1. INTRODUCTION

1.1 GENERAL

The National Highways Authority of India (NHAI) is engaged in the development of the National highways in the state of Uttar Pradesh. As part of this endeavor, NHAI has decided to upgrade some of the existing National Highways in the State of UP to National Highway standard. It was also decided to take up the preparation of DPR for these highways which are being upgraded to National Highway Standard. The consultancy services for preparation of Feasibility Report cum Detailed Project Report (DPR) of 4 laning of Ghazipur Ballia – UP/Bihar section from Km 0.000 to 128.000 of NH-31 and Construction of 2/4 laning Flyover at Ballia (Chandra Shekhar Mod to Satish Chandra College) was awarded to Aarvee Associates.

The Letter of Acceptance was communicated vide letter No. NHAI/ Tech/ NH-19/ Pkg-I/ 2016/ 103661 dated 31st July 2017. The Agreement for consultancy services was concluded with NHAI on 04/09/2017. Letter of commencement was issued vide letter No. NHAI/ Tech/ NH-19/Pkg-I/DPR/2016/105592 dated 08.09.2017.

Final DPR for the existing road "Special Repair and Maintenance work from Ghazipur to UP/Bihar border NH-31 from Km 405 to Km 535 including construction of New MJB at Km 412.130 and rehabilitation of MJB at Km 533 on EPC mode" submitted vide our letter no. AA/HW/NHAI/2114/18-19/9105 dated 26.03.2019. As per the directions from project authorities, the alignment proposals were reviewed in view of the MoRTH Circular No. NH-15017 / 21 / 2018 – P & M dated 26.02.2018. The greenfield alignment option including comparison table showing the cost comparison of widening of the existing alignment option via-a-via widening of was prepared and the same was reviewed at various levels and it was decided that green field alignment with spur providing connectivity to Buxar was approved during the meeting held in Ministry under the Chairmanship of Secretary and the Minutes of Meeting were communicated vide letter No. NHAI/Tech/ NH-19/Ghazipur-Ballia/ DPR/2016/122312 dated 13.08.2018.

The District Administration of Ballia held public consultations regarding the proposed elevated flyover and communicated their decisions vide MoM dated 1393/ 14 – 1 dated 20.10.2018. The MoM inter-alia state that widening of the existing road to four lane standards would serve the traffic problems in Ballia town and elevated flyover is not required since construction of the said flyover would result in acquisition of land and structures for the purpose of flyover.

Public consultation meeting on the project alignment was held in the office of District Magistrate Ballia on 05.09.2018 wherein the committee recommended that the bypass alignment for Ballia be considered on the south side. This will require modification of the alignment approved earlier in a length of approximately 38.50 km. The said modification was reviewed during the meeting held on 08.12.2018 at NHAI HQ, New Delhi under the chairmanship of Member (P) and agreed by Member. Variation with financial implication for new Greenfield alignment was approved from RO, Varanasi vide letter no. NHAI/UP (E)/GM (T)/NH-19/Ghazipur-Ballia/DPR/14 dated 27.10.2020. Accordingly, the Inception & Alignment report for the approved Greenfield alignment were prepared and submitted vide our letter no. AA/HW/NHAI/2114/20-21/2820 & 2966 dated 06.11.2020 & 16.11.2020.

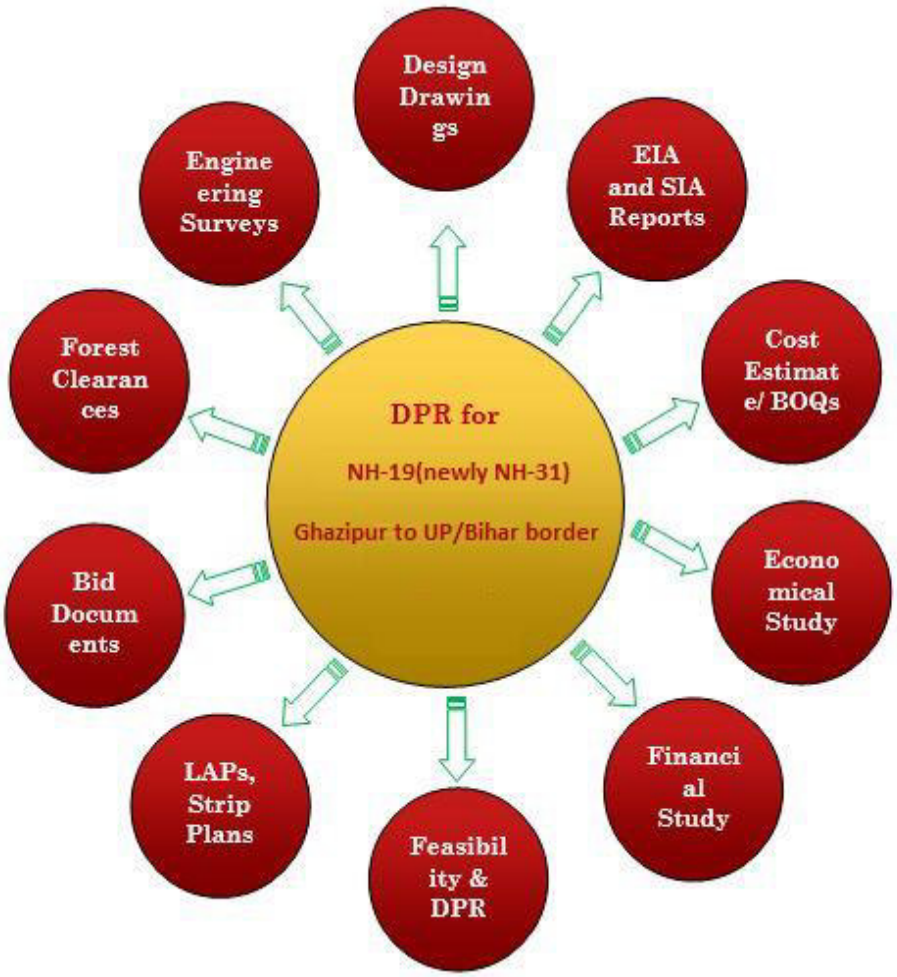
Table-1.1: Project Details for Greenfield Alignment

S. No	Project Highway	Design Chainage (Km)		Remarks
		From	To	
1	Ghazipur to Manjhi Ghat UP/ Bihar Border	0.000	115.600	NH-31
2	Buxar Spur	0.000	17.800	-

1.2 SCOPE OF THE STUDY

The scope of the services to be rendered essentially involves detailed designs based on field visits and engineering surveys. As per ToR, the scope of the current study is listed as under:

- ✓ Engineering surveys and investigations
- ✓ Highway & Structural design
- ✓ Environmental and Social Impact Assessment
- ✓ Estimation of Project Cost
- ✓ Economic & Financial Analysis
- ✓ Preparation of Feasibility study report and Detailed Project Report
- ✓ Preparation of Land Acquisition Plans
- ✓ Preparation of Bid Documents
- ✓ Obtain necessary Forest/ Environmental clearances, if any etc.



The New Greenfield alignment is proposed to Two lane with Paved Shoulder at normal sections and Four laning with service roads at Underpass locations with proposed Right of way of 60m. The Consultant shall furnish land acquisition details as per revenue records/maps for further processing.

The Consultant shall study the possible locations and design of toll plaza. Wayside amenities required on tolled highway shall also be planned. The local and slow traffic may need segregation from the main traffic and provision of service roads and fencing may be considered, wherever necessary to improve efficiency and safety.

The entire scope of services would, *inter-alia*, include the items mentioned in TOR. The Consultant will also make suitable proposals for widening/improvement of the existing road to Four lane configuration and strengthening of the carriageways, as required at the appropriate time to maintain the level of service over the design period. Already to implement 'good for construction' drawings shall be prepared.

Environmental Impact Assessment, Environmental Management Plan and Rehabilitation and Resettlement Studies shall be carried out by the Consultant meeting the requirements of the lending agencies like ADB/ World Bank/ JICA etc.

Wherever required, consultant will liaise with concerned authorities and arrange all clarifications. Approval of all drawings including GAD and detail engineering drawings will be got done by the consultant from the Railways. However, if Railways require proof checking of the drawings prepared by the consultants, the same will be got done by NHAI and payment to the proof consultant shall be made by NHAI directly. Consultant will also obtain 'No Objection Certificate' from Ministry of Environment and Forest and incorporate the estimates for shifting of utilities of all types involved from concerned local authorities in the DPR. Consultant is also required to prepare all Land Acquisition papers (i.e. all necessary schedules as per L.A. act) for acquisition of land either under NH Act or State Act.

The consultant shall prepare the Bid Documents, based on the feasibility report, due to exigency of the project for execution.

Consultant shall obtain all types of necessary clearances required for implementation of the project on the ground from the concerned agencies. The client shall provide the necessary supporting letters and any official fees as per the demand note issued by such concerned agencies from whom the clearances are being sought to enable implementation.

1.3 OBJECTIVE OF THE STUDY

The main objective of the consultancy service is to establish the technical, economic and financial viability of the project and prepare detailed project reports for Two lane road with paved shoulder and Four laning at underpass locations configuration by considering the investment requirements and financial return through toll and other revenues.

The viability of the project shall be established considering the requirements with regards to rehabilitation, upgrading and improvement based on highway design, pavement design, type of intersections, rehabilitation and widening of existing and/or construction of new bridges and structures, road safety features, quantities of various items of works and cost estimates and economic analysis.

The list of objectives to be achieved are listed as under:

a) Conduct detailed Engineering surveys & Investigations

b) Forecast the traffic demand on project stretch by conducting necessary volume count and origin-destination studies giving due weightage to the future development proposals along the project stretch

c) Design of pavement along the project stretch using respective IRC codes

d) Prepare the road geometric design along with plan & profiles based on LiDAR/Aerial LiDAR and Drone based survey in topographic survey

e) Design of bridges/ cross drainage structures and grade separated structures

f) Develop General Arrangement Drawings (GADs) of structures for assessment of quantities

g) Identify the Initial Social Impact Assessment by broadly identifying and assessing the extent of private lands to be acquired and the government lands/ forest land to be proposed for diversion

h) Identify the Initial Environmental Impact Assessment based on available reports and by assessing the levels of pollution from the projected traffic on the project highway

i) Prepare BOQ and cost estimates based on prevailing market rates and SSR

j) Prepare the economic and financial analysis of the project by bringing out the project packaging and various feasible procurement alternatives

k) Prepare Land acquisition plans, utility relocation plans along with strip plans

l) Obtain necessary forest and environmental clearances

m) Submission of necessary bid/ contractual documents

1.4 APPROACH

The consultant's approach towards the project is in accordance with the ToR in lines with the project objectives. The prescribed engineering surveys and investigations have been carried out on project stretch conforming to MORT&H/IRC/BIS specifications/Codes as per ToR to generate adequate database for preparing the most appropriate proposal for the rehabilitation and upgrading of the existing highway.

1.5 OUTCOME OF CURRENT STUDY

The Draft Feasibility study assists in predicting the workability and effectiveness of highway after its implementation. The viability of the project will be established

taking into account the requirements with regards to rehabilitation, upgrading and improvement based on highway design, pavement design, provision of service roads wherever necessary, type of intersections, rehabilitation and widening of existing and/ or construction of new bridges and structures, road safety features, quantities of various items of works and cost estimates and economic analysis.

The following structured outcome is presented in the current draft feasibility report:

1. Executive Summary
2. Introduction
3. Overview of NHAI
4. Existing features of the project corridor
5. Methodology adopted for the draft feasibility study
6. Socioeconomic profile of the project area
7. Indicative design standards, methodologies and specifications
8. Project Proposals of Green Field Stretch
9. Traffic demand assessment on project stretch for future horizon years
10. Pavement design based on traffic and pavement investigation surveys
11. Environmental screening and Preliminary Environmental Impact Assessment
12. Initial Social Impact Assessment and preliminary land acquisition/ resettlement plan
13. Cost estimates
14. Conclusions and Recommendations

1.6 TIME FRAME

The schedule for completion of assignment is 9 months.

