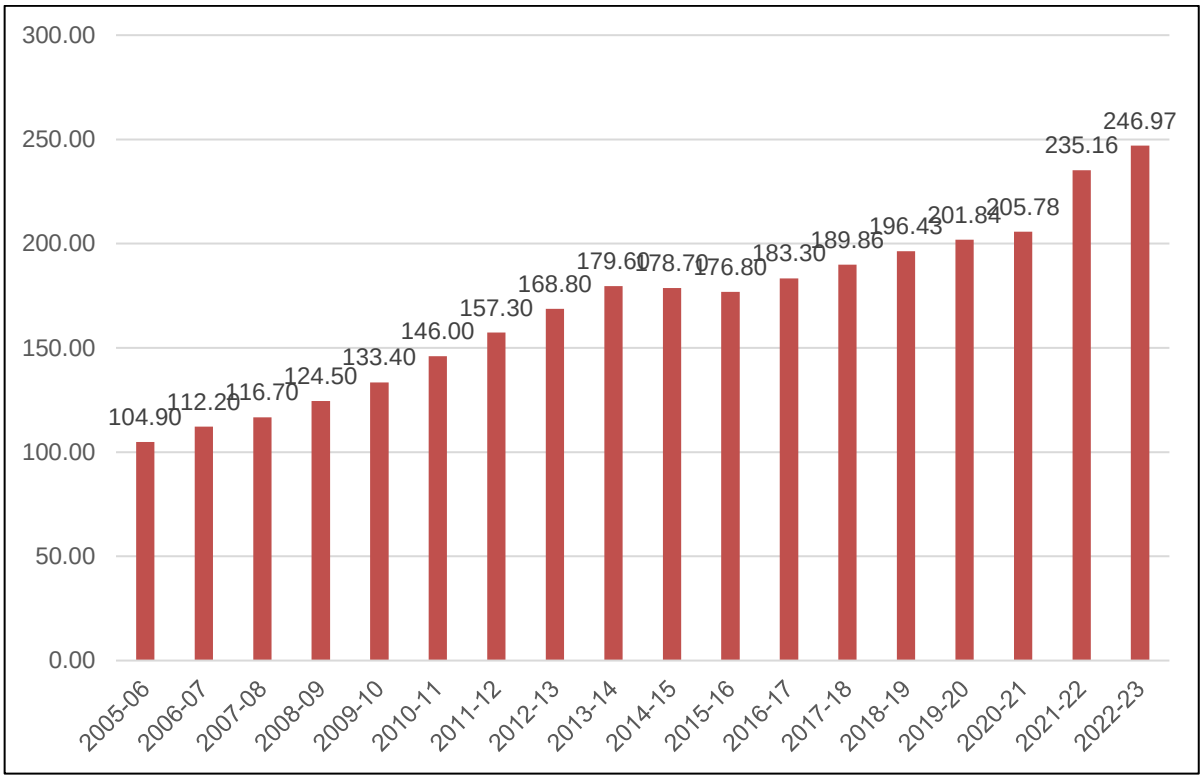


Figure 7-1 : Historical Rate of WPI Inflation in India

Average inflation in WPI in last few years is steadily growing. It grew in range of 4% - 5% in previous years. For future years initially it is takes 5% and Suitably Stepped down for future years.

7.3 Estimation of Toll Rates

As per the applicable MORTH notification and Schedule R of contract agreement, the following Base rate of fee for the categories mentioned in the table stands true in the National Highways Fee Rules applicable for contract.

Table 7-1 : Base Toll Rates June 2007-08

Type of Vehicle	Base Rate of Fee / Km (in Rs.)
Car, Jeep, Van or Light Motor Vehicle	0.65
Light Commercial Vehicle, Light Goods Vehicle or Minibus	1.05
Bus or Truck (Two Axles)	2.20
Three Axle Commercial Vehicles	2.40
Heavy Construction Machinery (HCM) or Earth Moving Equipment (EME) or Multi Axle Vehicle (MAV) (4 to 6 axles)	3.45
Oversized Vehicles (7 or more Axles)	4.20

There is no bypass or structure to be factored in for rates calculations.

Toll rates are calculated as per guidelines provided in schedule R (rounded to nearest Rs.) for the concession period and are given below.

Thus, worked out rates for various categories of vehicle and discounts are given as under.

Table 7-2 : Toll Rates for Single Journey@ Km 121.020

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	95	155	325	325	355
2024-25	100	165	340	340	375
2025-26	105	170	360	360	390
2026-27	110	180	375	375	410
2027-28	115	190	395	395	430
2028-29	120	200	415	415	450
2029-30	130	205	435	435	475
2030-31	135	215	455	455	495
2031-32	140	230	480	480	520
2032-33	150	240	500	500	545
2033-34	155	250	525	525	575
2034-35	165	265	550	550	600

2035-36	170	275	580	580	630
2036-37	180	290	605	605	660
2037-38	190	305	635	635	695
2038-39	195	320	665	665	730
2039-40	205	335	700	700	765
2040-41	215	350	735	735	800
2041-42	230	370	770	770	840

Table 7-3 : Toll Rates for Single Journey @ Km 184.020

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	100	160	335	335	370
2024-25	105	170	355	355	385
2025-26	110	180	370	370	405
2026-27	115	185	390	390	425
2027-28	120	195	410	410	445
2028-29	125	205	430	430	470
2029-30	135	215	450	450	490
2030-31	140	225	470	470	515
2031-32	145	235	495	495	540
2032-33	155	250	520	520	565
2033-34	160	260	545	545	595
2034-35	170	275	570	570	625
2035-36	175	285	600	600	655
2036-37	185	300	630	630	685
2037-38	195	315	660	660	720
2038-39	205	330	690	690	755
2039-40	215	345	725	725	795
2040-41	225	365	765	765	830
2041-42	235	380	800	800	875

Table 7-4 : Toll Rates for Return Journey @ Km 121.02

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	145	235	490	490	530
2024-25	150	245	510	510	560
2025-26	160	255	540	540	585
2026-27	165	270	565	565	615
2027-28	175	285	595	595	645
2028-29	185	295	620	620	680
2029-30	195	310	650	650	710
2030-31	200	325	685	685	745
2031-32	210	340	715	715	780
2032-33	220	360	750	750	820

2033-34	235	375	790	790	860
2034-35	245	395	825	825	900
2035-36	255	415	865	865	945
2036-37	270	435	910	910	990
2037-38	280	455	955	955	1040
2038-39	295	480	1000	1000	1090
2039-40	310	500	1050	1050	1145
2040-41	325	525	1105	1105	1205
2041-42	340	555	1160	1160	1265

Table 7-5 : Toll Rates for Return Journey @ Km 184.020

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	150	240	505	505	550
2024-25	155	255	530	530	580
2025-26	165	265	560	560	610
2026-27	175	280	585	585	640
2027-28	180	295	615	615	670
2028-29	190	310	645	645	705
2029-30	200	325	675	675	735
2030-31	210	340	710	710	775
2031-32	220	355	745	745	810
2032-33	230	370	780	780	850
2033-34	240	390	815	815	890
2034-35	255	410	855	855	935
2035-36	265	430	900	900	980
2036-37	280	450	945	945	1030
2037-38	290	470	990	990	1080
2038-39	305	495	1040	1040	1135
2039-40	320	520	1090	1090	1190
2040-41	340	545	1145	1145	1250
2041-42	355	575	1200	1200	1310

Table 7-6 : Toll Rates for Monthly Pass Local @ Km 121.020

Year	Car	Mini Bus /LCV
2023-24	330	1470
2024-25	345	1545
2025-26	365	1620
2026-27	385	1700
2027-28	400	1775
2028-29	420	1855

2029-30	440	1940
2030-31	460	2025
2031-32	485	2115
2032-33	510	2210
2033-34	535	2310
2034-35	560	2415
2035-36	585	2525
2036-37	615	2640
2037-38	645	2760
2038-39	680	2885
2039-40	710	3015
2040-41	745	3150
2041-42	785	3290

Table 7-7 : Toll Rates for Monthly Pass Local @ Km 184.020

Year	Car	Mini Bus /LCV
2023-24	330	1165
2024-25	345	1225
2025-26	365	1285
2026-27	385	1350
2027-28	400	1410
2028-29	420	1475
2029-30	440	1540
2030-31	460	1610
2031-32	485	1680
2032-33	510	1755
2033-34	535	1835
2034-35	560	1920
2035-36	585	2005
2036-37	615	2095
2037-38	645	2190
2038-39	680	2290
2039-40	710	2395
2040-41	745	2505
2041-42	785	2620

Table 7-8 : Toll Rates for Monthly Pass @ Km 121.020

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2023-24	3200	5170	10835	10835	11820
2024-25	3365	5435	11385	11385	12420
2025-26	3535	5710	11965	11965	13055
2026-27	3715	6000	12575	12575	13720

2027-28	3895	6290	13180	13180	14380
2028-29	4080	6595	13815	13815	15070
2029-30	4280	6910	14480	14480	15800
2030-31	4485	7245	15180	15180	16560
2031-32	4705	7595	15920	15920	17365
2032-33	4930	7965	16690	16690	18210
2033-34	5170	8355	17505	17505	19095
2034-35	5425	8765	18360	18360	20030
2035-36	5690	9190	19260	19260	21010
2036-37	5970	9645	20205	20205	22045
2037-38	6265	10120	21200	21200	23130
2038-39	6575	10620	22250	22250	24270
2039-40	6900	11145	23350	23350	25475
2040-41	7240	11700	24510	24510	26740
2041-42	7600	12280	25730	25730	28070

Table 7-9 : Toll Rates for Monthly Pass @ Km 184.020

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2023-24	3320	5365	11240	11240	12260
2024-25	3490	5635	11805	11805	12880
2025-26	3665	5920	12410	12410	13535
2026-27	3855	6225	13040	13040	14225
2027-28	4040	6525	13670	13670	14910
2028-29	4235	6840	14325	14325	15630
2029-30	4435	7170	15020	15020	16385
2030-31	4650	7515	15745	15745	17175
2031-32	4875	7880	16510	16510	18010
2032-33	5115	8260	17310	17310	18885
2033-34	5365	8665	18155	18155	19805
2034-35	5625	9090	19040	19040	20770
2035-36	5900	9535	19975	19975	21790
2036-37	6190	10000	20955	20955	22860
2037-38	6495	10495	21985	21985	23985
2038-39	6815	11010	23075	23075	25170
2039-40	7155	11555	24215	24215	26415
2040-41	7510	12130	25420	25420	27730
2041-42	7885	12735	26685	26685	29110

7.4 Toll Revenue

As indicated earlier, toll revenue on the Project Road has been calculated in all three scenarios based on above rates and projected traffic. The estimates of toll revenue under ***Optimistic***, ***Pessimistic*** and ***Most Likely*** growth scenarios are presented in the following section.

7.5 Toll Revenue at all toll plazas under Scenarios

Toll Revenue estimates under most likely scenario at each of the toll plaza up to 2041- 42 starting from the year 2023-24are shown in tables below.

Table 7-10 : Toll Revenue Optimistic Scenario

(Rs. Crores)

Year	TP-1	TP2	Total
2023-24	188.31	197.34	**385.66**
2024-25	209.65	219.46	**429.11**
2025-26	234.19	244.68	**478.88**
2026-27	259.78	272.72	**532.50**
2027-28	290.41	303.93	**594.34**
2028-29	322.15	337.16	**659.31**
2029-30	358.99	374.64	**733.63**
2030-31	394.00	411.45	**805.45**
2031-32	434.63	453.12	**887.74**
2032-33	476.46	497.54	**974.00**
2033-34	524.69	546.45	**1071.14**
2034-35	577.01	601.29	**1178.30**
2035-36	632.13	659.33	**1291.46**
2036-37	690.97	719.79	**1410.77**
2037-38	756.53	788.24	**1544.77**
2038-39	827.69	862.74	**1690.43**
2039-40	911.00	948.38	**1859.38**
2040-41	992.75	1033.57	**2026.31**
2041-42	1086.14	1129.31	**2215.45**

Table 7-11 : Toll Revenue Pessimistic Scenario

(Rs. Crores)

Year	TP-1	TP2	Total
2023-24	187.43	196.40	**383.83**
2024-25	207.67	217.48	**425.15**
2025-26	230.90	241.37	**472.27**
2026-27	254.92	267.82	**522.74**
2027-28	283.65	297.06	**580.71**
2028-29	313.09	327.97	**641.07**
2029-30	347.25	362.71	**709.97**
2030-31	379.35	396.48	**775.84**
2031-32	416.45	434.62	**851.07**
2032-33	454.30	475.01	**929.31**
2033-34	497.88	519.15	**1017.03**
2034-35	544.84	568.50	**1113.33**
2035-36	594.06	620.34	**1214.40**
2036-37	646.20	674.01	**1320.22**

Year	TP-1	TP2	Total
2037-38	704.04	734.55	**1438.59**
2038-39	766.57	800.06	**1566.63**
2039-40	839.71	875.28	**1714.99**
2040-41	910.69	949.32	**1860.01**
2041-42	991.52	1032.20	**2023.72**

Table 7-12 : Toll Revenue Most Likely Scenario

(Rs. Crores)

Year	TP-1	TP2	Total
2023-24	187.85	196.89	**384.73**
2024-25	208.66	218.47	**427.13**
2025-26	232.55	243.00	**475.55**
2026-27	257.35	270.21	**527.56**
2027-28	286.99	300.34	**587.33**
2028-29	317.57	332.39	**649.96**
2029-30	353.13	368.42	**721.55**
2030-31	386.66	403.72	**790.39**
2031-32	425.49	443.51	**869.00**
2032-33	465.22	485.85	**951.07**
2033-34	511.13	532.31	**1043.44**
2034-35	560.72	584.27	**1144.99**
2035-36	612.75	639.06	**1251.81**
2036-37	668.18	696.01	**1364.18**
2037-38	729.83	760.35	**1490.18**
2038-39	796.62	830.29	**1626.91**
2039-40	874.70	910.53	**1785.24**
2040-41	950.95	990.08	**1941.03**
2041-42	1037.80	1079.09	**2116.89**

CHAPTER 8

CONCLUSION & RECOMMENDATIONS

8.1 Conclusion & Recommendations

Project stretch of Gulabpura to Chittrorgarh section of NH-79 in state of Rajasthan from km 90.000 to km 214.870 nearing completion of six laning. The road is in sound condition and serves healthy traffic volumes. Project corridor is a part of the busy and prominent national highway NH-79 which connects Kishangarh to Udaipur via Bhiwala and Chittorgarh. There are large number of townships, industrial corridors and other business establishment coming up along project corridor. As discussed, dominant portion of traffic is long route traffic, which is more sensitive towards the growth of national economy. As Indian economy is poised to grow at 7%+, the project corridor is expected to pick up the same trend in terms of traffic flow. All these developments have potential to give positive impact to traffic flow on project. The following can be considered as major outcomes of the study

a) There is good amount of tollable traffic running on project

b) Project corridor has potential to witness traffic growth @ 6-8% annually in near future post COVID-19 due to various development in area and overall development of economy

c) Project corridor has committed traffic as long route traffic and does not run a risk of traffic leakage due to quality competing road

Based on above it can be considered a stable healthy project from traffic and revenue point of view.

GMD Consultants
503-504, Mayuresh Chambers Premises, Plot No. 60,
Sector -11, CBD Belapur, Navi Mumbai. 400 614.
Maharashtra.
Phone : +91-22-2756 4586 / 2756 5313
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

IRB INFRASTRUCTURE TRUST

KISHANGARH TO GULABPURA SECTION OF NH-79 &NH-79A IN THE STATE OF RAJASTHAN (LENGTH 90 KM)

TRAFFIC STUDY & REVENUE PROJECTION REPORT (FINAL)

APRIL 2023

GMD CONSULTANTS ★ NAVI MUMBAI ★

GMD Consultants
503, Mayuresh Chambers, Plot No. 60, Sector -11,
CBD Belapur, Navi Mumbai. 400 614.
Maharashtra.
Phone : +91-22-2756 4586 / 2756 5313
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

GMD Consultants
Adding Value

KISHANGARH TO GULABPURA SECTION OF NH-79 &NH-79A IN THE STATE OF RAJASTHAN (LENGTH 90 KM)

TRAFFIC STUDY & REVENUE PROJECTION REPORT (FINAL)

APRIL 2023

GMD CONSULTANTS ★ NAVI MUMBAI ★

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AADT	-	Annual Average Daily Traffic	**NHAI**	-	National Highway Authority of India
BOT	-	Build Operate Transfer	**NHDP**	-	National Highways Development Project
CAGR	-	Compound Annual Growth Rate	**NSDP**	-	Net State Domestic Product
CTV	-	Classified traffic volume	**O&M**	-	Operation & Maintenance
DBFOT	-	Design, Build, Finance, Operate & Transfer	**PCDP**	-	Per Capita Domestic Product
EME	-	Earth Moving Equipment	**PCI**	-	Per Capita Income
GDP	-	Gross Domestic Product	**PCU**	-	Passenger Car Unit
GSDP	-	Gross State Domestic Product	**PSC**	-	Pre-stressed Concrete
HCM	-	Heavy Construction Machinery	**RCC**	-	Reinforced cement concrete
HCV	-	Heavy Commercial Vehicle	**RHS**	-	Right Hand Side
HTMS	-	Highway Traffic Management System	**SH**	-	State Highway
IRC	-	Indian Road Congress	**TP**	-	Toll Plaza
IRR	-	Internal Rate of Return	**WPI**	-	Wholesale Price Index
LCV	-	Light Commercial Vehicle	**SIR**	-	Special Investment Region
LHS	-	Left Hand Side	**c.**	-	Circa
LGV	-	Light Goods Vehicle	**ROB**	-	Railway Over Bridge
MAV	-	Multi Axle Vehicle	**MDR**	-	Major District Road
MORTH	-	Ministry of Road Transport and Highways	**ODR**	-	Other District Road
NH	-	National Highway	**CA**	-	Concession Agreement
PCC	-	Plain Cement Concrete	**RMT**	-	Running Meter
CR	-	Coarse Rubble			

CHAPTER 1

INTRODUCTION

1.1 Background

The Government of India through National Highway Authority of India (NHAI) embarked upon a program to enhance the traffic capacity and safety for efficient transportation of goods as well as passenger traffic on National Highway Sections under NHDP Phase V. Under Phase V NHAI has planned to convert 6,500 km of existing 4-lane National Highways into 6-lane National Highway. Sections envisaged under 6-laning comprise the Golden Quadrilateral section (5,700 km) and some other sections which are 800 km in length.

The project under consideration, Six Laning of **Kishangarh** to **Gulabpura** section of NH-79A & NH-79 (length 90.00km) is one such road project NHAI intended to implement on a BOT basis in the DBFOT format. *M/s Kishangarh Gulabpura Tollway Ltd.* (Concessionaire) has been awarded the Project for a concession period of 20 years starting from 21st February 2018. The Project has been commissioned and is currently in the operation / maintenance phase. Six laning of project has also been completed in July 2022.

Length of project road is 90.00 Kms. The project road is section of NH-79A & 79 A, which connects Ajmer to Ghat Bilod. Project section of NH-79 passes through district of Bhiwara and Ajmer.

Project road alignment passes through the small towns of Shreenagar, Nasirabad, Jharwasa, Bandanwara and Bijainagar (Vijay Nagar). Following figure shows alignment of project road section from Kishangarh to Gulabpura.

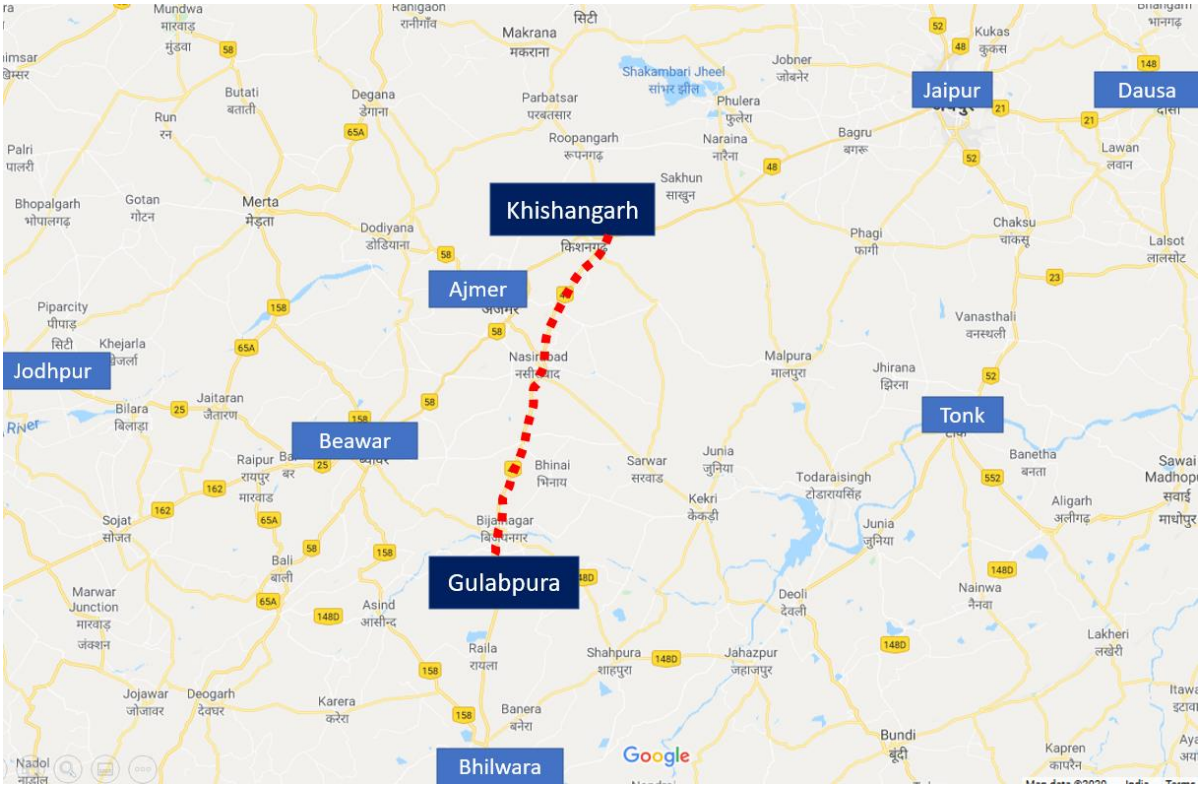


Figure 1-1 : Alignment of Project Stretch

1.2 Objective of the Study

M/s IRB INFRASTRUCTURE TRUST has engaged *GMD Consultants* to assess the future traffic and toll potential of project along with related operation & maintenance expenditure involved.

This report named as **"Traffic Study & *Toll Revenue Projection Report*"** mainly focuses on traffic and revenue aspects of the project. Other parameters like competing road, area developments etc. have been considered from a traffic development point of view.

1.2.1 Scope of Services

The broad scope of work covered in the assignment is as follows

a) Analysis of Traffic Growth
b) Toll Rate Growth
c) Revenue Forecasting

The Concessionaire has provided basic traffic data and other project details on the basis of which the above analysis has been carried out.

CHAPTER 2

PROJECT DETAILS

2.1 Project Corridor

National Highway 79 (NH 79) is important link for traffic connecting Delhi, Jaipur to Udaipur, Chittorgarh and down south. The project road is the section of the former NH-79A &NH-79 which has now been re-designated as NH-48. The project road section takes off at Kishangarh and ends at Gulabpura, both in the state of Rajasthan. The NH-79A was the section from Kishangarh to Nasirabad and part of NH-79 (Ajmer to Ghata Billod) was the remaining section from Nasirabad to Gulabpura

It is one of the major north-south road connectivity for the traffic from northern states of Haryana, Punjab and Delhi to Industrial and tourist areas of Rajasthan like Jaipur, Chittorgarh, Udaipur and then to Dahod, Ratlam and other parts of Madhya Pradesh.

After renumbering of all national highways by National Highway Authority of India in 2010, the current NH 48 was formed by merging the old NH 8 (Delhi-Mumbai section) and NH 4 (Mumbai-Chennai). National Highway 48 starts at Delhi and terminates at Chennai and goes through Jaipur, Udaipur, Vadodara, Mumbai, Pune and Bengaluru, traversing through six states of India. It has a total length of 2807 km (1744 miles)

2.2 Project Stretch Description

Section of NH-79 from Kishangarh to Gulabpura is part of major transportation link in the area connecting industrial / tourist cities of Jaipur- , Bhilwara, Chittorgarh and Udaipur. Project stretch would be faster connectivity to Udaipur from Jaipur once six laning is complete.

Major mining industries of marble, Zink, felspar, quarts of Udaipur and textile industry of Bhiwara provide are major contributor of commercial traffic on project corridor. Additionally Jaipur, Ajmer, Udaipur, Chittorgarh and Bhilwara major tourist centers of India. This adds substantial value for passenger traffic on project corridor section.

Like other parts of India rapid ribbon development is happening around these cities on project highway. This also contributes to sustainable traffic growth.

There are one operative toll plaza at project stretch at Bandanwara at km 61.020. Following figure show project alignment and toll plaza locations.

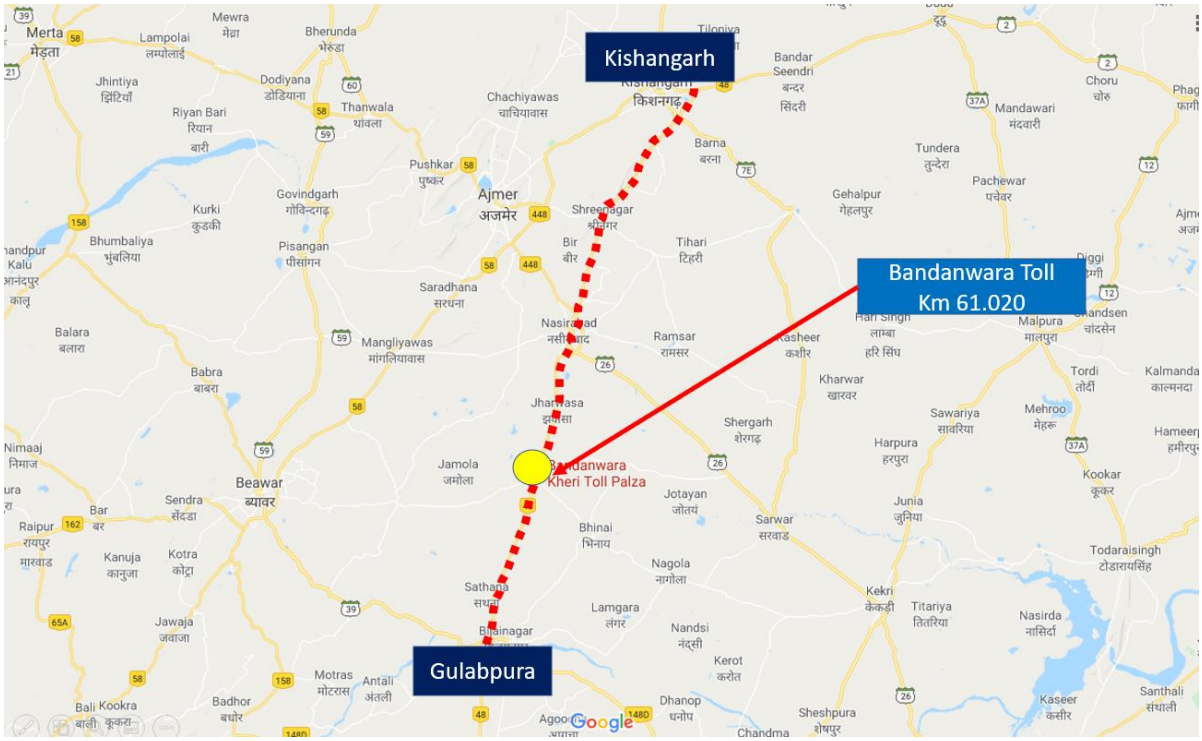


Figure 2-1 : Project Alignment with Toll Plaza

2.3 Project Corridor Illustration

Six laning of project stretch is in progress and would be completed soon. Following photographs illustrate project section along the corridor.

Figure 2-2 : Photographs showing Project Corridor

CHAPTER 3

TRAFFIC SURVEYS AND ANALYSIS

3.1 Traffic Surveys

The Consultants have collected the required information for project corridor to understand the general traffic and travel characteristics on the corridor.

The following traffic data has been collected from client for project.

- Classified traffic volume counts at toll plaza location on Kishangarh – Gulabpura section of NH-79 for year 2018-19 (part), 2019-20, 2020-21, 2021-22 & traffic data from April 2022 to March 2023.
- Local Component of traffic
- Component of Return Journey
- Component of Monthly Pass Journey

The main objective of the traffic data analysis is to:

- Determine the existing traffic movement characteristics of the project
- Establish base year traffic
- Identification of travel patterns and modal split of project traffic
- Deriving growth factors for traffic forecasting
- Estimation of corridor traffic including traffic diversion if any
- Preparation of revenue model and projection of revenue as per toll policy for various scenarios

Table 3-1 below lists provides details of locations from where traffic details have been collected.

Table 3-1 : Traffic Data Details

SR. NO	LOCATION	CTV	Single Journey Traffic	Daily Return Journey	Monthly Pass	Local Pass
1	Km 61.020 Toll Plaza at Bandanwara	AADT for Year 2018-19, 2019-2020 ,2020-2021, 2021-2022 & 2022-23	For Year 2018-19, 2019-2020 ,2020-2021, 2021-2022 & 2022-23	For Year 2018-19, 2019-2020 ,2020-2021, 2021-2022 & 2022-23	For Year 2018-19, 2019-2020 ,2020-2021, 2021-2022 & 2022-23	For Year 2018-19, 2019-2020 ,2020-2021, 2021-2022 & 2022-23

3.2 Classified traffic volume

The objective of conducting a Classified Traffic Volume Count is to understand the traffic flow pattern including modal split on a roadway. The Classified Traffic Volume Count survey has been provided by the concessionaire of project highway from actual traffic data gathered at toll plaza locations based on monthly data shared with NHAI.

The vehicles can broadly be classified into fast moving / motorized and slow moving / non-motorized vehicles, which can be further classified into specific categories of vehicles. The groupings of vehicles are further segregated to capture the tollable vehicle categories specifically and toll exempted vehicles are counted separately. The detailed vehicle classification system as per IRC: 64-1990 is given in table below

Table 3-2 : Vehicle Classification System

Vehicle Type	
Auto Rickshaw	
Passenger Car	Car, Jeep, Taxi & Van (Old / new technology)
Bus	Minibus
	Standard Bus
Truck	Light Goods Vehicle (LCV)
	2 – Axle Truck
	3 Axle Truck (HCV)
	Multi Axle Truck (4-6 Axle)
	Oversized Vehicles (7 or more axles)

Other Vehicles	Agriculture Tractor, Tractor & Trailer

Source - IRC: 64 – 1990

However, since project highway is currently under toll operation, the data collected is corresponding to category of tollable vehicles. Following are the type of vehicles as per concession agreement.

- Car / Jeep / van
- Min Bus /LCV
- Truck / Bus
- Multi Axle

3.3 Traffic Characteristic

Toll revenue of project highway does not solely depend on traffic volume. There are certain characteristics of traffic which have substantial potential to affect toll collection. Component of local traffic, component of passenger and commercial traffic, portion of return journey traffic, % of monthly pass traffic are some of such characteristics of traffic. These will be discussed in subsequent sections of report.

3.3.1 Traffic Data

Project concessionaire has provided Traffic data for base year 2019-20, 2020-21, 2021-2022 and from April 2022 to March 2023 as under for both toll plazas–

Table 3-3 : Traffic Data at Bandanwara Toll Plaza at Km 61.020

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)- 2019-20	Annual Average Daily Traffic (Nos.)- 2020-21	Annual Average Daily Traffic (Nos.)- 2021-22	Annual Average Daily Traffic (Nos.)- 2022-23
1	CAR	2572	448	3827	5400
2	Minibus /LCV	1009	326	522	736
3	Bus	376	38	337	486
4	Truck	1511	264	1756	2375
5	3-Axle Commercial vehicle	2095	318	1805	2045
6	Multi axle	4421	748	4141	4709

7	Oversized Vehicle	19	70	319	296
Total		**12003**	**2212**	**12707**	**16046**

Pandemic of COVID-19 (Corona Virus) had impacted entire world. Taking precaution, government of India announced a complete lockdown in last of March 2020 and traffic on highways was stopped which was eased out progressively later. There after India was hit by Covid-19 second and third wave in February 21 to July - 21 and December 21 to March-22. Recovering traffic pattern was somewhat again disturbed due to second and third wave of Covid-19. Traffic numbers of for period from April-2020 to March 2021 were not representative of traffic pattern at project corridor due to pandemic lockdown impact. However, for integrity of data same shown above. Traffic has almost recovered from Covid -19 impact as of now.

Since the traffic data is available year 2022-23 report has been updated taking this as base year traffic.

This data was then bifurcated to various components like through local, monthly, return journey etc. category. Same is discussed in detail in following section.

3.4 Data Analysis

3.4.1 Analysis of Traffic Volume Count

Understanding the character of existing traffic forms the basis of the traffic forecast. The various vehicle types having different sizes and characteristics can be converted into a single unit called Passenger Car Unit (PCU). Passenger Car equivalents for various vehicles are adopted based on recommendations of Indian Road Congress prescribed in "IRC-64-1990: Guidelines for Capacity of Roads in Rural areas". The adopted passenger car unit values (PCU) are presented in ***Table 3-4.***

Table 3-4 : PCU Factors Adopted for Study

Vehicle Type	PCUs
Car	1.0
Minibus	1.5
Standard Bus	3.0
LCV/LGV	1.5
2 Axle Truck	3.0
3 – 6 Axle Truck	4.5
MAV	4.5
Auto Rickshaw	1.0
Van/Tempo	1.0
Agriculture Tractor with Trailer	4.5
Agriculture Tractor without Trailer	1.5

Source: IRC: 64-1990

Traffic volume at each toll plaza was converted to PCU and same is presented as under

Table 3-5 : Traffic in PCU at Project Stretch Base Year 2019-20, 2020-21, 2021-22 & 2022-23

Toll Plaza Location (Km)	Year	Traffic No	PCU	PCU Index
Bandanwara 61.020	2019-20	12003	36011	3.00
	2020-21	2212	6478	2.93
	2021-22	12707	36374	2.86
	2022-23	16046	43739	2.73

It can be observed from above that project traffic has PCU index 3 which is an indicator of very high proportion of commercial traffic in traffic mix in project corridor. Following figure illustrates variation of PCU index at four toll plaza locations.

3.4.2 Components of Traffic

As discussed previously, components of traffic volume play an important role in determining project revenue. A larger component of commercial traffic with higher axle configuration adds to project revenue positively. Similarly, a larger component of local traffic affects the project revenue potential negatively.

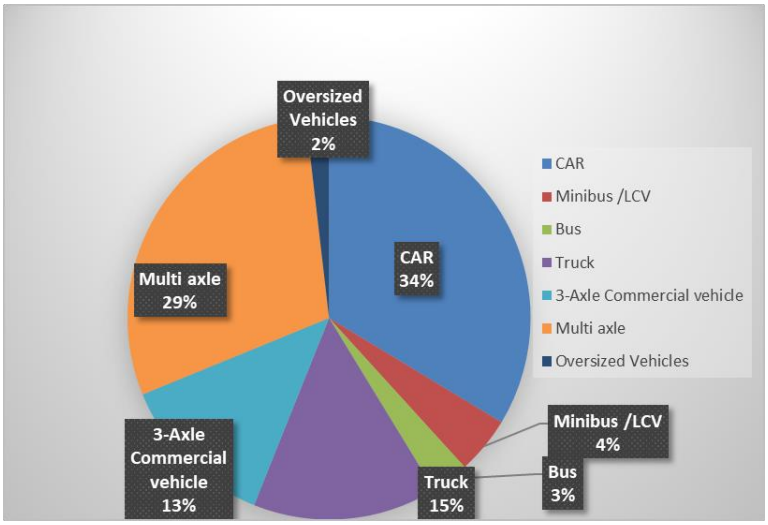


Figure 3-1 : Model Split of Tollable Vehicle

It is observed that car traffic forms about 34% of total traffic at toll plaza locations while multi axle commercial vehicles are about 44% of total traffic. Truck / Bus and LCV share about 18% and 4 % of traffic volume respectively.

Another important bifurcation of traffic is components of traffic with respect various type of toll ticketing like

1. Single Journey
2. Multi Journey
3. Monthly Pass (Local and General)

The following table provides numbers of vehicles falling in each of above category on base year 2022-23.

Table 3-6 : Journey Type Bifurcation of Traffic at Bandanwara TP KM 61.020

Sr. No	Type	Traffic Volume (Nos.)2022-23
1	Single Journey	12301
2	Return Journey	3312
3	Local Commercial Single Journey	413
4	Monthly Pass Local	5
5	Monthly Pass	15

Most dominant part of the above is the single journey type followed by return journey at project stretch. Monthly pass commuters are a very low fraction of the total traffic on the project corridor.

The single journey component in total traffic numbers is a high as 77%. Return journey component is 21%. The number of Local Commercial Single Journey is 2% and Monthly Pass Local 0% at Bandanwara toll plaza.

It is observed that the project corridor demonstrates pattern of single journey dominated mix of traffic at stretch which is typical of major national highways with high component of long distance traffic.

3.5 Secondary Data Collection

There are several other factors which have a substantial impact on traffic pattern and growth on any project corridor. Following are some of such important factors

- Industrial development around project corridor and its catchment
- Educational infrastructure along project corridor
- Demographic pattern
- Urban area development
- Tourism potential
- Upcoming major infrastructural or Industrial projects
- Special Industry in project corridor
- Overall trends of economic growth local as well as national / regional

Hence in addition to traffic details on project site, secondary data was also collected from various other sources. Typical secondary data includes the following:

1. Vehicle registration data of regional and national level.
2. Economic Data
   a) GDP
   b) NSDP
   c) Population Growth
   d) Per Capita Income growth
   e) Industrial Growth
   f) Special Industry Potential
   g) Regional and National development vision / plan
   h) Any other relevant data
3. Competing road network

We have collected and utilized such underlying data in the study to estimate the growth and risk factors for traffic along the project corridor.

CHAPTER 4

INFLUENCE ZONE TRANSPORT NETWORK ANALYSIS

4.1 Introduction

Highway corridors behave like integrated circuit network and more often than not every road is connected to various networks having different origin and destinations. Traffic running on these networks behave like fluid and flow on network on alignment of least friction.

Following Factors can be considered as major contributors to friction on transportation network.

- Travel Speed / Travel Time
- Geometric deficiencies like blind horizontal curves and steep vertical gradients etc,
- Configuration of road
- Riding quality
- Traffic delays,
- Length of road,
- Passing through built up or Urban Area,
- Terrain,
- Facilities,

4.2 Competing / Alternate route

Project stretch has toll application history from last few years, and it can be assumed that project traffic is settled. At local level there is no potential competing route bypassing toll plaza between.

At regional level, there can be two alternates for Udaipur traffic after Kishangarh. One via project road (Kishangarh – Bhiwara- Chittorgarh- Udaipur) and one via Ajmer, Beawer and Rajsamand.

Following maps show these routes in relation to project stretch at regional level.

Figure 4-1 : Alternate route at regional level

It can be observed that project highway forms the one of the main spine of the corridor between Kishangarh / Jaipur and Chittorgarh. Traffic on project road is now settled and it can be assumed as dedicated traffic on project road for logistic obligations.

At regional level for Udaipur traffic alternate route is faster and traffic is already using this alternate.

With six laning now nearing completion, project stretch would become slightly more attractive due to improved level of service. In such case further diversion of traffic from project road is not envisaged.

Following table provide summary of analysis of alternate route/ roads discussed above.

Table 4-1 : Competing Roads Details

Sr. No	Route Details	Designation	Length (Km)	Avg. Speed (KMPH)	Time Taken (Min)	Observations
Regional Level						
1	Jaipur – Ajmer- Udaipur	Alternate Route	395	61	6 Hr 23 Min	At present alternate route via Ajmer is a bit faster but after completion of six laning level of service would increase at project road as well
	Jaipur- Bhilwara - Chittorgarh- Udaipur	Project Road	398	51	6 Hr 58 Min	

It may be noted that since the project highway has already been commissioned and has a tolling history, the current traffic traversing the project corridor already factors in traffic diversion (if any) that may have taken place. Further after completion of six laning, level of service would improve on project corridor and this would create favorable conditions for traffic. Under these circumstances it is not envisaged that commercial or passenger traffic would switch to alternate roads from the project road. It is expected that there would be some additional traffic on project corridor once six lane is completed due to improvement in level of service.