2. OVERVIEW OF NHAI

VISION STATEMENT OF NHAI

"To meet the nation's need for the provision and maintenance of National Highways network to global standards and to meet user's expectations in the most time bound and cost effective manner, within the strategic policy framework set by the Government of India and thus promote economic wellbeing and quality of life of the people."

2.1 INTRODUCTION

National Highways Authority of India (NHAI) is an autonomous organisation under the Ministry of Road Transport & Highways and was constituted by an act of Parliament, the National Highways Authority of India Act, 1988. NHAI is responsible for the Development, Maintenance, and Management of National Highways and for matters concerned thereto. The authority was made operational with the appointment of full time Chairman and other Members in the year 1995. The first and foremost mandate for NHAI was the construction and development of five road stretches in the states of Haryana, Rajasthan, Bihar, West Bengal and Andhra Pradesh under loan assistance from Asian Development Bank. Subsequently, development works for other highway stretches were entrusted to NHAI.

NHAI is mandated to implement National Highways Development Project (NHDP) which is India's largest ever Highways Project. Presently National Highway network of about 79,243 km serve as the main road network of the country. Even though National Highways constitute only about 2% of the length of all roads, they carry about 40% of the road traffic. Rapid expansion of passenger and freight traffic makes it imperative to improve the road network in the country.

Accordingly, Government of India launched major initiatives to upgrade and strengthen National Highways through various phases of NHDP, which are:

NHDP Phase I was approved by the Government in December 2000 at an estimated cost of Rs. 30,300 crores and comprises GQ (5,846 km) and NS-EW Corridor (981km), Port connectivity (356 km) and others (315 km).

NHDP Phase II was approved in December 2003 at an estimated cost of Rs. 34,339 crores (2002 prices) and comprises NS-EW Corridor (6,161 km) and other National Highways of 486 km length with the total length of 6,647 km.

NHDP Phase III Government approved up-gradation and 4 laning of 4,815 km of National Highways on BOT basis at an estimated cost of Rs. 33,069 crores under

NHDP Phase IIIA. In April 2007, Government approved up-gradation and 4 laning of 7294 km at an estimated cost of Rs. 47,557 crores under NHDP Phase IIIB. Total approved length of NHDP Phase III is 12,109 km at an approved cost of Rs. 80,626 crore.

NHDP Phase IV Government, in February 2012, approved upgradation/ strengthening of 20,000 km of single/intermediate/two lane NHs to two lane with paved shoulder/4-lane under NHDP Phase-IV on BOT (Toll) and BOT (Annuity) basis.

NHDP Phase V Government, in October 2006, approved six laning of 6,500 km of existing 4 lane highways under NHDP Phase-V (on DBFOT basis) at an estimated cost of Rs. 41,210 crores. Six laning of 6,500 km includes 5,700 km of GQ and about 800 km of other stretches.

NHDP Phase VI Government, in November 2006, approved for 1000 km of expressways at an estimated cost of Rs. 16,680 Crores.

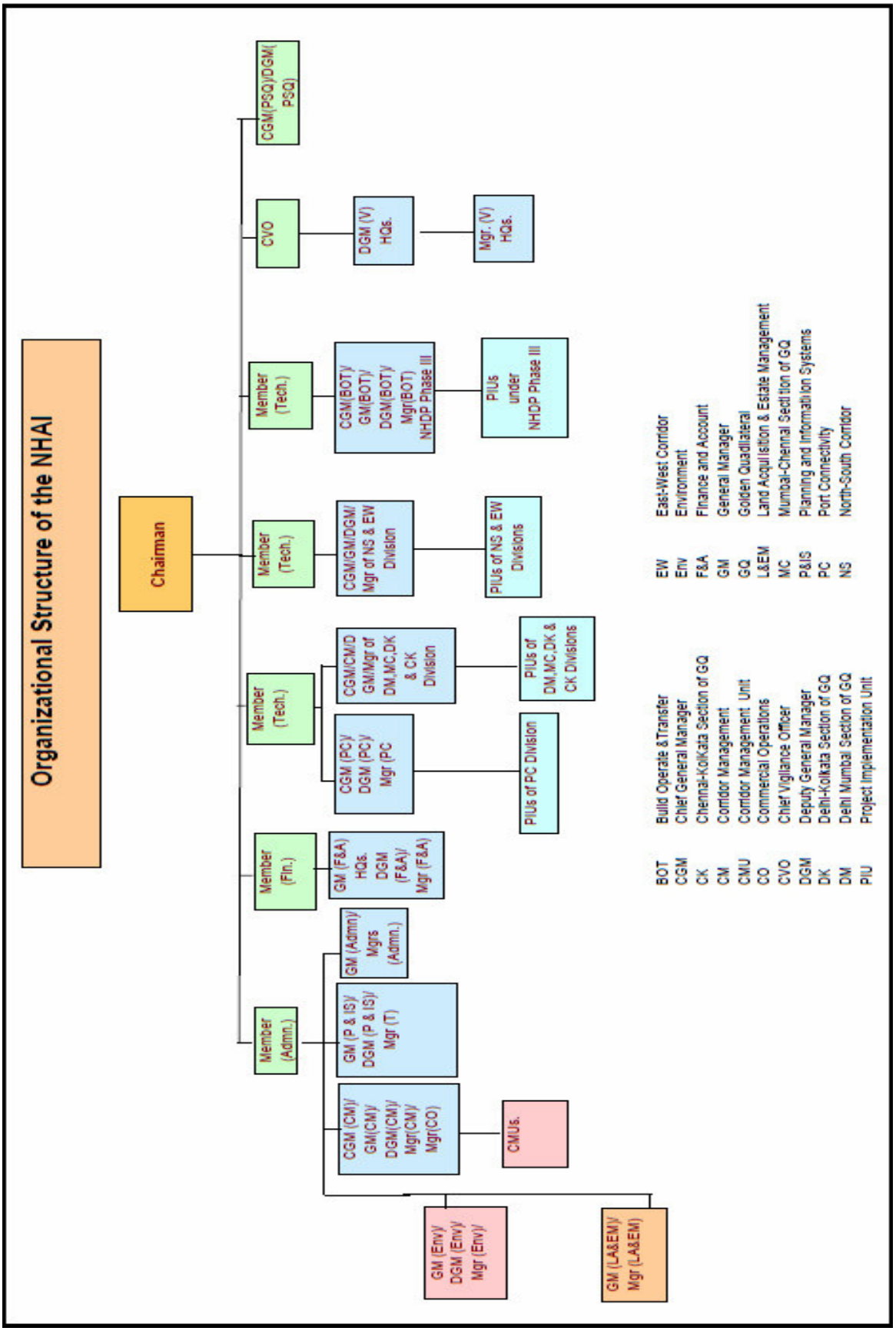
NHDP Phase VII Government, in December 2007, approved implementation of NHDP Phase VII which envisages construction of approximately 700 km of stand alone bypasses, grade separators, flyovers etc. at an estimated cost of Rs. 16,680 crores.

2.2 ORGANIZATION CHART

As per the National Highways Authority of India Act 1988, the Authority shall consist of a Chairman, not more than five full-time Members and not more than four part time Members, to be appointed by Central Government.

The Organizational Structure of the Authority is as shown below. The total manpower strength of the Authority under various categories, as on 31.03.2013 is as under:

Group post	Total No. of Employees	Regular	Deputation	Contract
A	565	110	441	14
B	274	53	6	215
C	193	13	0	180
D	3	3	0	0
Total	1035	179	447	409


Organizational Structure of the NHAI
Chairman
Member (Tech.)
CGM(PSQ)/DGM(PSQ)
CVO
DGM (V) HQs.
Mgr. (V) HQs.
CGM(BOT)/ GM(BOT)/ DGM(BOT)/ Mgr(BOT) NHDP Phase III
PIUs under NHDP Phase III
CGM/GM/DGM/ Mgr of NS & EW Division
PIUs of NS & EW Divisions
CGM/CM/D GM/Mgr of DM,MC,DK & CK Division
PIUs of DM,MC,DK & CK Divisions
CGM (PC)/ DGM (PC)/ Mgr (PC
PIUs of PC Division
Member (Fin.)
GM (F&A) HQs. DGM (F&A)/ Mgr (F&A)
Member (Admn.)
GM (Admn)/ Mgrs (Admn.)
GM (P & IS)/ DGM (P & IS)/ Mgr (T)
CGM (CM)/ GM(CM)/ DGM(CM)/ Mgr(CM)/ Mgr(CO)
CMUs.
GM (Env)/ DGM (Env)/ Mgr (Env)/
GM (LA&EM)/ Mgr (LA&EM)
BOT Build Operate &Transfer
CGM Chief General Manager
CK Chennai-Kolkata Section of GQ
CM Corridor Management
CMU Corridor Management Unit
CO Commercial Operations
CVO Chief Vigilance Officer
DGM Deputy General Manager
DK Delhi-Kolkata Section of GQ
DM Delhi Mumbai Section of GQ
PIU Project Implementation Unit
EW East-West Corridor
Env Environment
F&A Finance and Account
GM General Manager
GQ Golden Quadilateral
L&EM Land Acquisition & Estate Management
MC Mumbai-Chennai Section of GQ
P&IS Planning and Information Systems
PC Port Connectivity
NS North-South Corridor

2.3 NATIONAL HIGHWAYS

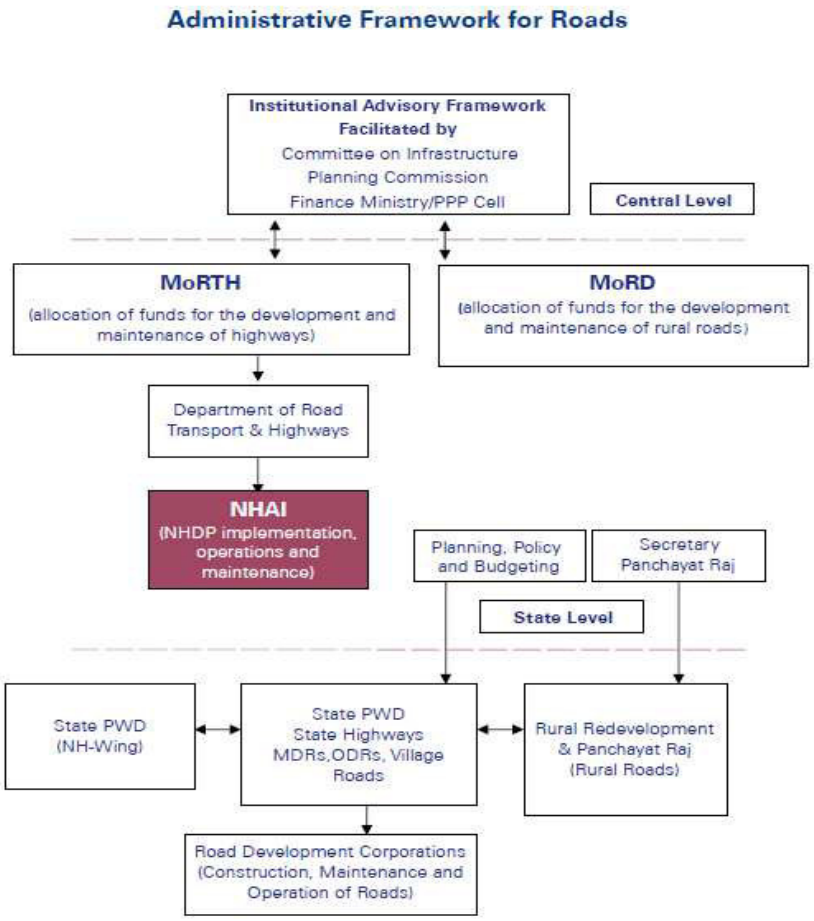
As National Highways comprise about 2% of the total road length in the country and yet carryover 40% of total traffic, the first and the foremost task mandated to the NHAI is the implementation of NHDP – comprising of the Golden Quadrilateral and North-South & East-West Corridors. In addition to the projects under NHDP, the NHAI is also currently responsible for about 1,000 km of Highways connecting major Ports & also on National Highways 8A, 24, 6, 45 & 27. Highways length with NHAI currently is around 22,900 km. About 65% of freight and 80% passenger traffic is carried by the roads.

Number of vehicles has been growing at an average pace of 10.16% per annum over the last five years.

CLASS	LENGTH (km) (Approx.)
Expressways	1000
Total National Highways	92,852
National Highways (4 / 6 laned)	22,900
State Highways	1,54,522
MDR and Other district roads	25,77,396
Rural and Other roads	14,33,577
Total Approx	42,45,429

NHAI is responsible for the implementation of National Highways Development Project (NHDP) and other agencies implement the Non – NHDP projects. The administrative framework for the road sector in India is given in the below figure:

Source: Guidelines for Investment in Road Sector – NHAI



2.4 INSTITUTIONAL CHANGES

The following are the major landmark changes in the institutional framework that facilitated the faster development of National Highways in India:

- National Highways Authority of India Act, 1988
- The National Highways (Collection of fees by any person for the use of section of National Highways / Permanent Bridge / Temporary Bridge – Public funded project) Rules, 1997
- The National Highways (Rate of fee) rules, 1997
- The National Highways Laws (Amendment) Act, 1997 to the National Highways Act, 1956 that facilitated Land acquisition under NH Act, 1956
- The control of National Highways (Land and Traffic) Act, 2002
- Duty waiver for import of equipment used in highway construction
- Tax concessions for private entrepreneurs, investments in Highway sector.

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2.5 NATIONAL HIGHWAYS DEVELOPMENT PROJECT (NHDP)

The Government launched the National Highways Development Project (NHDP) to upgrade and strengthen National Highways through the various phases of NHDP being implemented by NHAI. National Highways Development Project is being implemented in all phases except phase VI at present. The present phases improving more than 49,260 km of arterial routes of NH Network to international standards.

The project-wise details NHDP all Phases as below.

NHDP Phase		Total Length (km.)	Already 4/6Laned (km.)	Under Implementation (km.)	Contracts Under Implementation (No.)	Balance length for award (km.)
NHDP	Golden Quadrilateral	5,846	5,846	0	0	-
	NS – EW Ph. I & II	7,142	6,360	365	42	417
	Port Connectivity	380	379	1	1	0
	NHDP Phase III	12,109	6,393	4,373	89	1,343
	NHDP Phase IV*	14,799	942	5,904	55	7,953
	NHDP Phase V	6,500	2,001	2,080	27	2,419
	NHDP Phase VI	1,000	-	-	-	1,000
	NHDP Phase VII	700	22	19	1	659
	NHDP Total	48,476	21,943	12,742	215	13,791
Others (Ph.-I, Ph.-II & Misc.)		1754	1428	326	10	-
SARDP -NE		388	99	12	1	277
Total by NHAI		50,618	23,470	13,080	226	14,068

*Total 20,000 Km. was approved under NHDP Phase IV.Out of which 14,799 Km. was assigned to NHAI remaining Km. with MORTH.*Source: www.nhai.org (as per 31.01.2015)*

Various phases of National Highways Development Project (NHDP)*- includes about 47,054 km of total NHs other than overlapping lengths of NHs (about 5,700 km common under NHDP-I and NHDP-V).

Government, in December 2007, approved implementation of NHDP Phase VII which envisages construction of approximately 700 km of stand alone bypasses, grade separators, flyovers etc. at an estimated cost of Rs.16,680 crores.

Tentative list of NHDP Phase VII projects

S.No.	Name of City project
1	Ring road/bypass for Hyderabad
2	Ring road/bypass for Tirunelveli
3	Ring road/bypass for Kanpur
4	Grade Separated Intersection/ Flyover at Ranchi on NH-75
5	Ring road/bypass for Tiruchchirapalli
6	Ring road/bypass for Nasik
7	Grade Separated Intersection/Flyover at Solapur at Junction of NH-9 and NH-211
8	Ring road/bypass for Chennai
9	Ring road/bypass for Jaipur
10	Ring road/bypass for Amritsar
11	Grade Separated Intersection/flyover at Padalsingi and at Gandhi at Junction of NH-211and 222
12	Ring road/bypass for Madurai
13	Ring road/bypass for Patna
14	Ring road/bypass for Thiruvanthapuram
15	Ring road/bypass for Surat
16	Ring road/bypass for Aligarh
17	Ring road/bypass for Bangalore
18	Grade Separated Intersection/Flyover at Alephata at Junction of NH-50 and 222
19	Ring road/bypass for Ahmedabad.
20	Ring road/bypass for Vishakhapatnam.
21	Ring roads/bypasses for Jammu & Srinagar citites
22	Ring road/bypass for Kolkata

S.No.	Name of City project
23	Elevated link road to Chennai Port
24	Ring Road/bypass for Meerut
25	Ring Road/bypass for Coimbatore
26	Ring road/bypass for Bhopal
27	Ring road/bypass for Salem
28	Ring road/bypass for Nagpur
29	Ring road/bypass for Indore
30	Ring road/bypass for Lukcnow
31	Ring road/bypass for Imphal
32	Ring road/bypass for Pune
33	Ring road/bypass for Varanasi
34	Ring road/bypass for Dhanbad
35	Ring road /bypass for Ranchi
36	Grade Separated Intersection/flyover near Ratangiri at Junction of NH 17 and 204

2.6 SALIENT FEATURES OF NHDP PROJECTS

2.6.1 Steps Taken for Expediting Project Execution

NHAI is quickly adapting to the site problems by effectively utilising the experience gained in the earlier projects. Its efforts to complete all the pre-construction activities well before the award of the civil works contract are steps in the right direction. The sizes of the contracts, the technical guidelines to the consultants are being constantly updated based on the feedback received from time to time.

2.6.2 Safety Aspects

Fatality rate on Indian highways is very high. NHAI has introduced many safety provisions in the design of highways for making highway travel safer. Some of these are listed below:

- SAFETY BARRIERS / DELINEATORS HARD SHOULDERS ON MAIN ROADS
  - Traffic signs and pavement markings.
  - Underpasses and other grade separators at congested junctions.
  - Removal of junctions and direct access points on main roads
  - Improved median openings with stacking lanes
  - Separate provision for safety and diversion in BOQ.
  - Service roads in towns and villages for segregating local and through traffic.

- Safety audit for all the projects during FS/DPR as well as project implementation.

2.6.3 Way Side Amenities

Wayside amenities are being provided with some of the following features:

- Fueling and servicing facilities.
- Restaurants
- Rest areas
- Telephone facilities
- Separate parking areas for goods and passenger vehicles
- Trauma care for accident victims

2.7 FUNDS FOR HIGHWAY DEVELOPMENT AND MAINTENANCE

Traditionally, financing for development of National Highways in India was from the budgetary resources of the Government of India. In order to augment the available resources, loans have also been raised from multilateral agencies like World Bank, Asian Development Bank (ADB) and Japan Bank of International Cooperation (JBIC).Around 80 per cent of the external assistance is provided to NHAI as a grant by the Central government. The balance is made available as long-term loans to NHAI, with the Centre bearing the foreign exchange risk. Such loans are usually provided for 15-25 years with a moratorium of 5 years. Total cost of NHDP has been estimated to be Rs. 54,000 Crores or US$ 13.2 billions whose components are as below:

Likely sources	Rs.Cr. (1999 prices)	US$ Billions (1999 prices)
Cess on Petrol and Diesel	20000	4.9
External assistance	20000	4.9
Market borrowings	10000	2.4
Private Sector Participation	4000	1

2.7.1 Central Road Fund

In a historic decision, the Government of India introduced a Cess on both Petrol and Diesel. This amount at that time (at 1999 prices) came to a total of approximately

Rs. 2,000 crores per annum. Further, Parliament decreed that the fund so collected were to be put aside in a Central Road Fund (CRF) for exclusive utilization for the development of a modern road network. The developmental work that it could be tapped to fund and the agencies to whom it was available were clearly defined as

- Construction and Maintenance of State Highways by State Governments
- Development of Rural Roads by State Governments
- Construction of Rail over- bridges by Indian Railway
- Construction and Maintenance of National Highways by NHDP and Ministry of Road Transport & Highways

Today, The Cess contributes between Rs 5 to 6 thousand crores per annum towards NHDP. The annual accruals on account of this increase are approximately Rs. 5,800 Crores and this amount is distributed among National Highways, State Roads, Roads of Economic Importance and Railways for taking up safety works such as ROBs, manning of level crossings etc. The share of the National Highways from the Central Road Fund is Rs. 2,000 Crores per annum.

2.7.2 Highway Infrastructure Bonds

Highway Infrastructure bonds are issued with benefits of tax savings for raising funds for NHAI.

Policy Initiatives for Attracting Private Investment:

- Government will carry out all preparatory work including land acquisition and utility removal. Right of way (ROW) to be made available to concessionaires free from all encumbrances.
- NHAI / GOI to provide capital grant up to 40% of project cost to enhance viability on a case to case basis 100% tax exemption for 5 years and 30% relief for next 5 years, which may be availed of in 20 years.
- Concession period allowed up to 30 years
- Arbitration and Conciliation Act 1996 based on UNICITRAL provisions.
- In BOT projects entrepreneur are allowed to collect and retain tolls.
- Duty free import of specified modern high capacity equipment for highway construction.
- Foreign Direct Investment up to 100 % in road sector.Declaration of the road sector as an industry (Infrastructure as defined in section 18(1) (12) of the Infrastructure Act includes Roads).
- Easier external commercial borrowing norms.

2.7.3 Modes Of Procurement

Broadly, modes of procurement adopted for implementation of highway projects may be classified into Public Private Partnership (PPP) and public funded projects. The details of modes of procurements are given below: -

PPP PROJECTS: PPP projects are categorized into two types, namely, BOT (Toll) and BOT (Annuity).

BOT (TOLL) MODEL: Concessionaire is procured through steps of Request For Qualification (RFQ) and Request For Proposal (RFP). Construction, operation, maintenance and tolling responsibility rests with the Concessionaire during entire concession period, which is normally, between 20 to 30 year.

- In a BOT (Toll) Model, the concessionaire (private sector) is required to meet the upfront/construction cost and the expenditure on annual maintenance.
- The Concessionaire recovers the entire upfront/construction cost along with the interest and a return on investment out of the future toll collection.
- The viability of the project greatly depends on the traffic (i.e., toll). However, with a view to bridge the gap between the investment required and the gains arising out of it, i.e., to increase the viability of the projects, capital grant is also provided (up to a maximum of 40% of the project cost has been provided under NHDP).

BOT (ANNUITY) MODEL: Concessionaire is procured through steps of RFQ and RFP. Construction, operation and maintenance rest with the Concessionaire during the concession period. While toll is collected by the Authority through a bidding process, the developer receives annuity payments through the concession period.

(i) In an BOT (Annuity) Model, the Concessionaire (private sector) is required to meet the entire upfront/construction cost (no grant is paid by the client) and the expenditure on annual maintenance.

(ii) The Concessionaire recovers the entire investment and a pre-determined cost of return out of the annuities payable by the client every year.

(iii) The selection is made based on the least annuity quoted by the bidders (the concession period being fixed).The client (Government/NHAI) retains the risk with respect to traffic (toll), since the client collects the toll.

PRIVATE SECTOR PARTICIPATION:

- Major policy initiatives have been taken by the Government to attract

foreign as well as domestic private investments. To promote involvement of the private sector in construction and maintenance of National Highways, Some Projects are offered on Build Operate and Transfer (BOT) basis to private agencies. After the concession period, which can range up to 30 years, this road is to be transferred back to NHAI by the Concessionaires

- NHAI funds are also leveraged by the setting up of Special Purpose Vehicles (SPVs).The SPVs will be borrowing funds and repaying these through toll revenues in the future. This model will also be tried in some other projects. Some more models may emerge in the near future for better leveraging of funds available with NHAI such as Annuity, which is a variant of BOT model.