CHAPTER 5

GROWTH OF TRAFFIC ON PROJECT HIGHWAY

5.1 Introduction

Traffic growth is a function of the interplay of a number of contributory factors such as National economy, Government policy, socio-economic conditions of the people, and changes in land uses along the project corridor precincts etc. As these factors have a number of uncertainties associated with them, forecasts of traffic are dependent on the projections of other factors such as population, gross domestic product (GDP), vehicle ownership, per capita income (PCI), agricultural output, fuel consumption etc. Future pattern of change in these factors can be estimated with only a reasonable degree of accuracy and hence the resultant traffic forecast levels may not be precise.

Traffic growth forecast for project corridor Kishangarh to Gulabpur section of NH-79 has been done taking the above factors into consideration. "**IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**" is established best practice and has been used for traffic growth forecast.

5.2 Trend Analysis

One of the methods of estimation of future rate of growth is to assume the same rate of growth as in the past. Although such a method is more suitable to projects of short durations say 5-10 years, however for long term projections it would-be erroneous to assume that the past rate of growth will continue to prevail for a long time in future. Economic conditions, which are major influencing factors, are bound to change over a long period of time. Thus, it would be necessary to modify the past trends of growth suitably.

Elasticity model of growth projection is one of the most widely acceptable methods for traffic forecast. The same is recommended in **IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**.

In this method the past trend of vehicular data is paired with an economic indicator and a regression analysis is done to yield the economic model of growth. Growth of vehicle traffic varies for different type of vehicle. It is a proven fact that the growth pattern for passenger and goods vehicle is different. Traffic growth on any highway

typically depends on number of economic parameters. Most important and direct parameters are given as under

- Per Capita Income
- Net State Domestic Product (NSDP)
- Population

It can be observed that the ownership of a car is more closely related to affordability; hence per capita is the index which closely fits the growth of car traffic among other criteria. In a similar fashion, the following can be pairs of vehicle type and independent variable for elasticity modeling of growth.

- Car / Jeep – Par Capita Income
- Bus / Minibus – Population
- Goods Vehicle – NSDP

5.3 Estimation of Traffic Demand Elasticity

Elasticity of traffic demand is defined as the rate at which traffic intensity varies due to a change in the corresponding indicator selected. Hence, In order to estimate the elasticity of traffic demand, it is necessary to establish relationship between the growth in number of given category of vehicles with the relevant economic variable considered, such as NSDP, per capita income and population growth. Latest available data for vehicle registration, per capita income, NSDP and population is used in analysis.

As per IRC: 108-1996 the model for estimating elasticity index for the project corridor is of the following form and is given as below:

$$Log\ (P) = k \times Log\ (EI) + A$$

Where,

P = *Number of Vehicles (Mode wise)*

EI = *Economic Indicator*

A = *Regression constant*

k = *Elasticity coefficient (Regression coefficient)*

The elasticity for car and bus (passenger vehicles) is calculated based on the Population and Per Capita Domestic Product (PCDP) and the elasticity for trucks is calculated based on the Net State Domestic Product (NSDP).

The project corridor spreads across state of Rajasthan. Toll plaza at Bandanwara is in the state of Rajasthan but it has influence of Gujarat also. For elasticity calculations, working data from Rajasthan and Gujarat has been analyzed.

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Rajasthan State.

Table 5-1 : Per Capita Income Vs Car Rajasthan

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	57192	591069	4.76	5.77		
2013	58441	659542	4.77	5.82	2%	
2014	61053	733916	4.79	5.87	4%	
2015	64496	814079	4.81	5.91	6%	
2016	68565	899307	4.84	5.95	6%	
2017	71394	988391	4.85	5.99	4%	4.55%

Regression analysis of same is given in figure below

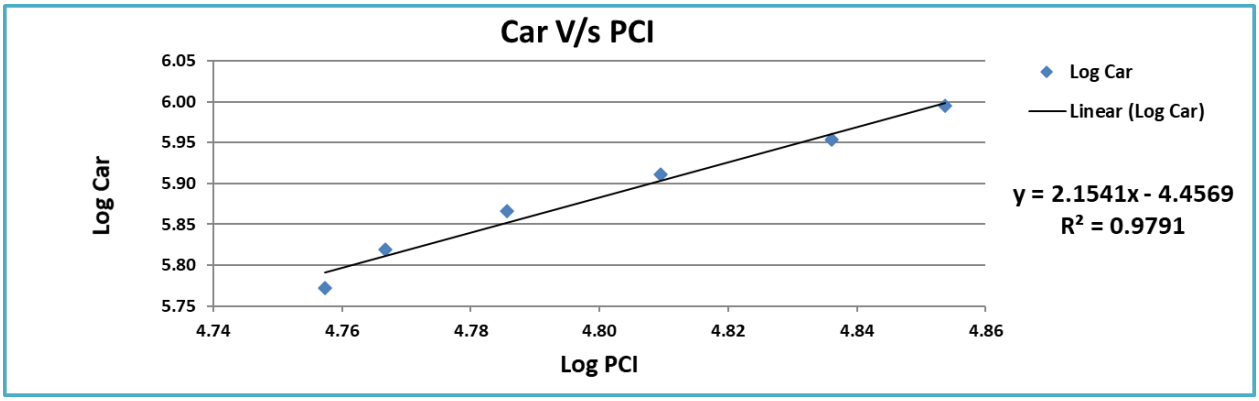


Figure 5-1 : Regression and Elasticity PCI vs. Car – Extrapolation Rajasthan

Table 5-2 : Population Vs Bus Rajasthan

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	68548437	83345	7.84	4.92		
2013	69783885	88616	7.84	4.95	2%	
2014	71016445	93892	7.85	4.97	2%	
2015	72245688	97650	7.86	4.99	2%	
2016	73471198	102818	7.87	5.01	2%	
2017	74692571	108680	7.87	5.04	2%	1.73%

Regression analysis of same is given in figure below

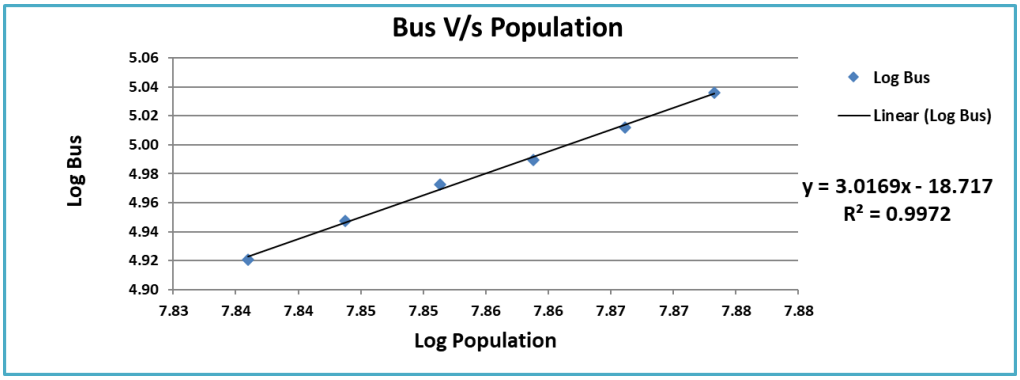


Figure 5-2 : Regression and Elasticity Population vs. Bus – Extrapolation Rajasthan

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-3 : LCV Traffic Vs NSDP Rajasthan

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth
2012	395331	69509	5.60	4.84		
2013	409802	76396	5.61	4.88	4%	
2014	434292	33379	5.64	4.52	6%	
2015	465408	91787	5.67	4.96	7%	
2016	501922	99763	5.70	5.00	8%	6.16%

Following figure depict regression analysis and extrapolation.

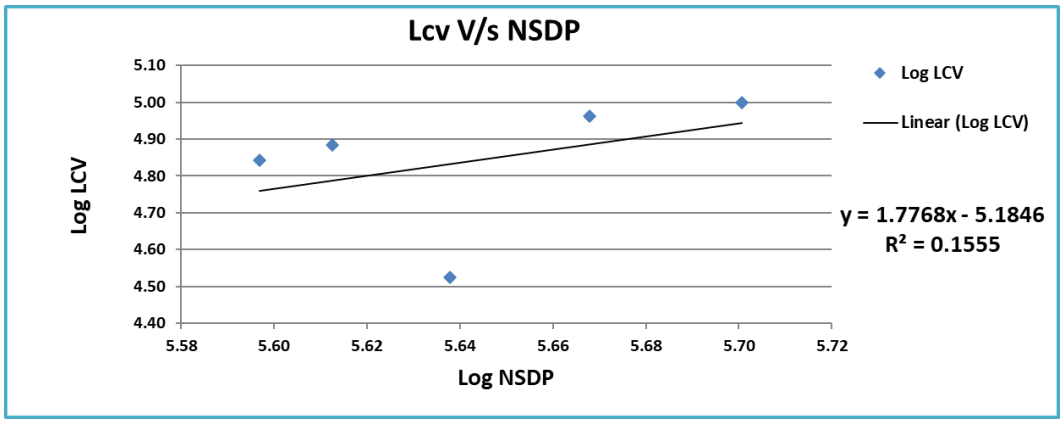


Figure 5-3 : Regression and Elasticity NSDP vs. LCV Traffic - extrapolation Rajasthan

Following figure depict regression analysis and extrapolation.

Table 5-4 : Goods Traffic Vs NSDP Rajasthan

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth
2012	395331	362028	5.60	5.56		
2013	409802	401983	5.61	5.60	4%	
2014	434292	434379	5.64	5.64	6%	
2015	465408	472365	5.67	5.67	7%	
2016	501922	517604	5.70	5.71	8%	
2017	530172	561158	5.72	5.75	6%	6.06%

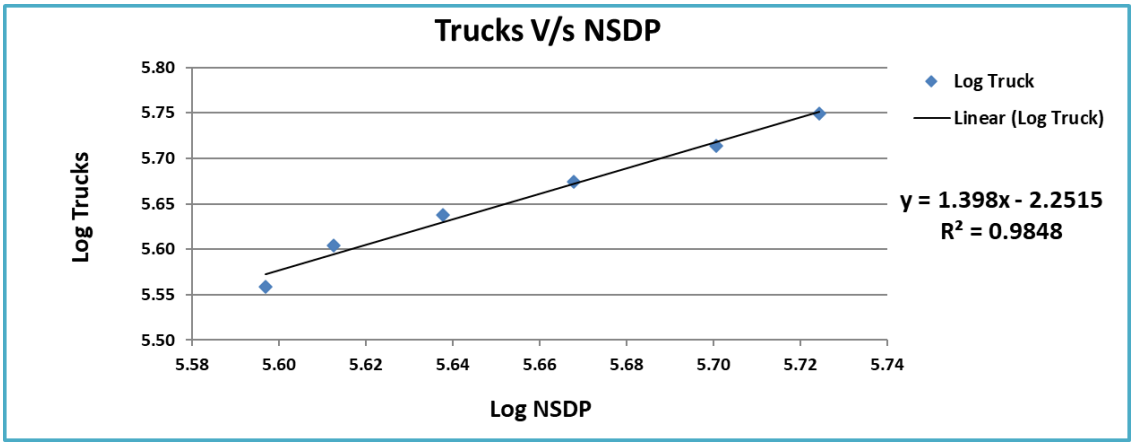


Figure 5-4 : Regression and Elasticity NSDP vs. Goods Traffic - extrapolation Rajasthan

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below.

Table 5-5 : Summary Regression Analysis Rajasthan

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average IV Growth (5yrs)	Growth Elastic Model	Remarks
Rajasthan	Car/Jeep	PCI	y = 2.1541x + -4.4569	R^2 = 0.9791	2.1541	4.55%	9.79%	Good Regression
	Bus	Population	y = 3.0169x - -18.7174	R^2 = 0.9972	3.0169	1.73%	5.22%	Good Regression
	LCV	NSDP	y = 1.7768x - -5.1846	R^2 = 0.1555	1.7768	6.16%	10.95%	Poor Regression
	Truck	NSDP	y = 1.398x - -2.2515	R^2 = 0.9848	1.3980	6.06%	8.46%	Good Regression

Table 5-6 : Per Capita Income Vs Car Gujarat

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	87481	1411898	4.94	6.15		
2013	96683	1602129	4.99	6.20	11%	
2014	102589	1771298	5.01	6.25	6%	
2015	111370	2008748	5.05	6.30	9%	
2016	120683	2260084	5.08	6.35	8%	
2017	129738	2527537	5.11	6.40	8%	8.21%

Regression analysis of same is given in figure below

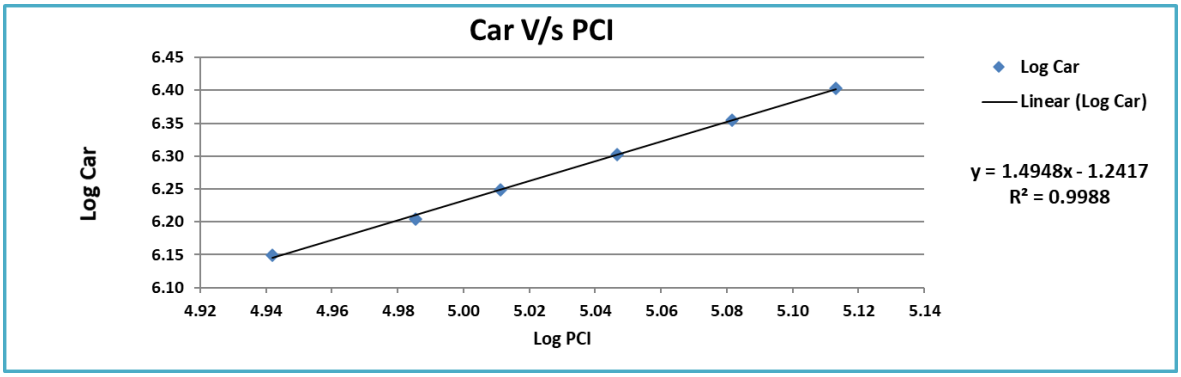


Figure 5-5 : Regression and Elasticity PCI vs. Car – Extrapolation Gujarat

Table 5-7 : Population Vs Bus Gujarat

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	60439692	67546	7.78	4.83		
2013	61563037	70615	7.79	4.85	2%	
2014	62684375	72998	7.80	4.86	2%	
2015	63803304	76435	7.80	4.88	2%	

2016	64919427	82734	7.81	4.92	2%	
2017	66032362	74855	7.82	4.87	2%	1.79%

Regression analysis of same is given in figure below

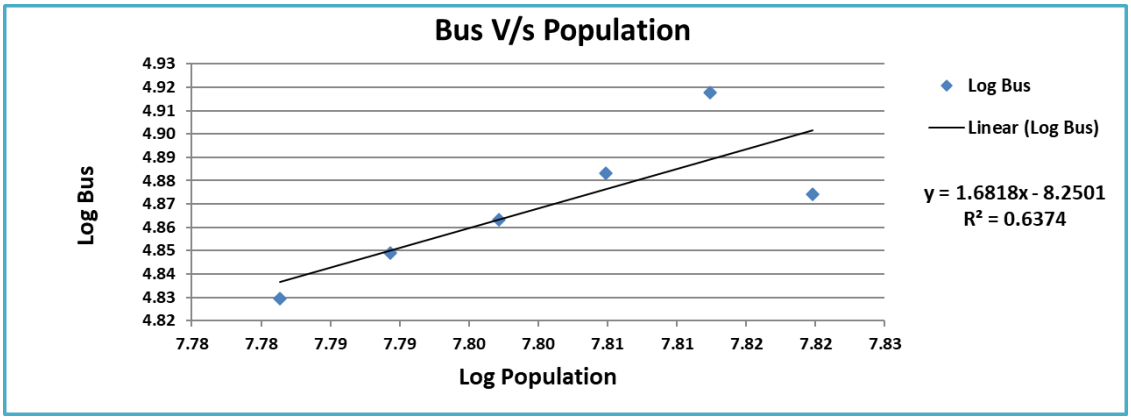


Figure 5-6 : Regression and Elasticity Population vs. Bus – Extrapolation Gujarat

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-8 : LCV Traffic Vs NSDP Gujarat

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth
2012	532809	448958	5.73	5.65		
2013	596659	499277	5.78	5.70	12%	
2014	641489	542918	5.81	5.73	8%	
2015	705629	589984	5.85	5.77	10%	
2016	774775	633599	5.89	5.80	10%	9.82%

Following figure depict regression analysis and extrapolation.

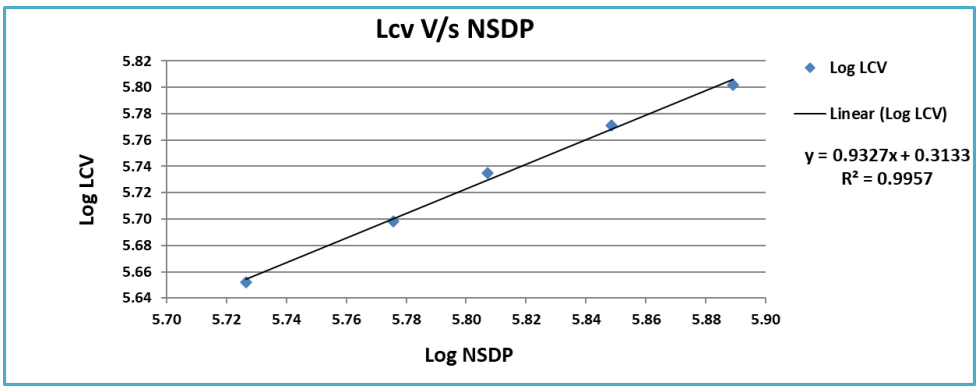


Figure 5-7 : Regression and Elasticity NSDP vs. LCV Traffic - extrapolation Gujarat

Following figure depict regression analysis and extrapolation.

Table 5-9 : Goods Traffic Vs NSDP Gujarat

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth
2012	532809	301533	5.73	5.48		
2013	596659	319207	5.78	5.50	12%	
2014	641489	332185	5.81	5.52	8%	
2015	705629	352225	5.85	5.55	10%	
2016	774775	375265	5.89	5.57	10%	
2017	843930	396061	5.93	5.60	9%	9.64%

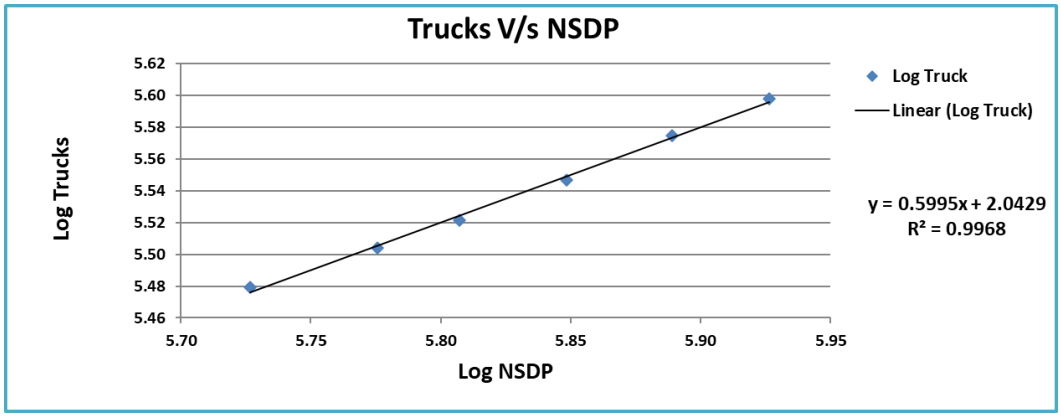


Figure 5-8 : Regression and Elasticity NSDP vs. Goods Traffic - extrapolation Gujarat

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below.

Table 5-10 : Summary Regression Analysis Gujarat

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average IV Growth (5yrs)	Growth Elastic Model	Remarks
Gujarat	Car/Jeep	PCI	y = 1.4948x + -1.2417	R^2 = 0.9988	1.4948	8.21%	12.27%	Good Regression
	Bus	Population	y = 1.6818x - -8.2501	R^2 = 0.6374	1.6818	1.79%	3.00%	Fair Regression
	LCV	NSDP	y = 0.9327x - 0.3133	R^2 = 0.9957	0.9327	9.82%	9.16%	Good Regression
	Truck	NSDP	y = 0.5995x - 2.0429	R^2 = 0.9968	0.5995	9.64%	5.78%	Good Regression

Economical model for predicting growth is good tool, however other local, regional, national factors should also be considered before finalizing growth factors. Considering factors such as proposed developments and other influencing economic factors, moderated growth should be considered. These factors are discussed in subsequent sections.

5.4 Analysis of Historic Traffic Data

Historical traffic data forms useful information for any highway project. It provides useful information for establishing past trend of growth. Project stretch of Kishangarh to Gulabpura is under tolling operation with current concessionaire and has two year of tolling history from 2018-19. As traffic data available with the project concessionaire of year two years, we do not have sufficient data points to be able to establish a reliable past trend of traffic growth. A minimum of about 5 -6 years' traffic data is required for establishing a reliable past trend.

5.5 Other Factors Influencing Growth

There are many factors which have impact on traffic growth. As discussed previously these factors can be economical, social, educational, and industrial.

Potentiality of such factors for project highway is discussed as under.

ECONOMY

After witnessing a slowdown during 2011-12, the economy recovered in 2013-14, and a high growth rate of GDP was recorded in up to 2018-19. Pandemic of COVID-

19 impacted all economies of world including India. Following figure show trend of GDP growth in India.

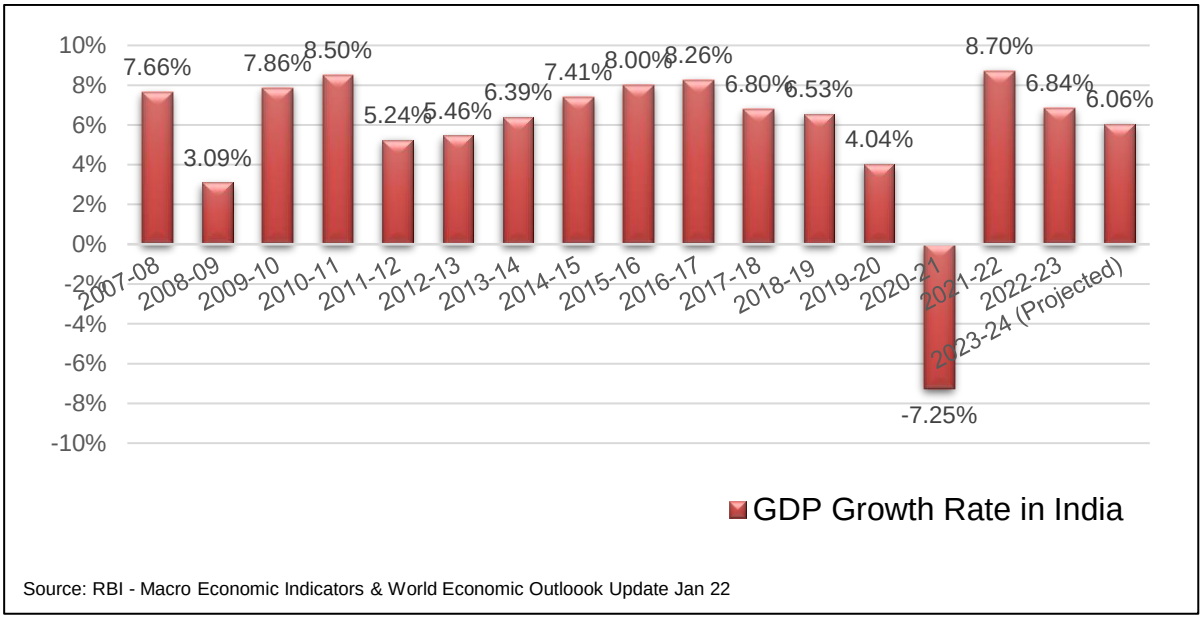


Figure 5-9 : Growth of GDP in India

FY 2017-18 recorded a growth of 6.7% which had slight impact of GST and demonetization. Indian economy appears on recovery path with estimated growth of 6.8% in FY 2018-19. Government took major policy decision including tax infrastructure reforming, banking sector improvement and ease of doing business.

Major economies of world collapsed due to pandemic COVID-19 including India. Indian economy is also registered negative growth in financial year 2020-21. After that Indian economy recovered handsomely and registered a growth of about 9% in Year 2021-22. This was partly due to low base of year 2020-21 as well.

Honorable Prime Minister has announced a major relief package of Rs. 20 lakh crores which is about 10% of GDP. This is aimed at turning this major crisis of COVID-19 into opportunity by providing major impetus to industrial production to the limit of becoming a self-reliant economy. With major thrust of this package being on **Make -In- India** it is expected that industry in India would grow at rapid pace and recover handsomely in post COVID-19 scenario. World Economic Outlook update also has predicted a growth rate of about 7.5 % in year 2022-23.

5.6 Developments along and around the Project Corridor & State

This Highway passes through Ajmer district of Rajasthan, having Industrial Areas of RIICO Kishangarh and Silora. There are Large Scale Industries of Cement, Marble & Granite and Medium Scale Industries of engineering and instrumentation in this area Asset primarily serves traffic travelling between Delhi, Rajasthan, Gujarat and Maharashtra. It is observed that the vehicle distribution to be dominated by heavy vehicles. We further noticed several textile industries and marble/granite industries bordering the Asset. Udaipur serves as a big tourism hub as well as a consumption centre which also result in traffic feeding into the demand being generated.

In addition, Chittorgarh has 4 major cement plants located in Chanderiya and Nimbahera villages. There is a regular movement of Cement bulkers to and from these locations along asset. Chanderiya Lead-Zinc Smelter, is the one of the largest zinc-lead smelting complexes in the world, is also located in Chittorgarh. Bhilwara is home to textiles industry and only centre in the country producing insulation bricks. Mining is another major sector for large scale mining of sandstone, soap stone feldspar, quartz, mica China clay and granite. Also, Iron Ore, Led, and Zinc is mined and processed in Bhilwara

growth of Rajasthan has been comparable to the national average economic growth. Rajasthan is rich in natural resources and benefits from its strategic geographic location in India. The state is pre-eminent in quarrying, mining in India and has been a leader in crude oil extraction over the past the few years. Moreover, Rajasthan is also a relevant tourism attractor in India. Considering the scenario, it may be assumed that the traffic growth on project highway would remain high and there are minimal risks in terms of growth.

Table 5-11 : GDP of India, UP and other important states

Year	India (GDP)	Bihar	Haryana	Madhya Pradesh	Maharashtra	Odisha	Punjab	Rajasthan	Uttar Pradesh	Uttarakhand	West Bengal	Delhi
1980-81	12336	514	357	623	1464	529	504	560	1631	138	830	269
1981-82	13030	543	371	639	1498	528	551	607	1670	141	808	291
1982-83	13411	548	394	668	1556	497	568	620	1800	152	840	328
1983-84	14464	601	402	702	1654	597	578	761	1871	158	939	320
1984-85	15037	658	418	668	1675	569	623	706	1900	161	964	333
1985-86	15663	672	493	726	1807	635	670	704	1975	167	1005	386
1986-87	16339	725	493	694	1832	643	694	771	2060	174	1045	411
1987-88	16917	685	484	789	1955	623	730	718	2154	182	1101	447
1988-89	18635	772	602	847	2159	754	769	1014	2434	206	1148	486

1989-90	19778	759	610	865	2515	805	834	993	2502	212	1188	531
1990-91	20824	831	674	987	2629	668	849	1149	2651	224	1251	553
1991-92	21122	784	688	916	2620	753	888	1061	2662	225	1349	638
1992-93	22254	737	688	983	3017	740	930	1220	2690	228	1389	660
1993-94	23519	755	719	1088	3349	788	970	1121	2757	233	1490	705
1994-95	25023	842	771	1107	3414	826	995	1325	2901	254	1594	790
1995-96	26846	712	787	1174	3791	864	1032	1374	2995	251	1713	804
1996-97	28987	893	879	1252	3941	804	1107	1535	3327	267	1832	915
1997-98	30234	850	887	1318	4158	920	1137	1721	3292	270	1985	1063
1998-99	32255	904	934	1405	4324	948	1203	1797	3316	274	2112	1116
1999-00	34837	950	1002	1552	4735	1008	1267	1801	3440	274	2264	1170
2000-01	36282	1106	1081	1426	4589	982	1309	1743	3511	308	2343	1215
2001-02	38236	1043	1165	1528	4751	1042	1326	1941	3575	323	2512	1262
2002-03	39719	1175	1236	1449	5079	1034	1348	1708	3690	353	2600	1359
2003-04	42883	1099	1358	1611	5471	1185	1433	2251	3885	381	2753	1433
2004-05	45906	1238	1475	1664	5948	1340	1504	2196	4079	431	2936	1588
2005-06	50257	1207	1608	1748	6810	1399	1577	2344	4317	492	3121	1752
2006-07	55066	1416	1791	1907	7748	1574	1748	2620	4660	551	3366	1969
2007-08	60199	1489	1931	1997	8650	1708	1899	2739	4959	648	3627	2191
2008-09	64248	1716	2080	2250	8786	1837	2004	2969	5336	716	3774	2464
2009-10	69769	1798	2340	2463	9634	1852	2132	3142	5668	839	4067	2667
2010-11	75987	2073	2498	2592	10732	1968	2270	3614	6120	927	4313	2888
2011-12	81069	2285	2712	2824	11222	2042	2392	3953	6451	1020	4471	3147
2012-13	85463	2369	2894	3069	11842	2163	2518	4098	6736	1095	4838	3342
2013-14	90636	2469	3142	3226	12671	2331	2675	4343	7075	1178	5247	3565
2014-15	97121	2557	3314	3394	13322	2359	2777	4656	7297	1257	5633	3882
2015-16	105033	2749	3612	3597	14417	2557	2926	4981	7894	1355	-	4291
2016-17	112476	3033	3927	4129	15744	2828	3095	5352	8457	1448	-	4658
2017-18	119762	-	-	4432	-	3029	-	5736	9011	1547	-	5035
Growth 1981-2018	6.34	5.05	6.88	5.44	6.82	4.83	5.17	6.49	4.73	6.75	5.79	8.24
Growth 1994-2018	7.02	6.23	7.66	6.03	6.96	5.77	5.17	7.04	5.06	8.20	6.54	8.53
Growth 2000-2018	7.10	7.07	8.37	6.00	7.32	6.30	5.40	6.65	5.50	10.10	6.27	8.45

5.6.1 Industrial Units along Project Corridor

There are number of medium and big size industrial establishments along project corridor. Following figure show spread of these industries along project road.

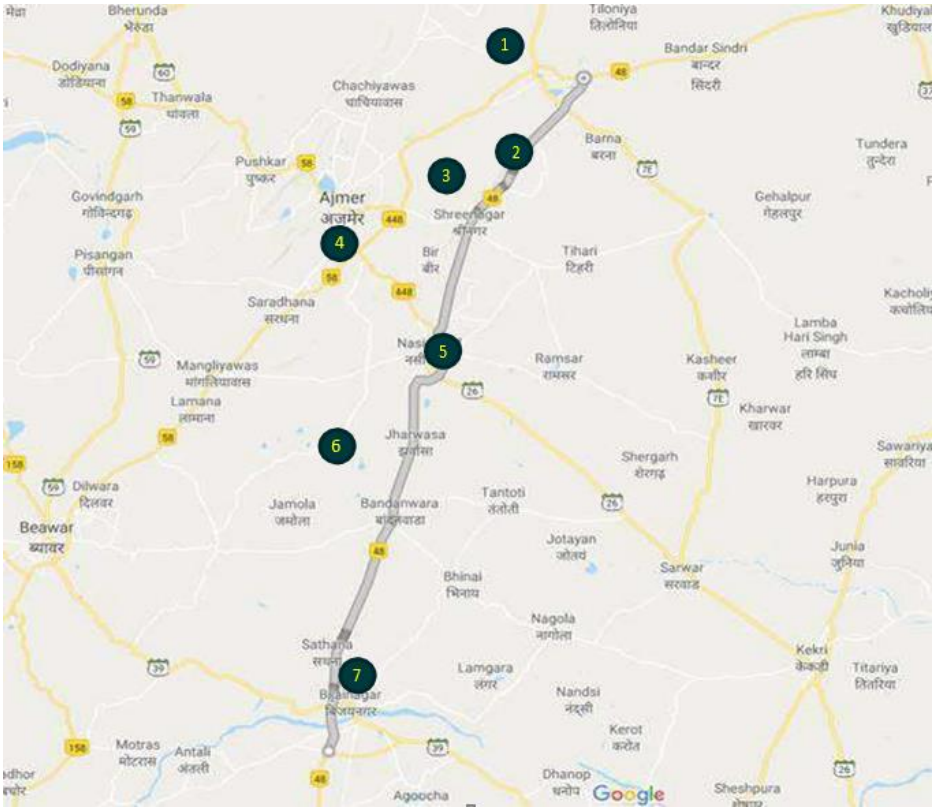


Figure 5-10 : Industrial Units along project corridor

1. RIICO Industrial Area **Kishangarh** (Marbel & Cement Manufacturing Industries)
2. RIICO **Silora** (Wire Product, Ice Factory)
3. Welding Wire & Plastic Manufacturing Industries
4. Industrial Process Measurement & Control Instruments
5. FMCG & Quartz Manufacturers
6. Brick Manufacturers
7. **Bijainnagar** (Cattle Feed Products Manufacturer – Kapila)

Presence of these units promotes sustainable traffic on project corridor.

5.7 Recommended Growth Rates of Traffic

Based on the above analysis and after giving due consideration to the entire listed factors, the following overall growth rates are recommended for each category of vehicle as under. Rate of growth is moderated in light of overall regional trend. Growth of Multi-Axle is kept slightly higher as trend of technological advances in logistic industry favors multi-axle over 2/3 axle carriage. It is also expected that as the economy moves from developing to developed, rate of growth diminishes. Same growth rate is not sustainable for long. Traffic growth is suitably stepped down for future years.

Growth rates are recommended for three scenarios for sensitivity analysis namely **Optimistic, Pessimistic** and **Most Likely** with a positive and negative variation 0.5% from Most Likely case for corridor in both states.

5.7.1 Recommended Growth Rates of Traffic for Project Stretch

Table 5-12 : Recommended Growth Rates Optimistic

Category / Year	2021-2026	2026-2031	2031-2036	2036-2041	2041-2046	2046-2051
Car/Jeep/Van	9.26%	8.70%	8.16%	7.62%	7.58%	7.03%
Bus	4.38%	4.12%	3.88%	3.64%	3.57%	3.33%
LCV	3.56%	3.74%	3.92%	4.10%	4.27%	4.44%
2- Axle	4.39%	3.95%	3.52%	3.09%	2.86%	2.41%
3 - Axle	5.43%	4.88%	4.33%	3.80%	3.67%	3.08%
4 to6 Axle	6.46%	5.80%	5.15%	4.50%	4.27%	3.58%
7 and Above Axle	6.46%	5.80%	5.15%	4.50%	4.27%	3.58%

Table 5-13 : Recommended Growth Rates Pessimistic

Category / Year	2021-2026	2026-2031	2031-2036	2036-2041	2041-2046	2046-2051
Car/Jeep/Van	8.76%	8.20%	7.66%	7.12%	7.08%	6.53%
Bus	3.88%	3.62%	3.38%	3.14%	3.07%	2.83%
LCV	3.06%	3.24%	3.42%	3.60%	3.77%	3.94%
2- Axle	3.89%	3.45%	3.02%	2.59%	2.36%	1.91%
3 - Axle	4.93%	4.38%	3.83%	3.30%	3.17%	2.58%
4 to6 Axle	5.96%	5.30%	4.65%	4.00%	3.77%	3.08%
7 and Above Axle	5.96%	5.30%	4.65%	4.00%	3.77%	3.08%

Table 5-14 : Recommended Growth Rates Most Likely

Category / Year	2021-2026	2026-2031	2031-2036	2036-2041	2041-2046	2046-2051
Car/Jeep/Van	9.01%	8.45%	7.91%	7.37%	7.33%	6.78%
Bus	4.13%	3.87%	3.63%	3.39%	3.32%	3.08%
LCV	3.31%	3.49%	3.67%	3.85%	4.02%	4.19%
2- Axle	4.14%	3.70%	3.27%	2.84%	2.61%	2.16%
3 - Axle	5.18%	4.63%	4.08%	3.55%	3.42%	2.83%
4 to6 Axle	6.21%	5.55%	4.90%	4.25%	4.02%	3.33%
7 and Above Axle	6.21%	5.55%	4.90%	4.25%	4.02%	3.33%

5.8 COVID-19 Impact

All social and economic activities had been completely disrupted due worldwide pandemic of Corona Virus. This had affected traffic on project stretch as well. Traffic

was severely affected form March-2020 due to lockdown and then in second wave and third waves.

Government has announced a mega economic stimulate and package of Rs. 20 Lakh Crore to bring the economy back on track and recover the losses. Traffic has shown impressive recovery post lockdown period and has recovered to normal level.

Taking recommended traffic growth and additional factors as discussed above into consideration traffic forecast for concession period is done and presented in next chapter.

Traffic and revenue has been worked out on the basis of above growths and same is presented in subsequent chapter of report.

CHAPTER 6

TRAFFIC FORECAST

6.1 Traffic Projections

Growth rates recommended in previous section of report are used to arrive at traffic projections for future years. Toll plaza wise futuristic traffic projection is given in tables below.

These projections have been done for following three cases of growth up to concession period

1. Optimistic Scenario
2. Pessimistic Scenario
3. Most Likely Scenario

Table 6-1 : Total Tollable Traffic @ Toll Plaza Chainage KM 61.02

(Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	6195	876	583	2852	2479	5764	362	19112	52820
2024-25	6769	908	608	2978	2614	6136	384	20397	56071
2025-26	7358	942	634	3095	2741	6492	406	21668	59222
2026-27	7999	978	660	3218	2875	6868	430	23028	62566
2027-28	8695	1015	687	3345	3015	7267	455	24479	66108
2028-29	9452	1053	716	3477	3162	7689	481	26030	69862
2029-30	10275	1092	745	3614	3316	8135	509	27686	73836
2030-31	11113	1135	774	3741	3459	8554	535	29311	77638
2031-32	12019	1179	805	3873	3609	8995	562	31042	81655
2032-33	12999	1225	836	4009	3765	9458	591	32883	85887
2033-34	14059	1273	869	4150	3928	9944	621	34844	90352
2034-35	15206	1323	903	4296	4098	10456	653	36935	95072
2035-36	16364	1377	936	4429	4253	10927	682	38968	99524
2036-37	17610	1433	970	4565	4415	11419	712	41124	104199
2037-38	18952	1491	1005	4706	4582	11933	744	43413	109114
2038-39	20396	1552	1041	4851	4755	12470	777	45842	114277
2039-40	21950	1615	1079	5001	4935	13031	812	48423	119711
2040-41	23613	1683	1117	5144	5116	13587	846	51106	125217
2041-42	25272	1758	1155	5268	5273	14073	876	53675	130268
2042-43	27048	1836	1193	5395	5436	14576	907	56391	135548

Table 6-2 : Total Tollable Traffic @ Toll Plaza 2- Chainage KM 61.02 (Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	6167	872	580	2838	2469	5737	361	19024	52578
2024-25	6707	899	601	2949	2590	6080	381	20207	55550
2025-26	7257	929	622	3051	2703	6402	401	21365	58392
2026-27	7851	960	644	3156	2822	6741	422	22596	61391
2027-28	8494	991	667	3265	2946	7098	444	23905	64554
2028-29	9189	1023	690	3378	3075	7474	467	25296	67887
2029-30	9941	1056	715	3494	3210	7870	492	26778	71411
2030-31	10701	1092	738	3599	3333	8236	515	28214	74729
2031-32	11520	1129	763	3707	3461	8619	539	29738	78218
2032-33	12401	1167	788	3819	3594	9020	564	31353	81883
2033-34	13349	1206	814	3934	3732	9440	590	33065	85733
2034-35	14370	1248	841	4052	3875	9878	617	34881	89774
2035-36	15393	1293	867	4157	4002	10273	642	36627	93528
2036-37	16489	1339	894	4264	4134	10685	668	38473	97462
2037-38	17662	1387	922	4374	4270	11112	695	40422	101572
2038-39	18919	1437	950	4487	4411	11557	723	42484	105879
2039-40	20265	1488	980	4603	4556	12020	752	44664	110388
2040-41	21699	1544	1010	4712	4700	12473	780	46918	114920
2041-42	23115	1605	1038	4802	4821	12857	804	49042	118980
2042-43	24623	1668	1067	4894	4945	13252	829	51278	123208

Table 6-3 : Total Tollable Traffic @ Toll Plaza 3- Chainage KM 61.02 (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	6181	874	581	2844	2474	5751	362	19067	52698
2024-25	6739	904	604	2962	2602	6108	383	20302	55809
2025-26	7309	936	628	3071	2723	6447	404	21518	58809
2026-27	7927	969	652	3185	2849	6805	426	22813	61978
2027-28	8597	1003	678	3303	2981	7183	450	24195	65336
2028-29	9324	1039	704	3426	3119	7582	475	25669	68886
2029-30	10112	1076	731	3553	3263	8003	501	27239	72635
2030-31	10911	1115	758	3669	3397	8395	525	28770	76196
2031-32	11774	1156	786	3788	3536	8806	551	30397	79945
2032-33	12705	1199	815	3912	3680	9238	578	32127	83897
2033-34	13708	1243	844	4039	3830	9691	606	33961	88048
2034-35	14791	1288	875	4171	3986	10165	635	35911	92419
2035-36	15881	1337	904	4289	4127	10598	662	37798	96517
2036-37	17051	1388	935	4411	4274	11049	690	39798	100819
2037-38	18307	1442	966	4536	4426	11519	719	41915	105325
2038-39	19656	1497	999	4664	4583	12009	749	44157	110051
2039-40	21105	1554	1033	4796	4746	12520	781	46535	115016
2040-41	22652	1616	1067	4921	4909	13023	812	49000	120025
2041-42	24188	1683	1100	5027	5048	13456	839	51341	124565
2042-43	25827	1753	1134	5136	5190	13903	867	53810	129302

6.2 Modification in Concession Period

As per Article 29 of the concession agreement, if actual traffic on the project falls short or exceeds Target Traffic on project highway on defined date, concession period shall be modified subject to calculation stipulated therein. For Gulabpura - Chittorgarh project, the Target Date and Target Traffic are defined as under:

Target Date - 1st May 2026

Target Traffic - 76236 in PCU

It was observed that as per traffic projections, average traffic volume falls short of target traffic in all scenarios. Probable extension of concession period is estimated according to article 29 of concession agreement which comes to about three years. Traffic forecast and revenue projections are done for probable extended period accordingly.