PUBLIC FUNDED PROJECTS:

The traditional mode of executing public funded projects was Item Rate Contract. This was prone to time and cost overruns. This mode has been replaced by New Engineering Procurement and Construction (EPC) contracts. The projects which are not viable under BOT (Toll) mode, such as those in far flung areas would have to be done under EPC mode. Model EPC Contract Agreement has been finalised and implemented all across highway projects. Model EPC agreement relies on assigning the responsibility for investigations, design and construction to the contractor for a lump sum price determined through competitive bidding. Model EPC agreement incorporates international best practices and provides a sound contractual framework that specifies the allocation of risks and rewards, equity of obligations between Government and the Contractor, precision and predictability of costs, force majeure, termination and dispute resolution, apart from transparent and fair procedures.

2.8 FUTURE PROGRAMMES

A committee headed by the Honorable Prime Minister has proposed a massive infrastructure developmental programme for the next 7 years.

The following development projects will be taken up under this programme.

a) Completion of GQ and EW-NS corridors.
b) Completion of 4-laning of 10,000 km under NHDP Phase-III
c) 2-laning with paved shoulders of 20,000 km of National Highways under NHDP Phase- IV.
d) Augmenting highways in North East under Special Accelerated Programme.

e) 6-laning of selected stretches of National Highways under NHDP Phase-V.

f) Development of 1000 km of expressways under NHDP Phase-VI, and

g) Construction of ring roads, flyovers and bypasses on selected stretches under NHDP Phase-VII.

h) Government has planned that all the future NHDP projects i.e. NHDP Phase- III to Phase-VII will be implemented through public private sector participation. Out of the above proposal Government has approved 4-laning of 4000 km of National Highways under Phase-IIIA and preparation of detailed project reports for balance 6000 km under NHDP Phase-IIIB.

i) Actions have been initiated for getting the approval of the Government for the remaining projects.

j) In June 2009, it was decided to build 20km per day of National Highways. After oneyear, from June 2010 onwards, the Government has geared itself towards achieving this target. The total achievement now stands at 15.96km per day as on 31.01.2012.

Improvement of Road Connectivity in Left Wing Extremism (LWE) affected areas:

The Government has also taken up a programme for the development of about 5,477 km (1,126 km of NH and 4,351 km of State Roads) in Left Wing Extremism (LWE) affected areas as a special project estimated to cost about Rs. 7,300 crore in 34 districts in eight states namely in Andhra Pradesh, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Odisha and Uttar Pradesh. Development of 1,084 km length has been completed by March, 2012. It has been targeted to complete all the works by March, 2015.

Special Programme for 2-laning of entire balance NH network not covered under any approved programmes:

Out of the total NH length of 76,818 km, the total balance length of NHs not covered under any programme is about 23,500 km. Out of this, about 10,000 km are less than 2-lane standards, i.e. 27 less than the minimum stipulated standards for NHs. MORTH has taken initiatives to develop/ upgrade about 4,614 km length of such stretches of NHs to 2-lane standards following Corridor Development Approach by December 2014 through budgetary resources [1,564 km of less than 2-lane NHs] and also through possible Loan Assistance from the World Bank [3,770 km having 3,050 km length of less than 2-lane NHs]. The balance length of about 5,400 km length of NHs having less than 2-lane NH standards are required to be upgraded to minimum

acceptable 2-lane NH standards also. Total length proposed to be taken up through World Bank funding is about 3,770 km. The DPRs are under preparation for these projects proposed to be funded through World Bank loan assistance.

Creation of National Road Safety and Traffic Management Board:

The Government had introduced a Bill in LokSabha on 4.5.2010 to create a National Road Safety and Traffic Management Board to oversee the road safety activities in the country which was referred to the Department related Parliamentary Standing Committee for examination. The Parliamentary Committee submitted its report on 21.7.2010. Its recommendations have been examined. The Government is in the process of carrying out certain amendments in the Bill for consideration by the Parliament.

2.9 BORROWINGS FROM MULTI-LATERAL AGENCIES

Borrowing from multi – lateral funding agencies such as ADB, World Bank and JBIC (OECF) is also one of the major sources for funding of Highway projects.

2.10 Cost Recovery Mechanisms and Finance Mechanism

The investments are being recovered either directly through tolls or indirectly through cess on petrol and diesel.

CESS: In a historic decision, the Government of India introduced a Cess on both Petrol and Diesel. This amount at that time (at 1999 prices) came to a total of approximately Rs. 2,000 crores per annum. Further, Parliament decreed that the fund so collected were to be put aside in a Central Road Fund (CRF) for exclusive utilization for the development of a modern road network. The developmental work that it could be tapped to fund and the agencies to whom it was available were clearly defined as:

- Construction and Maintenance of State Highways by State Governments.
- Development of Rural Roads by State Governments
- Construction of Rail over- bridges by Indian Railways
- Construction and Maintenance of National Highways by NHDP and Ministry of Road Transport & Highways
- Today, The Cess contributes between Rs 5 to 6 Thousands crores per annum towards NHDP

LOAN ASSISTANCE FROM INTERNATIONAL FUNDING AGENCIES: Loan assistance is available from multilateral development agencies like Asian Development Bank and

World Bank or Other overseas lending agencies like Japanese Bank of International Cooperation.

MARKET BORROWING: NHAI proposes to tap the market by securities cess receipts.

PRIVATE SECTOR PARTICIPATION: Major policy initiatives have been taken by the Government to attract foreign as well as domestic private investments. To promote involvement of the private sector in construction and maintenance of National Highways, Some Projects are offered on Build Operate and Transfer (BOT) basis to private agencies. After the concession period, which can range up to 30 years, this road is to be transferred back to NHAI by the Concessionaires.

NHAI funds are also leveraged by the setting up of Special Purpose Vehicles (SPVs).The SPVs will be borrowing funds and repaying these through toll revenues in the future. This model will also be tried in some other projects. Some more models may emerge in the near future for better leveraging of funds available with NHAI such as Annuity, which is a variant of BOT model.

2.11 ISSUES TO BE ADDRESSED BY NHAI

2.11.1 Expressways

The road development plan of MORT&H envisages construction of expressways for a total length of 10,000 Km. The stretches of National Highways that are required to be upgraded to Expressways need to be identified and FS/ DPR studies may need to be carried out for the construction of expressways and their implementation needs to be taken up.

2.11.2 Data Center

- NHAI should endeavor to set up a road data center for all the highways under its control. There is urgent need to store vast records pertaining to the projects that are completed and or under execution so that the data can be retrieved any time. For example, the land records of the lands acquired for the purpose of road widening, As-built drawings, details of highway furniture etc are to be stored in a database so that the information can be retrieved any time.
- Road data in respect of all the highways entrusted to NHAI such as road inventory, Bridge Inventory, traffic data, riding quality etc
- Unit rates for various items of work along the highway.
- Locations of borrow areas and the material available from them.
- Location of congested towns and villages existing along Nhs.

- Permissions being accorded from time to time and due date for their renewal
- Guarantees provided by the contractors / suppliers for various equipment such as expansion joints, bearings, delineators, traffic safety devices installed on highways.
- Location of toll gates, the details of the concessionaires/ contractors and the revenues
- Details of specialized equipment and their details such as name of supplier, the type of material, the warranty provided its performance and so on.

2.11.3 Corridor Management

There is urgent need for effective Corridor management covering all the aspects of pavement maintenance, land management, removing traffic hazards, preventing ribbon development and control overloading of vehicles and incidence management. The scope of existing institutional framework should be enlarged to include control of misuse of highway property such as highway furniture by way of theft, defacing by means of sticking posters, painting colors, or damaging. Though the required legislation by way of National Highways (Land and Traffic) Act, 2002 is in place, proper corridor management is yet to be effected. For making corridor control effective, NHAI may consider creation of a Highway Protection Force on the lines of Railway Protection Force and Industrial Protection Force. Highway police may be activated for enforcing adherence to traffic rules.

Video monitoring of highways which is being done on experimental basis on NH 8 is to be extended to all Highways in a phased manner for effective corridor management and enforcing driver discipline.

2.11.4 Check Posts

NHAI and MORT&H should interact with the State Governments to regulate the location and operation of check posts so that vehicular traffic is put to minimum inconvenience and delay. The concerned regulating agencies should be made to interact with NHAI for finalising the location and layout of the check posts so that through traffic is put to minimum inconvenience.

2.11.5 Institutional Strengthening

The principle of NHAI to be a lean and thin organisation is laudable. But, it is imperative for NHAI to have a dedicated cadre of personnel with specialisation in various aspects such as legal, contract administration, transport planning, land

management, project preparation, project execution, social aspects, inter-modal transportation etc.

2.11.6 Dispute Resolution

The mechanism of Dispute Resolution should be monitored from time to time to see whether the mechanism could be improved further.

2.11.7 Land Acquisition

There has been inordinate delay in acquisition of land in some States mostly due to procedural formalities, court cases and low level of cooperation from the State Govt. officials. There have been delays in disbursement of compensation by the Competent Authority to the affected land owners, although NHAI deposits the compensation amount determined by the competent authority well in advance.

2.11.8 Environment and Forest clearances

The Ministry of Environment & Forests (MoEF), vide circular dated 31.03.2011, linked the grant of environment clearance (EC) with the forest clearance whereby EC is to be considered only after submission of in-principle approval of Govt. of India (Stage-1 clearance) for diversion of forest irrespective of the quantum of forest area to be diverted. This linking had a major adverse impact on the NHDP Programme as NHAI was unable to declare the Appointed Date for many projects to start the work even if a small part of the ROW falls within the forest area. With constant pursuance of NHAI at several forums in the meetings of Committee of Secretaries, Finance and Law Ministry, MOEF approached Hon'ble Supreme Court for necessary modifications in the guidelines for National Highways projects and the process for obtaining environment and forest clearances has been simplified. As per latest notification of MoEF, Environmental clearance is not required for projects upto 100 kms and also for projects having more than 100 km. length in case it involves acquisition of additional ROW less than 40 Mtrs in case of existing alignments and less than 60 Mtrs in case of by-passes or new alignments respectively.

There have been considerable delays in obtaining forest clearances. Besides the conditions stipulated by the Central Government (MOEF) in the first stage clearance (in-principle approval), the State forest departments impose additional conditions which are, at times, unreasonable and difficult to meet such as staff quarters, wireless systems, vehicles etc. The demand for compensatory afforestation also varies greatly from state to state from two times in some states to as much as twelve times in some states.

NHAI along with the Government of India and other institutions and authorities is working towards implementing the changes and reforms to achieve the target of building 20km per day.

3. PROJECT BRACKGROUND

3.1 GENERAL

Uttar Pradesh abbreviated as UP, is the most populous state in the Republic of India as well as the most populous country subdivision in the world. The state, located in the northern_region of the Indian subcontinent, has over 200 million inhabitants. It was created on 1 April 1937 as the United Provinces during British rule and was renamed Uttar Pradesh in 1950.

It covers 243,290 square kilometers, equal to 7.33% of the total area of India, and is the fourth largest Indian state by area. Uttar Pradesh is the third largest Indian state by economy, with a GDP of 9,763 billion. Agriculture and service industries are the largest parts of the state's economy. The service sector comprises travel and tourism, hotel industry, real estate, insurance and financial consultancies. The two major rivers of the state, the Ganges and Yamuna, join at Allahabad and then flow as the Ganges further east. The state has several historical, natural and religious tourist destinations, such as, Agra, Varanasi, Raebareli, Kaushambi, Ballia, Shravasti,Gorakhpur,Kushinagar,Lucknow,Jhansi,Allahabad,Budaun,Meerut,Mathura, Muzaffarnagar and Shahjahanpur.

The Greenfield project highway starts at Km.0.000 near Hridaypur, Sarai Bandi on NH-29 Ghazipur- Gorakhpur road at Km 84.800 (NH-29 Chainage) and ends on NH-19 Bahoran Tola village in Bihar of Raghunathpur- Chappra Road. The total project highway traverses in the Ghazipur and Ballia and Saran districts. It traverses mostly through plain terrain and a mixed land use of residential and agricultural can be seen throughout the corridor.

Table-3.1: Project Stretch Details

S. No	Project Highway	Design Chainage (Km)		Remarks
		From	To	
1	Ghazipur to Manjhi Ghat UP/Bihar Border	0.000	115.600	NH-31
2	Buxar Spur	0.000	17.800	

The Consultant had conducted detailed reconnaissance survey to get acquainted with the actual site conditions. The observations made are discussed in subsequent sections.

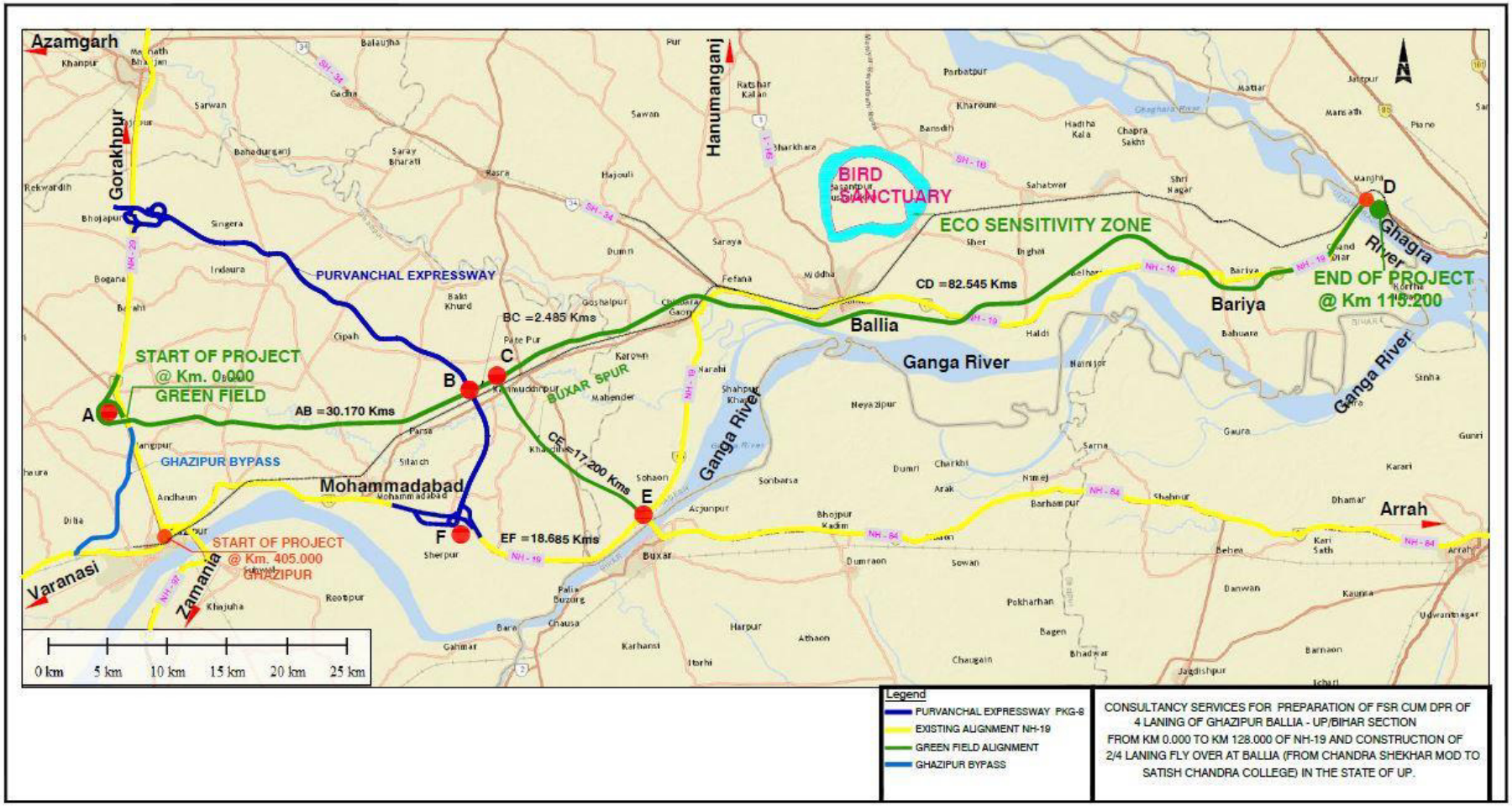


Fig:1 Figure Showing Project Location Map

3.2 TERRAIN

Terrain is classified by the general slope of the country across the highway alignment. Based on this criterion, the entire project stretch traverses predominantly through Plain terrain (70%) followed by Rolling terrain (30%).

3.3 ABUTTING LANDUSE

In terms of land use, majority of adjoining lands were observed to be used for agriculture purposes (70%) and the rest is barren land (30%). Important crops grown along the project stretch are Wheat and Sugarcane. Moderately built-up areas and a mix of fast and slow traffic characterize this corridor. Different types of residential/ commercial structures (Permanent/Semi permanent) are noticed in the built-up section.

3.4 CROSS DRAINAGE STRUCTURES

As a part of upgrading of the project, it is required to make an assessment of existing structures with regards to their adequacies to ensure that they meet the objectives of the project. List of proposed cross drainage structures and underpass locations along the project stretch are shown below from *Table-3.2 to Table-3.7*.

Table-3.2: Proposed Major Bridges

S. No	Design Chainage	Proposed	Span	Remarks
1	48+000	MJB	3 x 25.0	New
2	91+195	MJB	2 x 30.0	New
3	114+043	MJB	3 x 65.5 + 15 x 64.8	Retained

Table-3.3: Proposed Minor Bridges

S. No	Design Chainage	Proposed	Span	Remarks
1	3+046	MIB	1 x 15.0	New
2	17+057	MIB	1 x 15.0	New
3	31+605	MIB	1 x 7.0	New
4	35+269	MIB	1 x 6.0	New
5	36+419	MIB	1 x 7.0	New
6	49+720	MIB	2 x 5.0	New
7	53+730	MIB	2 x 5.0	New
8	63+984	MIB	1 x 15.0	New

9	69+229	MIB	1 x 20.0	New
10	70+172	MIB	2 x 25.0	New
11	73+450	MIB	2 x 25.0	New
12	81+974	MIB	2 x 5.0	New
13	86+484	MIB cum LVUP	1 x 15.0+ 1 x 12.0 x 4.0	New
14	88+887	MIB	1 x 15.0	New
15	109+014	MIB	1 x 7.0	New
16	110+137	MIB	3 x 9.38	Retained

Table-3.4: Proposed Culverts

S. No	Design Chainage	Proposed Span	Type	Remarks
1	1+020	1 x 2.0	Box Culvert	New
2	1+457	1 x 2.0	Box Culvert	New
3	2+097	1 x 1.20	Pipe Culvert	New
4	2+331	1 x 3.0	Box Culvert	New
5	2+669	1 x 3.0	Box Culvert	New
6	3+329	1 x 4.0	Box Culvert	New
7	3+534	1 x 3.0	Box Culvert	New
8	3+705	1 x 3.0	Box Culvert	New
9	4+240	1 x 3.0	Box Culvert	New
10	5+542	1 x 2.0	Box Culvert	New
11	7+008	1 x 2.0	Box Culvert	New
12	7+117	1 x 2.0	Box Culvert	New
13	7+318	1 x 1.20	Pipe Culvert	New
14	7+480	1 x 20.0	Pipe Culvert	New
15	7+750	1 x 2.0	Box Culvert	New
16	8+800	1 x 3.0	Box Culvert	New
17	8+950	1 x 2.0	Box Culvert	New
18	9+159	1 x 1.20	Pipe Culvert	New
19	9+300	1 x 1.20	Pipe Culvert	New
20	9+882	1 x 1.20	Pipe Culvert	New
21	10+065	1 x 1.20	Pipe Culvert	New
22	10+120	1 x 2.0	Box Culvert	New
23	10+206	1 x 1.20	Pipe Culvert	New
24	10+439	1 x 1.20	Pipe Culvert	New
25	11+458	1 x 1.20	Pipe Culvert	New
26	11+766	1 x 2.0	Box Culvert	New
27	12+107	1 x 1.20	Pipe Culvert	New

S. No	Design Chainage	Proposed Span	Type	Remarks
28	13+216	1 x 1.20	Pipe Culvert	New
29	14+368	1 x 2.0	Box Culvert	New
30	14+920	1 x 2.0	Box Culvert	New
31	15+060	1 x 2.0	Box Culvert	New
32	15+411	1 x 4.0	Box Culvert	New
33	15+742	1 x 3.0	Box Culvert	New
34	16+070	1 x 2.0	Box Culvert	New
35	16+500	1 x 3.0	Box Culvert	New
36	17+872	1 x 1.20	Pipe Culvert	New
37	19+197	1 x 2.0	Box Culvert	New
38	19+590	1 x 1.20	Pipe Culvert	New
39	19+992	1 x 5.0	Box Culvert	New
40	20+940	1 x 2.0	Box Culvert	New
41	22+052	1 x 5.0	Box Culvert	New
42	24+990	1 x 3.0	Box Culvert	New
43	26+409	1 x 1.20	Pipe Culvert	New
44	26+761	1 x 2.0	Box Culvert	New
45	28+089	1 x 1.20	Pipe Culvert	New
46	32+870	1 x 2.0	Box Culvert	New
47	33+320	1 x 1.20	Pipe Culvert	New
48	34+331	1 x 1.20	Pipe Culvert	New
49	35+576	1 x 1.20	Pipe Culvert	New
50	35+545	1 x 2.0	Box Culvert	New
51	36+836	1 x 1.20	Pipe Culvert	New
52	36+944	1 x 5.0	Box Culvert	New
53	37+849	1 x 1.20	Pipe Culvert	New
54	38+062	1 x 1.20	Pipe Culvert	New
55	38+269	1 x 1.20	Pipe Culvert	New
56	39+700	1 x 1.20	Pipe Culvert	New
57	39+925	1 x 1.20	Pipe Culvert	New
58	41+068	1 x 2.0	Box Culvert	New
59	44+735	1 x 5.0	Box Culvert	New
60	45+502	1 x 1.20	Pipe Culvert	New
61	48+542	1 x 1.20	Pipe Culvert	New
62	48+900	1 x 1.20	Pipe Culvert	New
63	50+010	1 x 1.20	Pipe Culvert	New
64	50+460	1 x 2.0	Box Culvert	New
65	52+280	1 x 2.0	Box Culvert	New
66	52+884	1 x 3.0	Box Culvert	New

S. No	Design Chainage	Proposed Span	Type	Remarks
67	54+151	1 x 2.0	Box Culvert	New
68	55+269	1 x 5.0	Box Culvert	New
69	55+528	1 x 2.0	Box Culvert	New
70	55+606	1 x 4.0	Box Culvert	New
71	57+448	1 x 2.0	Box Culvert	New
72	58+247	1 x 1.20	Pipe Culvert	New
73	59+637	1 x 2.0	Box Culvert	New
74	62+647	1 x 5.0	Box Culvert	New
75	64+247	1 x 2.0	Box Culvert	New
76	64+327	1 x 4.0	Box Culvert	New
77	66+637	1 x 3.0	Box Culvert	New
78	77+442	1 x 1.20	Pipe Culvert	New
79	80+750	1 x 1.20	Pipe Culvert	New
80	81+567	1 x 3.0	Box Culvert	New
81	82+667	1 x 2.0	Box Culvert	New
82	84+605	1 x 2.0	Box Culvert	New
83	93+367	1 x 2.0	Box Culvert	New
84	94+797	1 x 2.0	Box Culvert	New
85	95+137	1 x 1.20	Pipe Culvert	New
86	99+434	1 x 2.0	Box Culvert	New
87	101+963	1 x 1.20	Pipe Culvert	New
88	105+813	1 x 4.0	Box Culvert	D & R
89	107+140	1 x 2.0	Box Culvert	D & R
90	110+825	1 x 3.0	Box Culvert	D & R

Table-3.5: Proposed ROB's

S. No	Design Chainage	Proposed	Span
1	51+442	ROB	1 x 20.0 + 1 x 46.0 + 1 x 20.0

Table-3.6: Proposed Vehicular Underpass (VUP/LVUP)