Most Likely

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2026	76236	62041	-19%	28%	20%	20	4.0

Optimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2026	76236	62632	-18%	27%	20%	20	4.0

Pessimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2026	76236	61445	-19%	29%	20%	20	4.0

CHAPTER 7

FORECAST OF TOLL REVENUE

7.1 General

This chapter presents the tolling rate calculations, categories and toll revenue of the project.

7.2 Discount Categories

The fee schedule in the CA of Kishangarh- Gulabpura section of NH-79 is based on the old toll policy. As per the Toll Notification (Schedule - G) the discounts and special provisions have been considered. In addition to discounts as per Fee Notification concessionaire has declared special category rates also. Salient features of toll rate structure are given as under

1. Monthly Pass: For frequent users monthly pass would be issued for 50 trips in month at 2/3d rate.
2. Multiple Journeys (for Return Trip): Will be charged at 1.5 times single journey.
3. Single Journey: Full single journey toll would be charged to this category of vehicles who are infrequent travelers or whose frequency does not yield any discount from the above categories.
4. Local Discounts: There are several categories of local discounts.
    a) Local Car Jeep Van I - Rs. 275 per
    b) Local Commercial Vehicles at 50% rate for single journey

Building of inflation and escalation of rate on the basis of WPI are done as per toll notification (Schedule G) as given under as extract from concession agreement.

The formula for determining the applicable rate of fee shall be as follows:-

$$\text{Applicable rate of fee} = \text{base rate} + \text{base rate} \times \left\{ \frac{\text{WPI A-WPI B}}{\text{WPI B}} \right\} \times 0.4$$

Factor of inflation / growth has been incorporated as per Schedule R. WPI numbers (2011-12 series) are available up to 2018-19. A moderate growth in Wholesale Price Index (WPI) has been assumed after that. The following graph provides historical rate of inflation (WPI) in India. Data has been sourced from the Office of Economic Advisor web site (www.eaindustry.nic.in) WPI for year 2017-18 and 2018-2019 is worked back by applying a correlation factor for 2004-05 series as 2017-18 and 2018-2019 data is available in 2011-12 series only. Ratio of WPI for year 2016-17 for both series is used for conversion of WPI in 2004-05 series

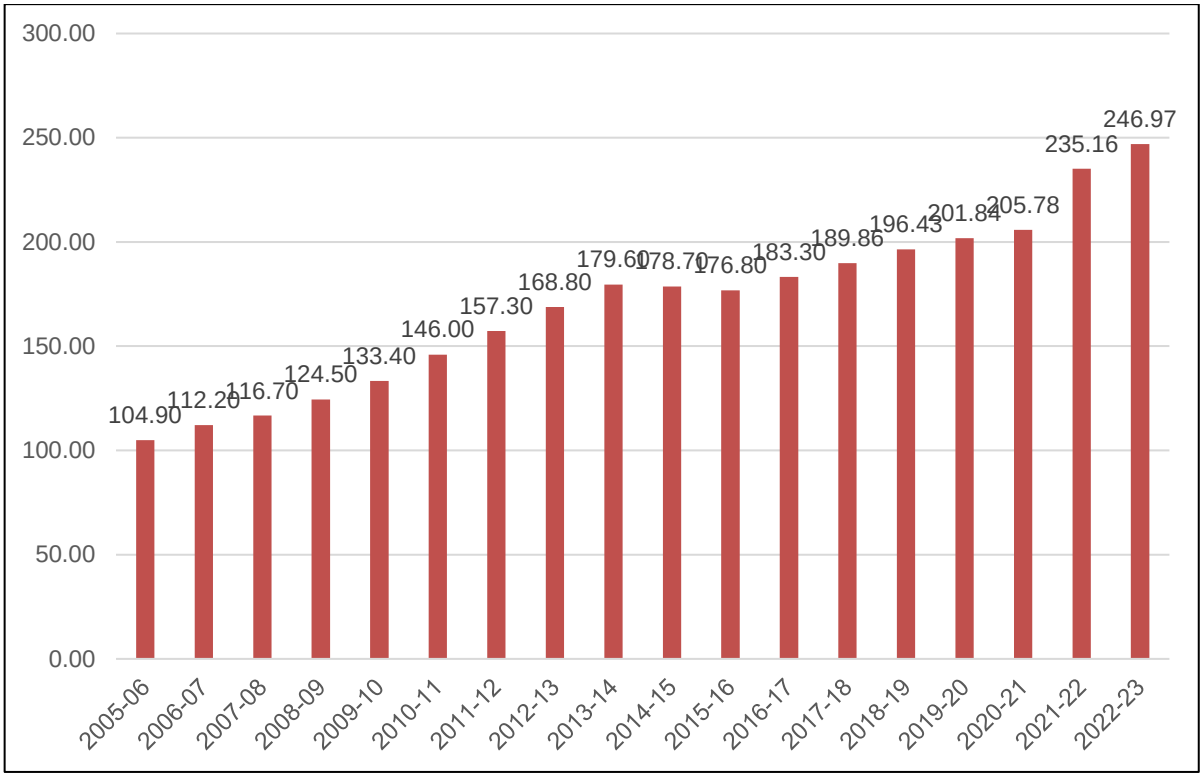


Figure 7-1 : Historical Rate of WPI Inflation in India

Average inflation in WPI in last few years is steadily growing. It grew in range of 4% - 5% in previous years. For future years initially it is takes 5% and Suitably Stepped down for future years.

7.3 Estimation of Toll Rates

As per the applicable MORTH notification and Schedule R of contract agreement, the following Base rate of fee for the categories mentioned in the table stands true in the National Highways Fee Rules applicable for contract.

Table 7-1 : Base Toll Rates June 2007-08

Type of Vehicle	Base Rate of Fee / Km (in Rs.)
Car, Jeep, Van or Light Motor Vehicle	0.65
Light Commercial Vehicle, Light Goods Vehicle or Minibus	1.05
Bus or Truck (Two Axles)	2.20
Three Axle Commercial Vehicles	2.40
Heavy Construction Machinery (HCM) or Earth Moving Equipment (EME) or Multi Axle Vehicle (MAV) (4 to 6 axles)	3.45
Oversized Vehicles (7 or more Axles)	4.20

There is no bypass or structure to be factored in for rates calculations.

Toll rates are calculated as per guidelines provided in schedule R (rounded to nearest Rs.) for the concession period and are given below.

Thus worked out rates for various categories of vehicle and discounts are given as under

Table 7-2 : Toll Rates for Single Journey @ Chainage KM 61.02

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles
2023-24	140	225	475	475	515	745	905
2024-25	145	240	500	500	545	780	950
2025-26	155	250	525	525	570	820	1000
2026-27	165	265	550	550	600	865	1050
2027-28	170	275	575	575	630	905	1100
2028-29	180	290	605	605	660	950	1155
2029-30	185	300	635	635	690	995	1210
2030-31	195	315	665	665	725	1040	1270
2031-32	205	330	695	695	760	1090	1330
2032-33	215	350	730	730	795	1145	1395
2033-34	225	365	765	765	835	1200	1460
2034-35	235	385	805	805	875	1260	1535
2035-36	250	400	845	845	920	1320	1610
2036-37	260	420	885	885	965	1385	1690
2037-38	275	445	930	930	1010	1455	1770
2038-39	290	465	975	975	1060	1525	1860
2039-40	300	490	1020	1020	1115	1600	1950
2040-41	315	510	1070	1070	1170	1680	2045
2041-42	335	535	1125	1125	1230	1765	2150
2042-43	350	565	1180	1180	1290	1855	2255

Table 7-3 : Toll Rates for Return Journey @ Chainage KM 61.02

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles
2023-24	210	340	710	710	775	1115	1360
2024-25	220	355	745	745	815	1170	1425
2025-26	230	375	785	785	855	1230	1500
2026-27	245	395	825	825	900	1295	1575
2027-28	255	415	865	865	945	1355	1650
2028-29	270	435	905	905	990	1420	1730
2029-30	280	455	950	950	1035	1490	1815
2030-31	295	475	995	995	1085	1560	1900
2031-32	310	500	1045	1045	1140	1640	1995
2032-33	325	525	1095	1095	1195	1720	2090
2033-34	340	550	1150	1150	1255	1800	2195
2034-35	355	575	1205	1205	1315	1890	2300
2035-36	375	605	1265	1265	1380	1980	2415
2036-37	390	635	1325	1325	1445	2080	2530
2037-38	410	665	1390	1390	1520	2180	2655
2038-39	430	695	1460	1460	1595	2290	2790
2039-40	455	730	1530	1530	1670	2405	2925
2040-41	475	770	1610	1610	1755	2525	3070
2041-42	500	805	1690	1690	1840	2650	3225
2042-43	525	845	1775	1775	1935	2780	3385

Table 7-4 : Toll Rates for Monthly Pass Local@ Chainage KM 61.02

Year	Car	Mini Bus /LCV
2023-24	330	330
2024-25	345	345
2025-26	365	365
2026-27	385	385
2027-28	400	400
2028-29	420	420
2029-30	440	440
2030-31	460	460
2031-32	485	485
2032-33	510	510
2033-34	535	535
2034-35	560	560
2035-36	585	585
2036-37	615	615
2037-38	645	645

2038-39	680	680
2039-40	710	710
2040-41	745	745
2041-42	785	785
2042-43	825	825

Table 7-5 : Toll Rates for Monthly Pass @ Chainage KM 61.02

Year	Car	Mini Bus /LCV	Bus	Truck	3-Axle Commercial Vehicle	Multi Axle	Oversized Vehicle
2023-24	4670	7545	15805	15805	17240	24785	30170
2024-25	4905	7925	16605	16605	18115	26040	31700
2025-26	5155	8330	17450	17450	19035	27365	33315
2026-27	5420	8755	18340	18340	20010	28760	35015
2027-28	5680	9175	19220	19220	20970	30145	36695
2028-29	5955	9615	20150	20150	21980	31595	38465
2029-30	6240	10080	21120	21120	23040	33120	40320
2030-31	6540	10565	22140	22140	24155	34720	42270
2031-32	6860	11080	23215	23215	25325	36405	44320
2032-33	7190	11620	24345	24345	26555	38175	46475
2033-34	7545	12185	25530	25530	27850	40035	48740
2034-35	7910	12780	26775	26775	29210	41990	51120
2035-36	8300	13405	28090	28090	30640	44050	53625
2036-37	8705	14065	29470	29470	32150	46210	56260
2037-38	9135	14755	30920	30920	33730	48490	59030
2038-39	9585	15485	32450	32450	35395	50885	61945
2039-40	10060	16255	34055	34055	37150	53405	65015
2040-41	10560	17060	35745	35745	38995	56055	68240
2041-42	11085	17910	37525	37525	40935	58845	71640
2042-43	11640	18805	39400	39400	42980	61785	75215

7.4 Toll Revenue

As indicated earlier, toll revenue on the Project Road has been calculated in all three scenarios based on above rates and projected traffic. The estimates of toll revenue under ***Optimistic***, ***Pessimistic*** and ***Most Likely*** growth scenarios are presented in the following section.

7.5 Toll Revenue at all toll plazas under Scenarios

Toll Revenue estimates under all scenarios at each of the toll plaza up to 2042-43 starting from the year 2023-24 are shown in tables below.

Table 7-6 : Toll Revenue Optimistic Scenario

(Rs. Crores)

Year	TP-1
2023-24	296.74
2024-25	329.47
2025-26	365.55
2026-27	406.81
2027-28	450.26
2028-29	498.17
2029-30	550.11
2030-31	605.51
2031-32	668.82
2032-33	735.73
2033-34	810.51
2034-35	894.09
2035-36	984.76
2036-37	1076.22
2037-38	1183.06
2038-39	1298.76
2039-40	1428.49
2040-41	1562.12
2041-42	1707.82
2042-43	1863.18

Table 7-7 : Toll Revenue Pessimistic Scenario

(Rs. Crores)

Year	TP-1
2023-24	295.37
2024-25	326.37
2025-26	360.39
2026-27	399.17
2027-28	439.66
2028-29	484.16
2029-30	532.09
2030-31	582.90
2031-32	640.84
2032-33	701.58
2033-34	769.20
2034-35	844.46
2035-36	925.61
2036-37	1006.85
2037-38	1101.49
2038-39	1203.53
2039-40	1317.45
2040-41	1433.91
2041-42	1560.23
2042-43	1693.97

Table 7-8 : Toll Revenue Most Likely Scenario

(Rs. Crores)

Year	TP-1
2023-24	296.02
2024-25	327.88
2025-26	362.96
2026-27	403.01
2027-28	444.96
2028-29	491.11
2029-30	541.06
2030-31	594.11
2031-32	654.66
2032-33	718.48
2033-34	789.68
2034-35	869.01
2035-36	954.90
2036-37	1041.17
2037-38	1141.77
2038-39	1250.46
2039-40	1372.12
2040-41	1496.85
2041-42	1632.46
2042-43	1776.79

CHAPTER 8

CONCLUSION & RECOMMENDATIONS

8.1 Conclusion & Recommendations

Project stretch of Kishangarh to Gulabpura section of NH-79 in state of Rajasthan is nearing completion of six laning. The road is in sound condition and serves healthy traffic volumes. Project corridor is a part of the busy and prominent national highway NH-79 which connects Kishangarh to Udaipur via Bhiwala and Chittorgarh. There are large number of townships, industrial corridors and other business establishment coming up along project corridor. As discussed, dominant portion of traffic is long route traffic, which is more sensitive towards the growth of national economy. As Indian economy is poised to grow at 7%+ post COVID-19, the project corridor is expected to pick up the same trend in terms of traffic flow. All these developments have potential to give positive impact to traffic flow on project. The following can be considered as major outcomes of the study

a) There is good amount of tollable traffic running on project

b) Project corridor has potential to witness traffic growth @ 7-8% annually in near future due to various development in area and overall development of economy

c) Project corridor has committed traffic as long route traffic and does not run a risk of traffic leakage due to quality competing road

Based on above it can be considered a stable healthy project from traffic and revenue point of view.

.

GMD Consultants
503-504, Mayuresh Chambers Premises, Plot No. 60,
Sector -11, CBD Belapur, Navi Mumbai. 400 614.
Maharashtra.
Phone : +91-22-2756 4586 / 2756 5313
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

HAPUR TO MORADABAD SECTION OF NH-9 IN THE STATE OF UTTAR PRADESH (KM 50.000 TO KM148.277)

TRAFFIC STUDY & REVENUE PROJECTION REPORT (FINAL)

APRIL 2023

GMD Consultants

2, Park View Society, Sector -17,
Nerul East, Navi Mumbai. 400706. Maharashtra.
Phone : +91-22-27716391 / 27700233 / 27700991
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

HAPUR TO MORADABAD SECTION OF NH-9 IN THE STATE OF UTTAR PRADESH (KM 50.000 TO KM148.277)

TRAFFIC STUDY & REVENUE PROJECTION REPORT (FINAL)

APRIL 2023

GMD CONSULTANTS ★ NAVI MUMBAI ★

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AADT	-	Annual Average Daily Traffic	**NHAI**	-	National Highway Authority of India
BOT	-	Build Operate Transfer	**NHDP**	-	National Highways Development Project
CAGR	-	Compound Annual Growth Rate	**NSDP**	-	Net State Domestic Product
CTV	-	Classified traffic volume	**O&M**	-	Operation & Maintenance
DBFOT	-	Design, Build, Finance, Operate & Transfer	**PCDP**	-	Per Capita Domestic Product
EME	-	Earth Moving Equipment	**PCI**	-	Per Capita Income
GDP	-	Gross Domestic Product	**PCU**	-	Passenger Car Unit
GSDP	-	Gross State Domestic Product	**PSC**	-	Pre-stressed Concrete
HCM	-	Heavy Construction Machinery	**RCC**	-	Reinforced cement concrete
HCV	-	Heavy Commercial Vehicle	**RHS**	-	Right Hand Side
HTMS	-	Highway Traffic Management System	**SH**	-	State Highway
IRC	-	Indian Road Congress	**TP**	-	Toll Plaza
IRR	-	Internal Rate of Return	**WPI**	-	Wholesale Price Index
LCV	-	Light Commercial Vehicle	**SIR**	-	Special Investment Region
LHS	-	Left Hand Side	**c.**	-	Circa
LGV	-	Light Goods Vehicle	**ROB**	-	Railway Over Bridge
MAV	-	Multi Axle Vehicle	**MDR**	-	Major District Road
MORTH	-	Ministry of Road Transport and Highways	**ODR**	-	Other District Road
NH	-	National Highway	**CA**	-	Concession Agreement
PCC	-	Plain Cement Concrete	**RMT**	-	Running Meter
CR	-	Coarse Rubble			

CHAPTER 1

INTRODUCTION

1.1 Background

The Government of India through National Highway Authority of India (NHAI) embarked upon a program to enhance the traffic capacity and safety for efficient transportation of goods as well as passenger traffic on National Highway Sections under NHDP Phase V. Under Phase V NHAI has planned to convert 6,500 km of existing 4-lane National Highways into 6-lane National Highway. Sections envisaged under 6-laning comprise the Golden Quadrilateral section (5,700 km) and some other sections which are 800 km in length.

The project under consideration, Six Laning of **Hapur Bypass** to **Moradabad** section of NH-9 from km 50.000 to km 148.277is one such road project NHAI intended to implement on a BOT basis in the DBFOT format. *M/s IRB Hapur Moradabad Tollway Ltd*. (Concessionaire) has been awarded the Project for a concession period of 22 years starting from 28th May 2019. The Project is under capacity augmentation to six lane. Tolling operation under current concession started in May 2019.COD-2 has been received in April 2023.

Project stretch from Hapur to Moradabad is part of new NH-9 which starts from Fazilka in Punjab and terminates in Uttarakhand at Pithoragarh. Previously this section was part of old NH-24 which is still popularly known and Delhi – Lucknow road. New NH-9 takes off towards Pithoragarh from Rampur. A number of sections along project road from Hapur to Moradabad have witnessed urban development along highway. Places like Pilakhua, Babugarh, Brijghat, Gajrola and Joya are fast upcoming urban centers. Close proximity to Delhi and this being main connectivity of region to NCR is main region for this ribbon development along highway. Following figure shows the project road alignment.

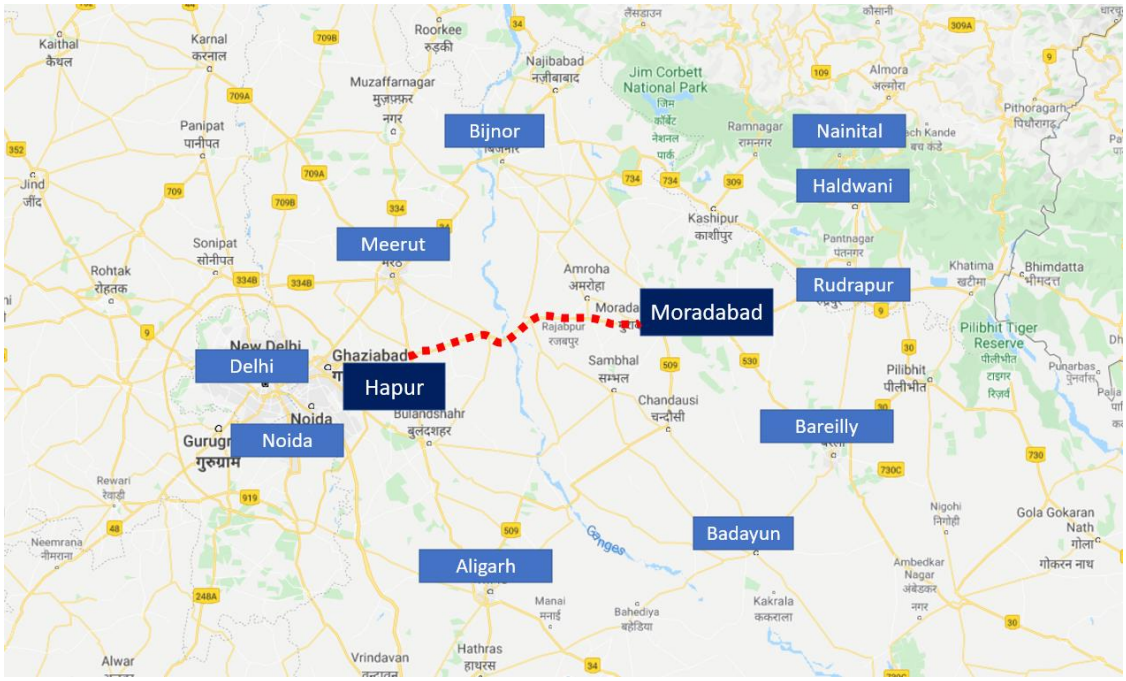


Figure 1-1: Alignment of Project Stretch

1.2 Objective of the Study

M/s IRB INFRASTRUCTURE TRUST has engaged *GMD Consultants* to assess the future traffic and toll potential of project along with related operation & maintenance expenditure involved.

This report named as **"Traffic Study &*Toll Revenue Projection Report*"** mainly focuses on traffic and revenue aspects of the project. Other parameters like competing road, area developments etc. have been considered from a traffic development point of view.

1.2.1 Scope of Services

The broad scope of work covered in the assignment is as follows

a) Analysis of Traffic Growth
b) Toll Rate Growth
c) Revenue Forecasting

The Concessionaire has provided basic traffic data and other project details on the basis of which the above analysis has been carried out.

CHAPTER 2

PROJECT DETAILS

2.1 Project Corridor

The project road is the section of the former NH-24 which has now been re-designated as NH-9 connecting Fazilka in Punjab to Pithoragarh in Uttarakhand. On the way it connects several important cities in five states in North India (from west towards east): Malout, Sirsa, Hisar, Rohtak, Bahadurgarh, Delhi, Ghaziabad, Hapur, Moradabad, Rampur, Rudrapur, Sitarganj, Khatima, Pithoragarh. The total length of the highway is 811 Km. After renumbering of all national highways by National Highway Authority of India in2010, the current NH 9 was formed by merging five differently numbered national highways in 2010, including Old NH 10 (Fazilka-Delhi section), Old NH 24 (Delhi-Rampur section), Old NH 87 (Rampur-Rudrapur section), Old NH 74 (Rudrapur-Sitarganj-Khatima section) and Old NH 125 (Tanakpur-Pithoragarh section)

2.2 Project Stretch Description

The Project section starts from Hapur Bypass (Km50.000) and ends in Moradabad (Km148.277). The total design length of project road section is about 100 Kms. The existing road is four lane divided carriageway, which is proposed to be six laned.The road passes through the districts of Hapur, Amrohaand Moradabad; all in Uttar Pradesh.

Project road alignment passes through the small towns/built-up areas of Pakwara, Joya and Babugarh. Simbhaoli, one of the largest integrated sugar refinery complexes is right on the project road

Hapur – Moradabad section of NH-9 was previously known as Delhi road locally. This forms main connectivity of areas like Moradabad, Rampur, Bareilly and important destination in Uttarakhand like Rudrapur, Kashipur, Ranikhet, Pithoragarh etc to national capital of Delhi.

There are two operative toll plazas at project stretch. First is at Garh at Km 90.661 and second at Joya at Km 123.875. Following figure show project alignment and toll plaza locations.

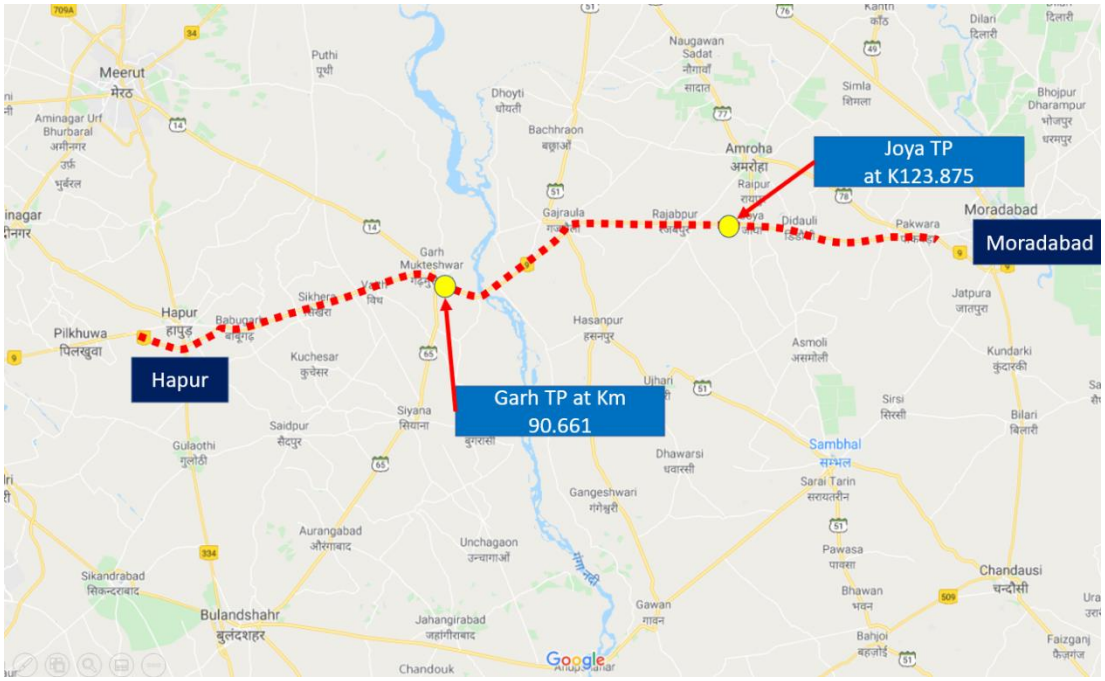


Figure 2-2: Project Alignment with Toll Plaza

2.3 Project Corridor Illustration

Six laning of project stretch is in progress and would be competed soon. Following photographs illustrate project section along the corridor.

Figure 2-3: Photographs showing Project Corridor

CHAPTER 3

TRAFFIC SURVEYS AND ANALYSIS

3.1 Traffic Surveys

The Consultants have collected the required information for project corridor to understand the general traffic and travel characteristics on the corridor.

The following traffic data has been collected from client for project.

- Classified traffic volume counts at toll plaza locations on Hapur- Moradabad section of NH-9 for period from May 2019 to March 2020, 2020-21, 2021-2022 and Traffic Data from April 2022 to March 2023.
- Local Component of traffic
- Component of Return Journey
- Component of Monthly Pass Journey

The main objective of the traffic data analysis is to:

- Determine the existing traffic movement characteristics of the project
- Establish base year traffic
- Identification of travel patterns and modal split of project traffic
- Deriving growth factors for traffic forecasting
- Estimation of corridor traffic including traffic diversion if any
- Preparation of revenue model and projection of revenue as per toll policy for various scenarios

ic details have been collected.

Table 3-1below lists provides details of locations from where traffic details have been collected.

Table 3-1 : Traffic Data Details

SR. NO	LOCATION	CTV	Single Journey Traffic	Daily Return Journey	Monthly Pass	Local Pass

1	Km 90.661 Toll Plaza at Garh	AADT for Period from 2019 to 2020, 2020 to 2021, 2021 to 2022 and 2022 to 2023	For Period from 2019 to 2020, 2020 to 2021, 2021 to 2022 and 2022 to 2023	For Period from 2019 to 2020, 2020 to 2021, 2021 to 2022 and 2022 to 2023	For Period from 2019 to 2020, 2020 to 2021, 2021 to 2022 and 2022 to 2023	For Period from 2019 to 2020, 2020 to 2021, 2021 to 2022 and 2022 to 2023
2	Km 123.875 Toll Plaza at Zoro ka Khera	AADT for Period from 2019 to 2020, 2020 to 2021, 2021 to 2022 and 2022 to 2023	For Period from 2019 to 2020, 2020 to 2021, 2021 to 2022 and 2022 to 2023	For Period from 2019 to 2020, 2020 to 2021, 2021 to 2022 and 2022 to 2023	For Period from 2019 to 2020, 2020 to 2021, 2021 to 2022 and 2022 to 2023	For Period from 2019 to 2020, 2020 to 2021, 2021 to 2022 and 2022 to 2023

3.5 Classified Traffic Volume

The objective of conducting a Classified Traffic Volume Count is to understand the traffic flow pattern including modal split on a roadway. The Classified Traffic Volume Count survey has been provided by the concessionaire of project highway from actual traffic data gathered at toll plaza locations based on monthly data shared with NHAI.

The vehicles can broadly be classified into fast moving / motorized and slow moving / non-motorized vehicles, which can be further classified into specific categories of vehicles. The groupings of vehicles are further segregated to capture the tollable vehicle categories specifically and toll exempted vehicles are counted separately. The detailed vehicle classification system as per IRC: 64-1990 is given in table below

Table 3-2 : Vehicle Classification System

Vehicle Type

Auto Rickshaw	
Passenger Car	Car, Jeep, Taxi & Van (Old / new technology)
Bus	Minibus
	Standard Bus
Truck	Light Goods Vehicle (LCV)
	2 – Axle Truck
	3 Axle Truck (HCV)
	Multi Axle Truck (4-6 Axle)
	Oversized Vehicles (7 or more axles)
Other Vehicles	Agriculture Tractor, Tractor & Trailer

Source - IRC: 64 – 1990

However, since project highway is currently under toll operation, the data collected is corresponding to category of tollable vehicles. Following are the type of vehicles as per concession agreement.

- Car / Jeep / van
- Min Bus /LCV
- Bus
- Truck
- 3-Axle
- Multi Axle

3.6 Traffic Characteristic

Toll revenue of project highway does not solely depend on traffic volume. There are certain characteristics of traffic which have substantial potential to affect toll collection. Component of local traffic, component of passenger and commercial traffic, portion of return journey traffic, % of monthly pass traffic are some of such characteristics of traffic. These will be discussed in subsequent sections of report.

3.6.1 Traffic Data

Project concessionaire has provided Traffic data for base year 2019-20,2020-21, 2021-22 and from April 2022 to March 2023 as under for both toll plazas–

Table 3-3 : Traffic Data at Garh Toll Plaza at Km 90.661

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)- 2019-20	Annual Average Daily Traffic (Nos.)- 2020-21	Annual Average Daily Traffic (Nos.)- 2021-22	Annual Average Daily Traffic (Nos.)- 2022-23
1	CAR	14878	15865	21889	24088
2	Minibus/LCV	3704	3119	1995	1730
3	Bus	2033	1573	1862	2069
4	Truck	1289	1354	1674	1972
5	3-Axle	1318	1105	1112	1070
6	Multi Axle	1753	1635	1745	1962
7	Oversized Vehicle	2	6	6	9
	Total	**24977**	**24657**	**30283**	**32899**

Table 3-4 : Traffic Data at Zoya Toll Plaza at Km 123.875

Sr. No	Type of Vehicle	Annual Average Daily Traffic (Nos.)- 2019-20	Annual Average Daily Traffic (Nos.)- 2020-21	Annual Average Daily Traffic (Nos.)- 2021-22	Annual Average Daily Traffic (Nos.)- 2022-23
1	CAR	10298	10526	13695	16037
2	Minibus/LCV	2595	2259	1335	1181
3	Bus	1062	1303	1485	1768
4	Truck	1532	1040	1184	1436

5	3-Axle	1128	1064	1081	1008
6	Multi Axle	1365	1370	1458	1765
7	Oversize Vehicle	2	8	8	9
	Total	**17982**	**17570**	**20246**	**23203**

Pandemic of COVID-19 (Corona Virus) had impacted entire world. Taking precaution, government of India announced a complete lockdown in last of March 2020 and traffic on highways was stopped which was eased out progressively later. There after India was hit by Covid-19 second and third wave in February 21 to July - 21 and December 21 to March-22. Recovering traffic pattern was somewhat again disturbed du to second and third wave of Covid-19. Traffic numbers of for period from April-2020 to March 2021 were not representative of traffic pattern at project corridor due to pandemic lockdown impact. However, for integrity of data same shown above. Traffic has almost recovered from Covid -19 impact as of now.

Since the traffic data is available year 2022-23 report has been updated taking this as base year traffic.

This data was then bifurcated to various components like through local, monthly, return journey etc category. Same is discussed in detail in following section.

3.7 Data Analysis

3.7.1 Analysis of Traffic Volume Count

Understanding the character of existing traffic forms the basis of the traffic forecast. The various vehicle types having different sizes and characteristics can be converted into a single unit called Passenger Car Unit (PCU). Passenger Car equivalents for various vehicles are adopted based on recommendations of Indian Road Congress prescribed in "IRC-64-1990: Guidelines for Capacity of Roads in Rural areas". The adopted passenger car unit values (PCU) are presented in ***Table*** 3-5**.**

Table 3-5 : PCU Factors Adopted for Study

Vehicle Type	PCUs
Car	1.0
Minibus	1.5
Standard Bus	3.0
LCV/LGV	1.5
2 Axle Truck	3.0
3 – 6 Axle Truck	4.5
MAV	4.5
Auto Rickshaw	1.0
Van/Tempo	1.0
Agriculture Tractor with Trailer	4.5
Agriculture Tractor without Trailer	1.5

Source: IRC: 64-1990

Traffic volume at each toll plaza was converted to PCU and same is presented as under

Table 3-6 : Traffic in PCU at Project Stretch Base Year 2022-23

Toll Plaza Location (Km)	Year	Traffic No	PCU	PCU Index
Garh Km 90.661	2019-2020	24977	42251	1.69
	2020-2021	24657	40024	1.62
	2021-2022	30283	46705	1.54
	2022-2023	32899	50882	1.55
Joya Km 123.875	2019-2020	17982	31508	1.75
	2020-2021	17570	30337	1.73

	2021-2022	20246	33545	1.66
	2022-2023	23203	38427	1.66

It can be observed from above that project traffic has PCU index in range of 1.5 to 1.7 which is an indicator of high proportion of Passenger traffic in traffic mix in project corridor. Following figure illustrates variation of PCU index at four toll plaza locations.

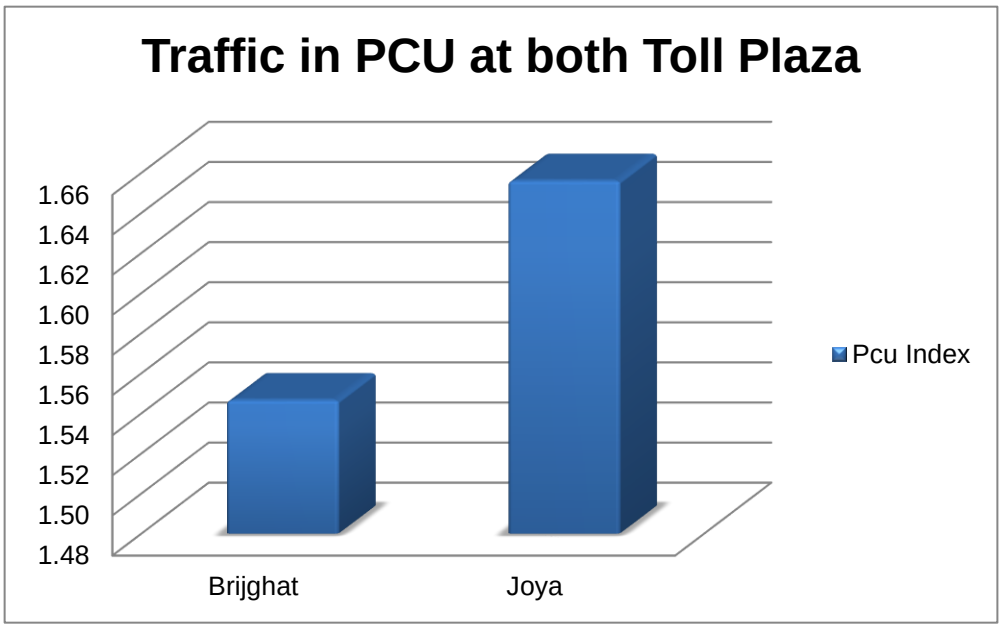


Figure 3-1: Comparison of PCU Index

It can be observed that PCU index is consistent at both toll plaza locations.

3.7.2 Components of Traffic

As discussed previously, components of traffic volume play an important role in determining project revenue. A larger component of commercial traffic with higher axle configuration adds to project revenue positively. Similarly, a larger component of local traffic affects the project revenue potential negatively.

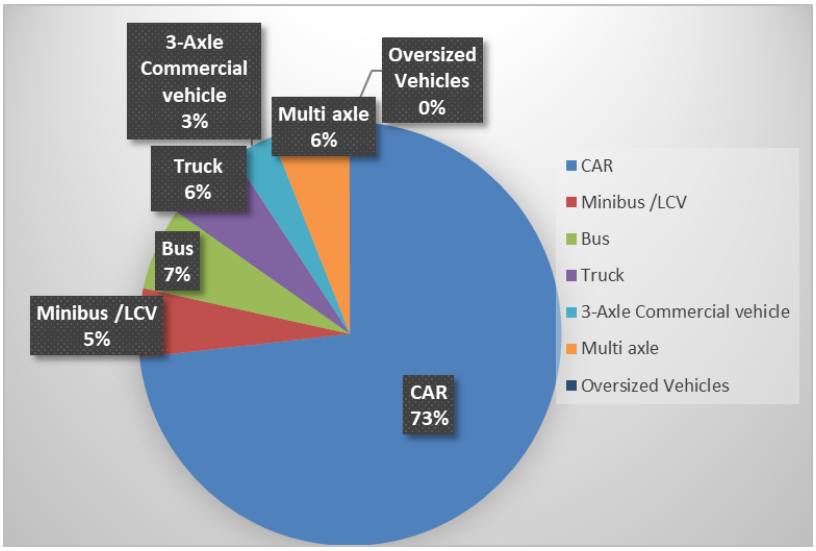


Figure 3-2 : Model Split of Tollable Vehicle @TP-1

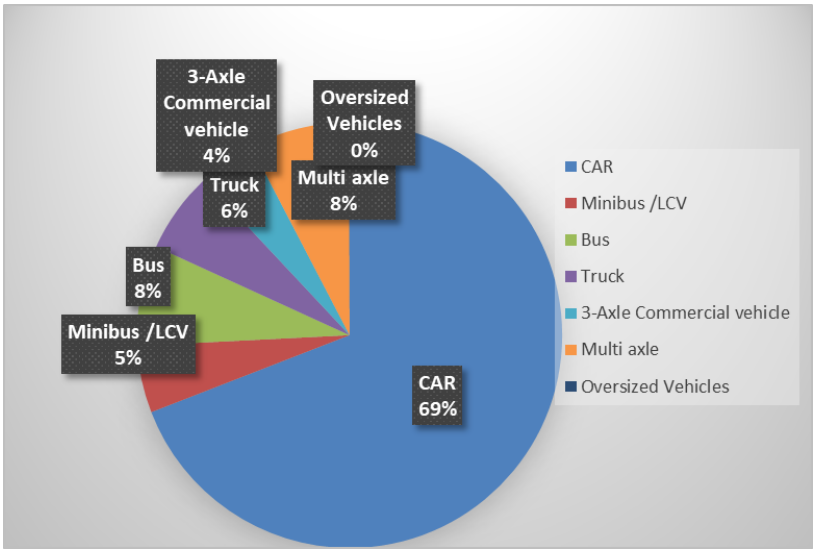


Figure 3-3 : Model Split of Tollable Vehicle @TP-2

It is observed that car traffic forms about 73%- 69% of total traffic at toll plaza locations while multi axle commercial vehicles are about 9% -12% of total traffic. Truck / Bus and LCV share about 13%-14% and 5% of traffic volume respectively.