S. No	Design Chainage	Proposed Span	Type	Remarks
1	0+423	2 x 30.0 X 5.5	VUP	
2	3+701	1 x 12.0 x 4.0	LVUP	New

S. No	Design Chainage	Proposed Span	Type	Remarks
3	7+112	1 x 12.0 x 4.0	LVUP	New
4	8+960	1 x 20.0 x 5.5	VUP	New
5	12+307	1 x 12.0 x 4.0	LVUP	New
6	18+471	1 x 20.0 (Exp) + 1 x 10.0 (Exp)	VUP cum stream	New
7	21+553	1 x 12.0 x 4.0	LVUP	New
8	23+792	1 x 20.0 (Exp) + 1 x 10.0 (Exp)	VUP cum stream	New
9	26+353	1 x 12.0 x 4.0	LVUP	New
10	29+916	4 x 30 x 5.5	VUP	New
11	34+773	1 x 20.0 x 5.5	VUP cum stream	New
12	39+143	1 x 12.0 x 4.0	LVUP	New
13	44+513	1 x 12.0 x 4.0	LVUP	New
14	51+792	1 x 30.0 x 5.5	VUP	New
15	54+394	1 x 12.0 x 4.0	LVUP	New
16	57+727	1 x 12.0 x 4.0	LVUP	New
17	64+271	1 x 12.0 x 4.0	LVUP	New
18	70+317	1 x 30.0 x 5.5	VUP	New
19	74+169	1 x 30.0 x 5.5	VUP	New
20	77+432	1 x 12.0 x 4.0	LVUP	New
21	79+711	1 x 20.0 x 5.5	VUP	New
22	82+180	1 x 12.0 x 4.0	LVUP	New
23	84+612	1 x 12.0 x 4.0	LVUP	New

S. No	Design Chainage	Proposed Span	Type	Remarks
24	89+661	1 x 12.0 x 4.0	LVUP	New
25	92+283	1 x 12.0 x 4.0	LVUP	New
26	95+779	1 x 12.0 x 4.0	LVUP	New
27	97+519	1 x 30.0 x 5.5	VUP	New
28	99+414	1 x 20.0 x 5.5	VUP	New
29	101+989	1 x 12.0 x 4.0	LVUP	New
30	103+870	1 x 30.0 x 5.5	VUP	New
31	114+829	1 x 14.0	VUP	R & W

Summary of Proposed Structures:

- Major Bridges = 3
- Minor Brides = 16
- Box Culverts = 56
- Pipe Culverts = 34
- ROB = 1
- VUPs = 14
- LVUPs = 17

BUXAR SPUR PROPOSED STRUCTURES:

Table-3.7: Proposed Structures in Buxar Spur

S.no.	Design Chainage	Proposed Span	Type	Remarks
1	0+592	1 x 20.0 x 36.0 1 x 20.0	ROB	New
2	1+114	1 x 2.0	Box Culvert	New
3	1+676	1 x 8.0	MIB	New
4	2+410	2 x 15.0	MIB	New
5	4+610	1 x 2.0	Box Culvert	New

S.no.	Design Chainage	Proposed Span	Type	Remarks
6	6+263	1 x 2.0	Box Culvert	New
7	10+032	1 x 2.0	Box Culvert	New
8	13+490	1 x 3.0	Box Culvert	New
9	15+388	1 x 2.0	Box Culvert	New
10	16+508	1 x 2.0	Box Culvert	New
11	17+003	1 x 1.2	Pipe Culvert	New
12	17+129	1 x 2.0	Box Culvert	New

3.5 SETTLEMENTS

The project stretch passes through villages of Gazipur and Ballia Districts in the project stretch. The complete list of villages abutting the project stretch is shown below in *Table-3.8*.

Table-3.8: Settlements Limits – Greenfield Alignment

S. No	Design Chainage (Km)		Village Name
	From	To	
1	0.000	0.570	Hridaypur
2	0.570	0.750	Saraibandi
3	0.860	1.025	
4	0.750	0.860	Nasirpur
5	1.025	1.450	
6	1.450	1.635	Dadi Kala
7	1.635	2.015	Khazapur
8	2.015	2.500	Dhobha
9	2.500	2.550	Ramdoopur
10	2.550	3.050	Mirzapur Mafi
11	3.050	3.550	Bhikharipur
12	3.550	4.280	Manpur
13	4.280	5.335	Tikari
14	5.335	6.070	Sathipur
15	6.070	6.210	Bisunpur Datta
16	6.210	6.295	Newada
17	6.295	7.950	Subhakarpur
18	7.950	8.530	Akhatiyarpur
19	8.530	9.200	Chak Ajam
20	9.620	9.660	Raibanpah
21	9.200	9.620	Badhui khurd
22	9.660	10.100	Chak Niamtulla

S. No	Design Chainage (Km)		Village Name
23	10.100	10.210	Badhui Buzurg
24	10.210	10.860	Thanaipur
25	10.860	11.880	Hardia
26	11.880	12.605	Rasoolpur ahmad
27	12.605	13.090	Said chak
28	13.090	13.335	Abbaspur
29	13.335	14.935	Baluwa Mu. Nonhara
30	14.935	15.400	Lalapur adai
31	15.400	17.050	Sukhpura
32	17.050	17.575	Todarpur Urf Partap pur
33	17.575	18.065	Fakkrabad
34	18.315	18.575	
35	18.065	18.315	Sakatpur Bareji
36	18.575	19.970	
37	19.970	21.550	Paharipur
38	21.550	22.100	Gajraj Gadaipur
39	22.100	24.370	Parsa
40	24.370	24.885	Indrapur
41	24.885	25.560	Tarapur
42	25.560	26.670	Faizullapur
43	26.670	26.900	Mahmoodpur irf dodadih
44	26.900	27.550	Bagend
45	27.550	28.740	Rampur
46	28.740	28.790	Raipur M. Rajapur
47	28.790	29.580	Padraw
48	29.580	30.510	Sher
49	30.510	30.560	Baddopur
50	30.560	31.800	Bathor
51	31.800	32.340	Dilawaalpur
52	32.340	32.600	New urf uchadih
53	32.600	32.850	Chandkur
54	32.850	34.150	Karimuddinpur
55	34.150	34.200	Baijnathpur
56	34.200	34.870	Lathudih
57	34.985	35.150	
58	34.870	34.985	Jayantipur
59	35.150	35.450	Chak gareeb
60	35.450	35.610	Vishambharpur Aarzai Maafi
61	35.610	36.250	Karkatpur Mu.utraon
62	36.450	36.580	
63	36.250	36.450	Karkatpur Mauja
64	36.580	36.820	Vishambharpur panjum
65	36.820	37.030	Bisambarpur Panjam

S. No	Design Chainage (Km)		Village Name
66	37.030	37.240	Vishambharpu
67	37.240	37.350	Bibipur Khas
68	37.350	37.820	Bharaouli Kalan
69	37.820	39.230	Patar
70	39.230	39.500	Tajpur
71	39.650	40.750	
72	39.500	39.650	Patar
73	40.750	41.070	Bhediausar
74	41.070	41.480	Kajichak
75	41.480	41.910	Gopalchak
76	41.910	42.350	Bharauli Ala
77	42.350	43.200	Sahapur
78	43.200	43.550	Lakra
79	43.550	43.800	Badhwalia
80	43.800	44.250	Awagilwa
81	44.250	45.550	Hardarpur
82	45.550	47.050	Tikapur
83	47.050	48.050	Basaratpur
84	48.050	49.750	Sultanpur
85	49.750	50.390	Kotwari
86	50.390	50.780	Kurchunda Mu. Singhpur
87	50.780	50.930	Kalyanpur
88	50.930	51.250	Kurchunda Ekoni
89	51.250	52.200	Ekoni
90	52.200	52.400	TeteDad
91	52.400	52.600	Teekha
92	52.600	53.850	Teekha
93	53.850	53.900	Cheruia
94	53.900	54.220	Bairiya
95	54.220	54.550	Bhawarkol
96	54.550	55.250	Narhi
97	55.250	56.250	Gangahara
98	56.350	56.890	
99	56.250	56.350	Vaina
100	56.890	57.350	Baghe Ji
101	57.350	58.980	Sagarapalli
102	58.980	59.350	Daraopur
103	59.350	59.670	Kaap Nasirabad
104	59.670	60.200	Sharfuddinpur Mu
105	60.200	60.390	Devariyakurdh
106	60.390	60.730	Mubarakpur
107	60.730	60.890	Khap Khori Pakar
108	60.890	61.190	Parsipatti

S. No	Design Chainage (Km)		Village Name
109	61.190	61.280	Maldepur
110	61.280	62.120	Haibatpur
111	62.120	63.280	Bijaipur
112	63.280	63.800	Bankata
113	63.850	64.120	
114	63.800	63.850	Makhdumhi
115	64.120	64.420	Bedua
116	64.420	65.050	Hirpur
117	65.050	65.110	Neori Taluka Jamuaon
118	65.110	65.280	Chandanapur
119	65.280	65.550	Kanspur
120	65.550	65.950	Jamuwa
121	65.950	66.770	Moorki
122	66.770	67.430	Jamun
123	67.430	68.180	Kishun Nagar
124	68.180	68.390	Mohan Chhapra
125	68.390	69.950	Nagwa
126	69.950	70.310	Harlal Chhapra
127	70.310	71.600	Jinari
128	71.600	71.870	Mafi Janari
129	71.870	73.300	Bhel Sarh
130	73.300	73.330	Urgasenpur
131	73.450	73.650	
132	73.330	73.450	Bhimpatti
133	73.650	74.380	Oujha Kacchua
134	74.380	75.350	Kachha Khas
135	75.350	76.530	Rampur Titihi
136	76.530	77.130	Pochhari
137	77.130	78.100	Pindari
138	78.100	79.100	Sihakhund
139	79.100	80.690	Bharkoka
140	80.690	80.920	Kathal
141	80.920	81.450	Mudadih
142	82.070	84.130	
143	81.450	82.070	Laakhpur
144	84.130	85.700	Belhari
145	85.700	86.340	Malikpura Mu. Jagchhapra
146	86.340	87.150	Dudaila
147	87.150	87.910	Khajuhati
148	87.910	88.800	Raghunathpur
149	88.800	89.590	Kanchanpur
150	89.590	90.350	Kewa
151	90.350	91.000	Mansing Chapra

S. No	Design Chainage (Km)		Village Name
152	91.000	92.250	Cherdih
153	92.250	97.030	Moon Chhupra
154	97.030	97.450	Bairiya
155	98.460	100.800	
156	97.450	98.460	Tengarahi
157	100.800	105.920	Sonabarsa
158	105.920	108.850	Ibrahimabad Uparwar
159	108.850	109.850	Chanddiar
160	112.100	113.290	
161	109.850	112.100	
162	113.290	114.550	
163	114.550	114.890	Bahoran Tola
164	115.200	115.460	
165	114.890	115.200	

Table-3.9: Settlements Limits – Buxar Spur

S. No	Design Chainage (Km)		Village Name
	From	To	
1	0.000	0.050	Bathor
2	0.050	0.350	Chandpur
3	0.350	2.450	Karimuddin pur
4	2.450	3.250	Kotiya Kodartal
5	3.250	4.500	Deoria
6	4.500	5.050	Maragupur
7	5.050	5.750	Musur Dewa
8	5.750	7.250	Khardiha
9	7.250	8.430	Bhushula
10	8.430	8.730	Muktapur Urf Charkha
11	8.730	9.450	Murera Bhuzurg
12	9.450	10.000	Shah pur
13	10.000	11.050	Basnia
14	11.050	11.250	Tetarpur Mutkle Dularpur
15	11.250	12.600	Tetarpur Kalan
16	12.600	13.850	Ramgarh
17	13.850	14.550	Kamal Pur
18	14.550	14.600	Jajar Kalsa
19	14.600	15.780	Kurmidi
20	15.780	16.470	Chintamanpatti
21	16.470	17.280	Kumkum Patti

3.6 EXISTING GEOMETRICS

The existing road from Km 523.300 to Km 535.000 is utilized and upgraded to four lane standards with concentric widening and a small realignment at Ibrahimbad Uparwar village. The existing geometric alignment of the project stretch might have been designed as per State Highway standards and may not meet the present standards of a National Highway. The design is deficient in sight distance, curve radii and super elevation at few locations. Further, there are several curves near village limits which might require improvement/realignments.

3.7 CARRIAGEWAY

The existing carriageway details are shown in below *Table-3.10.*

Table-3.10: Carriageway Details

S.No.	Design Chainage (Km)		Existing Chainage (Km)		Existing Pavement Configuration	Existing Width (m)	Remarks
	From	To	From	To			
1	103.900	115.200	523.600	535.300	Two lane	7m	In Built up locations varying from 7 – 10 m

3.8 PAVEMENT

Flexible pavement is observed along the existing project stretch except the riding quality/pavement condition varies from good to fair along the entire stretch with very few sections of the road showing various types of distresses such as Raveling, Potholes, undulations and cracks.

3.9 RIGHT OF WAY

The existing Right of Way (RoW) varies between 24m to 30m along the corridor. RoW pillars was not found along the project stretch. The precise RoW details will be ascertained from the revenue records to clarify on the exact land available for construction. Land acquisition plans would be prepared to have uniform ROW in accordance with NHAI guidelines. Additional land acquisition will be proposed as per project requirements and in accordance with TOR/ NHAI guidelines.

3.10 SCHEME OF WIDENING

To accommodate Four lane with paved shoulders within proposed ROW, concentric widening may be advisable along the existing alignment. However, final decision regarding scheme of widening will be taken after finalization of geometric design considering different parameters such as right of way availability, presence of utilities, sensitive structures, economics and other considerations.

3.11 UTILITIES

The project road has utilities that come in the way of the proposed upgradation scheme. The Electric lines are observed to be nearly at 5-10m from road edge and crossing of High Transmission lines observed along the project corridor. In most of the locations the electrical poles are within the Right of Way which should be relocated. High Transmission towers and sub-stations are observed to be away from Right of Way in the project stretch.

3.12 ADDITIONAL LAND ACQUISITION

Additional land acquisition may become necessary for the following, subject to the improvement proposals made after a detailed study:

- § Bus bays and Truck lay-byes
- § Underpasses with Slip roads
- § Service Roads at Urban Locations
- § Proposed bypasses
- § Realignment sections
- § Toll Plazas
- § Rest areas
- § ROB's

4. METHODOLOGY ADOPTED

4.1 GENERAL APPROACH

The Consultants will collect the available data and information relevant for the Study. The data and documents of major interest will include, but not be limited to, the following:

i. Climate

ii. Road inventory

iii. Road condition, year of original construction, year and type of major maintenance/rehabilitation works

iv. Condition of bridges and cross-drainage structures

v. Sub-surface and Geo-technical data for existing bridges

vi. Hydrological data, drawings and details of existing bridges

vii. Existing geological maps, catchment area maps, contour plans etc. for the project area

viii. Condition of existing riverbank / protection works, if any

ix. Details of sanctioned/on-going works on the stretch sanctioned by MoRT&H/ other agencies

x. Survey and evaluation of locally available construction materials

xi. Historical data on classified traffic volume (preferably for 5 years or more)

xii. Origin-destination and commodity movement characteristics; if available

xiii. Speed and delay characteristics, if available

xiv. Commodity-wise traffic volume; if available

xv. Accident statistics

xvi. Vehicle loading behaviour (axle load spectrum), if available

xvii. Type and location of existing utility services (e.g. Fibre Optical Cable, O/H and U/G Electric, Telephone line, Water mains, Sewer, Trees etc.)

xviii. Environmental setting and social baseline of the project.

The detailed methodology of the surveys, investigations, data collection, analysis, preparation of reports, designs and drawings etc. shall be in line with the indicative

methodologies given in the Terms of Reference and a brief account of the same is furnished in the following sections.

4.2 SURVEYS AND INVESTIGATIONS

4.2.1 Road & Structural Inventory Survey

Road inventory will be carried out for the existing roads in standard formats at every 500m interval along with the recording of condition of existing structures by the expert team. Features like terrain, land-use, surfacing type and width, shoulder, sub-grade, local soil type, curve details, intersectional details, retaining structures details, location of water bodies, location of forest areas, height of embankment or depth of cut, ROW, CD structures, road side arboriculture, existing utility services, Existing Railway crossings, cross roads, structures, junctions and general drainage conditions etc., will be recorded for every 500m distance. The road inventory will be referenced to the existing km posts established along the roadside. The details would be utilized to arrive at the preliminary assessment of the scope of design.

Inventory of all the structures (bridges, viaducts, ROBs/RUBs and other grade separated structures, culverts etc.) will be carried out along the project road as per the guidelines stipulated in the manual of IRC: SP:35-2015. The inventory of culverts will be presented in a tabular form covering relevant physical and hydraulic parameters.

4.2.2 Pavement Condition Survey

The visual condition survey data will be recorded at site. This includes information on visible deficiencies and ongoing/ recent improvements. The condition survey inventory will be conducted by adopting the following details:

·Cracking area as percentage of total surface area

· Pothole No./100m length and area as percentage of total surface area

· Ravelling area as percentage of total surface area

·Rutting was measured as three categories None (0-10mm)/ Moderate (10mm 20mm)/ Severe (>20mm)

· Patching as percentage of total surface area

· Pavement edge drop in mm

· Shoulder condition

· Embankment condition

4.2.3 Culvert Condition Survey

The condition survey of the existing Pipe, Slab and Arch Culverts on the project corridor is mainly intended to assess hydraulic adequacy, structural condition and durability. The aim of condition survey is to assess the condition of existing culverts for their capacity to carry four lanes of traffic with or without widening. As a partial component of condition survey, visual observations will be made keeping in view above said aim. Various condition features of culverts will be recorded and presented for each culvert. In addition to condition survey, other particulars like presence of scour, flow direction, type of crossing (Straight/Skew), adequacy of water way, purpose of culvert (balancing/ drainage) and proposed rehabilitation measures will also be presented for all culverts.

4.2.4 Condition Survey for Bridges & ROB

The condition survey of the existing bridges and structures on the project corridor is mainly intended to assess the following:

· Structural condition

· Durability aspects

The aim of condition survey is to assess the condition of existing bridges and structures for their capacity to carry two lanes of traffic with or without widening. As a partial component of condition survey visual observations were made keeping in view the requirement of IRC: SP:35-2015 and IRC: SP:40-1993. As Per IRC: SP:40-1993, the normally observed signs of distresses are listed below. The common distress signals in RCC bridges are as follows:

· Cracking; cracks could be of different types and widths

· Scaling

· Spalling of concrete

· Leaching, Rust stains

· Delimitation, Deformation

· Holes in Deck Slab

Visual observations carried out during the condition survey will be made to find out the above listed distresses. In addition to the superstructure, the substructure also will be inspected to locate visual signs of settlement, tilting, cracking, decay, corrosion, cavitation, abnormal scour and damage due to impact of floating bodies.

4.2.5 Falling Weight Deflectometer Method

4.2.5.1 Introduction:

The following Falling Weight Deflectometer (FWD) procedure is adopted to evaluate the strengthening requirements of existing flexible pavements.

4.2.5.2 Accessories for FWD Test:

➢ Six to Nine velocity transducers (geophones) are adequate.

➢ Falling Weight Deflectometer apparatus

➢ KGP Backcalcualtion Software

4.2.5.3 Theory:

Falling Weight Deflectometer (FWD) is an impulse-loading device in which a transient load is applied and deflected shape of Pavement is measured using Displacement Sensors to ascertain the structural strength of the pavement and to determine the thickness of overlay required for sustaining the projected traffic load.

Falling Weight Deflectometer

Based on the data collected from condition survey, the road length shall be classified into sections of uniform performance. Identification of sections of "good, fair and poor" performance may have made separately for each lane and shoulders separately.

The length of each uniform section is kept at a minimum of 1 km except in the case of localized failures section length restricted to 0.3 km. Sub grade samples for FWD purpose, also shall be collected at each of FWD observation location. The entire project shall be analyzed for the calculation of Modulus of Elasticity of existing Pavement using KGPBACK software.

4.2.5.4 Interval of test points and Marking for FWD Test:

The interval at which data should be collected will depend on the length of uniform section. Different measurement schemes can be adopted. These include

(i). measurement along the most distressed wheel path of the carriageway

(ii). measurement along inner as well as outer wheel paths of all the lanes

(iii). measurement along both wheel paths of only the outer most lanes and

(iv). measurement along the more distressed wheel paths of each of the lanes.

The guidelines given in below mentioned table are recommended for selection of deflection measurement schemes for different types of carriageways.

Table-4.1: Guidelines for Selection of Deflection Measurement Scheme

Type of Carriage way	Recommended Measurement Scheme	Maximum Spacing (m) for test points along selected wheel path of different classifications		
		Poor	Fair	Good
Two-lane Two-way Single Carriageway	Measure along both outer wheel paths	60	130	500

4.2.5.5 Marking of FWD Test Points:

1. Mark a point at a distance of 1 m from outer edge of outer lane for two-lane two- way carriage way

2. Repeat the process of marking points at an interval of (Based upon the Determined spacing for each uniform performance section).

4.2.5.6 Procedure:

1. The following steps may be followed for measuring the deflections at each test point.

2. Mark the test point on the Pavement as the interval obtained from the Pavement condition survey.

3. Center the load plate of the duly calibrated FWD over the test point.

4. Lower the load plate onto the pavement. There should be no standing water on the pavement surface. The loading plate should be in proper contact with pavement surface. If a non-segmental plate is used the presence of rutting at test location Should be noted if it affects the contact between plate and pavement surface. The longitudinal and transverse slope of the pavement should not exceed 10 % at the test location for accurate measurement of deflection.

5. Lower the frame holding the displacement transducers (geophones) so that the transducers are in contact with pavement surface.

6. Raise the mass to a predetermined height for producing a target load of 40 KN.

7. Drop one seating load. Load and deflection data for seating load drop need not be recorded.

8. Raise the mass and drop. Record load and deflection data into the computer through data acquisition system. While peak load and peak deflections at different selected radial positions must be recorded, complete time history of load and deflections can be stored for each load drop if feasible.

9. Repeat the above step at least two more times.

10. If the measured deflection is less than 10 μm, the tested repeated by changing the peak load.

11. Raise the geophone frame and load plate and move to the next test point.

12. Record air temperature at half hourly interval. Record pavement surface temperature if non-contact temperature sensors are available.

13. Deflection measurements should not be made when the pavement temperature is more than 45^0C. In colder areas and areas of altitude greater than 1000 m where the average daily temperature is less than 20^0C for more than 4 months in a year, the standard pavement temperature of 35 ^{0}C will not apply. In such cases the ambient temperature is greater than 20^0C. No temperature is applied for back calculated moduli of bituminous layers.

4.2.5.7 Corrections and Analysis:

Following analysis & corrections are to be applied to the FWD test observations during its analysis:

1. The deflections obtained from the above procedure, different pavement layer thicknesses, Standard Load, No. of deflections measuring sensors used in test & their radial distance, poisson's ratio of different layers & assumed moduli ranges for different pavement layers are used as inputs for back calculation of Elastic modulus using KGP Back calculation software.

2. The pavement temperature and seasonal variation in climate influence the deflections measured by the Falling Weight Deflectometer.

3. Measure Pavement surface layer temperature at half-hourly intervals by drilling holes of 40 mm depth into the pavement surface layer. Fill the hole with a drop of glycerol. Insert the thermometer into the hole and measure the temperature after three minutes. Correction shall be applied to the deflection measured in accordance with the procedure described in IRC: 115-2014, if the observed temperature is different from 35^0C.

4. The back calculated modulus obtained from of bituminous layer obtained from deflection survey conducted at a temperature "T2" °C can be corrected to estimate the modulus corresponding to a temperature of "T1" °C using below mentioned equation

$$E_{T1}=\lambda E_{T2} \text{ where,}$$

λ, temperature correction factor, is given as

$$\lambda=$$

E_{T1}= back-calculated modulus (Mpa) at temperature T_1 ($_0$C)

E_{T2}=back-calculated modulus (Mpa) at temperature T_2 ($_0$C)

5. Seasonal correction is to be applied using the relationships developed for different seasons (Winter/ summer/ monsoon) given in the Clause 6.5.2 of IRC: 115-2014.