Another important bifurcation of traffic is components of traffic with respect various type of toll ticketing like

1. Single Journey
2. Multi Journey
3. Monthly Pass (Local and General)

The following table provides numbers of vehicles falling in each of above category on base year 2022-23

Table 3-7 : Journey Type Bifurcation of Traffic at GarhTP-1KM 90.661

Sr. No	Type	Traffic Volume (Nos.)2022-23
1	Single Journey	14920
2	Return Journey	17940
3	Local Commercial Single Journey	9
4	Monthly Pass Local	22
5	Monthly Pass	8

Most dominant part of the above is the single journey type followed by return journey at project stretch. Monthly pass commuters are a very low fraction of the total traffic on the project corridor.

The single journey component in total traffic numbers is a high as 45%. Return journey component is 55%. The number of monthly pass local and Local Commercial Journey is 0% and 0% at Brijghat.

Following tables give the detail of journey distribution at Joya toll plaza at Km 123.875.

Table 3-8 : Journey Type Bifurcation of Traffic at Zoro ka Khera TPKM 121.020

Sr. No	Type	Traffic Volume (Nos.)2022-23
1	Single Journey	12357
2	Return Journey	10822
3	Local Commercial Single Journey	11
4	Monthly Pass Local	5
5	Monthly Pass	8

It is observed that the project corridor demonstrates a similar pattern of single journey dominated mix of traffic across the entire stretch which is typical of major national highways.

3.8 Secondary Data Collection

There are several other factors which have a substantial impact on traffic pattern and growth on any project corridor. Following are some of such important factors

- Industrial development around project corridor and its catchment
- Educational infrastructure along project corridor
- Demographic pattern
- Urban area development
- Tourism potential
- Upcoming major infrastructural or Industrial projects
- Special Industry in project corridor
- Overall trends of economic growth local as well as national / regional

Hence in addition to traffic details on project site, secondary data was also collected from various other sources. Typical secondary data includes the following:

1. Vehicle registration data of regional and national level.
2. Economic Data
   a) GDP
   b) NSDP
   c) Population Growth
   d) Per Capita Income growth
   e) Industrial Growth
   f) Special Industry Potential
   g) Regional and National development vision / plan
   h) Any other relevant data
3. Competing road network

We have collected and utilized such underlying data in the study to estimate the growth and risk factors for traffic along the project corridor.

CHAPTER 4

INFLUENCE ZONE TRANSPORT NETWORK ANALYSIS

4.1 Introduction

Highway corridors behave like integrated circuit network and more often than not every road is connected to various networks having different origin and destinations. Traffic running on these networks behave like fluid and flow on network on alignment of least friction.

Following Factors can be considered as major contributors to friction on transportation network

- Travel Speed / Travel Time
- Geometric deficiencies like blind horizontal curves and steep vertical gradients etc,
- Configuration of road
- Riding quality
- Traffic delays,
- Length of road,
- Passing through built up or Urban Area,
- Terrain,
- Facilities,

4.2 Competing / Alternate route

Project stretch has toll application history from last few years, and it can be assumed that project traffic is settled. However, for analysis point of view there can be few alternate routes at local level. Garh toll plaza is very near to major river Ganga over which major bridge about 1 km in length is constructed. Due to this there is no locals alternative route to toll plaza at Garh. There can be one alternative route which can bypass toll plaza at Joya. From Atrasi one can take left and bypass Toll Plaza at Joya and join back to NH-9 at Moradabad. This route quite long and passes through congested areas of Amroha. Further the road alignment of these district road is very poor with little chance of improvement.

Following maps show these routes in relation to project stretch at local level.

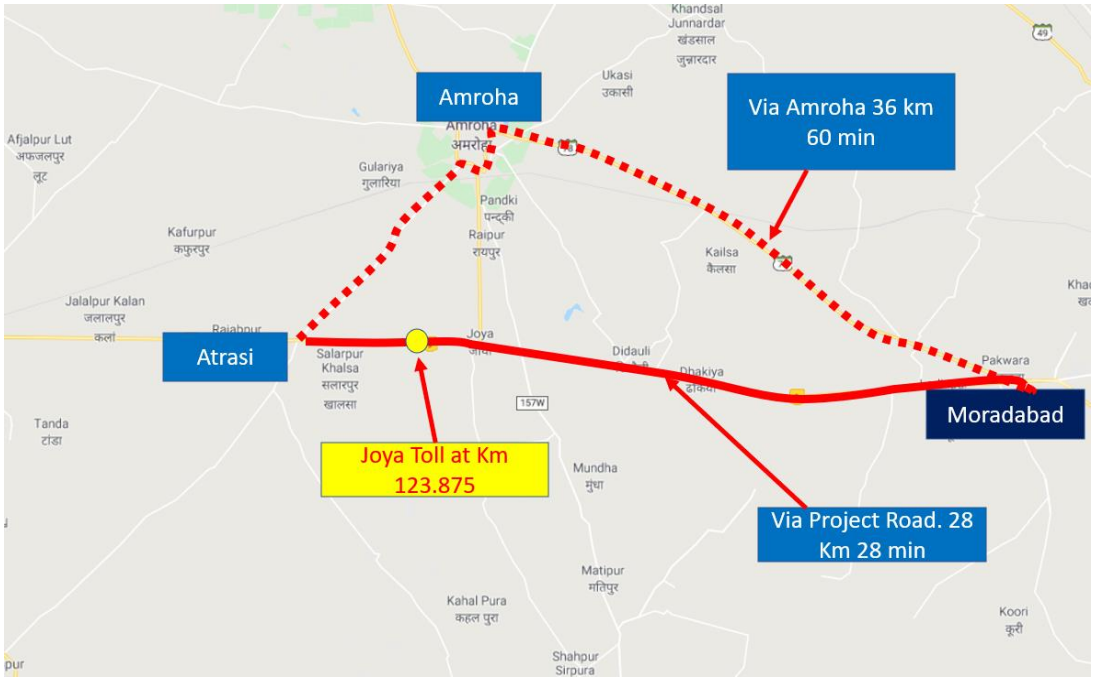


Figure 4-1: Alternate route at regional level

At regional level if we take Hisar and Rudrapur two origin destination representing Delhi/ Haryana and Uttarakhand region, there can be one alternate via Bulandshahar – Sambhal Road. One can take Bulaandshahar road after getting down from Peripheral Expressway at after Ghaziabad. This road bypasses NH-9 between Ghaziabad and Moradabad. This route is also quite long as compared to NH-9 and also road between Bulandshahar – Sambhal and Moradabad is poor and mostly of two lane specifications. Hence in such case it has very little potential of any further traffic diversion from project road.

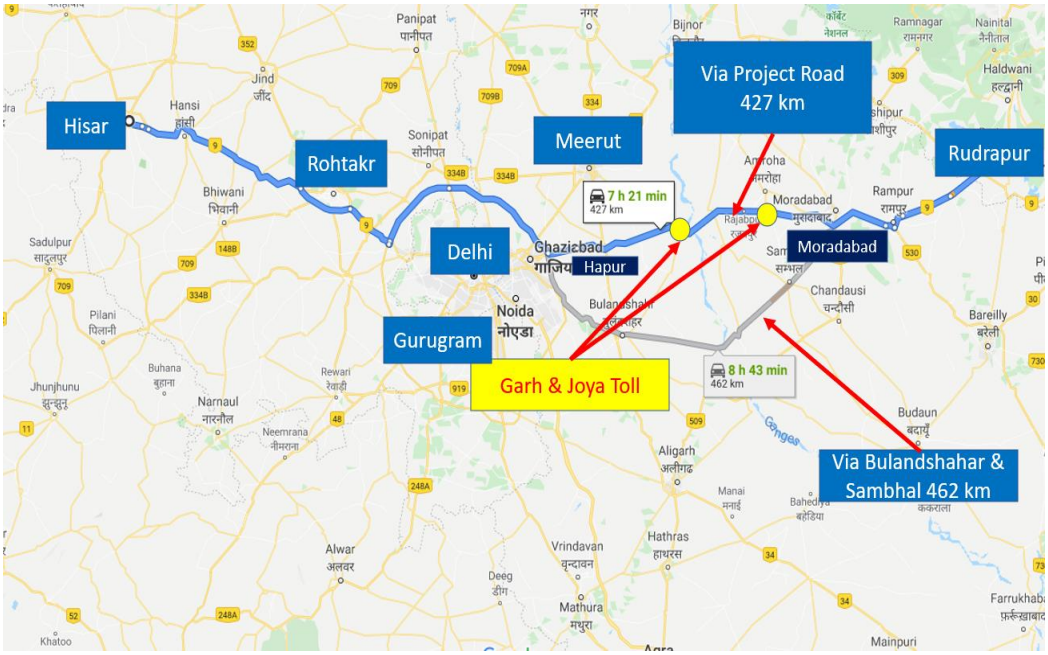


Figure 4-2: Alternate route at local level

It can be observed that project highway forms the one of the main spine of the corridor between Delhi / Ghaziabad/ Hapurand Moradabad / Rudrapur/ Haldwani. Traffic on project road is now settled and it can be assumed as dedicated traffic on project road for logistic obligations.

With six laning now nearing completion, project stretch would become slightly more attractive due to improved level of service. In such case any diversion of traffic from project road is not envisaged.

Following table provide summary of analysis of alternate route/ roads discussed above.

Table 4-1 : Competing Roads Details

Sr. No	Route Details	Designation	Length (Km)	Avg. Speed (KMPH)	Time Taken (Min)	Observations
Regional Level						
1	Hisar-Delhi-Bulandshahar- Sambhal-Moradabad - Rudrapur	Alternate Route	462	53	8Hr 43 Min	Alternate route is longer and has poor geometrics and specifications. Traffic diversion not envisaged
	Hisar-Delhi- Hapur-Gajrola- Moradabad - Rudrapur	Project Road	427	57	7 Hr 27 Min	
Local Level						
2	Atrasi- Amroha- Pakbara-Moradabad (bypassing Joya Toll)	Alternate Route	36	51	1 Hr.	Alternate route is unlikely to attract project traffic due to very poor geometrics and high congestion
	Atrasi- Joya- Palkbara-Moradabad	Project Road	220	50	28 Min	

Under these circumstances it is not envisaged that commercial or passenger traffic would switch to alternate roads from the project road. Further, it may be noted that since the project highway has already been commissioned and has a tolling history, the current traffic traversing the project corridor already factors in traffic diversion (if any) that may have taken place.

CHAPTER 5

GROWTH OF TRAFFIC ON PROJECT HIGHWAY

5.1 Introduction

Traffic growth is a function of the interplay of a number of contributory factors such as National economy, Government policy, socio-economic conditions of the people, and changes in land uses along the project corridor precincts etc. As these factors have a number of uncertainties associated with them, forecasts of traffic are dependent on the projectionsof other factors such as population, gross domestic product (GDP), vehicle ownership, per capita income (PCI), agricultural output, fuel consumption etc. Future pattern of change in these factors can be estimated with only a reasonable degree of accuracy and hence the resultant traffic forecast levels may not be precise.

Traffic growth forecast for project corridor Hapur–Moradabad section of NH-9has been done taking the above factors into consideration. "**IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**" is established best practice and has been used for traffic growth forecast.

5.2 Trend Analysis

One of the methods of estimation of future rate of growth is to assume the same rate of growth as in the past. Although such a method is more suitable to projects of short durations say 5-10 years, however for long term projections it would-be erroneous to assume that the past rate of growth will continue to prevail for a long time in future. Economic conditions, which are major influencing factors, are bound to change over a long period of time. Thus, it would be necessary to modify the past trends of growth suitably.

Elasticity model of growth projection is one of the most widely acceptable methods for traffic forecast. The same is recommended in **IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**.

In this method the past trend of vehicular data is paired with an economic indicator and a regression analysis is done to yield the economic model of growth. Growth of vehicle traffic varies for different type of vehicle. It is a proven fact that the growth pattern for passenger and goods vehicle is different. Traffic growth on any highway

typically depends on number of economic parameters. Most important and direct parameters are given as under

- Per Capita Income
- Net State Domestic Product (NSDP)
- Population

It can be observed that the ownership of a car is more closely related to affordability; hence per capita is the index which closely fits the growth of car traffic among other criteria. In a similar fashion, the following can be pairs of vehicle type and independent variable for elasticity modeling of growth.

- Car / Jeep – Par Capita Income
- Bus / Minibus – Population
- Goods Vehicle – NSDP

5.3 Estimation of Traffic Demand Elasticity

Elasticity of traffic demand is defined as the rate at which traffic intensity varies due to a change in the corresponding indicator selected. Hence, In order to estimate the elasticity of traffic demand, it is necessary to establish relationship between the growth in number of given category of vehicles with the relevant economic variable considered, such as NSDP, per capita income and population growth.Latest available data for vehicle registration, per capita income, NSDP and population is used in analysis.

As per IRC: 108-1996 the model for estimating elasticity index for the project corridor is of the following form and is given as below:

$$Log\ (P) = k \times Log\ (EI) + A$$

Where,

P = *Number of Vehicles (Mode wise)*

EI = *Economic Indicator*

A = *Regression constant*

k = *Elasticity coefficient (Regression coefficient)*

The elasticity for car and bus (passenger vehicles) is calculated based on the Population and Per Capita Domestic Product (PCDP) and the elasticity for trucks is calculated based on the Net State Domestic Product (NSDP).

The project corridor spreads across state of Rajasthan. Toll plazas at Garh and Joya are in the state of Uttar Pradesh. For elasticity calculations, working data from Uttar Pradesh, Delhi and Haryana has been analyzed since Delhi and Haryana have substantial impact on project traffic.

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Maharashtra State.

Table 5-1 : Per Capita Income Vs Car Uttar Pradesh

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	32002	1108100	4.51	6.04		
2013	32908	1205374	4.52	6.08	3%	
2014	34044	1423020	4.53	6.15	3%	
2015	34583	1572217	4.54	6.20	2%	
2016	36973	1746117	4.57	6.24	7%	
2017	40641	2027972	4.61	6.31	10%	4.94%

Regression analysis of same is given in figure below

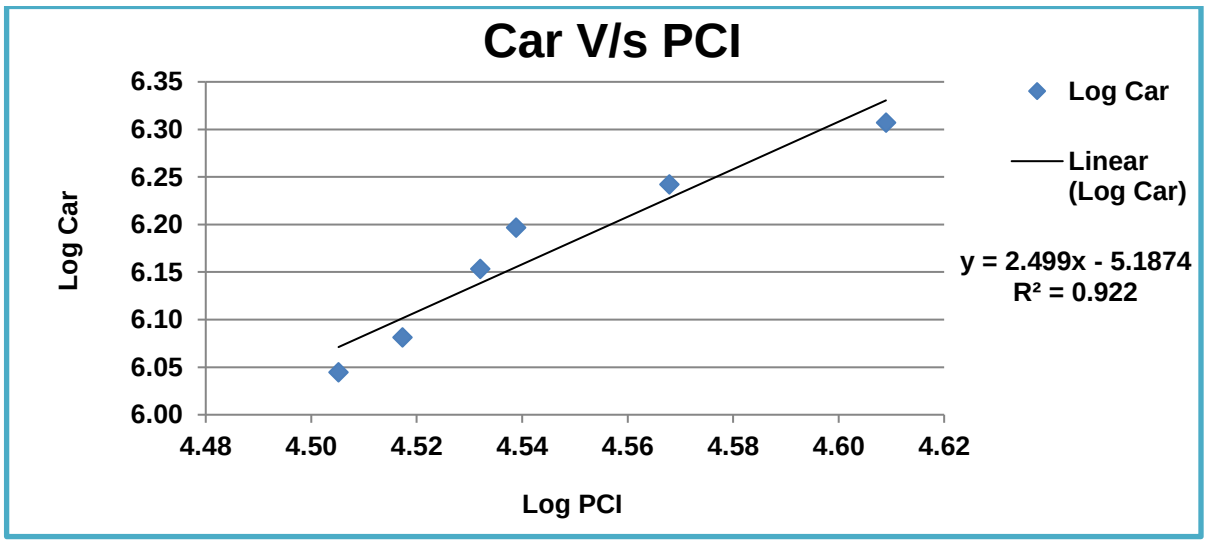


Figure 5-1: Regression and Elasticity PCI vs. Car–Extrapolation Uttar Pradesh

Table 5-2 : Population Vs Bus Uttar Pradesh

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	199812341	57901	8.30	4.76		
2013	203382046	64147	8.31	4.81	2%	
2014	206942855	74389	8.32	4.87	2%	
2015	210493544	80460	8.32	4.91	2%	
2016	214032922	89127	8.33	4.95	2%	
2017	217559836	112020	8.34	5.05	2%	1.72%

Regression analysis of same is given in figure below

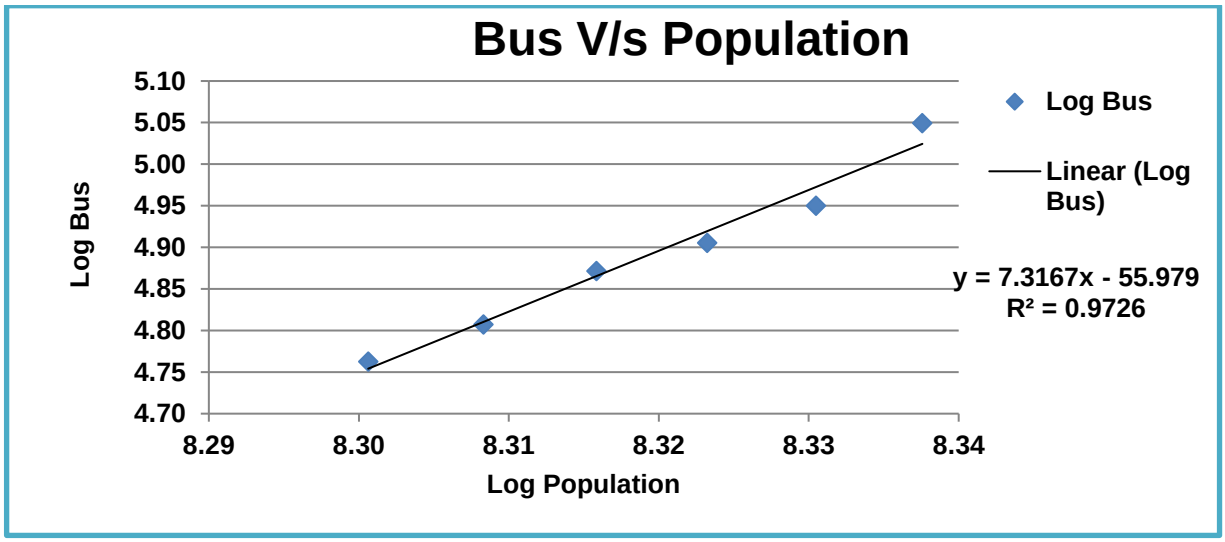


Figure 5-2: Regression and Elasticity Population vs. Bus – Extrapolation Uttar Pradesh

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-3 : LCV Traffic Vs NSDP Uttar Pradesh

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth (5 Year)
2012	645132	176164	5.81	5.25		
2013	673552	213657	5.83	5.33	4%	
2014	707469	265025	5.85	5.42	5%	
2015	729686	294022	5.86	5.47	3%	
2016	792049	316815	5.90	5.50	9%	5.28%

Following figure depict regression analysis and extrapolation.

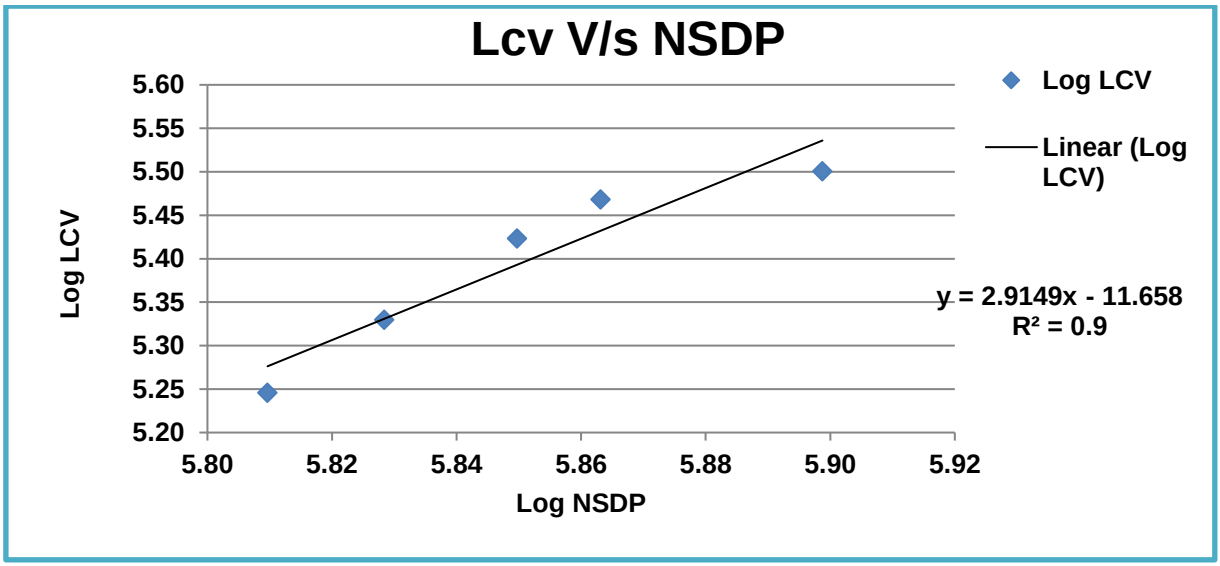


Figure 5-3: Regression and Elasticity NSDP vs. LCV Traffic – extrapolation Uttar Pradesh

Table 5-4: Trucks Traffic Vs NSDP Uttar Pradesh

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	645132	162813	5.81	5.21		
2013	673552	186404	5.83	5.27	4%	
2014	707469	202761	5.85	5.31	5%	
2015	729686	217609	5.86	5.34	3%	

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2016	792049	245688	5.90	5.39	9%	
2017	883962	265167	5.95	5.42	12%	6.55%

Following figure depict regression analysis and extrapolation.

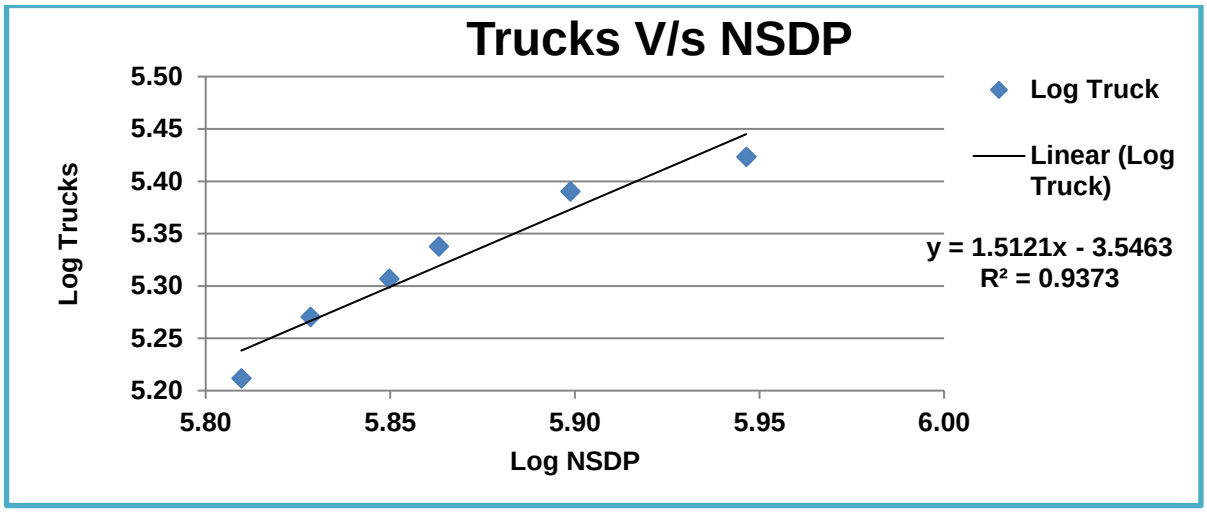


Figure 5-4: Regression and Elasticity NSDP vs. Truck Traffic – extrapolation Uttar Pradesh

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below.

Table 5-4 : Summary Regression Analysis Uttar Pradesh

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average Growth	Growth Elastic Model
Uttar Pradesh	Car/Jeep	PCI	y = 2.499x + -5.1874	R^2 = 0.922	2.4990	4.94%	12.34%
	Bus	Population	y = 7.3167x - -55.9791	R^2 = 0.9726	7.3167	1.72%	12.56%
	LCV	NSDP	y = 2.9149x - -11.6585	R^2 = 0.9	2.9149	5.28%	15.40%
	Truck	NSDP	y = 1.5121x - -3.5463	R^2 = 0.9373	1.5121	6.55%	9.90%

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Delhi State.

Table 5-5 : Per Capita Income Vs Car Delhi

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	185361	2172069	5.27	6.34		
2013	193175	2416974	5.29	6.38	4%	
2014	202216	2568380	5.31	6.41	5%	
2015	215726	2730071	5.33	6.44	7%	
2016	235737	2986579	5.37	6.48	9%	
2017	247255	3061817	5.39	6.49	5%	5.95%

Regression analysis of same is given in figure below

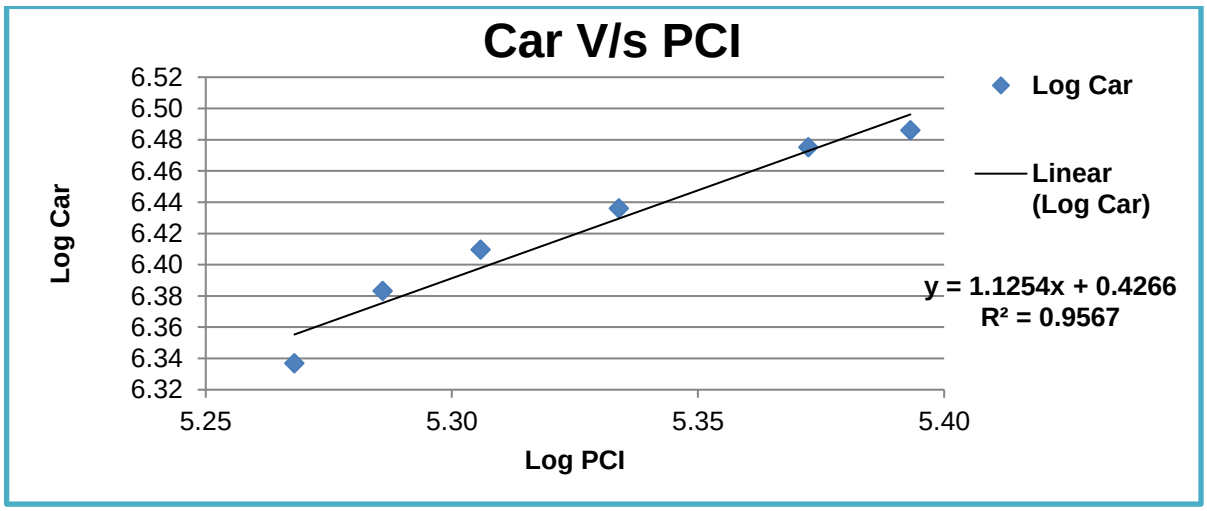


Figure 5-5: Regression and Elasticity PCI vs. Car–Extrapolation Delhi

Table 5-6 : Population Vs Bus Delhi

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	16787941	109790	7.22	5.04		
2013	17071599	19917	7.23	4.30	2%	
2014	17354281	19595	7.24	4.29	2%	
2015	17635897	19700	7.25	4.29	2%	
2016	17916359	43723	7.25	4.64	2%	
2017	18195583	41686	7.26	4.62	2%	1.62%

Regression analysis of same is given in figure below

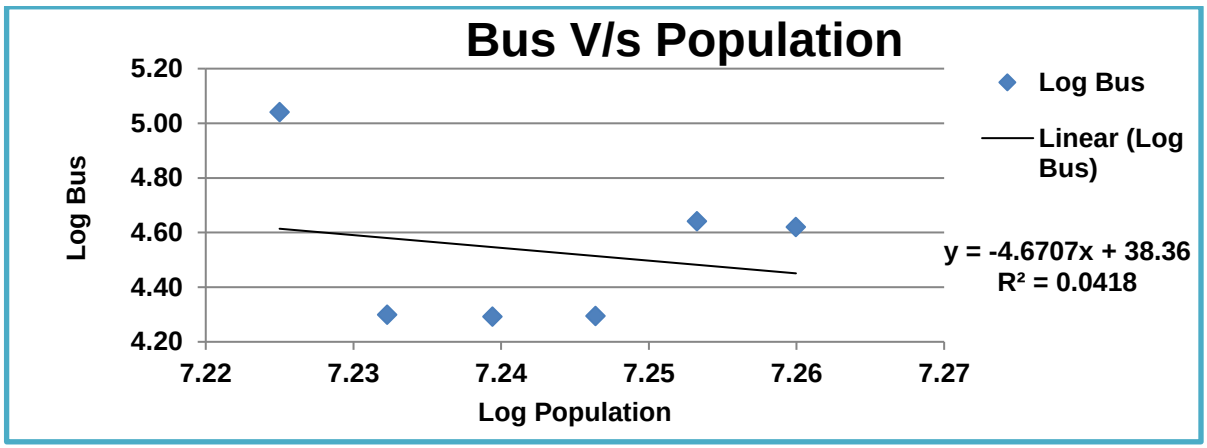


Figure 5-6: Regression and Elasticity Population vs. Bus – Extrapolation Delhi

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-7 : LCV Traffic Vs NSDP Delhi

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth (5 Year)
2012	314650	124547	5.50	5.10		
2013	334193	126539	5.52	5.10	6%	
2014	356528	136110	5.55	5.13	7%	
2015	387639	145903	5.59	5.16	9%	
2016	431730	183486	5.64	5.26	11%	
2017	461476	221068	5.66	5.34	7%	7.98%

Following figure depict regression analysis and extrapolation.

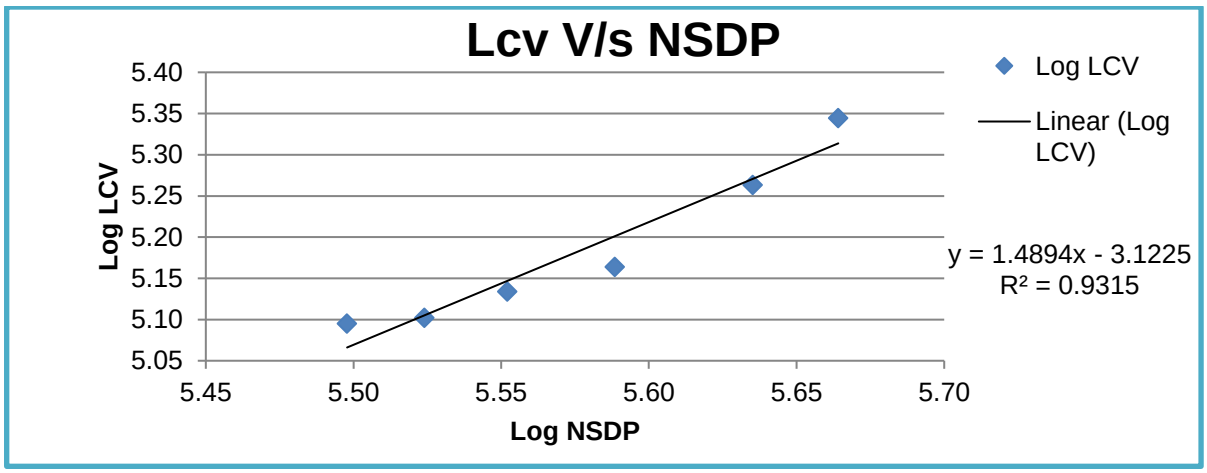


Figure 5-7: Regression and Elasticity NSDP vs. LCV Traffic – extrapolation Delhi

Table 5-4: Trucks Traffic Vs NSDP Delhi

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	314650	4792	5.50	3.68		
2013	334193	5176	5.52	3.71	6%	
2014	356528	6093	5.55	3.78	7%	
2015	387639	7503	5.59	3.88	9%	
2016	431730	8703	5.64	3.94	11%	
2017	461476	10440	5.66	4.02	7%	7.98%

Following figure depict regression analysis and extrapolation.

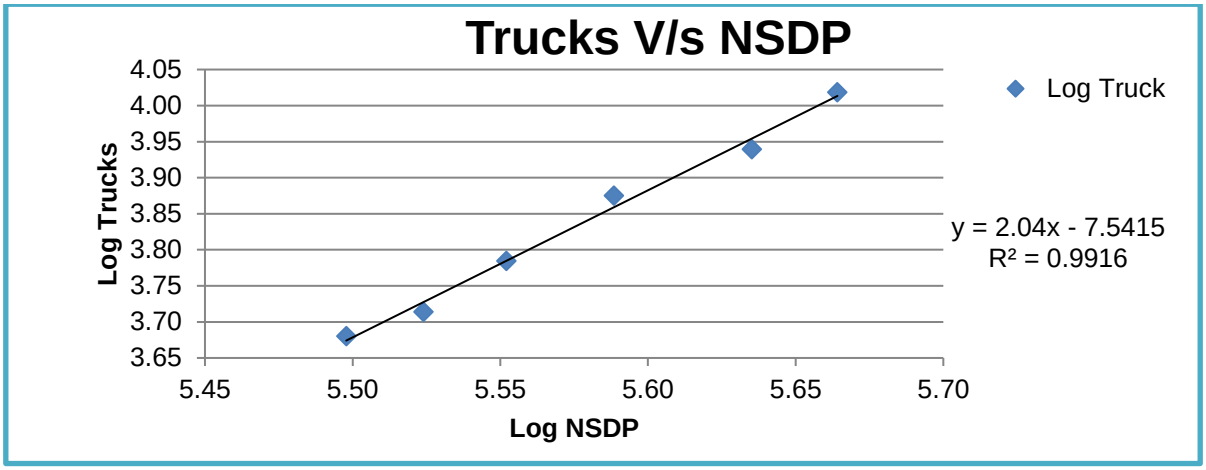


Figure 5-8: Regression and Elasticity NSDP vs. Truck Traffic – extrapolation Delhi

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below

Table 5-8 : Summary Regression Analysis Delhi

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average Growth	Growth Elastic Model
Delhi	Car/Jeep	PCI	y = 1.1254x + 0.4266	R² = 0.9567	1.1254	5.95%	6.69%
	Bus	Population	y = -4.6707x - 38.36	R² = 0.0418	-4.6707	1.62%	-7.58%
	LCV	NSDP	y = 1.4894x - -3.1225	R² = 0.9315	1.4894	7.98%	11.88%
	Truck	NSDP	y = 2.04x - - 7.5415	R² = 0.9916	2.0400	7.98%	16.27%

Following tables and graphs depict regression and elasticity of growth model for stretch falling in Haryana State.

Table 5-9 : Per Capita Income Vs Car Haryana

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2012	106085	1134514	5.03	6.05		
2013	111780	1293065	5.05	6.11	5%	
2014	119791	1454182	5.08	6.16	7%	
2015	125032	1609544	5.10	6.21	4%	
2016	137818	1764448	5.14	6.25	10%	
2017	150241	1879587	5.18	6.27	9%	7.23%

Regression analysis of same is given in figure below

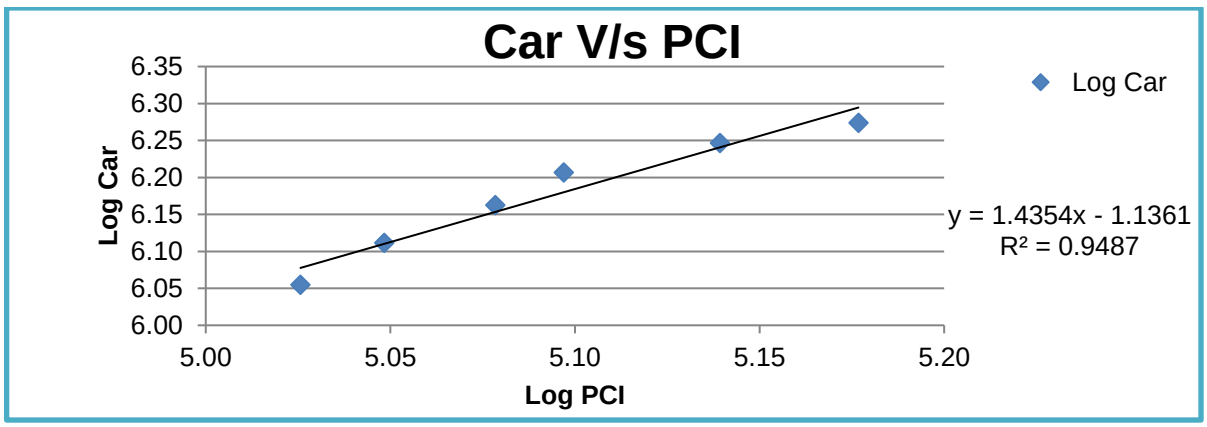


Figure 5-9: Regression and Elasticity PCI vs. Car–Extrapolation Harya

Table 5-10 : Population Vs Bus Haryana

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2012	25351462	39153	7.40	4.59		
2013	25751257	43456	7.41	4.64	2%	
2014	26149236	46558	7.42	4.67	2%	
2015	26545282	52640	7.42	4.72	2%	
2016	26939286	55781	7.43	4.75	1%	
2017	27331141	60129	7.44	4.78	1%	1.52%

Regression analysis of same is given in figure below

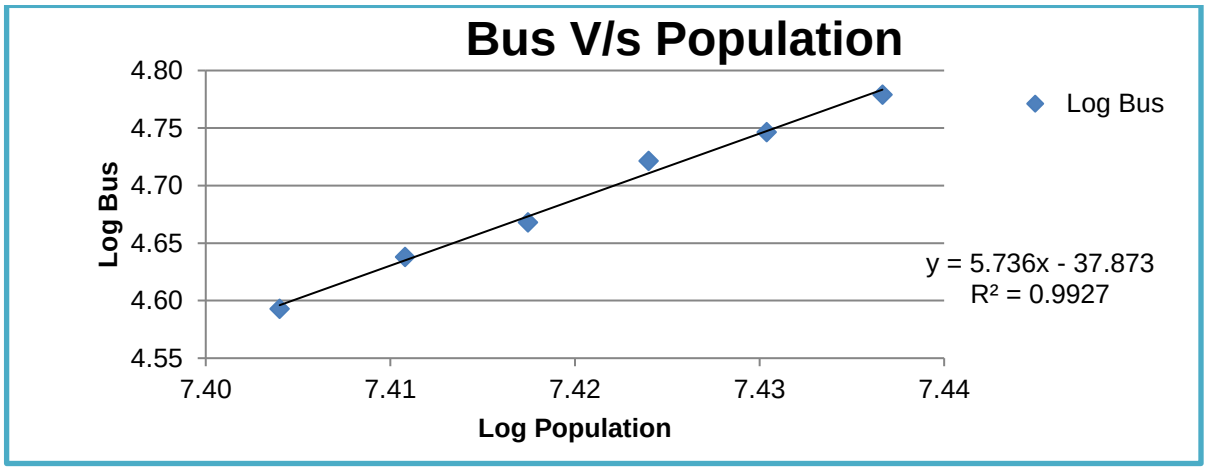


Figure 5-10: Regression and Elasticity Population vs. Bus – Extrapolation Haryana

Elasticity of goods traffic has been worked out by regression analysis with NSDP. Following table represents the data and details.

Table 5-11 : LCV Traffic Vs NSDP Haryana

Year	NSDP	LCV	Log NDSP	Log LCV	NSDP Growth	Average Growth (5 Year)
2012	271152	124897	5.43	5.10		
2013	289756	137511	5.46	5.14	7%	

2014	314931	152069	5.50	5.18	9%	
2015	333359	167901	5.52	5.23	6%	
2016	372659	182776	5.57	5.26	12%	8.30%

Following figure depict regression analysis and extrapolation.

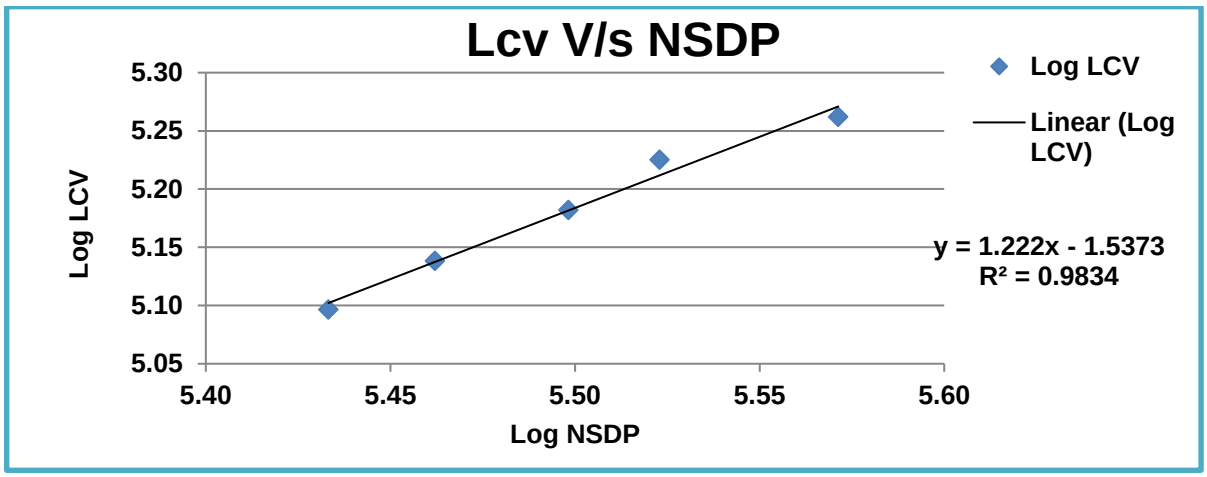


Figure 5-11: Regression and Elasticity NSDP vs. LCV Traffic – extrapolation Haryana

Table 5-4 : Trucks Traffic Vs NSDP Haryana

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2012	271152	292735	5.43	5.47		
2013	289756	307509	5.46	5.49	7%	
2014	314931	327882	5.50	5.52	9%	
2015	333359	348732	5.52	5.54	6%	
2016	372659	367730	5.57	5.57	12%	
2017	412006	390321	5.61	5.59	11%	8.75%

Following figure depict regression analysis and extrapolation.

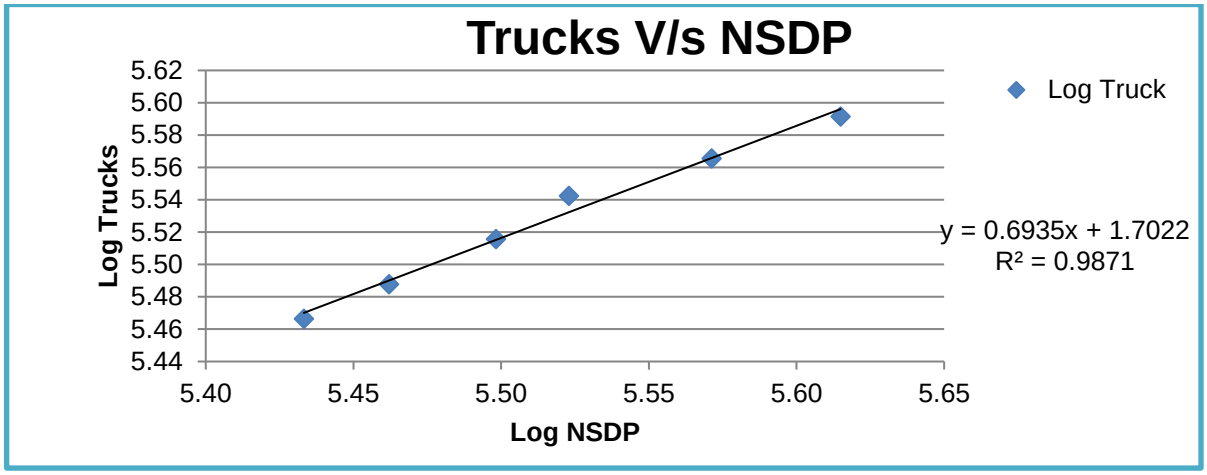


Figure 5-12: Regression and Elasticity NSDP vs. Truck Traffic – extrapolation Haryana

Using the regression analysis above, we have arrived at the elasticity of traffic demand for each class of vehicle to a given change in relevant economic indicators. Average traffic growth of a vehicle class is multiplied by the corresponding elasticity coefficient to arrive at traffic growth. R2 statistical measure of how close the data are to the fitted regression line. It varies from 0 to 1. Higher the value of R2 more representative is the regression model of data.

The results of these analyses for *the good fit* regression as reflected by R^2 values are presented in the Table below

Table 5-12 : Summary Regression Analysis Haryana

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average Growth	Growth Elastic Model
Haryana	Car/Jeep	PCI	y = 1.4354x - -1.1361	R² = 0.9487	1.4354	7.23%	10.38%
	Bus	Population	y = 5.736x - -37.8732	R² = 0.9927	5.7360	1.52%	8.69%
	LCV	NSDP	y = 1.222x - -1.5373	R² = 0.9834	1.2220	8.30%	10.14%
	Truck	NSDP	y = 0.6935x - 1.7022	R² = 0.9871	0.6935	8.75%	6.07%

Economical model for predicting growth is good tool, however other local, regional, national factors should also be considered before finalizing growth factors. Considering factors such as proposed developments and other influencing economic factors, moderated growth should be considered. These factors are discussed in subsequent sections.

5.4 Analysis of Historic Traffic Data

Historical traffic data forms useful information for any highway project. It provides useful information for establishing past trend of growth. Project stretch of Hapur to Moradabad is under tolling operation with current concessionaire and has less than a year of tolling history from May 2019. Traffic data for last two years is affected by COVID-19 impact. Hence sufficient data points are not available to be able to establish a reliable past trend of traffic growth. A minimum of about 5 -6 years' traffic data is required for establishing a reliable past trend.

5.5 Other Factors Influencing Growth

There are many factors which have impact on traffic growth. As discussed previously these factors can be economical, social, educational, and industrial.

Potentiality of such factors for project highway is discussed as under.

ECONOMY

After witnessing a slowdown during 2011-12, the economy recovered in 2013-14, and a high growth rate of GDP was recorded in up to 2018-19. Pandemic of COVID-19 impacted all economies of world including India. Following figure show trend of GDP growth in India.

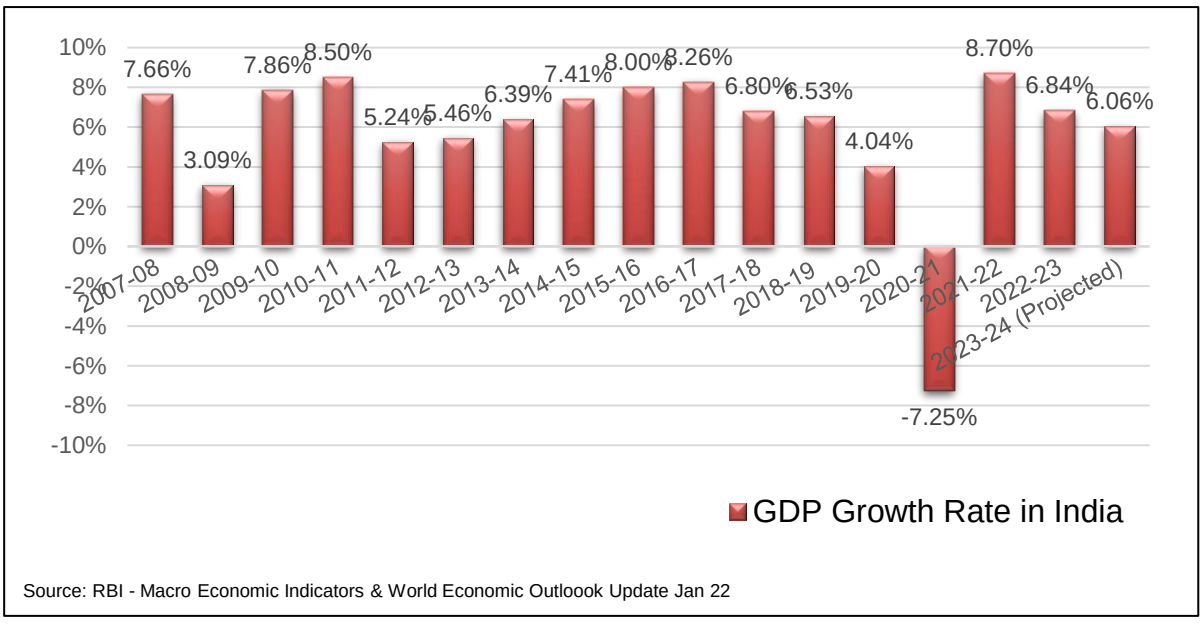


Figure 0-13 : Growth of GDP in India

FY 2017-18 recorded a growth of 6.7% which had slight impact of GST and demonetization. Indian economy appears on recovery path with estimated growth of

6.8% in FY 2018-19. Government took major policy decision including tax infrastructure reforming, banking sector improvement and ease of doing business.

Major economies of world collapsed due to pandemic COVID-19 including India. Indian economy is also registered negative growth in financial year 2020-21. After that Indian economy recovered handsomely and registered a growth of about 9% in Year 2021-22. This was partly due to low base of year 2020-21 as well.

Honorable Prime Minister has announced a major relief package of Rs. 20 lakh crores which is about 10% of GDP. This is aimed at turning this major crisis of COVID-19 into opportunity by providing major impetus to industrial production to the limit of becoming a self-reliant economy. With major thrust of this package being on **Make -In- India** it is expected that industry in India would grow at rapid pace and recover handsomely in post COVID-19 scenario. World Economic Outlook update also has predicted a growth rate of about 7.5 % in year 2022-23.

5.6 Developments along and around the Project Corridor & State

Though growth of Uttar Pradesh has been consistently below the national average economic growth, it is the largest state in terms of population and consumption driven demand for goods and services will remain significantly high. The rate of growth of NSDP also seems to be catching up with the national average over the years. Other regions in the influence area states namely Delhi, Haryana and Uttarakhand are all growing significantly faster than the national average. Considering the scenario, it may be assumed that the traffic growth on project highway would remain high and there are minimal risks in terms of growth.

The corridor passes through heavily cultivated Gangetic plains and also connects the fertile Doaba regions of the Uttarakhand plains. Simbaoli, one of the largest and modern sugar refinery complexes falls right on the project corridor. Sugar refineries like this link agriculture, distillery, clean fuel technologies, green energy generation including cogeneration etc. which is a positive influence on this agriculturally right region. Other parts of the capital region of Delhi are also experiencing rapid urbanization fueled by industrialization and growth. Thus induced traffic from these developments around the project corridor and due to the improved facility will be a positive contributing factor to the traffic growth on the project corridor

5.6.1 Industrial Units along Project Corridor

This project section of the NH-24 (newNH-9) crosses three districts of Uttar Pradesh (Hapur, Amroha and Moradabad). There are about 1000 significant industrial units in these districts out of which there are 40 large Scale and 11 Medium Scale industries. The major industrial base is dependent on agriculture and timber in the surrounding region. Being a sugarcane growing region, there are a number of sugar mills in the project catchment. Simbhawli Sugarmill is one of the largest integrated refinery producing gsugar, ethanol and other related products. Following map shows some of major industrial establishments along and in influence area of project stretch.

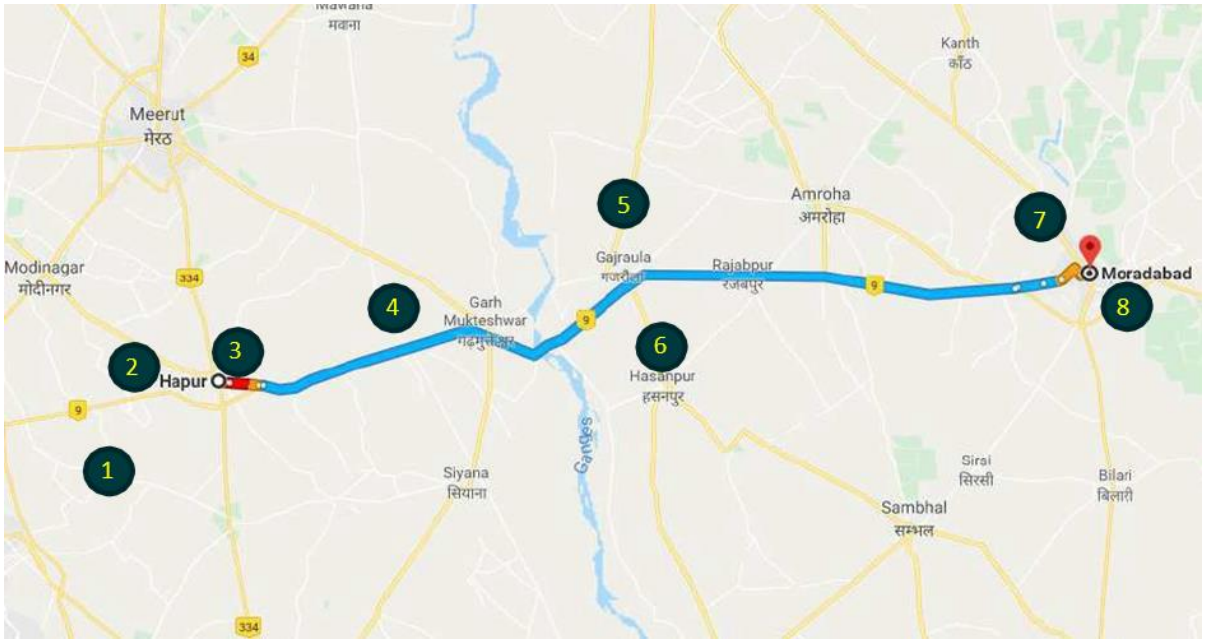


Figure 0-14 : Industrial Units along project corridor

Industries shown in above map are listed as below.

1. **Dhaolana** (Chetak enterprises, Spooner Industries Pvt. Ltd., Astech build product India Pvt. ltd.,
2. **Jindal Nagar, Hapur** (Marino Industries Jindal Nagar Hapur)– Large Scale Industry of Laminated Furnitures.
3. Medium Scale Industries in **Shakti Nagar, Hapur**
4. Sugar Mills (**Simbhawali** Sugar mills)
5. **GajraulaIndustrialArea1&2**(Paper & Sugar Mills, Food Products, Organic food Products)
6. Trivani Engineering & Industries Ltd.,**Hasanpur** (Engineering Goods)
7. **Agwanpur** (Industries of Milk Powder, Ghee, Acrylic Fibre, Crystal Sugar, Craft Paper)
8. **Dalpatpur** (Moradabad Dugdh Utpadan Sahakari Sangh– Milk & Milk Products)

Rapid expansion of NCR and NOIDA has triggered growth along project corridor as well. Large number of residential projects can be seen coming up along project road

near Hapur, Gajraula and Moradabad. In fact there is a new city "New Moradabad" has come up near Pakbara on Delhi road.

5.7 Recommended Growth Rates of Traffic

Based on the above analysis and after giving due consideration to the entire listed factors, the following overall growth rates are recommended for each category of vehicle as under. Rate of growth is moderated in light of overall regional trend. Growth of Multi-Axle is kept slightly higher as trend of technological advances in logistic industry favors multi-axle over 2/3 axle carriage. It is also expected that as the economy moves from developing to developed, rate of growth diminishes. Same growth rate is not sustainable for long It is established practice to stepdown future growth rates at suitable interval of years.

Growth rates are recommended for three scenarios for sensitivity analysis namely **Optimistic, Pessimistic** and **Most Likely** with a positive and negative variation 0.5% from Most Likely case for corridor in both states.

5.7.1 Recommended Growth Rates of Traffic for Project Stretch

Table 5-13 : Recommended Growth Rates Optimistic

Category / Year	2021-2022	2022-2023	2023-2026	2026-2031	2031-2036	2036-2041	2041-2046
Car/Jeep/Van	10.04%	7.18%	6.23%	6.01%	5.78%	4.36%	4.17%
LCV	5.47%	3.81%	3.26%	3.06%	2.47%	1.76%	1.57%
BUS	5.64%	3.84%	3.33%	3.20%	3.44%	2.73%	2.62%
2- Axle	5.80%	4.47%	3.81%	3.61%	3.17%	1.76%	1.57%
3 - Axle	6.13%	4.47%	3.81%	3.61%	3.17%	1.76%	1.57%
4 to6 Axle	7.12%	4.81%	4.14%	3.92%	3.43%	1.89%	1.68%
7 and Above Axle	7.12%	4.81%	4.14%	3.92%	3.43%	1.89%	1.68%

Table 5-14 : Recommended Growth Rates Pessimistic

Category / Year	2021-2022	2022-2023	2023-2026	2026-2031	2031-2036	2036-2041	2041-2046
Car/Jeep/Van	9.54%	6.68%	5.73%	5.51%	5.28%	3.86%	3.67%
LCV	4.97%	3.31%	2.76%	2.56%	1.97%	1.26%	1.07%
BUS	5.14%	3.34%	2.83%	2.70%	2.94%	2.23%	2.12%
2- Axle	5.30%	3.97%	3.31%	3.11%	2.67%	1.26%	1.07%
3 - Axle	5.63%	3.97%	3.31%	3.11%	2.67%	1.26%	1.07%
4 to6 Axle	6.62%	4.31%	3.64%	3.42%	2.93%	1.39%	1.18%
7 and Above Axle	6.62%	4.31%	3.64%	3.42%	2.93%	1.39%	1.18%

Table 5-15 : Recommended Growth Rates Most Likely

Category / Year	2021-2022	2022-2023	2023-2026	2026-2031	2031-2036	2036-2041	2041-2046
Car/Jeep/Van	9.79%	6.93%	5.98%	5.76%	5.53%	4.11%	3.92%
LCV	5.22%	3.56%	3.01%	2.81%	2.22%	1.51%	1.32%
BUS	5.39%	3.59%	3.08%	2.95%	3.19%	2.48%	2.37%
2- Axle	5.55%	4.22%	3.56%	3.36%	2.92%	1.51%	1.32%
3 - Axle	5.88%	4.22%	3.56%	3.36%	2.92%	1.51%	1.32%
4 to6 Axle	6.87%	4.56%	3.89%	3.67%	3.18%	1.64%	1.43%
7 and Above Axle	6.87%	4.56%	3.89%	3.67%	3.18%	1.64%	1.43%

Traffic and revenue have been worked out on the basis of above growths and same is presented in subsequent chapter of report.

5.8 COVID-19 Impact

All social and economic activities had been completely disrupted due worldwide pandemic of Corona Virus. This had affected traffic on project stretch as well. Traffic was severely affected form March-2020 due to lockdown and then in second wave and third waves.

Government has announced a mega economic stimulate and package of Rs. 20 Lakh Crore to bring the economy back on track and recover the losses. Traffic has shown impressive recovery post lockdown period and has recovered to normal level.

Taking recommended traffic growth and factors as discussed above into consideration traffic forecast for concession period is done and presented in next chapter.

CHAPTER 6

TRAFFIC FORECAST

6.1 Traffic Projections

Growth rates recommended in previous section of report are used to arrive at traffic projections for future years. Toll plaza wise futuristic traffic projection is given in tables below.

These projections have been done for following three cases of growth up to concession period

1. Optimistic Scenario
2. Pessimistic Scenario
3. Most Likely Scenario

Table 6-1 : Total Tollable Traffic @ Toll Plaza 1- Garh @90.661 KM

(Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	25588	1787	2138	2048	1111	2044	9	34725	53398
2024-25	27181	1845	2209	2126	1153	2128	9	36651	56029
2025-26	28815	1902	2279	2202	1194	2211	9	38612	58683
2026-27	30548	1960	2351	2281	1237	2298	9	40684	61477
2027-28	32385	2020	2426	2364	1282	2388	9	42874	64418
2028-29	34332	2082	2504	2449	1328	2482	9	45186	67508
2029-30	36396	2146	2584	2537	1375	2579	9	47626	70749
2030-31	38499	2199	2673	2618	1419	2667	9	50084	73970
2031-32	40724	2253	2765	2701	1464	2758	9	52674	77345
2032-33	43077	2308	2860	2787	1510	2853	9	55404	80889
2033-34	45567	2365	2958	2875	1557	2951	9	58282	84605
2034-35	48201	2423	3060	2966	1606	3052	9	61317	88506
2035-36	50304	2466	3144	3018	1634	3109	9	63684	91422
2036-37	52499	2509	3230	3071	1662	3168	9	66148	94448
2037-38	54790	2553	3318	3125	1691	3228	9	68714	97588
2038-39	57181	2598	3408	3180	1721	3289	9	71386	100846
2039-40	59676	2644	3501	3236	1752	3351	9	74169	104229
2040-41	62166	2685	3593	3287	1780	3407	9	76927	107546
2041-42	64759	2727	3687	3339	1808	3464	9	79793	110980
2042-43	67461	2770	3783	3391	1836	3522	9	82772	114536
2043-44	70276	2813	3882	3444	1865	3581	9	85870	118224
2044-45	73209	2857	3984	3498	1894	3641	9	89092	122048
2045-46	76127	2896	4084	3546	1921	3695	9	92278	125792

Table 6-2 : Total Tollable Traffic @ Toll Plaza 2- Joya @123.875 KM

(Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	17035	1220	1827	1491	1046	1838	9	24466	40269
2024-25	18094	1259	1887	1548	1085	1914	9	25796	42196
2025-26	19182	1298	1947	1603	1124	1989	9	27152	44142
2026-27	20335	1337	2010	1661	1165	2067	9	28584	46191
2027-28	21557	1378	2074	1721	1207	2148	9	30094	48337
2028-29	22853	1420	2140	1783	1250	2232	9	31687	50587
2029-30	24227	1463	2209	1847	1294	2320	9	33369	52952
2030-31	25626	1499	2285	1905	1335	2400	9	35059	55290
2031-32	27106	1536	2363	1965	1377	2482	9	36838	57735
2032-33	28672	1574	2444	2028	1420	2567	9	38714	60301
2033-34	30329	1613	2528	2092	1464	2655	9	40690	62989
2034-35	32082	1652	2615	2158	1511	2747	9	42774	65814
2035-36	33481	1681	2686	2196	1538	2799	9	44390	67899
2036-37	34942	1711	2760	2235	1565	2851	9	46073	70059
2037-38	36466	1741	2836	2274	1593	2905	9	47824	72300
2038-39	38057	1771	2913	2314	1621	2960	9	49645	74618
2039-40	39717	1802	2993	2355	1649	3016	9	51541	77024
2040-41	41374	1830	3071	2392	1674	3067	9	53417	79372
2041-42	43100	1859	3152	2430	1701	3118	9	55369	81809
2042-43	44898	1888	3234	2468	1728	3170	9	57395	84326
2043-44	46771	1918	3318	2507	1755	3224	9	59502	86937
2044-45	48722	1948	3405	2546	1783	3278	9	61691	89638
2045-46	50663	1975	3491	2581	1807	3326	9	63852	92270

Table 6-3 : Total Tollable Traffic @ Toll Plaza 1- Garh @ 90.661 KM
(Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	25467	1778	2128	2037	1106	2033	9	34558	53136
2024-25	26925	1826	2188	2104	1143	2107	9	36302	55491
2025-26	28409	1872	2247	2169	1179	2179	9	38064	57848
2026-27	29975	1920	2308	2236	1216	2254	9	39918	60319
2027-28	31627	1969	2370	2305	1253	2331	9	41864	62895
2028-29	33370	2019	2433	2377	1292	2410	9	43910	65590
2029-30	35210	2071	2499	2451	1332	2492	9	46064	68417
2030-31	37070	2112	2572	2516	1368	2565	9	48212	71189
2031-32	39028	2153	2648	2583	1404	2640	9	50465	74083
2032-33	41089	2196	2726	2652	1441	2718	9	52831	77112
2033-34	43258	2239	2806	2723	1479	2798	9	55312	80272
2034-35	45542	2283	2889	2795	1519	2880	9	57917	83576
2035-36	47302	2312	2953	2830	1538	2920	9	59864	85914
2036-37	49130	2341	3019	2866	1557	2961	9	61883	88333
2037-38	51029	2371	3087	2902	1576	3002	9	63976	90830
2038-39	53001	2401	3156	2938	1596	3044	9	66145	93411

2039-40	55049	2431	3226	2976	1616	3086	9	68393	96077
2040-41	57071	2457	3294	3008	1634	3123	9	70596	98659
2041-42	59167	2484	3364	3041	1652	3160	9	72877	101325
2042-43	61340	2511	3435	3074	1670	3197	9	75236	104071
2043-44	63592	2538	3507	3107	1688	3235	9	77676	106903
2044-45	65928	2565	3582	3140	1706	3273	9	80203	109829
2045-46	68226	2588	3654	3168	1721	3304	9	82670	112646

Table 6-4 : Total Tollable Traffic @ Toll Plaza 2- Joya @123.875 KM

(Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	16954	1213	1818	1483	1041	1829	9	24347	40071
2024-25	17924	1247	1870	1532	1075	1896	9	25553	41798
2025-26	18912	1279	1921	1579	1108	1961	9	26769	43520
2026-27	19954	1311	1973	1628	1142	2028	9	28045	45316
2027-28	21054	1345	2026	1678	1177	2097	9	29386	47192
2028-29	22215	1379	2080	1730	1214	2169	9	30796	49157
2029-30	23439	1414	2136	1783	1252	2243	9	32276	51207
2030-31	24675	1442	2199	1830	1285	2308	9	33748	53207
2031-32	25977	1470	2264	1879	1319	2376	9	35294	55301
2032-33	27348	1499	2330	1929	1354	2445	9	36914	57479
2033-34	28791	1529	2399	1981	1390	2517	9	38616	59762
2034-35	30310	1559	2469	2034	1427	2590	9	40398	62134
2035-36	31481	1579	2524	2059	1445	2625	9	41722	63787
2036-37	32696	1599	2581	2085	1463	2662	9	43095	65501
2037-38	33959	1619	2639	2112	1482	2699	9	44519	67273
2038-39	35270	1639	2698	2139	1501	2737	9	45993	69100
2039-40	36633	1660	2758	2166	1520	2775	9	47521	70983
2040-41	37978	1678	2816	2189	1536	2808	9	49014	72795
2041-42	39372	1696	2875	2213	1552	2841	9	50558	74661
2042-43	40818	1714	2936	2237	1569	2875	9	52158	76593
2043-44	42317	1732	2999	2261	1586	2909	9	53813	78584
2044-45	43871	1750	3063	2285	1603	2943	9	55524	80633
2045-46	45399	1766	3125	2305	1617	2972	9	57193	82604

Traffic projections for Most Likely scenario are given as under

Table 6-5 : Total Tollable Traffic @ Toll Plaza 1- Garh @ 90.661 KM
(Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	25528	1782	2132	2042	1108	2038	9	34639	53259
2024-25	27053	1835	2198	2115	1148	2117	9	36475	55756
2025-26	28612	1886	2262	2186	1186	2195	9	38336	58261
2026-27	30260	1939	2329	2260	1226	2275	9	40298	60892
2027-28	32004	1993	2398	2336	1267	2358	9	42365	63648
2028-29	33848	2048	2468	2414	1309	2444	9	44540	66532
2029-30	35799	2105	2540	2495	1353	2534	9	46835	69564
2030-31	37778	2151	2621	2568	1393	2614	9	49134	72554
2031-32	39867	2199	2705	2642	1434	2697	9	51553	75686
2032-33	42071	2247	2791	2719	1476	2783	9	54096	78964
2033-34	44398	2297	2880	2798	1519	2872	9	56773	82399
2034-35	46853	2348	2972	2879	1564	2963	9	59588	85994
2035-36	48781	2383	3045	2922	1587	3012	9	61739	88612
2036-37	50788	2419	3121	2967	1611	3061	9	63976	91329
2037-38	52877	2455	3199	3012	1635	3111	9	66298	94138
2038-39	55052	2492	3278	3057	1659	3162	9	68709	97042
2039-40	57317	2529	3359	3103	1684	3214	9	71215	100052
2040-41	59566	2563	3438	3144	1706	3260	9	73686	102985
2041-42	61902	2597	3519	3185	1729	3306	9	76247	106014
2042-43	64330	2631	3603	3227	1752	3354	9	78906	109156
2043-44	66854	2666	3689	3270	1775	3402	9	81665	112405
2044-45	69476	2701	3776	3313	1798	3451	9	84524	115759
2045-46	72071	2731	3861	3351	1818	3493	9	87334	119017

Table 6-6 : Total Tollable Traffic @ Toll Plaza 2- Joya @123.875 KM
(Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU(Including Exempted)
2023-24	16994	1217	1822	1488	1044	1834	9	24408	40175
2024-25	18009	1253	1878	1541	1081	1906	9	25677	42006
2025-26	19047	1288	1933	1593	1118	1975	9	26963	43839
2026-27	20144	1324	1990	1646	1156	2047	9	28316	45758
2027-28	21305	1361	2049	1701	1195	2122	9	29742	47771
2028-29	22532	1399	2109	1758	1235	2199	9	31241	49873
2029-30	23830	1438	2171	1817	1277	2280	9	32822	52083
2030-31	25147	1470	2240	1870	1314	2353	9	34403	54253
2031-32	26537	1502	2311	1925	1352	2428	9	36064	56521
2032-33	28004	1536	2385	1981	1391	2505	9	37811	58892
2033-34	29552	1570	2461	2039	1432	2585	9	39648	61376
2034-35	31186	1604	2539	2099	1474	2667	9	41578	63970
2035-36	32468	1629	2602	2130	1497	2710	9	43045	65834
2036-37	33803	1654	2667	2162	1520	2754	9	44569	67765
2037-38	35193	1679	2733	2195	1543	2799	9	46151	69761
2038-39	36640	1704	2801	2228	1566	2845	9	47793	71824
2039-40	38147	1729	2871	2261	1590	2892	9	49499	73961

2040-41	39643	1752	2939	2291	1611	2934	9	51179	76038
2041-42	41198	1775	3009	2321	1633	2976	9	52921	78182
2042-43	42813	1798	3080	2352	1655	3019	9	54726	80397
2043-44	44492	1821	3152	2383	1677	3062	9	56596	82679
2044-45	46237	1845	3227	2414	1699	3106	9	58537	85042
2045-46	47963	1866	3299	2442	1718	3144	9	60441	87328

6.2 Modification in Concession Period

As per Article 29 of the concession agreement, if actual traffic on the project falls short or exceeds Target Traffic on project highway on defined date, concession period shall be modified subject to calculation stipulated therein. For Hapur-Moradabad project, the Target Date and Target Traffic are defined as under:

Target Date - 1st April 2028

Target Traffic - 67413 in PCU

It was observed that as per traffic projections, average traffic volume is in excess of target traffic in all scenarios. Probable extension of concession period is estimated according to article 29 of concession agreement which comes to about 2 years. Traffic forecast and revenue projections has been kept up to concession period in report till actual finalization of modification.

Most Likely

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2028	67413	58245	-14%	20%	20%	22	4.4

Optimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2028	67413	59092	-12%	19%	19%	22	4.1

Pessimistic

Target Year	Target Traffic	Actual Traffic	% of Excess / Short traffic	% Revision (+ or -) in CP as per CA	% Variation in CP	Original CP	Change in CP (In Years)
2028	67413	57409	-15%	22%	20%	22	4.4

CHAPTER 7

FORECAST OF TOLL REVENUE

7.1 General

This chapter presents the tolling rate calculations, categories and toll revenue of the project.

7.2 Discount Categories

The fee schedule in the CA of Hapur-Moradabad section of NH-9 is based on the old toll policy. As per the Toll Notification (Schedule -G) the discounts and special provisions have been considered. In addition to discounts as per Fee Notification concessionaire has declared special category rates also. Salient features of toll rate structure are given as under

1. Monthly Pass: For frequent users monthly pass would be issued for 50 trips in month at 2/3d rate.
2. Multiple Journeys (for Return Trip): Will be charged at 1.5 times single journey.
3. Single Journey: Full single journey toll would be charged to this category of vehicles who are infrequent travelers or whose frequency does not yield any discount from the above categories.
4. Local Discounts: There are several categories of local discounts.
    a) Local Car Jeep Van I - Rs. 265 per month
    b) Local Commercial Vehicles at 50% rate for single journey

Building of inflation and escalation of rate on the basis of WPI are done as per toll notification (Schedule G) as given under as extract from concession agreement.

The formula for determining the applicable rate of fee shall be as follows:-

$$\text{Applicable rate of fee} = \text{base rate} + \text{base rate} \times \left\{ \frac{\text{WPI A-WPI B}}{\text{WPI B}} \right\} \times 0.4$$

Factor of inflation / growth has been incorporated as per Schedule R. WPI numbers (2011-12 series) are available up to 2018-19. A moderate growth in Wholesale Price Index (WPI) has been assumed after that. The following graph provides historical rate of inflation (WPI) in India. Data has been sourced from the Office of Economic Advisor web site (www.eaindustry.nic.in) WPI for year 2017-18 and 2018-2019 is worked back by applying a correlation factor for 2004-05 series as 2017-18 and 2018-2019 data is available in 2011-12 series only. Ratio of WPI for year 2016-17 for both series is used for conversion of WPI in 2004-05 series

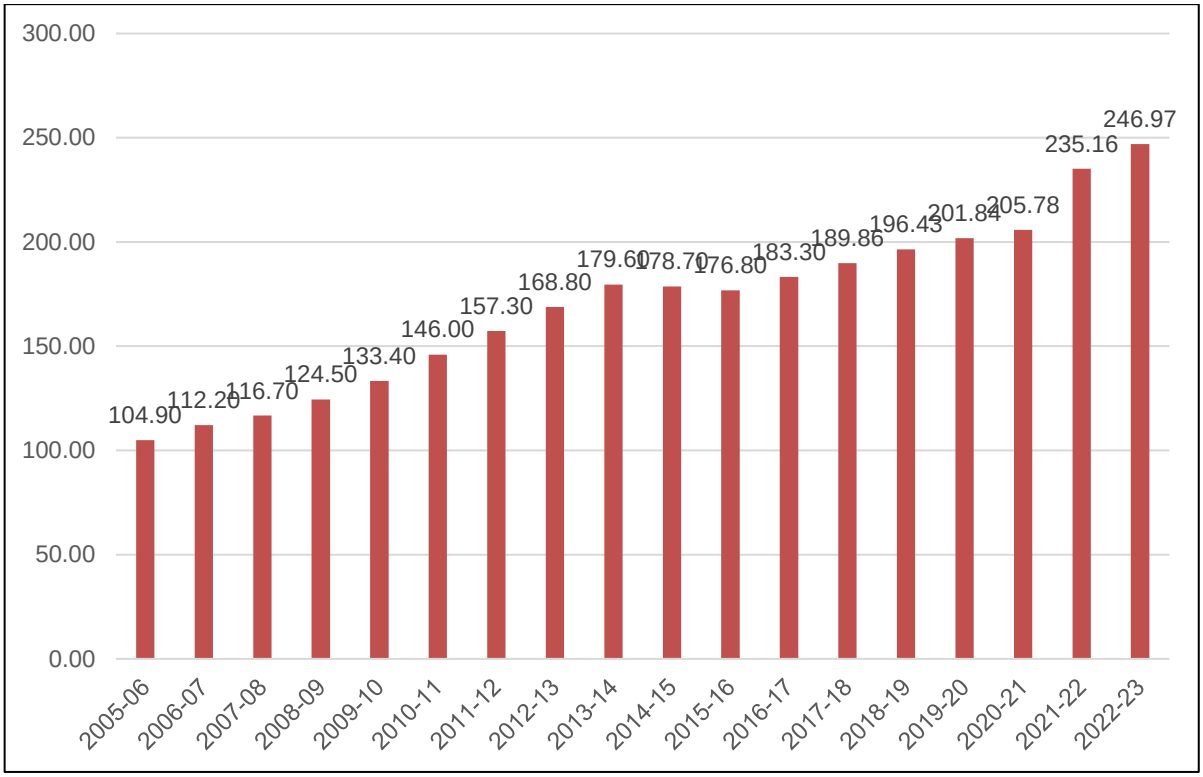


Figure 7-1 : Historical Rate of WPI Inflation in India

Average inflation in WPI in last few years is steadily growing. It grew in range of 4% - 5% in previous years. For future years initially it is takes 5% and Suitably Stepped down for future years.

7.3 Estimation of Toll Rates

As per the applicable MORTH notification and Schedule R of contract agreement, the following Base rate of fee for the categories mentioned in the table stands true in the National Highways Fee Rules applicable for contract.

Table 7-1 : Base Toll Rates June 2007-08

Type of Vehicle	Base Rate of Fee / Km (in Rs.)
Car, Jeep, Van or Light Motor Vehicle	0.65
Light Commercial Vehicle, Light Goods Vehicle or Minibus	1.05
Bus or Truck (Two Axles)	2.20
Three Axle Commercial Vehicles	2.40
Heavy Construction Machinery (HCM) or Earth Moving Equipment (EME) or Multi Axle Vehicle (MAV) (4 to 6 axles)	3.45
Oversized Vehicles (7 or more Axles)	4.20

There is no bypass or structure to be factored in for rates calculations.

Toll rates are calculated as per guidelines provided in schedule R (rounded to nearest Rs.) for the concession period and are given below.

Thus worked out rates for various categories of vehicle and discounts are given as under.

Table 7-2 : Toll Rates for Single Journey@ Km 90.661

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	105	170	360	360	390
2024-25	115	185	385	385	420
2025-26	120	190	400	400	440
2026-27	125	200	425	425	460
2027-28	130	210	445	445	485
2028-29	140	220	465	465	510
2029-30	145	235	490	490	535
2030-31	150	245	510	510	560
2031-32	160	255	535	535	585
2032-33	165	270	565	565	615
2033-34	175	280	590	590	645
2034-35	185	295	620	620	675
2035-36	190	310	650	650	710
2036-37	200	325	680	680	745
2037-38	210	340	715	715	780
2038-39	220	360	750	750	820
2039-40	230	375	785	785	860

2040-41	245	395	825	825	900
2041-42	255	415	865	865	945
2042-43	270	435	910	910	990
2043-44	280	455	955	955	1040
2044-45	295	480	1005	1005	1095
2045-46	310	505	1055	1055	1150
2046-47	325	530	1105	1105	1205

Table 7 3 : Toll Rates for Single Journey @ Km 123.875

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	70	110	230	230	250
2024-25	70	115	240	240	265
2025-26	75	120	255	255	280
2026-27	80	130	270	270	290
2027-28	85	135	280	280	305
2028-29	85	140	295	295	320
2029-30	90	145	310	310	335
2030-31	95	155	325	325	350
2031-32	100	160	340	340	370
2032-33	105	170	355	355	390
2033-34	110	180	375	375	405
2034-35	115	185	390	390	425
2035-36	120	195	410	410	445
2036-37	125	205	430	430	470
2037-38	135	215	450	450	490
2038-39	140	225	475	475	515
2039-40	145	235	495	495	540
2040-41	155	250	520	520	570
2041-42	160	260	550	550	595
2042-43	170	275	575	575	630
2043-44	180	290	610	610	665
2044-45	190	305	640	640	700
2045-46	200	325	675	675	740
2046-47	210	340	715	715	780

Table 7-3 : Toll Rates for Return Journey @ Km 90.661

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	160	255	540	540	590
2024-25	170	275	575	575	625
2025-26	180	290	605	605	660
2026-27	185	305	635	635	690
2027-28	195	320	665	665	725
2028-29	205	335	700	700	760
2029-30	215	350	735	735	800
2030-31	225	365	770	770	840
2031-32	240	385	805	805	880
2032-33	250	405	845	845	920
2033-34	260	420	885	885	965
2034-35	275	445	930	930	1015
2035-36	290	465	975	975	1060
2036-37	300	485	1020	1020	1115
2037-38	315	510	1070	1070	1170
2038-39	330	535	1125	1125	1225
2039-40	350	565	1180	1180	1285
2040-41	365	590	1240	1240	1350
2041-42	385	620	1300	1300	1420
2042-43	405	650	1365	1365	1490
2043-44	425	685	1430	1430	1565
2044-45	445	720	1505	1505	1640
2045-46	465	755	1580	1580	1725
2046-47	490	790	1660	1660	1810

Table 7-4 : Toll Rates for Return Journey @ Km 123.875

Year	CAR	Minibus /LCV	Truck/Bus	Multi axle	Oversized Vehicles
2023-24	100	165	345	345	375
2024-25	105	175	365	365	395
2025-26	115	180	380	380	415
2026-27	120	190	400	400	440
2027-28	125	200	420	420	460
2028-29	130	210	440	440	480
2029-30	135	220	460	460	505
2030-31	145	230	485	485	530
2031-32	150	245	510	510	555
2032-33	155	255	535	535	580
2033-34	165	265	560	560	610
2034-35	175	280	585	585	640
2035-36	180	295	615	615	670
2036-37	190	310	645	645	705
2037-38	200	325	675	675	740

2038-39	210	340	710	710	775
2039-40	220	355	745	745	815
2040-41	230	375	780	780	855
2041-42	245	390	820	820	895
2042-43	255	415	865	865	945
2043-44	270	435	910	910	995
2044-45	285	460	960	960	1050
2045-46	300	485	1015	1015	1105
2046-47	315	510	1070	1070	1165

Table 7-5 : Toll Rates for Monthly Pass Local @ Km 90.661

Year	Car	Mini Bus /LCV
2023-24	330	330
2024-25	330	330
2025-26	345	345
2026-27	365	365
2027-28	385	385
2028-29	400	400
2029-30	420	420
2030-31	440	440
2031-32	460	460
2032-33	485	485
2033-34	510	510
2034-35	535	535
2035-36	560	560
2036-37	585	585
2037-38	615	615
2038-39	645	645
2039-40	680	680
2040-41	710	710
2041-42	745	745
2042-43	785	785
2043-44	825	825
2044-45	865	865
2045-46	905	905
2046-47	955	955

Table 7-7 : Toll Rates for Monthly Pass Local @ Km 123.87

Year	Car	Mini Bus /LCV
2023-24	330	330
2024-25	345	345

2025-26	365	365
2026-27	385	385
2027-28	400	400
2028-29	420	420
2029-30	440	440
2030-31	460	460
2031-32	485	485
2032-33	510	510
2033-34	535	535
2034-35	560	560
2035-36	585	585
2036-37	615	615
2037-38	645	645
2038-39	680	680
2039-40	710	710
2040-41	745	745
2041-42	785	785
2042-43	825	825
2043-44	870	870
2044-45	920	920
2045-46	970	970
2046-47	1020	1020

Table 7-8 : Toll Rates for Monthly Pass @ Km 90.661

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2023-24	3540	5720	11985	11985	13070
2024-25	3775	6095	12770	12770	13930
2025-26	3965	6405	13415	13415	14635
2026-27	4165	6730	14100	14100	15380
2027-28	4380	7070	14820	14820	16165
2028-29	4590	7410	15530	15530	16940
2029-30	4810	7770	16280	16280	17760
2030-31	5040	8145	17065	17065	18615
2031-32	5285	8540	17890	17890	19515
2032-33	5540	8950	18755	18755	20460
2033-34	5810	9385	19670	19670	21455
2034-35	6095	9845	20625	20625	22500
2035-36	6390	10325	21635	21635	23600
2036-37	6705	10830	22695	22695	24755
2037-38	7035	11365	23810	23810	25975
2038-39	7380	11925	24980	24980	27255
2039-40	7745	12510	26215	26215	28600
2040-41	8130	13130	27515	27515	30015
2041-42	8535	13785	28880	28880	31505
2042-43	8960	14470	30320	30320	33075
2043-44	9405	15195	31830	31830	34725
2044-45	9875	15955	33425	33425	36465

2045-46	10370	16755	35105	35105	38295
2046-47	10895	17595	36870	36870	40220

Table 7-9 : Toll Rates for Monthly Pass @ Km 123.875

Year	Car	Mini Bus /LCV	Truck/Bus	Multi Axle	Oversized Vehicle
2023-24	2270	3670	7685	7685	8385
2024-25	2385	3855	8075	8075	8810
2025-26	2510	4050	8490	8490	9260
2026-27	2635	4260	8920	8920	9735
2027-28	2765	4465	9350	9350	10200
2028-29	2895	4675	9800	9800	10690
2029-30	3035	4905	10275	10275	11205
2030-31	3180	5140	10770	10770	11750
2031-32	3335	5390	11290	11290	12320
2032-33	3500	5650	11840	11840	12920
2033-34	3670	5925	12420	12420	13545
2034-35	3850	6215	13025	13025	14210
2035-36	4035	6520	13665	13665	14905
2036-37	4235	6840	14335	14335	15640
2037-38	4445	7180	15040	15040	16410
2038-39	4665	7535	15785	15785	17220
2039-40	4895	7905	16565	16565	18070
2040-41	5135	8300	17390	17390	18970
2041-42	5395	8710	18255	18255	19915
2042-43	5685	9180	19235	19235	20985
2043-44	5990	9675	20275	20275	22120
2044-45	6315	10200	21375	21375	23320
2045-46	6660	10755	22540	22540	24590
2046-47	7025	11345	23770	23770	25930

7.4 Toll Revenue

As indicated earlier, toll revenue on the Project Road has been calculated in all three scenarios based on above rates and projected traffic. The estimates of toll revenue under ***Optimistic***, ***Pessimistic*** and ***Most Likely*** growth scenarios are presented in the following section.

7.5 Toll Revenue at all toll plazas under Scenarios

Toll Revenue estimates under all scenario at each of the toll plaza up to 2045-46 starting from the year 2023-24 are shown in tables below.

Table 7-10 : Toll Revenue Optimistic Scenario

(Rs. Crores)

Year	TP-1	TP2	Total
2023-24	202.45	97.57	**300.02**
2024-25	229.76	106.04	**335.79**
2025-26	251.28	117.79	**369.08**
2026-27	275.49	129.83	**405.32**
2027-28	305.48	142.88	**448.36**
2028-29	333.81	154.15	**487.96**
2029-30	364.92	169.27	**534.19**
2030-31	402.33	186.11	**588.44**
2031-32	439.91	203.98	**643.90**
2032-33	480.76	222.08	**702.85**
2033-34	529.26	243.82	**773.08**
2034-35	577.94	266.96	**844.90**
2035-36	625.26	288.07	**913.33**
2036-37	675.19	310.37	**985.56**
2037-38	730.91	338.34	**1069.26**
2038-39	793.00	365.19	**1158.18**
2039-40	863.51	394.18	**1257.69**
2040-41	930.68	426.89	**1357.57**
2041-42	1009.86	460.54	**1470.39**
2042-43	1089.33	499.41	**1588.74**
2043-44	1183.60	545.12	**1728.72**
2044-45	1276.20	590.25	**1866.46**
2045-46	1380.24	639.86	**2020.11**

Table 7-11 : Toll Revenue Pessimistic Scenario

(Rs. Crores)

Year	TP-1	TP2	Total
2023-24	201.47	97.12	**298.59**
2024-25	227.59	105.07	**332.66**

2025-26	247.77	116.20	**363.97**
2026-27	270.36	127.45	**397.81**
2027-28	298.35	139.57	**437.93**
2028-29	324.48	149.87	**474.35**
2029-30	353.04	163.80	**516.84**
2030-31	387.40	179.26	**566.67**
2031-32	421.58	195.56	**617.14**
2032-33	458.51	211.88	**670.39**
2033-34	502.42	231.48	**733.90**
2034-35	546.07	252.22	**798.29**
2035-36	587.84	270.81	**858.65**
2036-37	631.72	290.36	**922.09**
2037-38	680.56	315.00	**995.56**
2038-39	734.86	338.36	**1073.22**
2039-40	796.36	363.43	**1159.79**
2040-41	854.21	391.69	**1245.90**
2041-42	922.38	420.52	**1342.89**
2042-43	990.13	453.82	**1443.95**
2043-44	1070.63	492.97	**1563.59**
2044-45	1148.87	531.16	**1680.03**
2045-46	1236.45	573.02	**1809.46**

Table 7-12 : Toll Revenue Most Likely Scenario

(Rs. Crores)

Year	TP-1	TP2	Total
2023-24	201.96	97.35	**299.31**
2024-25	228.68	105.56	**334.25**
2025-26	249.50	116.99	**366.49**
2026-27	272.88	128.65	**401.53**
2027-28	301.82	141.23	**443.05**
2028-29	329.00	151.99	**480.99**
2029-30	358.83	166.50	**525.33**
2030-31	394.63	182.69	**577.32**
2031-32	430.47	199.76	**630.23**
2032-33	469.28	216.96	**686.24**
2033-34	515.44	237.61	**753.05**
2034-35	561.59	259.53	**821.11**
2035-36	606.06	279.35	**885.41**
2036-37	652.92	300.23	**953.15**
2037-38	705.15	326.47	**1031.62**
2038-39	763.18	351.52	**1114.70**
2039-40	829.08	378.47	**1207.56**
2040-41	891.40	408.90	**1300.30**
2041-42	964.82	440.05	**1404.87**
2042-43	1038.24	476.09	**1514.33**
2043-44	1125.39	518.39	**1643.78**
2044-45	1210.56	559.96	**1770.53**
2045-46	1306.11	605.52	**1911.63**

CHAPTER 8

CONCLUSION & RECOMMENDATIONS

8.1 Conclusion & Recommendations

Project stretch of Hapur to Moradabad section of NH-9 in state of Uttar Pradesh from km 50.000 to km 148.277is currently four lane and would be augmented to six lane in current concession. The road is in sound condition and serves healthy traffic volumes. Project corridor is a part of the busy and prominent national highway NH-9which is main link for traffic from Punjab, Haryana, Delhi to Moradabad, Rampur and eastern part of Uttarakhand. There are large number of townships, industrial corridors and other business establishment coming up along project corridor. As Indian economy is poised to grow at 7%+ post COVID-19, the project corridor is expected to pick up the same trend in terms of traffic flow. All these developments have potential to give positive impact to traffic flow on project. The following can be considered as major outcomes of the study

a) There is good amount of tollable traffic running on project

b) Project corridor has potential to witness traffic growth @ 6-8% annually Post COVID-19 in near future due to various development in area and overall development of economy

c) Project corridor has committed traffic as long route traffic and does not run a risk of traffic leakage due to quality competing road

Based on above it can be considered a stable healthy project from traffic and revenue point of view.

.

GMD Consultants
503-504, Mayuresh Chambers Premises, Plot No. 60,
Sector -11, CBD Belapur, Navi Mumbai. 400 614.
Maharashtra.
Phone : +91-22-2756 4586 / 2756 5313
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

IRB INFRASTRUCTURE TRUST

PALSIT TO DANKUNI SECTION OF NH 19 IN THE STATE OF WEST BENGAL (KM 588.870 TO KM 652.700)

APRIL 2023

TTRAFFIC STUDY & REVENUE PROJECTION REPORT (FINAL)

GMD CONSULTANTS ★ NAVI MUMBAI ★

GMD Consultants
2, Park View Society, Sector -17,
Nerul East, Navi Mumbai. 400706. Maharashtra.
Phone : +91-22-27716391 / 27700233 / 27700991
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in

GMD Adding Value

PALSIT TO DANKUNI SECTION OF NH 19
IN THE STATE OF WEST BENGAL
(KM 588.870 TO KM 652.700)

TRAFIC STUDY & REVENUE
PROJECTION REPORT (FINAL)

APRIL 2023

GMD CONSULTANTS ★ NAVI MUMBAI ★

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AADT	-	Annual Average Daily Traffic	**NHAI**	-	National Highway Authority of India
BOT	-	Build Operate Transfer	**NHDP**	-	National Highways Development Project
CAGR	-	Compound Annual Growth Rate	**NSDP**	-	Net State Domestic Product
CTV	-	Classified traffic volume	**O&M**	-	Operation & Maintenance
DBFOT	-	Design, Build, Finance, Operate & Transfer	**PCDP**	-	Per Capita Domestic Product
EME	-	Earth Moving Equipment	**PCI**	-	Per Capita Income
GDP	-	Gross Domestic Product	**PCU**	-	Passenger Car Unit
GSDP	-	Gross State Domestic Product	**PSC**	-	Pre-stressed Concrete
HCM	-	Heavy Construction Machinery	**RCC**	-	Reinforced cement concrete
HCV	-	Heavy Commercial Vehicle	**RHS**	-	Right Hand Side
HTMS	-	Highway Traffic Management System	**SH**	-	State Highway
IRC	-	Indian Road Congress	**TP**	-	Toll Plaza
IRR	-	Internal Rate of Return	**WPI**	-	Wholesale Price Index
LCV	-	Light Commercial Vehicle	**SIR**	-	Special Investment Region
LHS	-	Left Hand Side	**c.**	-	Circa
LGV	-	Light Goods Vehicle	**ROB**	-	Railway Over Bridge
MAV	-	Multi Axle Vehicle	**MDR**	-	Major District Road
MORTH	-	Ministry of Road Transport and Highways	**ODR**	-	Other District Road
NH	-	National Highway	**CA**	-	Concession Agreement
PCC	-	Plain Cement Concrete	**RMT**	-	Running Meter
CR	-	Coarse Rubble			

CHAPTER 1

INTRODUCTION

1.1 Background

The Government of India through National Highway Authority of India (NHAI) embarked upon a program to enhance the traffic capacity and safety for efficient transportation of goods as well as passenger traffic on National Highway Sections under NHDP Phase V. Under Phase V NHAI has planned to convert 6,500 km of existing 4-lane National Highways into 6-lane National Highway. Sections envisaged under 6-laning comprise the Golden Quadrilateral section (5,700 km) and some other sections which are 800 km in length.

The project under consideration, **Palsit** to **Dankuni** section of NH-19 from km 588.870 to km 652.700 is one such road project NHAI intended to implement on a BOT basis in the DBFOT format. *M/s Palsit Dankuni Tollway. Ltd*. (Concessionaire) has been awarded the Project for a concession period of 17 years starting from 2nd April 2022. The Project has been commissioned and is currently under construction for six laning. Six laning of project is underway and expected to complete soon.

Project stretch from Palsit to Dankuni is part of new NH-19 Which was previously referred as Delhi -Kolkata. During renumbering of National Highway, Delhi to Agra route was numbered as NH-44 and Agra to Kolkata has been assigned as NH-19. From transportation point of view it is Delhi – Kolkata corridor.

New NH-19 connects industrial cities like Agra, Kanpur, Allahabad, Varanasi, Dhanbad, Durgapur, Bardhman and terminates at Dankuni near Kolkata. Close proximity to Kolkata and Howrah has given impetus to industrial development around project highway at various locations.

Old Delhi road (GT Road) lies on east of project highway from Palsit onwards. Project stretch is developed at new alignment between Palsit and Dankuni and is known as Durgapur Expressway. Following figure shows the alignment of project stretch.

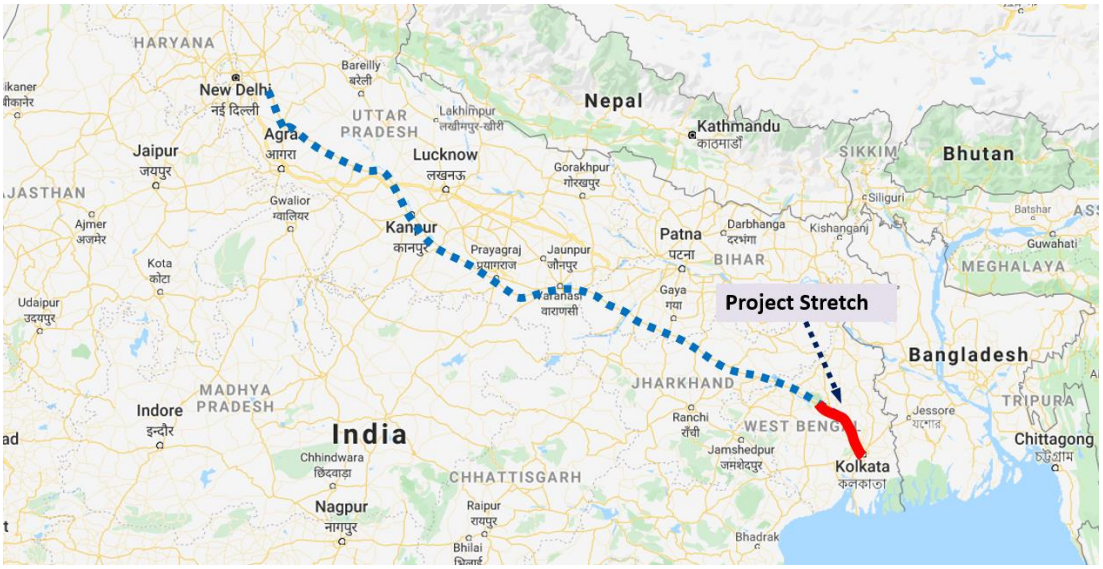


Figure 1-1: Alignment of Project Stretch

1.2 Objective of the Study

M/s IRB INFRASTRUCTURE TRUST has engaged *GMD Consultants* to assess the future traffic and toll potential of project stretch.

This report named as **"Traffic Study &*Toll Revenue Projection Report*"** mainly focuses on traffic and revenue aspects of the project. Other parameters like competing road, area developments etc. have been considered from a traffic development point of view.

1.2.1 Scope of Services

The broad scope of work covered in the assignment is as follows

a) Analysis of Traffic Growth
b) Toll Rate Growth
c) Revenue Forecasting

The Concessionaire has provided basic traffic data and other project details on the basis of which the above analysis has been carried out.

CHAPTER 2

PROJECT DETAILS

2.1 Project Corridor

National Highway 2 (NH 2) which is now renumbered as NH-19 is oldest highway in India and connects state of Delhi, Haryana, Uttar Pradesh, Bihar, Jharkhand and West Bengal. It constitutes a major portion of historical grand truck road.

It connects the national capital Delhi to the Kolkata, as well as important cities Mathura, Agra, Kanpur, Allahabad, Varanasi, Dhanbad, Asansol, Durgapur and Bardhman. The highway is part of the Golden Quadrilateral project undertaken by National Highways Authority of India (NHAI).

The project road is final link on Kolkata side between Palsit and Dankuni in the state of West Bengal. Dankuni is just out the outskirt of Kolkata on northern side. The main project influence area of the project road consists of Dhanbad, Durgapur and Kolkata.

2.2 Project Stretch Description

Section of NH-19 from Palsit to Dankuni is part of major transportation link in the area connecting industrial cities of Dhanbad, Asansol, Durgapur and Kolkata. Project stretch is basically and gateway link to Kolkata from northern India. Being just on outskirt of major metro city Kolkata large number of ware houses and logistic hubs are established on project road. This also contributes to sustainable traffic and growth on project highway.

There is one operative toll plaza at project stretch which is at Dankuni at km 646.005. Following figure show project alignment and toll plaza location.

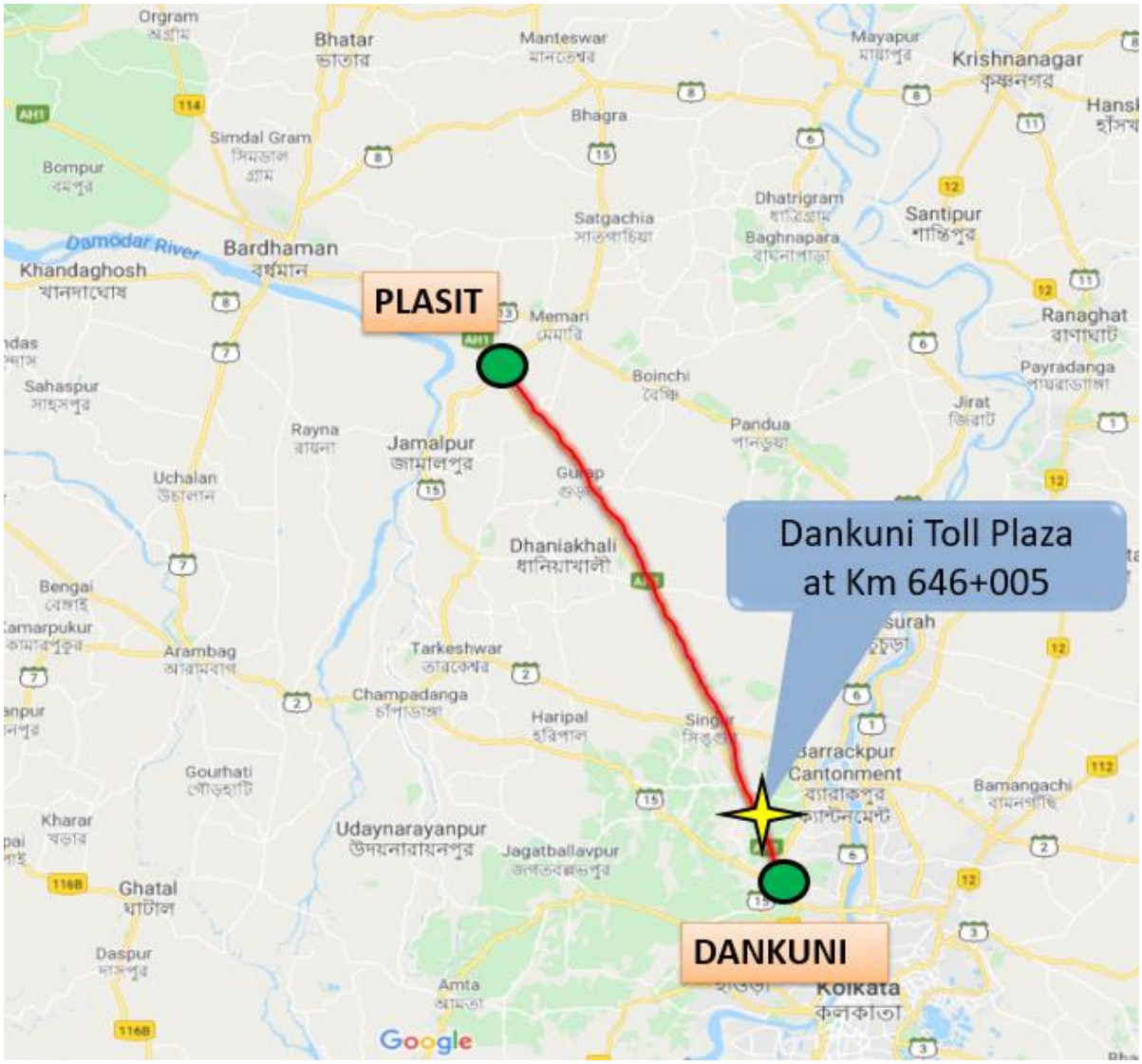


Figure 2-1: Project Alignment with Toll Plaza

2.3 Project Corridor Illustration

Four lane project is under operation. Six laning has commenced on corridor. Following photographs illustrate project section along the corridor.

Figure 2-2: Photographs showing Project Corridor

CHAPTER 3

TRAFFIC SURVEYS AND ANALYSIS

3.1 Traffic Surveys

The Consultants have collected the required information for project corridor to understand the general traffic and travel characteristics on the corridor.

The following traffic data has been collected from client for project.

- Classified traffic volume counts at toll plaza location on Palsit - Dankuni section of NH-19 for Yr.2022-23.
- Local Component of traffic
- Component of Return Journey
- Component of Monthly Pass Journey

The main objective of the traffic data analysis is to:

- Determine the existing traffic movement characteristics of the project
- Establish base year traffic
- Identification of travel patterns and modal split of project traffic
- Deriving growth factors for traffic forecasting
- Estimation of corridor traffic including traffic diversion if any
- Preparation of revenue model and projection of revenue as per toll policy for various scenarios

Table 3-1below lists provides details of locations from where traffic details have been collected.

Table 3-1 : Traffic Data Details

SR. NO	LOCATION	CTV	Single Journey Traffic	Daily Return Journey	Monthly Pass	Local Pass

1	Toll Plaza Dankuni at km 646.005	AADT for Yr.2022-23	AADT for Yr.2022-23	AADT for Yr.2022-23	AADT for Yr.2022-23	AADT for Yr.2022-23

3.2 Classified Traffic Volume

The objective of conducting a Classified Traffic Volume Count is to understand the traffic flow pattern including modal split on a roadway. The Classified Traffic Volume Count survey has been provided by the concessionaire of project highway from actual traffic data gathered at toll plaza locations based on monthly data shared with NHAI.

The vehicles can broadly be classified into fast moving / motorized and slow moving / non-motorized vehicles, which can be further classified into specific categories of vehicles. The groupings of vehicles are further segregated to capture the tollable vehicle categories specifically and toll exempted vehicles are counted separately. The detailed vehicle classification system as per IRC: 64-1990 is given in table below

Table 3-2 : Vehicle Classification System

Vehicle Type	
Auto Rickshaw	
Passenger Car	Car, Jeep, Taxi & Van (Old / new technology)
Bus	Minibus
	Standard Bus
Truck	Light Goods Vehicle (LCV)
	2 – Axle Truck
	3 Axle Truck (HCV)
	Multi Axle Truck (4-6 Axle)
	Oversized Vehicles (7 or more axles)
Other Vehicles	Agriculture Tractor, Tractor & Trailer

Source - IRC: 64 – 1990

However, since project highway is currently under toll operation, the data collected is corresponding to category of tollable vehicles. Following are the type of vehicles as per concession agreement.

- Car / Jeep / van
- Min Bus /LCV
- Bus
- Truck
- 3-Axle
- Multi Axle

3.3 Traffic Characteristic

Toll revenue of project highway does not solely depend on traffic volume. There are certain characteristics of traffic which have substantial potential to affect toll collection. Component of local traffic, component of passenger and commercial traffic, portion of return journey traffic, % of monthly pass traffic are some of such characteristics of traffic. These will be discussed in subsequent sections of report.

3.3.1 Traffic Data

Project concessionaire has provided Traffic data for base Year 2022-23 as under for toll plaza–

Table 3-3 : Traffic Data at Dankuni Toll Plaza at Km 646.005

Sr. No	Type of Vehicle	Annual Average Daily Traffic Fy-2022-23
1	CAR	10514
2	LCV	1398
3	BUS	789
4	Truck	3707
5	3-Axle	3061
6	Multi Axle	8974
7	Oversize Vehicle	8
	Total	**28451**

Pandemic of COVID-19 (Corona Virus) has impacted entire world. Taking precaution, government of India announced a complete lockdown in last of March 2020 and traffic on highways was stopped which was eased out progressively later.

Traffic on project corridor is recovering at good rate but still traffic numbers had effect of Pandemic. There after India was hit by Covid-19 second and third wave in February 21 to July -21 and December 21 to March-22. Recovering traffic pattern was somewhat again disturbed due to second and third wave of Covid-19. Traffic has almost recovered from Covid -19 impact as of now.

Since the traffic data is available year 2022-23 report has been updated taking this as base year traffic.

This data was then bifurcated to various components like through local, monthly, return journey etc category. Same is discussed in detail in following section.

3.4 Data Analysis

3.4.1 Analysis of Traffic Volume Count

Understanding the character of existing traffic forms the basis of the traffic forecast. The various vehicle types having different sizes and characteristics can be converted into a single unit called Passenger Car Unit (PCU). Passenger Car equivalents for various vehicles are adopted based on recommendations of Indian Road Congress prescribed in "IRC-64-1990: Guidelines for Capacity of Roads in Rural areas". The adopted passenger car unit values (PCU) are presented in ***Table*** 3-4**.**

Table 3-4 : PCU Factors Adopted for Study

Vehicle Type	PCUs
Car	1.0
Minibus	1.5
Standard Bus	3.0
LCV/LGV	1.5
2 Axle Truck	3.0
3 – 6 Axle Truck	4.5
MAV	4.5
Auto Rickshaw	1.0
Van/Tempo	1.0
Agriculture Tractor with Trailer	4.5

Agriculture Tractor without Trailer	1.5

Source: IRC: 64-1990

Traffic volume at each toll plaza was converted to PCU and same is presented as under

Table 3-5 : Traffic in PCU at Project Stretch Base Year 2022-23

Year	Toll Plaza Location (Km)	Traffic No	PCU	PCU Index
2022-2023	Dankuni Km 646.005	28451	75699	2.66

It can be observed from above that project traffic has PCU index More than 2.5 at Dankuni which is an indicator of high proportion of commercial traffic in traffic mix.

3.4.2 Components of Traffic

As discussed previously, components of traffic volume play an important role in determining project revenue. A larger component of commercial traffic with higher axle configuration adds to project revenue positively. Similarly, a larger component of local traffic affects the project revenue potential negatively.

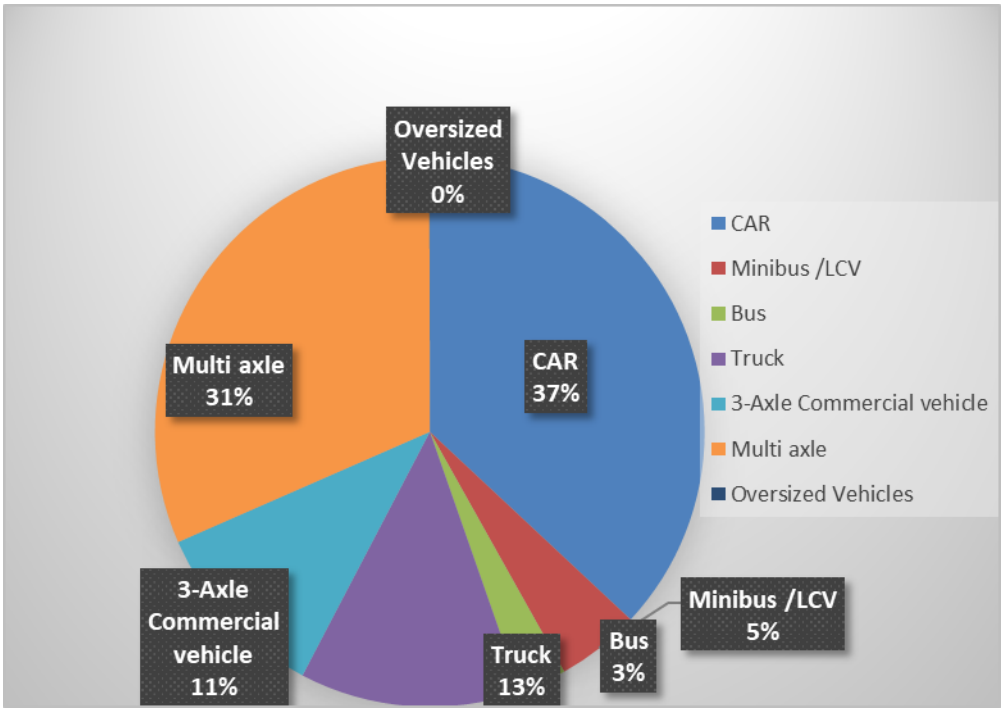


Figure 3-1 :Model Split of Tollable Vehicle-Dankuni Km 646.005

It is observed that car traffic forms about 37% of total traffic at Dankuni toll plaza location while multi axle commercial vehicles and trucks are about 63% of total traffic.

Another important bifurcation of traffic is components of traffic with respect various type of toll ticketing like

1. Single Journey
2. Multi Journey
3. Monthly Pass (Local and General)

The following table provides numbers of vehicles falling in each of above category on base year 2022-23

Table 3-6 : Journey Type Bifurcation of Traffic at Dankuni Toll Plaza KM 646.005

Sr. No	Type	Traffic Volume (Nos.)
		2022-23
1	Single Journey	14201
2	Return Journey	14238
3	Local Commercial Single Journey	0
4	Monthly Pass Local	7
5	Monthly Pass	5

Most dominant part of the above is the single journey type followed by return journey at project stretch. Monthly pass commuters are a very low fraction of the total traffic on the project corridor.

The single journey component in total traffic numbers is a high as 50%. Return journey component is 50%. The number of monthly pass is 0% at Dankuni toll plaza. This indicates higher share of long traffic.

It is observed that the project corridor demonstrates a similar pattern of single journey dominated mix of traffic across the entire stretch which is typical of major national highways.

3.5 Secondary Data Collection

There are several other factors which have a substantial impact on traffic pattern and growth on any project corridor. Following are some of such important factors.

- Industrial development around project corridor and its catchment
- Educational infrastructure along project corridor
- Demographic pattern
- Urban area development
- Tourism potential
- Upcoming major infrastructural or Industrial projects
- Special Industry in project corridor
- Overall trends of economic growth local as well as national / regional

Hence in addition to traffic details on project site, secondary data was also collected from various other sources. Typical secondary data includes the following:

1. Vehicle registration data of regional and national level.
2. Economic Data
   a) GDP
   b) NSDP
   c) Population Growth
   d) Per Capita Income growth
   e) Industrial Growth
   f) Special Industry Potential
   g) Regional and National development vision / plan
   h) Any other relevant data
3. Competing road network

We have collected and utilized such underlying data in the study to estimate the growth and risk factors for traffic along the project corridor.

CHAPTER 4

INFLUENCE ZONE TRANSPORT NETWORK ANALYSIS

4.1 Introduction

Highway corridors behave like integrated circuit network and more often than not every road is connected to various networks having different origin and destinations. Traffic running on these networks behave like fluid and flow on network on alignment of least friction.

Following Factors can be considered as major contributors to friction on transportation network

- Travel Speed / Travel Time
- Geometric deficiencies like blind horizontal curves and steep vertical gradients etc.,
- Configuration of road
- Riding quality
- Traffic delays,
- Length of road,
- Passing through built up or Urban Area,
- Terrain,
- Facilities,

4.2 Competing / Alternate route

Project stretch from Palsit to Dankuni is part of Golden Quadrilateral connecting four metros of India which has been widened to four lane in year 2005. Part of stretch, from Palsit to Dankuni, known as Durgapur Expressway, was constructed at different alignment to the east of old NH-2. Old NH-2, still known as GT road passes through congested built up areas like Memari, Boinchi, Saptagram etc. It has number of level rail crossings as well. Thus, traffic at project stretch is settled and as such has not much scope of diversion.

There are few alternate routes to project stretch. These are discussed in subsequent sections including their potential impact on project traffic.

Old NH-2 (GT Road)

Between Palsit and Dankuni old NH-2 is an available alternate route to project stretch (Durgapur Expressway). Following figure show both Durgapur Expressway and GT road.

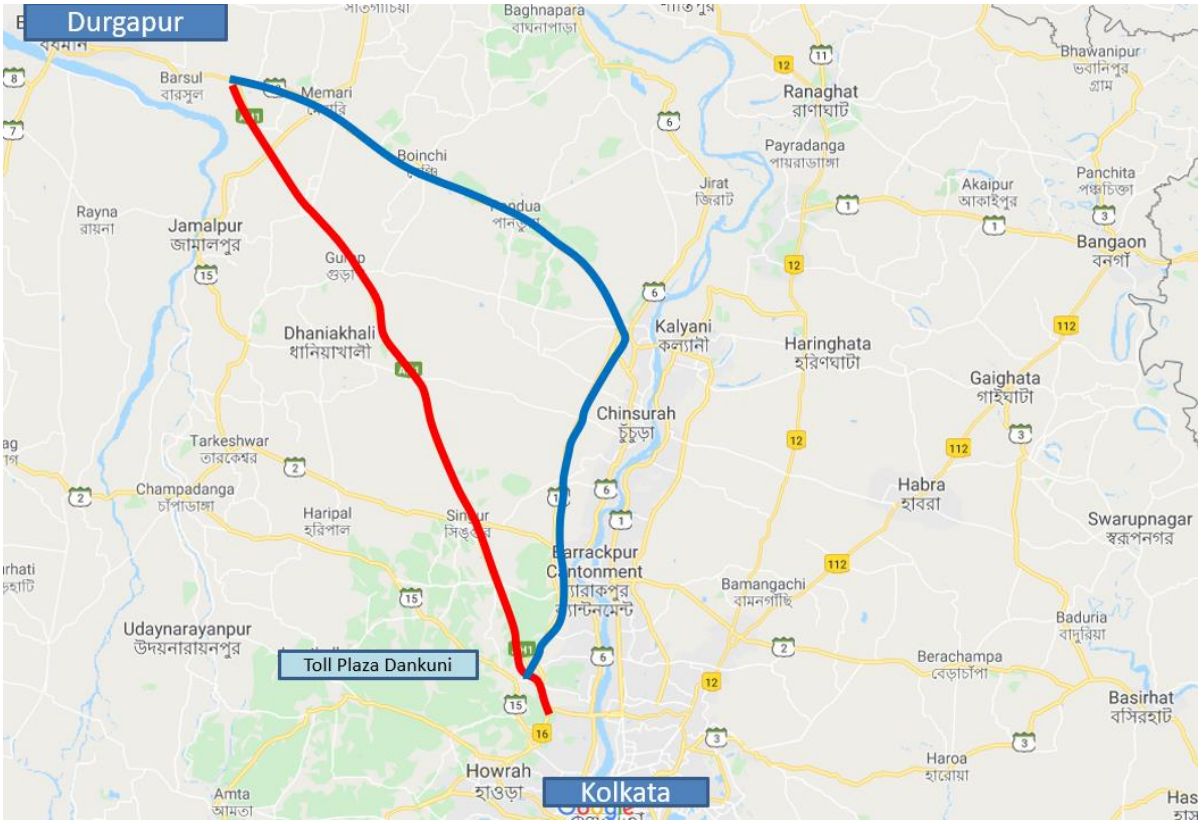


Figure 4-1 Project stretch and alternate GT Road

GT road passes through congested locations and is two lane currently in most of the stretch.

Following figure shows typical condition of GT road as compared to project stretch.

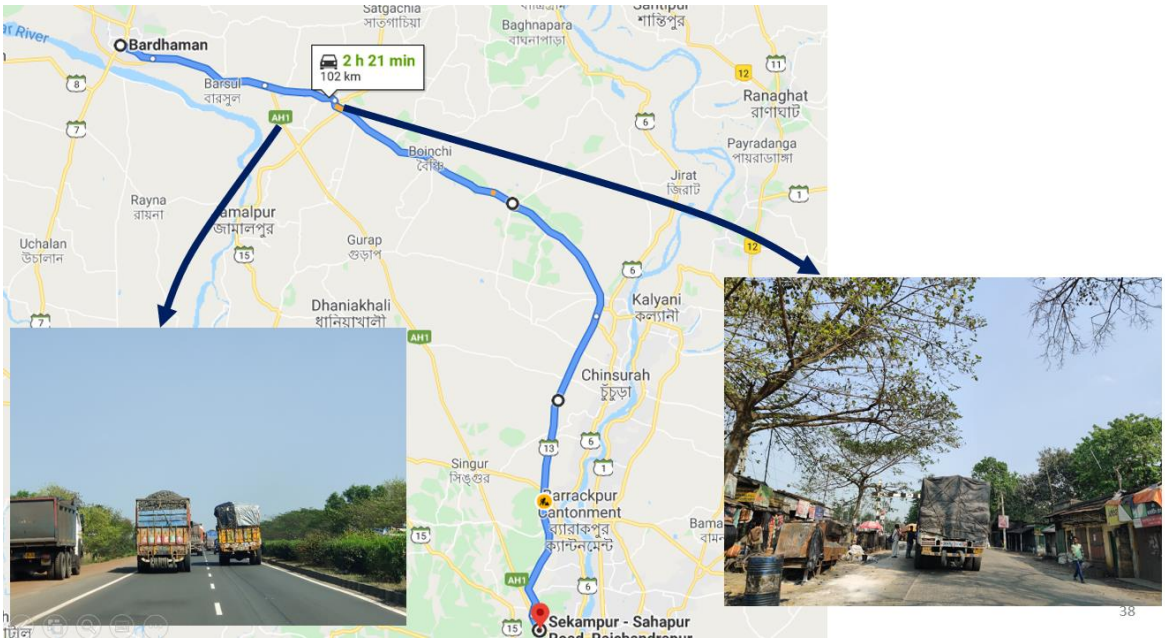


Figure 4-2 Project stretch and alternate GT Road Condition

There are as many as 5 level crossings on GT road which cause traffic congestion. Following figure show one such typical crossing.

Figure 4-3 Railway level crossing at GT road

Following table shows comparison of length and travel time via both project stretch and old GT road between Bardhman and Dankuni.

Table 4-1 Project Road and GT road comparison

Route	Distance (Km)	Time (Min)	Remarks
Bardhman -Kolkata Via Old NH-2 GT Road	102	141	Road is two lane in most places and passes through congested built up areas (Alikhoja, Memari, Boinchi, Saptagram) and 7 level crossings.
Bardhman -Kolkata Via Project Road	**84**	**79**	**Preferred Route**

Project road is quite short and saves lot of time. It such case any material shift of traffic from project stretch to old GT road is not envisaged.

B. Toll Plaza Local Leakage Roads

As such leakage roads are not there at toll plazas but there can be a longer detour to avoid toll plaza. Following figure show location and alignment of these roads at Dankuni Toll plaza.

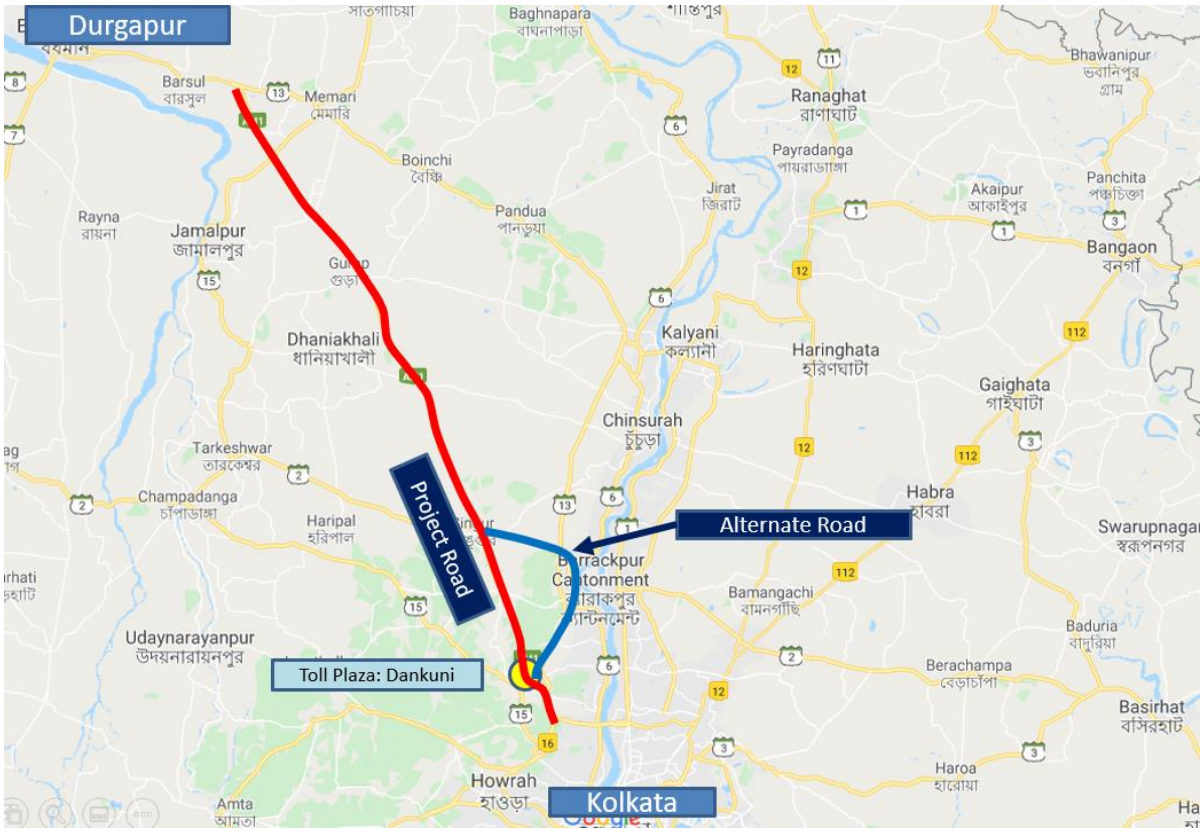


Figure 4-4 Local roads bypassing toll plaza

At **Dankuni Toll Plaza,** there can be one alternate route via Singur- Baidyavati (Tarkeshwar) – Dankuni. Link from Singur to old Delhi road is intermediate/ two lane. It's quite congested and geometrically very poor. Moreover, this road is used by pilgrims to reach famous Tarkeshwar temple of Lord Shiva. Almost all through the year people walk in large groups on the way to Tarkeshwar. Major concentration of this Yatra is in month of February to March and July- August. Following figure show typical condition of this link.

Old GT Road from Tarkeshwar to Dankuni in under widening to four lane. There is one ROB under construction. Toll plaza is also under construction at GT Road. Following figures show under construction ROB and Toll Plaza at GT Road.

Figure 4-5 ROB & Toll Plaza under construction

Following table provides comparison between project road and this alternate route around Dankuni toll plaza.

Table 4-2 Length time comparison of alternate route at Dankuni Toll

Route	Distance (Km)	Time (Min)	Remarks
Via Singur - Delhi Road (Old NH02)	27	41	From Singur to NH-2 road is intermediate lane and congested. Delhi road under four laning. Toll plaza under construction

Via Project road (Dankuni)	**21.4**	**24**	**Preferred Route**

Between Singur and Kolkata- Road from Singur to Old NH-2 is two lane and quite congested. Currently part of NH-2 is under 4 laning and there is no toll as of now. Already passenger vehicles are using. Heavy commercial traffic is not allowed on existing bridge. Hence when ROB will be opened to traffic, certain amount of commercial traffic may divert to alternate route of Singur- NH-2.

Part of alternate route is congested and there is habitation on both sides. Progress on ROB at GT road has been very slow which is further impacted by pandemic COVI-19. As the route is existing since long and traffic is settled on both project stretch and GT road, it is unlikely that any further diversion of passenger traffic would take place. After completion of six laning of project stretch some passenger traffic may also divert to project stretch due to better traffic conditions at project stretch. However same is ignored for current analysis and projections.

At present heavy commercial traffic is not allowed on existing ROB on NH-2 however light commercial traffic is using the same. Hence some part of above diversion has already taken place.

Geometrics and condition of road from Singur to GT road is not good but still some amount of commercial traffic may divert to old GT road after ROB at GT road is competed. Following table shows potential diversion of traffic commercial traffic is taken into consideration for projection of traffic. Considering the above facts following diversion of commercial traffic has been assumed for traffic projections in 2025-26.

- Optimistic Case- 5%
- Most Likely Case- 10%
- Pessimistic Case- 15%

CHAPTER 5

GROWTH OF TRAFFIC ON PROJECT HIGHWAY

5.1 Introduction

Traffic growth is a function of the interplay of a number of contributory factors such as National economy, Government policy, socio-economic conditions of the people, and changes in land uses along the project corridor precincts etc. As these factors have a number of uncertainties associated with them, forecasts of traffic are dependent on the projections of other factors such as population, gross domestic product (GDP), vehicle ownership, per capita income (PCI), agricultural output, fuel consumption etc. Future pattern of change in these factors can be estimated with only a reasonable degree of accuracy and hence the resultant traffic forecast levels may not be precise.

Traffic growth forecast for project corridor Surat- Dahisar section of NH-8has been done taking the above factors into consideration. "**IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**" is established best practice and has been used for traffic growth forecast.

5.2 Trend Analysis

One of the methods of estimation of future rate of growth is to assume the same rate of growth as in the past. Although such a method is more suitable to projects of short durations say 5-10 years, however for long term projections it would-be erroneous to assume that the past rate of growth will continue to prevail for a long time in future. Economic conditions, which are major influencing factors, are bound to change over a long period of time. Thus, it would be necessary to modify the past trends of growth suitably.

Elasticity model of growth projection is one of the most widely acceptable methods for traffic forecast. The same is recommended in **IRC: 108-2015-Guidelines for Traffic Prediction on Rural Highways**.

In this method the past trend of vehicular data is paired with an economic indicator and a regression analysis is done to yield the economic model of growth. Growth of vehicle traffic varies for different type of vehicle. It is a proven fact that the growth pattern for passenger and goods vehicle is different. Traffic growth on any highway

typically depends on number of economic parameters. Most important and direct parameters are given as under

- Per Capita Income
- Net State Domestic Product (NSDP)
- Population

It can be observed that the ownership of a car is more closely related to affordability; hence per capita is the index which closely fits the growth of car traffic among other criteria. In a similar fashion, the following can be pairs of vehicle type and independent variable for elasticity modeling of growth.

- Car / Jeep – Par Capita Income
- Bus / Minibus – Population
- Goods Vehicle – NSDP

5.3 Estimation of Traffic Demand Elasticity

Elasticity of traffic demand is defined as the rate at which traffic intensity varies due to a change in the corresponding indicator selected. Hence, in order to estimate the elasticity of traffic demand, it is necessary to establish relationship between the growth in number of given category of vehicles with the relevant economic variable considered, such as NSDP, per capita income and population growth. Latest available data for vehicle registration, per capita income, NSDP and population is used in analysis.

As per IRC: 108-1996 the model for estimating elasticity index for the project corridor is of the following form and is given as below:

$$Log\ (P) = k \times Log\ (EI) + A$$

Where,

P = *Number of Vehicles (Mode wise)*

EI = *Economic Indicator*

A = *Regression constant*

k = *Elasticity coefficient (Regression coefficient)*

The elasticity for car and bus (passenger vehicles) is calculated based on the Population and Per Capita Domestic Product (PCDP) and the elasticity for trucks is calculated based on the Net State Domestic Product (NSDP).

As observed in OD analysis, project stretch has share of traffic from mainly three states of West Bengal, Jharkhand and Bihar and some traffic from Uttar Pradesh and

Delhi. Hence regression of dependent variable and traffic has been done for these three states. Following tables and graphs present summary of elasticity model of growth for project corridor.

Table 5-1 : Per Capita Income Vs. Car- West Bengal

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2011	31314	610218	4.50	5.79		
2012	32164	695463	4.51	5.84	3%	
2013	34177	791069	4.53	5.90	6%	
2014	36293	829478	4.56	5.92	6%	
2015	38624	916475	4.59	5.96	6%	5.40%

Regression analysis of above is given in following figure

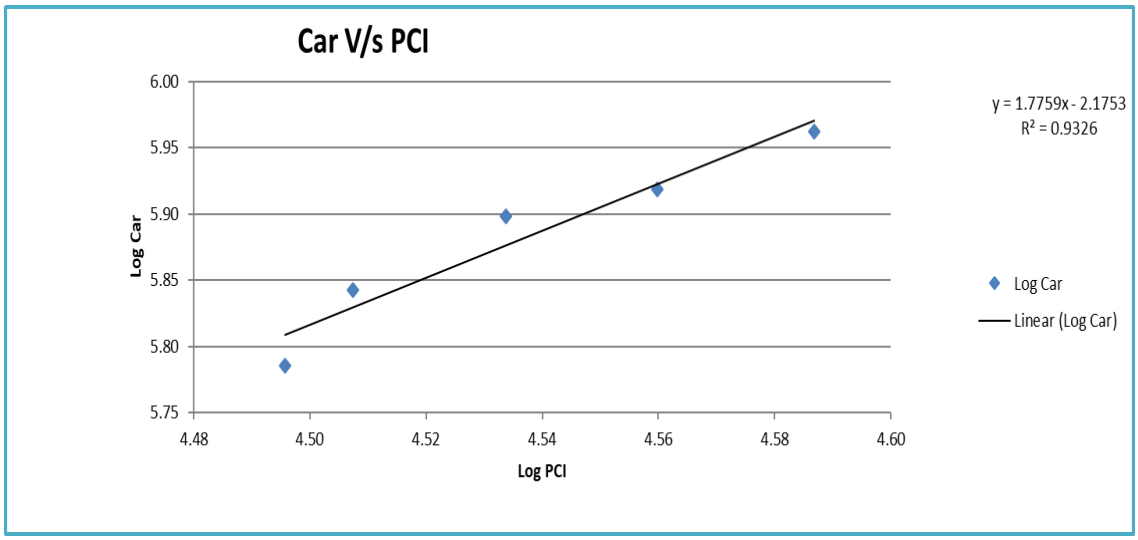


Figure 5-1 : Regression Analysis Car Vs. PCI West Bengal

Table 5-2 : NSDP Vs. Truck- West Bengal

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2011	27919100	285733	7.45	5.46		
2012	28943200	318573	7.46	5.50	4%	
2013	31033800	344816	7.49	5.54	7%	
2014	33242500	350565	7.52	5.54	7%	
2015	35684500	377636	7.55	5.58	7%	6.34%

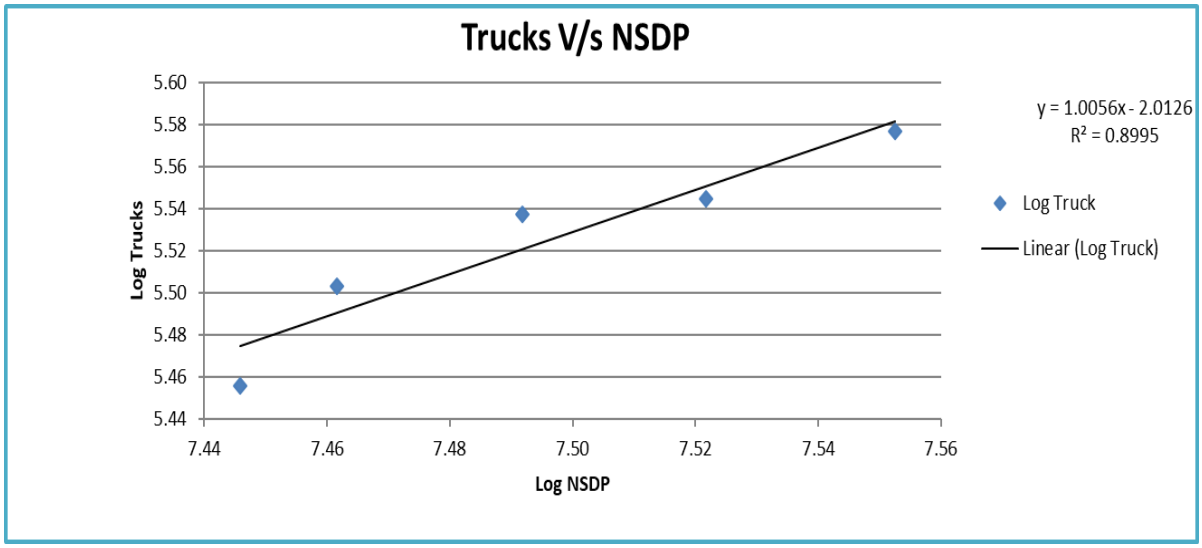


Figure 5-2 : Regression Analysis NSDP Vs. Truck West Bengal

Summary of regression analysis for elasticity and growth estimation for West Bengal are given in following table

Table 5-3 : Summary Regression Analysis- West Bengal

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average IV Growth (5yrs)	Growth Elastic Model	Remarks
West Bengal	Car/Jeep	PCI	y = 1.7759x - - 2.1753	R^2 = 0.9326	1.7759	5.40%	9.58%	Good Regression
	Bus	Population	y = 0.5092x - 0.5636	R^2 = 0.0364	0.5092	0.89%	0.46%	Poor Regression
	Truck	NSDP	y = 1.0056x - - 2.0126	R^2 = 0.8995	1.0056	6.34%	6.37%	Good Regression

Similarly, regression tables and graphs of economic model for Jharkhand are given as under.

Table 5-4 : Per Capita Income Vs. Car- Jharkhand

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2011	24330	317931	4.39	5.50		
2012	25265	360662	4.40	5.56	4%	
2013	27010	408016	4.43	5.61	7%	
2014	28882	461587	4.46	5.66	7%	
2015	30950	522192	4.49	5.72	7%	6.2%

Regression analysis of above is given in following figure

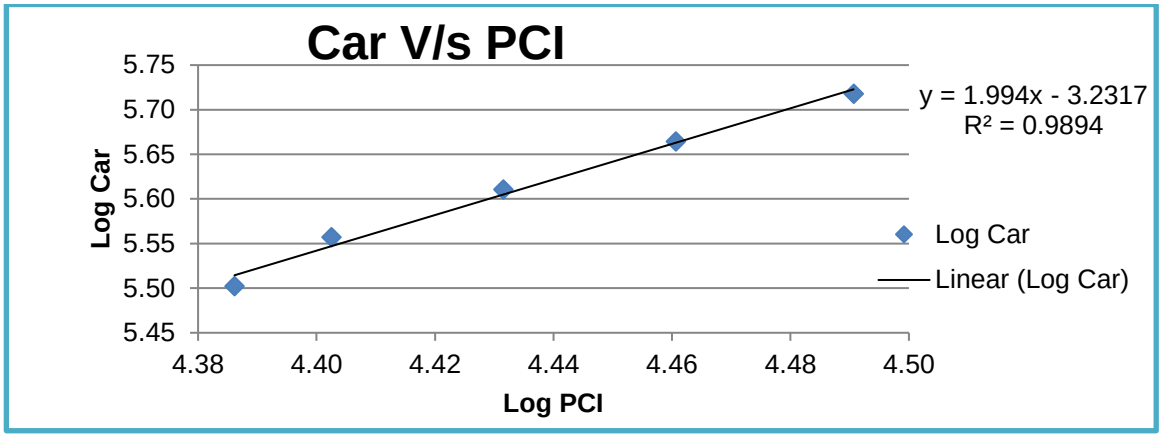


Figure 5-3 : Regression Analysis Car Vs. PCI Jharkhand

Table 5-5 : Population Vs. Bus- Jharkhand

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2011	31292000	12847	7.50	4.11		
2012	31726000	13561	7.50	4.13	1%	
2013	32159000	14189	7.51	4.15	1%	
2014	32588000	14846	7.51	4.17	1%	
2015	33020000	15534	7.52	4.19	1%	1.35%

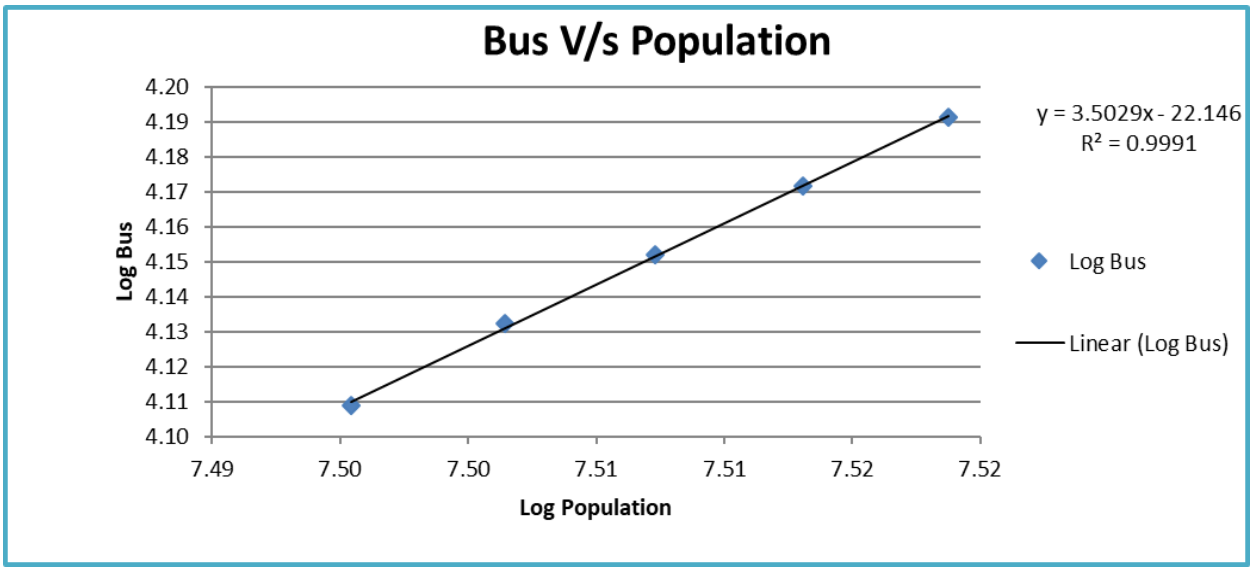


Figure 5-4 : Regression Analysis Population Vs. Bus Jharkhand

Table 5-6 : NSDP Vs. Truck- Jharkhand

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2011	76134	100257	4.88	5.00		
2012	80157	107769	4.90	5.03	5%	
2013	86861	114903	4.94	5.06	8%	
2014	94121	121031	4.97	5.08	8%	
2015	102196	127374	5.01	5.11	9%	7.65%

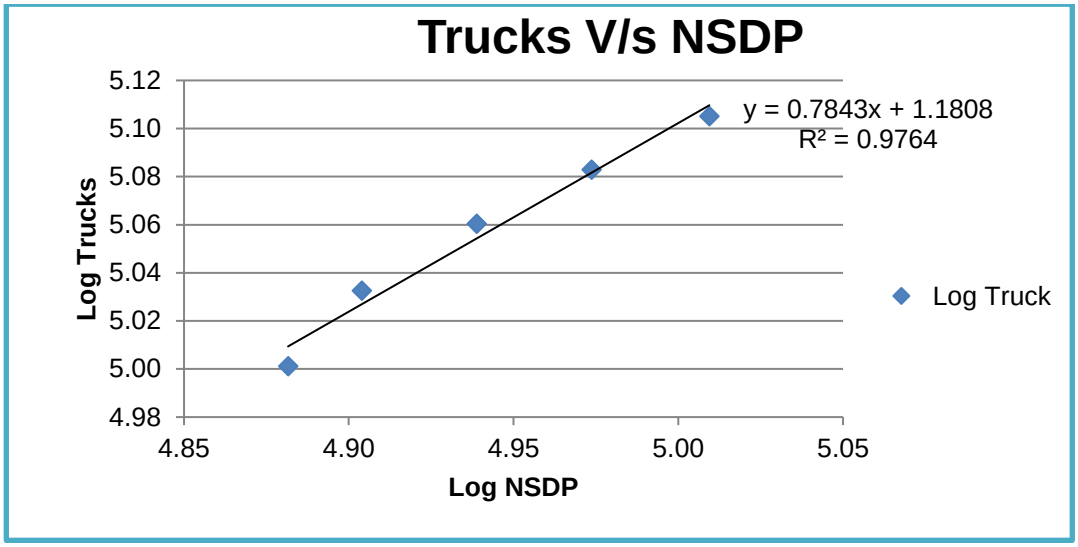


Figure 5-5 : Regression Analysis NSDP Vs. Jharkhand

Summary of regression analysis for elasticity and growth estimation for Jharkhand are given in following table

Table 5-7 : Summary Regression Analysis- Jharkhand

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average IV Growth (5yrs)	Growth Elastic Model	Remarks
JHARKHAND	Car/Jeep	PCI	y = 1.994x - -3.2317	R^2 = 0.9894	1.9940	6.21%	12.38%	Good Regression
	Bus	Population	y = 3.5029x - - 22.1461	R^2 = 0.9991	3.5029	1.35%	4.74%	Good Regression
	Truck	NSDP	y = 0.7843x - 1.1808	R^2 = 0.9764	0.7843	7.65%	6.00%	Good Regression

Similar analysis for state of Bihar is presented in table and regression graphs given below.

Table 5-8 : Per Capita Income Vs. Car- Bihar

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2011	12090	136845	4.08	5.14		
2012	13149	160340	4.12	5.21	9%	
2013	14356	184792	4.16	5.27	9%	
2014	15506	208205	4.19	5.32	8%	
2015	16801	235762	4.23	5.37	8%	8.6%

Regression analysis of above is given in following figure

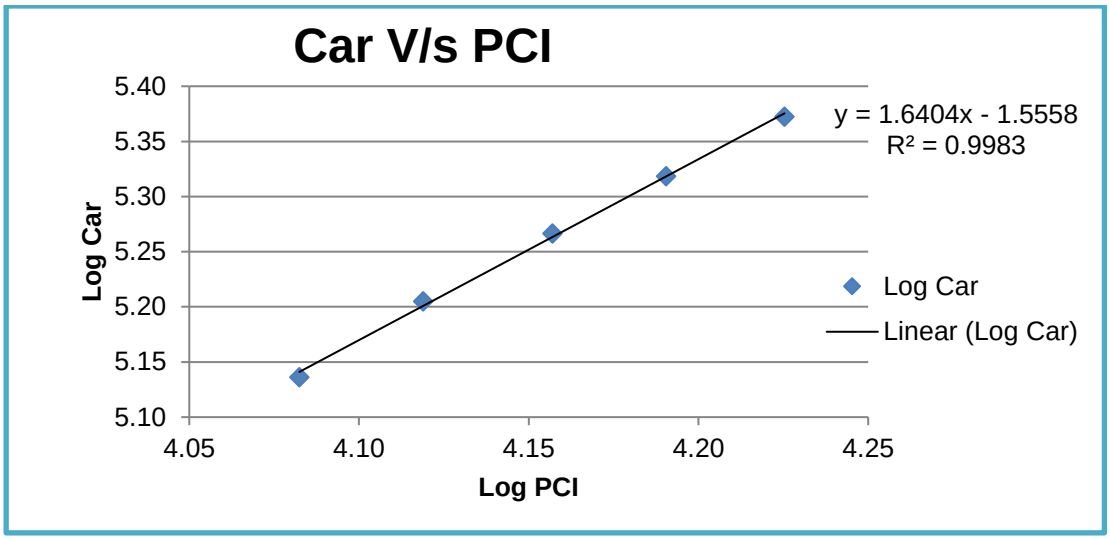


Figure 5-6 : Regression Analysis Car Vs. PCI Bihar

Table 5-9 : Population Vs. Bus- Bihar

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2011	104099452	22703	8.02	4.36		
2012	106763632	24097	8.03	4.38	3%	
2013	109441349	25992	8.04	4.41	3%	
2014	112131327	27638	8.05	4.44	2%	
2015	114832300	29384	8.06	4.47	2%	2%

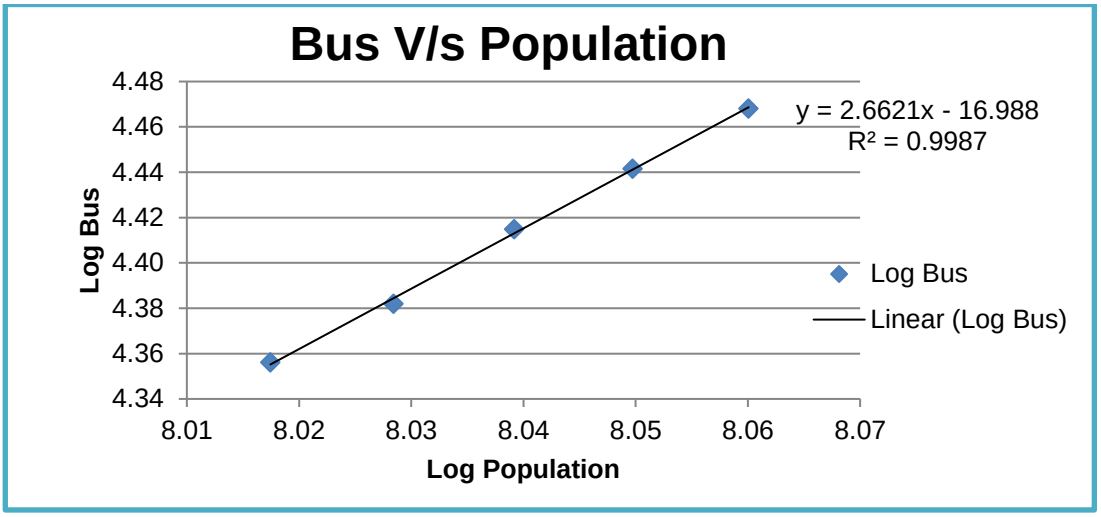


Figure 5-7 : Regression Analysis Population Vs. Bus Bihar

Table 5-10 : NSDP Vs. Truck- Bihar

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2011	11750314	73472	7.07	4.87		
2012	12952142	83191	7.11	4.92	10%	
2013	14324962	103211	7.16	5.01	11%	
2014	15667055	109010	7.19	5.04	9%	
2015	17180244	123744	7.24	5.09	10%	10%

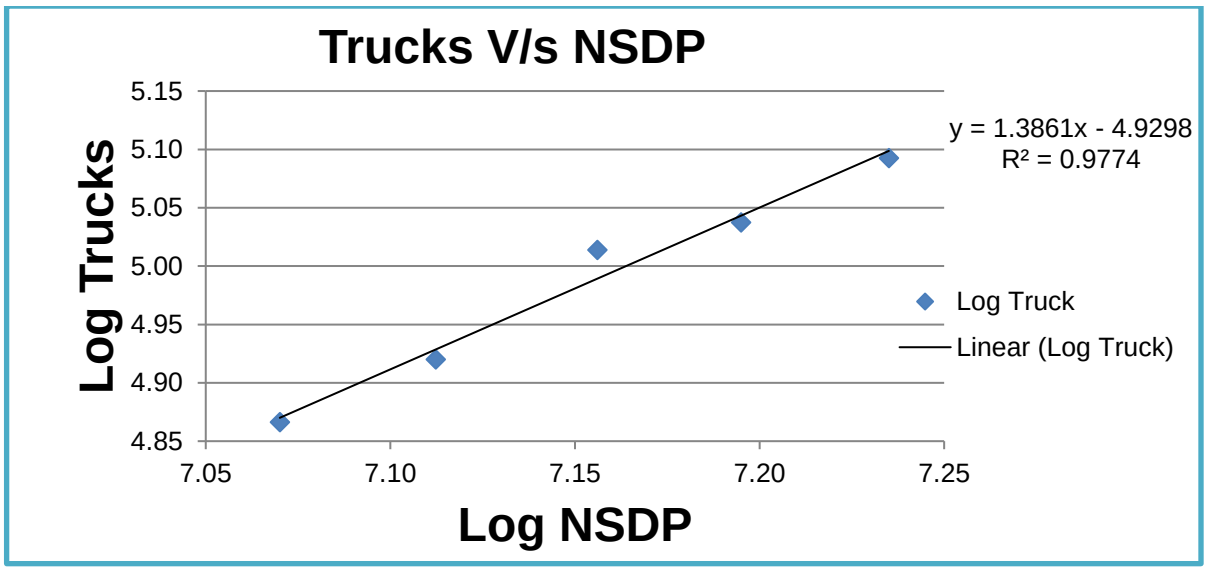


Figure 5-8 : Regression Analysis NSDP Vs. Truck Bihar

Summary of regression analysis for elasticity and growth estimation for Biharis given in following table

Table 5-11 : Summary Regression Analysis- Bihar

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average IV Growth (5yrs)	Growth Elastic Model	Remarks
BIHAR	Car/Jeep	PCI	y = 1.6404x - - 1.5558	R^2 = 0.9983	1.6404	8.58%	14.07%	Good Regression
	Bus	Population	y = 2.6621x - - 16.988	R^2 = 0.9987	2.6621	2.48%	6.61%	Good Regression
	Truck	NSDP	y = 1.3861x - - 4.9298	R^2 = 0.9774	1.3861	9.96%	13.81%	Good Regression

Table 5-12 : Per Capita Income Vs. Car- Uttar Pradesh

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2011	17388	984937	4.24	5.99		
2012	18014	1108100	4.26	6.04	4%	
2013	18635	1205374	4.27	6.08	3%	
2014	19233	1423020	4.28	6.15	3%	
2015	20057	1572217	4.30	6.20	4%	4%

Regression analysis of above is given in following figure

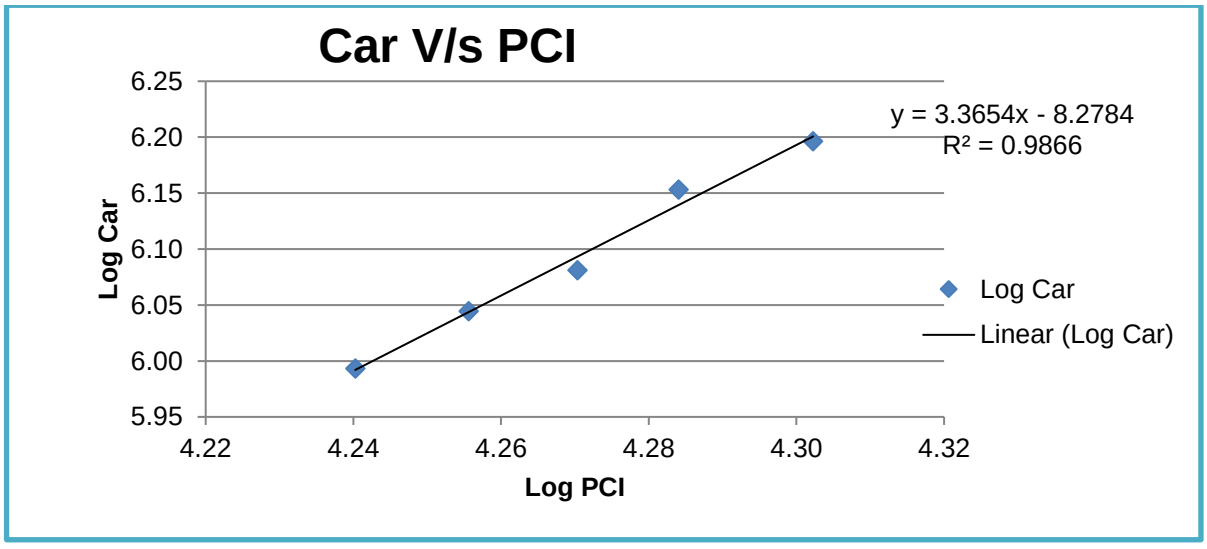


Figure 5-9 : Regression Analysis Car Vs. PCI Uttar Pradesh

Table 5-13 : Population Vs. Bus- Uttar Pradesh

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2011	199812341	31922	8.30	4.50		
2012	203382046	34428	8.31	4.54	2%	
2013	206942855	40501	8.32	4.61	2%	
2014	210493544	45607	8.32	4.66	2%	
2015	214032922	51866	8.33	4.71	2%	2%

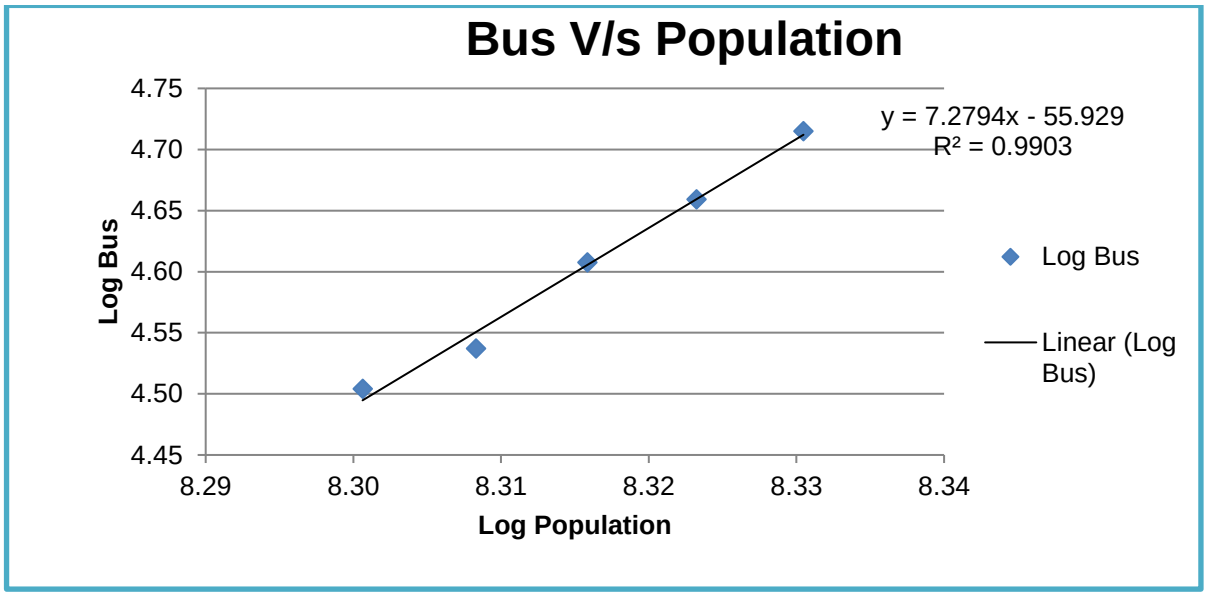


Figure 5-10 : Regression Analysis Population Vs. Bus Uttar Pradesh

Table 5-14 : NSDP Vs. Truck- Uttar Pradesh

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2011	34662085	307058	7.54	5.49		
2012	36537453	338977	7.56	5.53	5%	
2013	38445814	400061	7.58	5.60	5%	
2014	40350882	467786	7.61	5.67	5%	
2015	42775892	511631	7.63	5.71	6%	5%

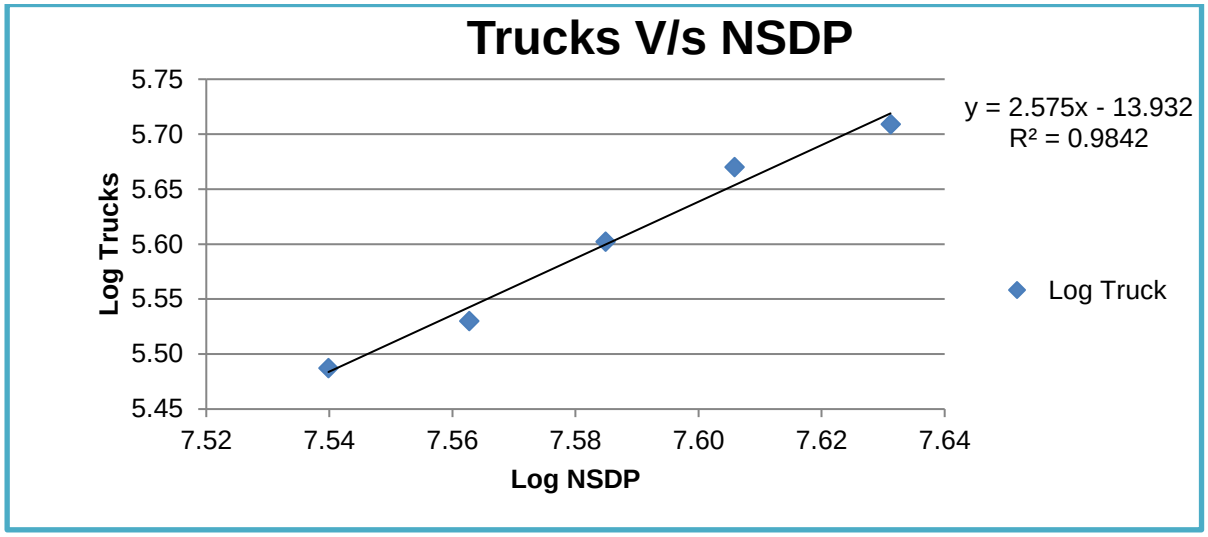


Figure 5-11 : Regression Analysis NSDP Vs. Truck Uttar Pradesh

Summary of regression analysis for elasticity and growth estimation for Uttar Pradesh are given in following table

Table 5-15 : Summary Regression Analysis- Uttar Pradesh

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average IV Growth (5yrs)	Growth Elastic Model	Remarks
Uttar Pradesh	Car/Jeep	PCI	y = 3.3654x - -8.2784	R² = 0.9866	3.3654	3.64%	12.23%	Good Regression
	Bus	Population	y = 7.2794x - -55.9289	R² = 0.9903	7.2794	1.73%	12.62%	Good Regression
	Truck	NSDP	y = 2.575x - -13.9315	R² = 0.9842	2.5750	5.40%	13.90%	Good Regression

Table 5-16 : Per Capita Income Vs. Car- Delhi

Year	PCI	Car	Log PCI	Log Car	PCI Growth	Average Growth
2011	103619	2258434	5.02	6.35		
2012	106677	2303052	5.03	6.36	3%	
2013	112441	2497167	5.05	6.40	5%	
2014	118411	2691282	5.07	6.43	5%	
2015	124698	2859620	5.10	6.46	5%	5%

Regression analysis of above is given in following figure

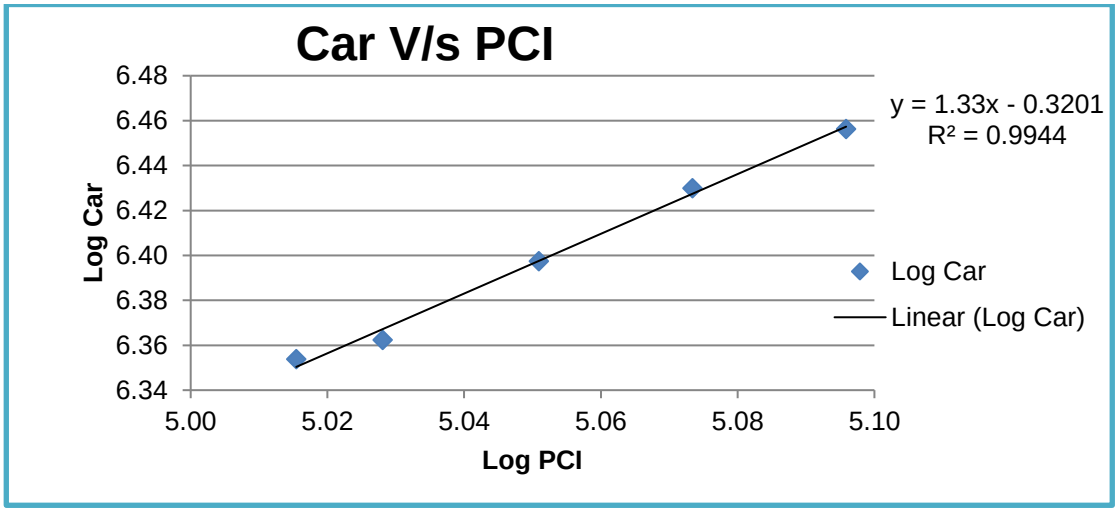


Figure 5-12 : Regression Analysis Car Vs. PCI Delhi

Table 5-17 : Population Vs. Bus- Delhi

Year	Population	Buses	Log Pop	Log Bus	Pop Growth	Average Growth
2011	16622000	135125	7.22	5.13		
2012	16941000	137310	7.23	5.14	2%	
2013	17266000	139495	7.24	5.14	2%	
2014	17597000	141680	7.25	5.15	2%	
2015	17934000	143865	7.25	5.16	2%	1.92%

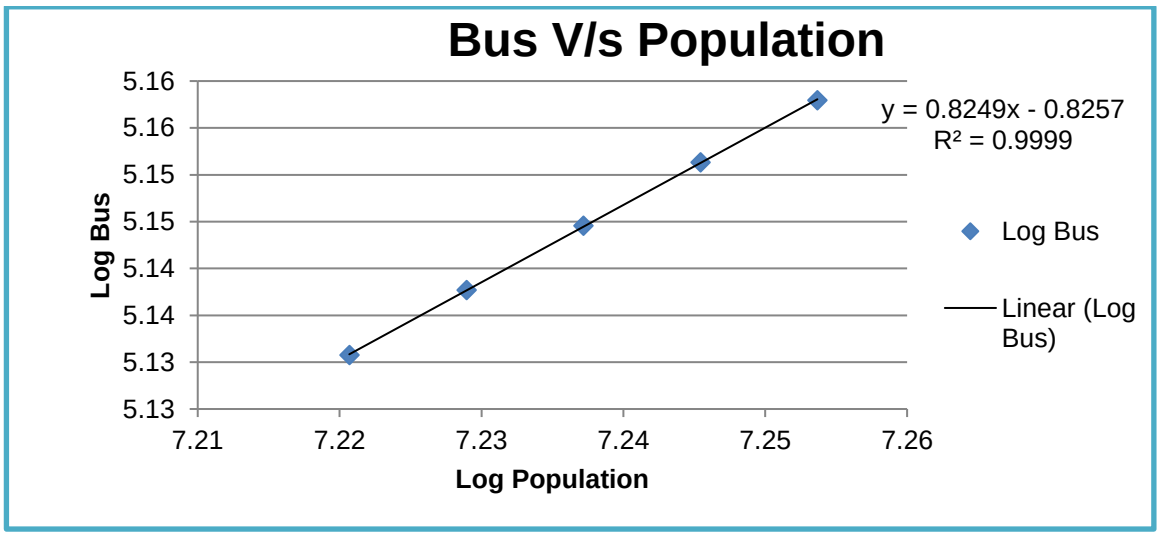


Figure 5-13 : Regression Analysis Population Vs. Bus Delhi

Table 5-18 : NSDP Vs. Truck- Delhi

Year	NSDP	Trucks	Log NDSP	Log Truck	NSDP Growth	Average Growth (5 Year)
2011	17223524	86301	7.24	4.94		
2012	18072223	87166	7.26	4.94	5%	
2013	19414032	88031	7.29	4.94	7%	
2014	20836819	88896	7.32	4.95	7%	
2015	22562961	89761	7.35	4.95	8%	7%

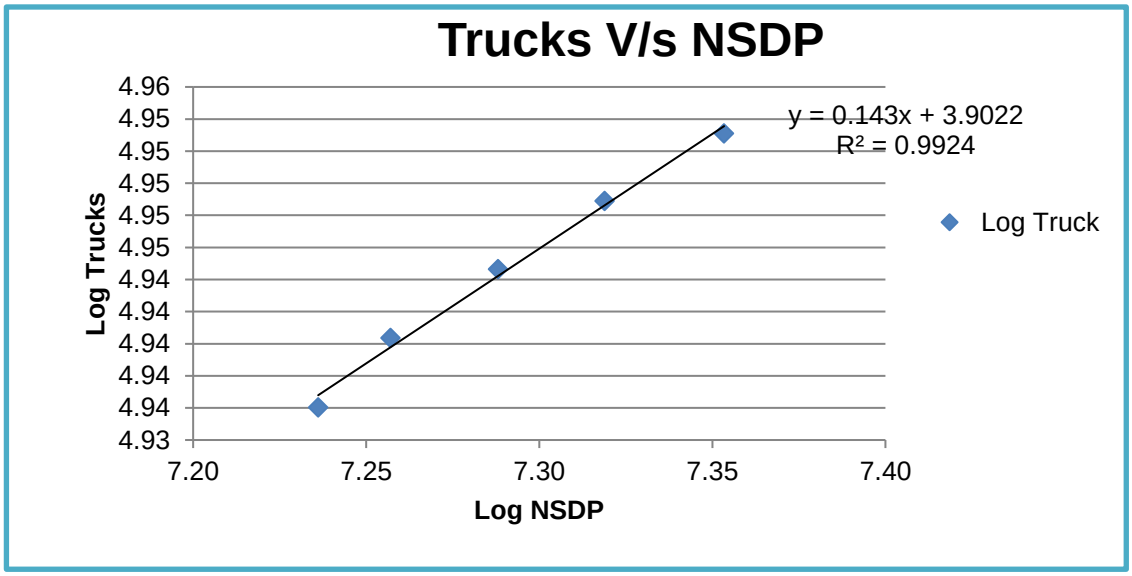


Figure 5-14 : Regression Analysis NSDP Vs. Truck Delhi

Summary of regression analysis for elasticity and growth estimation for Delhi are given in following table.

Table 5-19 : Summary Regression Analysis- Delhi

State	Vehicle Category	Independent Variable	Regression Equation	R Square	Elasticity Coefficient (y)	Average IV Growth (5yrs)	Growth Elastic Model	Remarks
Delhi	Car/Jeep	PCI	y = 1.33x - -0.3201	R^2 = 0.9944	1.3300	4.74%	6.31%	Good Regression
	Bus	Population	y = 0.8249x - -0.8257	R^2 = 0.9999	0.8249	1.92%	1.58%	Good Regression
	Truck	NSDP	y = 0.143x - 3.9022	R^2 = 0.9924	0.1430	6.99%	1.00%	Good Regression

Since most of the passenger traffic is from West Bengal and Jharkhand only hence growth from economical model is considered only from these states.

For commercial traffic weighted impact of these states in ratio of their respective share is considered

5.4 Analysis of Historic Traffic Data

Historical traffic data forms useful information for any highway project. It provides useful information for establishing past trend of growth. Project stretch of Agra to Etawah has recently been commissioned and is under tolling operation since 2022 with concessionaire. Hence, we do not have sufficient data points to be able to establish a reliable past trend of traffic growth. Moreover, part two years traffic is affected by COVID-19 impact. A minimum of about 5 -6 years' traffic data is required for establishing a reliable past trend.

5.5 Other Factors Influencing Growth

There are many factors which have impact on traffic growth. As discussed previously these factors can be economic, social, educational, and industrial.

Potentiality of such factors for project highway is discussed as under.

ECONOMY

After witnessing a slowdown during 2011-12, the economy recovered in 2013-14, and a high growth rate of GDP was recorded in up to 2018-19. Pandemic of COVID-19 impacted all economies of world including India. Following figure show trend of GDP growth in India.

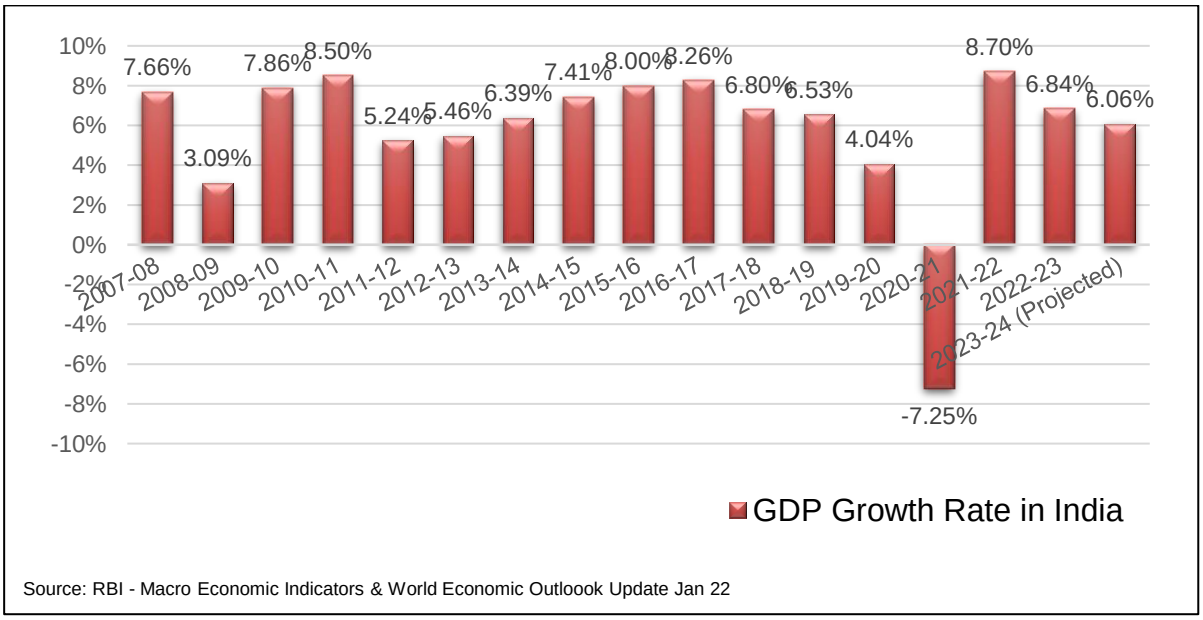


Figure 5-15 : Growth of GDP in India

FY 2017-18 recorded a growth of 6.7% which had slight impact of GST and demonetization. Indian economy appears on recovery path with estimated growth of 6.8% in FY 2018-19. Government took major policy decision including tax infrastructure reforming, banking sector improvement and ease of doing business.

Major economies of world collapsed due to pandemic COVID-19 including India. Indian economy is also registered negative growth in financial year 2020-21. After that Indian economy recovered handsomely and registered a growth of about 9% in Year 2021-22. This was partly due to low base of year 2020-21 as well.

Honorable Prime Minister has announced a major relief package of Rs. 20 lakh crores which is about 10% of GDP. This is aimed at turning this major crisis of COVID-19 into opportunity by providing major impetus to industrial production to the limit of becoming a self-reliant economy. With major thrust of this package being on **Make -In- India** it is expected that industry in India would grow at rapid pace and recover handsomely in post COVID-19 scenario. World Economic Outlook update also has predicted a growth rate of about 7.5 % in next year 2022-23

5.6 Developments along and around the Project Corridor & State

Project stretch falls in one of the most mineral rich area of India. Major Industries are developed for extraction of minerals and related manufacturing. Following are some major industrial establishments and areas in PIA

Howrah - Often termed as Sheffield of the East, Howrah is known as an engineering hub, mainly in the area of light engineering industry. In 1823, Bishop Reginald Heber described Howrah as the place "chiefly inhabited by shipbuilders". There are small engineering firms all over Howrah, particularly around Belilios Road area near Howrah station. There are many foundries in Liluah area.

Burn Standard Company, a major company in heavy engineering industry, has its oldest manufacturing unit located in Howrah. The Howrah plant of Shalimar Paints (established in 1902) was the first large-scale paint manufacturing plant to be set up not only in India but in entire South East Asia. The jute industry suffered during the Partition of Bengal (1947), when the larger jute production area became part of East Pakistan (now Bangladesh). The foundry

industry saw a decline in demand due to growth in steel industry. Still Howrah us major industrial hub in area and Howrah being major terminal on Delhi – Kolkata rail attracts lot of goods movement.

Bardhman - Burdwan was one of the premier districts in India in terms of minerals. The Raniganj coalfield was the birthplace of the Indian coal industry. Besides coal, important minerals found in the district are iron ores, calcium carbonate, abrasives, silica bricks and molding sands, glass sands, building materials, manganese, bauxite, laterite etc. Chittaranjan Locomotives, Bengal Iron Works, IISCO- India Iron and Steel Co are some of major industrial establishments in district.

Dhanbad - Dhanbad have one of the oldest markets of region and is also a hotbed of large-scale industries. It is famous for its coal mines and industrial establishments; the city is surrounded by about 112 coal mines with a total production of 27.5 million tonnes and an annual income of 7000 million rupees through coal business. There are a number of coal washeries present there. BCCL have it headquarter in Dhanbad and SAIL, Tata Steel and Eastern Coalfields (at Mugma) also operates their mines. Om Besco Rail Products.Ltd, a public limited rail wagon manufacturing company at Mugma, Hindustan Zinc Ltd (now Vendanta Resources) had a lead smelting pilot plant at Tundu, MaithonPower.Ltda J.V of Tata Power & DVC (first PPP project of India), HindusthanMalleables& Forgings Ltd, etc. are also operational in and around Dhanbad. Fertilizers Corporation of India (closed), Projects & Development IndiaLtd and ACC.Ltd at Sindri are also available and being one of the 5 divisions of South Eastern Railway zone, Indian Railways is also a big employer in Dhanbad. Also, Kandra Industrial Area at Gobindpur houses some small & middle scale industries

Durgapur- Durgapur is one of the biggest industrial hubs of India and was planned as an integrated industrial town. It lays on the banks of DamodarRiver and coalfields of Raniganj. Durgapur was a dream of former prime minister of India, Jawaharlal Nehru and chief minister of West Bengal, Bidhan Chandra Roy. The first project in Durgapur was Damodar Valley Corporation's Durgapur Barrage which attracted many public sector units. Durgapur Steel Plant was the first PSU established in the region in 1955 with the help of U.K which was later undertook by SAIL.

Durgapur Steel plant

Durgapur Steel Plant set up in late fifties is a leading producer of long products &only producer of Forged Railway Wheels & Axles in the country. Plant started production with an initial crude steel capacity of 1 MPTA (million ton per annum) in 1959, which has been progressively increased to 1.8 MTPA during the modernization in nineties and further to 2.2 MTPA during recently completed Modernization & Expansion Plan (MEP). The present Plant capacity is about 2.12 MTPA saleable steel.

Durgapur is also an emerging I.T and real estate hub has many proposed residential areas like DLF's Durgapur Township.

Kolkata - is the capital of the Indian state of West Bengal. According to the 2011 Indian census, it is the seventh most populous city in India; the city had a population of 4.5 million, while the suburb population brought the total to 14.1 million, making it the third-most populous metropolitan area in India. Kolkata Megalopolis is the area surrounding Kolkata Metropolitan city with additional population. Located on the east bank of the Hooghly River approximately 80 kilometres west of the border with Bangladesh, it is the principal commercial, cultural, and educational centre of East India, while the Port of Kolkata is India's oldest operating port and its sole major riverine port. The city nicknamed the "City of Joy" is widely regarded as the "cultural capital" of India and as of 2019, six Nobel Laureates have been associated with the city. Recent estimates of Kolkata Metropolitan Area's economy have ranged from $60 to $150 billion (GDP adjusted for purchasing power parity) making it the third most-productive metropolitan area in India, after Mumbai and Delhi. One end of project stretch at Dankuni is major gate to city from northern part of India.

Logistics and Warehousing–It is observed that as project stretch is the main connectivity between Kolkata and rest of India (specially north), there are large number of logistic and warehousing establishments on project stretch between Dankuni and Bardhman. Most computer companies have warehouses in Dankuni. As per a recent report an investment of Rs.4300 cr is expected in West Bengal by 2020 (May be delayed now due to COVID-19.)

5.7 Recommended Growth Rates of Traffic

Based on the above analysis and after giving due consideration to the entire listed factors, the following overall growth rates are recommended for each category of

vehicle as under. Rate of growth is moderated in light of overall regional trend. Growth of Multi-Axle is kept slightly higher as trend of technological advances in logistic industry favors multi-axle over 2/3 axle carriage. It is also expected that as the economy moves from developing to developed, rate of growth diminishes. Same growth rate is not sustainable for long. Traffic growth is suitably stepped down for future years.

Growth rates are recommended for three scenarios for sensitivity analysis namely **Optimistic, Pessimistic** and **Most Likely** with a positive and negative variation 0.5% from Most Likely case for corridor in both states.

5.7.1 Recommended Growth Rates of Traffic for Project Stretch

Table 5-20 : Recommended Growth Rates Optimistic

Category / Year	2020-2025	2025-2030	2030-2035	2035-2040	2039-2044	2044-2049
Car/Jeep/Van	9.39%	8.58%	5.99%	6.35%	5.18%	4.05%
Bus	5.69%	5.26%	4.81%	4.53%	4.21%	3.93%
Minibus	5.69%	5.26%	4.81%	4.53%	4.21%	3.93%
LCV	2.32%	2.11%	1.71%	1.32%	0.93%	0.55%
2- Axle	3.69%	3.34%	2.68%	2.03%	1.38%	0.75%
3 - Axle	5.41%	4.89%	3.89%	2.91%	1.95%	0.99%
4 to 6 Axle	6.45%	5.82%	4.62%	3.45%	2.29%	1.14%
7 and Above Axle	6.45%	5.82%	4.62%	3.45%	2.29%	1.14%

Table 5-21 : Recommended Growth Rates Pessimistic

Category / Year	2020-2025	2025-2030	2030-2035	2035-2040	2039-2044	2044-2049
Car/Jeep/Van	8.89%	8.08%	5.49%	5.85%	4.68%	3.55%
Bus	5.19%	4.76%	4.31%	4.03%	3.71%	3.43%
Minibus	5.19%	4.76%	4.31%	4.03%	3.71%	3.43%
LCV	1.82%	1.61%	1.21%	0.82%	0.43%	0.05%
2- Axle	3.19%	2.84%	2.18%	1.53%	0.88%	0.25%
3 - Axle	4.91%	4.39%	3.39%	2.41%	1.45%	0.49%
4 to 6 Axle	5.95%	5.32%	4.12%	2.95%	1.79%	0.64%

7 and Above Axle	5.95%	5.32%	4.12%	2.95%	1.79%	0.64%

Table 5-22 : Recommended Growth Rates Most Likely

Category / Year	2020-2025	2025-2030	2030-2035	2035-2040	2039-2044	2044-2049
Car/Jeep/Van	9.14%	8.33%	5.74%	6.10%	4.93%	3.80%
Bus	5.44%	5.01%	4.56%	4.28%	3.96%	3.68%
Minibus	5.44%	5.01%	4.56%	4.28%	3.96%	3.68%
LCV	2.07%	1.86%	1.46%	1.07%	0.68%	0.30%
2- Axle	3.44%	3.09%	2.43%	1.78%	1.13%	0.50%
3 - Axle	5.16%	4.64%	3.64%	2.66%	1.70%	0.74%
4 to 6 Axle	6.20%	5.57%	4.37%	3.20%	2.04%	0.89%
7 and Above Axle	6.20%	5.57%	4.37%	3.20%	2.04%	0.89%

Traffic and revenue have been worked out on the basis of above growths and same is presented in subsequent chapter of report.

5.8 COVID-19 Impact

All social and economic activities had been completely disrupted due worldwide pandemic of Corona Virus. This had affected traffic on project stretch as well. Traffic was severely affected form March-2020 due to lockdown and then in second wave and third waves.

Government has announced a mega economic stimulate and package of Rs. 20 Lakh Crore to bring the economy back on track and recover the losses. Traffic has shown impressive recovery post lockdown period and has recovered to normal level.

CHAPTER 6

TRAFFIC FORECAST

6.1 Traffic Projections

Growth rates recommended in previous section of report are used to arrive at traffic projections for future years. Toll plaza wise futuristic traffic projection is given in tables below.

These projections have been done for following three cases of growth up to concession period

1. Optimistic Scenario
2. Pessimistic Scenario
3. Most Likely Scenario

Table 6-1 : Total Tollable Traffic @ Toll Plaza Dankuni- Chainage 646.005 KM (Optimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	11501	1430	833	3844	3227	9552	8	30395	80378
2024-25	12582	1463	880	3687	3146	9405	7	31171	80273
2025-26	13661	1494	926	3810	3300	9953	8	33152	84835
2026-27	14833	1525	974	3937	3462	10533	8	35272	89674
2027-28	16105	1557	1025	4069	3631	11146	8	37541	94809
2028-29	17486	1590	1079	4205	3808	11794	8	39970	100256
2029-30	18986	1623	1136	4346	3994	12480	8	42573	106045
2030-31	20123	1650	1190	4462	4149	13057	8	44639	110794
2031-32	21329	1679	1247	4582	4311	13661	8	46817	115778
2032-33	22607	1708	1307	4705	4479	14293	8	49107	120997
2033-34	23961	1737	1370	4831	4653	14954	8	51514	126458
2034-35	25397	1766	1435	4961	4834	15645	8	54046	132175
2035-36	27010	1789	1500	5061	4974	16184	8	56526	137163
2036-37	28725	1813	1568	5163	5119	16742	8	59138	142370

Table 6-2 : Total Tollable Traffic @ Toll Plaza Dankuni- Chainage 646.005 KM (Pessimistic Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	11449	1423	830	3825	3212	9507	8	30254	80002
2024-25	12468	1449	873	3651	3116	9318	7	30882	79525
2025-26	13475	1472	915	3755	3253	9813	8	32691	83647
2026-27	14564	1496	958	3862	3396	10335	8	34619	88000
2027-28	15741	1520	1004	3972	3545	10885	8	36675	92603
2028-29	17012	1544	1052	4085	3700	11464	8	38865	97463
2029-30	18386	1569	1102	4201	3863	12074	8	41203	102607
2030-31	19396	1587	1149	4292	3994	12572	8	42998	106692
2031-32	20461	1607	1198	4385	4129	13091	8	44879	110953
2032-33	21585	1627	1250	4481	4269	13631	8	46851	115401
2033-34	22770	1647	1304	4579	4414	14193	8	48915	120036
2034-35	24020	1667	1360	4679	4563	14778	8	51075	124864
2035-36	25426	1680	1414	4750	4674	15213	8	53165	128955
2036-37	26913	1694	1471	4823	4786	15662	8	55357	133209

Traffic projections for Most Likely scenario are given as under

Table 6-3 : Total Tollable Traffic @ Toll Plaza Dankuni- Chainage 646.005 KM (Most Likely Growth Scenario)

Year	CAR	Minibus /LCV	Bus	Truck	3-Axle Commercial vehicle	Multi axle	Oversized Vehicles	Total Tollable Traffic	PCU (Including Exempted)
2023-24	11476	1427	832	3835	3219	9530	8	30327	80196
2024-25	12525	1456	878	3669	3131	9362	7	31029	79907
2025-26	13569	1483	922	3783	3277	9884	8	32926	84254
2026-27	14699	1510	968	3900	3429	10435	8	34949	88849
2027-28	15923	1538	1016	4021	3588	11016	8	37110	93713
2028-29	17249	1567	1067	4146	3754	11630	8	39421	98872
2029-30	18685	1596	1120	4274	3928	12278	8	41889	104332
2030-31	19757	1619	1171	4378	4071	12815	8	43819	108749
2031-32	20891	1643	1224	4485	4219	13375	8	45845	113363
2032-33	22090	1667	1280	4594	4373	13960	8	47972	118188
2033-34	23358	1691	1338	4706	4533	14570	8	50204	123227
2034-35	24699	1716	1399	4820	4698	15207	8	52547	128492
2035-36	26205	1734	1458	4906	4823	15693	8	54827	133022
2036-37	27803	1752	1520	4993	4951	16194	8	57221	137732

6.2 Modification in Concession Period

As per Article 29 of the concession agreement, if actual traffic on the project falls short or exceeds Target Traffic on project highway on defined date, concession period shall be modified subject to calculation stipulated therein. For Palsit - Dankuni project three target traffic have been defined in Article 29.

Target Date - 1st May 2026 Target Traffic 65830

Target Date - 1st May 2031 Target Traffic 100822

Target Date - 1st May 2036 Target Traffic 130452

It was observed that as per traffic projections, average traffic volume exceeds target traffic in first two target points. Probable shortening of concession period is estimated according to Article 29 of concession agreement for all cases which comes to about 3 years.

Pessimistic

Sr. No	Target Date	Target Traffic	Actual Traffic	Variation in CP as per CA %	Change in CP (Days	Total Variation in CP Years
1	01-May-26	65830	83647	-20.00%	-944	**-2.7**
2	01-May-31	100822	106692	-0.82%	-24	
3	01-May-36	130452	128955	0.00%	0	

Optimistic

Sr. No	Target Date	Target Traffic	Actual Traffic	Variation in CP as per CA %	Change in CP (Days	Total Variation in CP Years
1	01-May-26	65830	84835	-20.00%	-944	**-3.0**
2	01-May-31	100822	110794	-4.89%	-141	
3	01-May-36	135758	137163	0.00%	0	

Most Likely

Sr. No	Target Date	Target Traffic	Actual Traffic	Variation in CP as per CA %	Change in CP (Days	Total Variation in CP Years
1	01-May-26	65830	84254	-20.00%	-944	**-2.8**
2	01-May-31	100822	108749	-2.86%	-83	
3	01-May-36	133090	133022	0.00%	0	

CHAPTER 7

FORECAST OF TOLL REVENUE

7.1 General

This chapter presents the tolling rate calculations, categories, and toll revenue of the project.

7.2 Discount Categories

The fee schedule in the CA of Surat-Dahisar section of NH-8 is based on the old toll policy. As per the Toll Notification (Schedule -G) the discounts and special provisions have been considered. In addition to discounts as per Fee Notification concessionaire has declared special category rates also. Salient features of toll rate structure are given as under

1. Monthly Pass: For frequent user's monthly pass would be issued at fee 50 time the single journey fee at 2/3rd Rate.
2. Multiple Journeys (for Return Trip): Will be charged at 1.5 times single journey.
3. Single Journey: Full single journey toll would be charged to this category of vehicles who are infrequent travelers or whose frequency does not yield any discount from the above categories.
4. Local Discounts: Local Car Jeep Van -Rs. 275 per month (for locals residing within a radius of 20 kms from toll plaza). Additionally, local commercial vehicles are charged at 50% rate of single journey.

Building of inflation and escalation of rate on the basis of WPI are done as per toll notification (Schedule G) as given under as extract from concession agreement.

The formula for determining the applicable rate of fee shall be as follows:-

$$\text{Applicable rate of fee} = \text{base rate} + \text{base rate} \times \left\{ \frac{\text{WPI A-WPI B}}{\text{WPI B}} \right\} \times 0.4$$

Factor of inflation / growth has been incorporated as per Schedule R. WPI numbers (2011-12 series) are available up to 2021-22. A moderate growth in Wholesale Price

Index (WPI) has been assumed after that. Following graph provides projection of rate of inflation (WPI) in India. Data has been taken from Office of Economic Advisor web site (www.eaindustry.nic.in). WPI for year 2017-18 and 2018-2019 is worked back by applying a correlation factor for 2004-05 series as 2017-18 and 2018-2019 data is available in 2011-12 series only. Ratio of WPI for year 2016-17 for both series is used for conversion of WPI in 2004-05 series

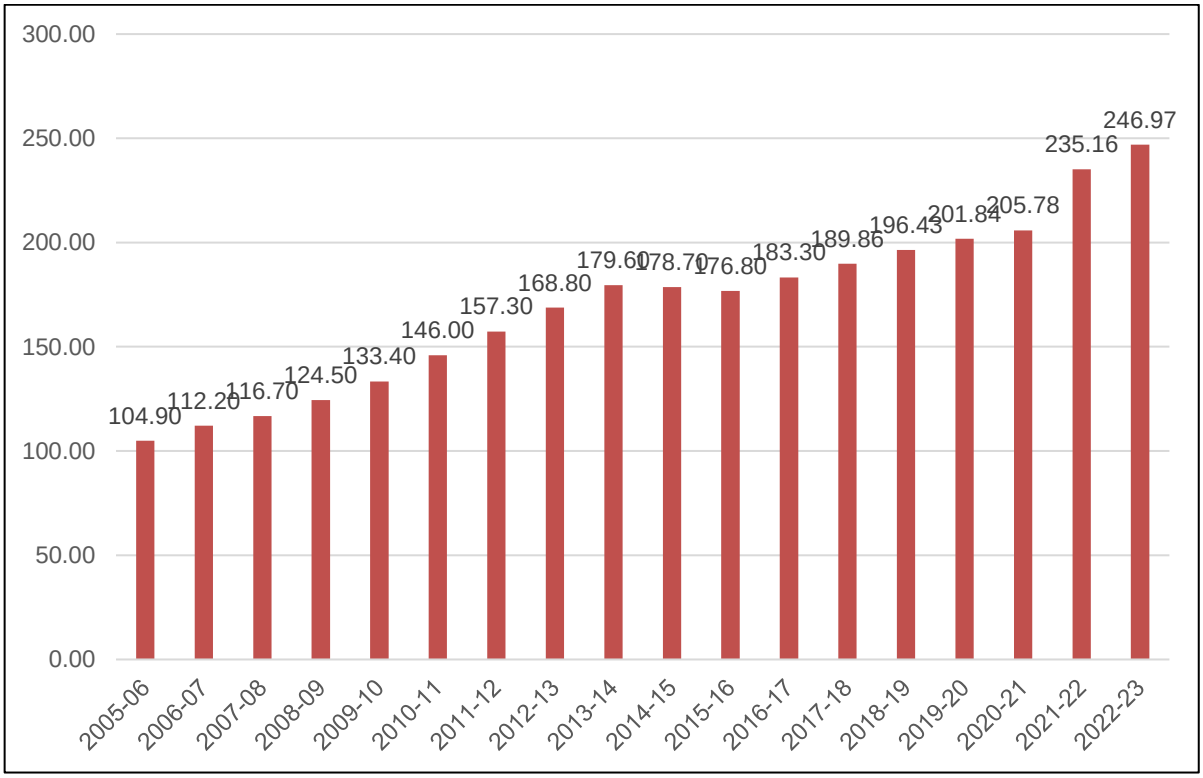


Figure 7-1 : Historical Rate of WPI Inflation in India

Average inflation in WPI in last few years is steadily growing. It grew in range of 4% - 5% in previous years. For future years initially it is takes 5% and Suitably Stepped down for future years.

Estimation of Toll Rates

As per the applicable MORTH notification and Schedule R of contract agreement, the following Base rate of fee for the categories mentioned in the table stands true in the National Highways Fee Rules applicable for contract.

Table 7-1 : Base Toll Rates June 2007-08

Type of Vehicle	Base Rate of Fee / Km (in Rs.)
Car, Jeep, Van or Light Motor Vehicle	0.65
Light Commercial Vehicle, Light Goods Vehicle or Minibus	1.05
Bus or Truck (Two Axles)	2.20
Three Axle Commercial Vehicles	2.40
Heavy Construction Machinery (HCM) or Earth Moving Equipment (EME) or Multi Axle Vehicle (MAV) (4 to 6 axles)	3.45
Oversized Vehicles (7 or more Axles)	4.20

Toll rates are calculated as per guidelines provided in schedule R (rounded to nearest Rs.) for the concession period and are given below.

Thus, worked out rates for various categories of vehicle and discounts are given as under

Table 7-2 : Toll Rates for Single Journey Dankuni @ Km 646.005

Year	Car	Mini Bus /LCV	Bus	Truck	3-Axle Commercial Vehicle	Multi Axle	Oversized Vehicle
2023-24	75	120	250	250	270	390	475
2024-25	75	120	250	250	270	390	475
2024-25	115	190	390	390	430	615	745
2025-26	120	190	395	395	430	615	750
2026-27	125	200	415	415	450	645	785
2027-28	130	210	435	435	475	680	825
2028-29	140	220	455	455	495	710	865
2029-30	145	230	475	475	520	745	905
2030-31	150	240	500	500	545	780	950
2031-32	160	255	525	525	570	820	995
2032-33	165	265	550	550	600	855	1045
2033-34	175	280	575	575	625	900	1095
2034-35	180	290	605	605	660	945	1145
2035-36	190	305	635	635	690	990	1200
2036-37	200	320	665	665	725	1035	1260

Table 7-3: Toll Rates for Return Journey Dankuni @ Km 646.005

Year	Car	Mini Bus /LCV	Bus	Truck	3-Axle Commercial Vehicle	Multi Axle	Oversized Vehicle
2023-24	110	175	370	370	405	585	710
2024-25	110	175	370	370	405	585	710
2024-25	175	285	590	590	640	920	1120
2025-26	180	285	590	590	645	925	1125
2026-27	190	300	620	620	675	970	1180
2027-28	200	315	650	650	710	1015	1235
2028-29	205	330	680	680	745	1065	1295
2029-30	215	345	715	715	780	1115	1360
2030-31	225	360	750	750	815	1170	1425
2031-32	240	380	785	785	855	1225	1490
2032-33	250	395	825	825	895	1285	1565
2033-34	260	415	865	865	940	1350	1640
2034-35	275	435	905	905	985	1415	1720
2035-36	285	460	950	950	1035	1485	1805
2036-37	300	480	995	995	1085	1555	1890

Table 7-4: Toll Rates for Monthly pass Local Dankuni @ Km 646.005

Year	Car	Mini Bus /LCV
2023-24	315	315
2024-25	315	315
2024-25	345	345
2025-26	345	345
2026-27	365	365
2027-28	380	380
2028-29	400	400
2029-30	420	420
2030-31	440	440
2031-32	460	460
2032-33	485	485
2033-34	505	505
2034-35	530	530
2035-36	555	555
2036-37	585	585

Table 7-5: Toll Rates for Monthly Pass Dankuni @ Km 646.005

Year	Car	Mini Bus /LCV	Bus	Truck	3-Axle Commercial Vehicle	Multi Axle	Oversized Vehicle
2023-24	2440	3945	8265	8265	9015	12960	15775
2024-25	2440	3945	8265	8265	9015	12960	15775

2024-25	3915	6280	13070	13070	14250	20455	24885
2025-26	3990	6355	13145	13145	14330	20530	24960
2026-27	4190	6675	13810	13810	15055	21570	26225
2027-28	4390	6990	14470	14470	15770	22600	27480
2028-29	4595	7325	15160	15160	16525	23685	28795
2029-30	4815	7670	15890	15890	17315	24820	30175
2030-31	5045	8040	16650	16650	18150	26010	31630
2031-32	5285	8425	17450	17450	19020	27265	33155
2032-33	5535	8830	18295	18295	19940	28585	34755
2033-34	5800	9255	19180	19180	20905	29965	36440
2034-35	6080	9700	20110	20110	21920	31425	38210
2035-36	6375	10170	21090	21090	22985	32955	40075
2036-37	6685	10665	22115	22115	24110	34565	42030

7.3 Toll Revenue

As indicated earlier, toll revenue on the Project Road has been calculated in all three scenarios based on above rates and projected traffic. The estimates of toll revenue under ***Optimistic***, ***Pessimistic*** and ***Most Likely*** growth scenarios are presented in the following section.

7.4 Toll Revenue at all toll plazas under Scenarios

Toll Revenue estimates under all scenarios at each of the toll plaza starting from the year 2023-24 are shown in tables below.

Table 7-3 : Toll Revenue Optimistic Scenario

(Rs. Crores)

Year	TP-1	Total
2023-24	219.65	**219.65**
2024-25	287.83	**287.83**
2025-26	373.48	**373.48**
2026-27	413.83	**413.83**
2027-28	460.56	**460.56**
2028-29	507.85	**507.85**
2029-30	562.20	**562.20**
2030-31	614.77	**614.77**
2031-32	677.33	**677.33**
2032-33	737.34	**737.34**
2033-34	808.69	**808.69**
2034-35	886.15	**886.15**
2035-36	965.42	**965.42**
2036-37	1046.12	**1046.12**

Table 7-4 : Toll Revenue Pessimistic Scenario

(Rs. Crores)

Year	TP-1	Total
2023-24	218.62	**218.62**
2024-25	285.14	**285.14**
2025-26	368.27	**368.27**
2026-27	406.10	**406.10**
2027-28	449.83	**449.83**
2028-29	493.68	**493.68**
2029-30	544.01	**544.01**
2030-31	592.06	**592.06**
2031-32	649.18	**649.18**
2032-33	703.35	**703.35**
2033-34	767.73	**767.73**
2034-35	837.19	**837.19**
2035-36	907.68	**907.68**
2036-37	978.80	**978.80**

Table 7-5 : Toll Revenue Most Likely Scenario

(Rs. Crores)

Year	TP-1	Total
2023-24	219.15	**219.15**
2024-25	286.52	**286.52**
2025-26	370.94	**370.94**
2026-27	410.06	**410.06**
2027-28	455.28	**455.28**
2028-29	500.90	**500.90**
2029-30	553.22	**553.22**
2030-31	603.56	**603.56**
2031-32	663.35	**663.35**
2032-33	720.41	**720.41**
2033-34	788.27	**788.27**
2034-35	861.68	**861.68**
2035-36	936.49	**936.49**
2036-37	1012.29	**1012.29**

CHAPTER 8

CONCLUSION & RECOMMENDATIONS

8.1 Conclusion & Recommendations

Project stretch of Palsit to Dankuni section of NH-19 from km 588.870 to km 652.700 in state of West Bengal is currently four lane road and being upgraded to six lane. The road is in sound condition and serves healthy traffic volumes. Project corridor is a part of the most busy and prominent national highway NH-19 which connects political and cultural capitals of India. This is one of the most important trunk road which spreads across many states. There are large number of townships, industrial corridors and other business establishment coming up along project corridor. As discussed, dominant portion of traffic is long route traffic, which is more sensitive towards the growth of national economy. As Indian economy is poised to grow at 7%+ post COVID-19, the project corridor is expected to pick up the same trend in terms of traffic flow. All these developments have potential to give positive impact to traffic flow on project. The following can be considered as major outcomes of the study

a) There is good amount of tollable traffic running on project

b) Project corridor has potential to witness traffic growth @ 6-8% annually in near future due to various development in area and overall development of economy

c) Project corridor has committed traffic as long route traffic and does not run a risk of traffic leakage due to quality competing road

Based on above it can be considered a stable healthy project from traffic and revenue point of view.

GMD Consultants
503-504, Mayuresh Chambers Premises, Plot No. 60,
Sector -11, CBD Belapur, Navi Mumbai. 400 614.
Maharashtra.
Phone : +91-22-2756 4586 / 2756 5313
Email : info@gmdconsultants.in
Web : www.gmdconsultants.in