Seasonal Corrections factors are given by equations for subgrade,

$$E_{sub\ mon} = 3.351 * (E_{sub\_win})0.7688 – 28.9$$

$$E_{sub\ mon} = 0.8554 * (E_{sub\_sum})0.7688 – 8.461$$

Seasonal Correction factors for Granular Layers are given by equations,

$$E_{granu\_mon}= - 0.0003 * (E_{granu\_Sum}) + 0.9584* (E_{granu\_Sum}) – 32.989$$

$$E_{granu\_mon} = 10.5523 * (E_{granu\_win})0.624-113.857; \quad \text{Where,}$$

E_{sub_win}/ E_{granu_win} = Subgrade/Granular layer Modulus in Winter (Mpa)

E_{sub_sum}/E_{granu_Sum} = Subgrade/Granular layer Modulus in Summer (Mpa)

E_{sub_mon}/E_{granu_mon} = Subgrade/Granular layer Modulus in Monsoon (Mpa)

4.2.6 Roughness Survey

The objective of roughness survey is to determine the riding quality of the existing pavement which shall form the basis for identifying the homogeneous sections and calculating the vehicle operating cost of the traffic plying on the project road so that the feasibility of improvement can be ascertained.

Roughness survey of existing pavement will be carried out along the outer wheel paths in each direction using bump integrator. The instrument will be fixed and operated in accordance with the manufacturer's instructions. The reading shown by the display unit which gives the roughness in cm/km will also be manually recorded for each kilometer. The results of the survey will be expressed in terms of BI and IRI. Based on the data, homogenous segments with respect to surface roughness will be determined using cumulative difference approach.

The roughness values, which represent pavement functional performance, are essentially intended for use in economic analysis, and for checking against the pavement designs proposed for different sections.

4.2.7 Traffic Surveys

Road network has been studied during the reconnaissance. As per the details of TOR, mid-block sections were identified for carrying out traffic surveys and all the detailed locations of traffic surveys will be finalized in consultation with NHAI.

The following surveys are proposed in conformance with the TOR.

1. Classified Traffic Volume Count Surveys
2. Origin and Destination and Commodity Movement Surveys
3. Axle Load Surveys
4. Intersection Volume Count Surveys – At all major intersections/ selected locations.
5. Pedestrian/ Animal Cross Traffic Survey
6. Speed-Delay Study

Actual survey locations will be approved by the Authority (NHAI) before commencement of the surveys.

Consultant proposes to carry out Classified Traffic Volume Count surveys (CTVC) at the approved locations for continuous 7 days with two teams for recording all vehicles passing the selected location of section in both directions. CTVC will be carried out by using Automatic Traffic Counter and Classifier (ATCC) System. ATCC System such as Pneumatic Tube Detector, Inductive Detector Loop, Video Image Detection and Infrared Sensor or equivalent technologies will be adopted. The survey data will be analysed for calculating ADT and AADT after applying seasonal correction factors.

Origin-Destination and commodity movement survey by Road Side Interview method will be conducted at approved locations for 24 hours by stopping the vehicles and interviewing truck drivers with the assistance of local police on a random sampling basis. Trained personnel will be engaged for collecting information as per questionnaire and compile the same.

To arrive at the contribution of single trip, return trip and monthly trips of vehicles in toll revenue analysis, *Number plate method OD survey* will be conducted for 24 hours

at same locations of RSI survey. Registered number of all vehicles surveyed will be noted including state name.

Turning Movement Survey will be conducted at all approved location for 24 hours. At each entry arm of the intersection, one enumerator will be positioned for recording each type of turning movement (i.e. left turning, right turning and straight moving) strategically so that they will be able to observe the turning movement of each vehicle and record appropriately. The survey will be conducted for a continuous period of 24 hours in accordance with IRC: SP: 41 – 1994.

Pedestrian/Animal crossing survey will be carried out at major crossings and as per the critical locations identified and discussed with the client. The survey will be done by trained enumerators who count the number of pedestrians/ animals crossing the road using hand tally mark system. Pedestrian count surveys will be performed near educational institutions, markets, bus stops and similar high – pedestrian activity areas whereas animal count surveys will be conducted at critical locations of highway where animals cross the road. The output of the survey will be useful in proposing the number and locations of pedestrian and animal underpasses along the project road.

The data obtained from the Origin-Destination survey, speed-delay survey and other surveys will be analysed to assess the requirements for short term and long term requirements of truck terminals at suitable locations along the project stretch.

Survey for Wayside Amenities will include an inventory of all the existing roadside facilities like fuel-filling stations, tyre /mechanical repair shops, Dhabas (way-side restaurant) /restaurants/hotels, motels and lay byes etc. The possibility of retaining the existing facilities, if any, namely, bus bays, truck lay-byes, kerbs, foot paths, drains, service roads shall be studied in accordance with the design standards given in the Two lane manual (IRC: SP:73-2018). Primary objective is to accommodate all the new facilities in the existing right of way. Any deviations shall be recorded and produced for approval of the competent authority.

4.2.8 Axle Load Surveys

Axle Load survey will be conducted at approved locations of the project stretch along with O-D surveys. Different types of trucks will be selected on random sampling basis and will be weighed to estimate the loading pattern. The ratio of loaded trucks to that of empty trucks will be ascertained from the results of the Origin-Destination survey conducted at the same location.

4.3 SUBGRADE INVESTIGATIONS

Basic objective of subgrade investigation is to determine the suitability of existing road sub grade to support the pavement in widening portion. The strength and the level of compaction of the existing sub grade will be determined by conducting various tests in the field and laboratory.

The investigations for subgrade characteristics are intended for design and strengthening requirements such as overlay for the existing pavement, and for designing new pavement for widening portions where the subgrade level of new pavement falls within the existing roadway.

For the above purpose, test pits of size 1.0 m x 1.0 m will be made up-to sub-grade level at a frequency of 2 pits for every 5.0km interval along the paved edge of the carriageway. The pits will be excavated in such a way that each pit will be located alternately on LHS & RHS @ 2.5km intervals or for each soil type, whichever is more. Sub grade sample of about 50 kg will be collected in these locations at the interface of carriageway and the shoulder and following activities shall be carried out:

· The pavement layers will be measured and logged.
· The field moisture content will be determined by rapid moisture meter at site or by oven dry method after bringing the samples to lab.
· The field density will be determined by core cutter method.
· Grain size analysis and Atterberg limits will be determined in the laboratory for classification of soils as per IS 2720 Part 5.
· The Maximum Dry Density and Optimum Moisture Content will be determined as per Modified AASTHO Compaction T 180
· CBR testing will be carried out on the specimens compacted at NMC at 3 different energy levels, on specimens soaked for 4 days as per AASHTO T 193.
· Field CBR using DCPT at each test pit as per TRRL Research Report LR 673
· Free Swell Index of the samples will be determined.

4.4 MATERIAL INVESTIGATIONS

The material investigations for road construction will be carried out to identify the source of construction materials like borrow soil, coarse and fine aggregates and water, including the information regarding the accessibility to source and lead from the project stretch. This is one of the most important activity for stable, economic and successful implementation of the project within the stipulated time.

4.4.1 Objectives

Material investigation shall be carried out based on the information collected from local PWD, locals interview, information from local panchayat and zilla parishad offices and from material suppliers.

The investigation on material sources will be carried out to fulfill the following basic objectives.

- Source location indicating place, chainage, approximate quantity of material available and lead distances from the project road to source.
- Ownership of land/quarry, whether Government or private.
- Visual classification and suitability for the construction.

A visit to the quarries and surrounding areas will be made and samples of soil, coarse and fine aggregates will be collected separately for visual observation and necessary laboratory tests.

During the process of investigation, due consideration will be taken to see that locally available materials are used for reducing the cost of construction. A mass haul diagram indicating locations, routes and lead will be prepared.

Following tests will be conducted on the samples.

On Borrow soils:

- Grain size Analysis
- Atterberg's Limits
- Modified Proctor test for OMC & MDD
- Unsoaked and Soaked CBR
- Free Swell Index (FSI)

On Coarse Aggregate:

- Specific gravity and water absorption.
- Aggregate Impact Value (AIV).

On Fine Aggregate:

- Grain size analysis for Zone Identification.
- Specific gravity and Water absorption.

4.5 SUB-SOIL INVESTIGATIONS

Geo-technical investigations will be carried out with a view to furnish the Detailed Technical Information of the nature of sub-soil strata for foundation design and assessment of stability of high embankments.

Basically, subsoil investigations will be carried out for new structures or the structures to be reconstructed on a sample basis.

Objectives and Scope of Work:

a) Objectives

The objectives of Sub-Soil Investigation are to evaluate the following:

- To ascertain the sub-soil strata.
- To study standing Ground Water table.
- To study the physical and engineering properties of soil strata.
- To evaluate allowable safe bearing capacity of soils to design foundations.
- To recommend type and depth of foundation.
- To recommend improvements to the weak soil strata if any.
- To evaluate the stability of high embankment.

b) Scope of the Work

Sub-soil investigations are proposed for all major structures. Borehole frequency as per length of bridge is tabulated below:

S.No.	Description	Location of Boring
1	**Overall length = 6 – 30 m**	**One abutment location**
2	**Overall length = 30 – 60 m**	**One abutment location and at least one intermediate location between abutments for structures having more than one span.**
3	**Overall length > 60 m**	**Each abutment and each pier locations.**

4.5.1 Field Investigations

- Boring of 150-mm dia holes in all kinds of soils up to 30.0 m or up to refusal strata (N>100 Blows for 30 cms penetration) using Auger equipment.

- Boring of 150-mm dia holes in all kinds of soils up to 15.0 m or 3.0 m in Hard Rock whichever encounter early using Calyx operated Rotary Boring Rig with Wash Boring Method.
- Conducting field-tests such as Standard Penetration Tests (SPT) as per IS 2131-1981 at various depths in the Boreholes.
- Collecting Disturbed/Representative samples (DS/RS) during drilling and also during SPT Tests. Disturbed samples using the split spoon sampler and UDS(Undisturbed) samples using 100 mm thin walled Shelby tubes shall be collected. The samples recovered will be packed in polythene bags, labeled and sent to the laboratory for testing.
- During field investigations the standing Water Table levels will be studied and recorded in the Borehole log.

4.5.2 Laboratory Testing

The scope of Laboratory Testing is as follows:

- For Soil Samples Obtained from SPT:
- Grain Size Analysis as per IS 2720 part 4.
- For Soil samples Obtained from UDS tube:
- Specific Gravity as per IS 2720- part 3-Section 1 and IS 2720 – part 3.
- Grain Size Analysis as per IS 2720 part 4.
- Atterberg's Limits as per IS 2720 part 5, IS 2720 part 2.
- Determination of natural moisture content as per IS 2720 part 2.
- Determination of field density as per IS 2720.
- Determination of Tri-axial Shear Strength tests by UU method as per IS 2720-part 10.
- For Rock Core Samples Obtained from Double tube core barrel:
- Uniaxial Compressive strength test as per IS: 9143
- Point load index as per IS: 8764
- Specific gravity, Water absorption & Porosity as per IS: 1124

4.6 TOPOGRAPHIC SURVEYS

The basic objective of the topographic survey is to collect the essential ground features along the alignment and develop Digital Terrain Model (DTM). The equipment used for this purpose is UAV (Unmanned Aerial Vehicle). This data forms the basis for

all the designs to be carried out, so as to take care of design requirements of new carriageway, possible improvements in highway geometrics, identifying areas of restriction and their remedies and relocation of utilities. The data collected will result in the final design and for the computation of earthwork and other quantities required.

4.7 ENVIRONMENTAL IMPACT ASSESSMENT

Inception Report reviews the proposed work plan related to environmental aspects and makes desirable modifications keeping in view the requirement of the Project Road. The methodology for carrying out the study and specifications to be adopted in this project are as follows:

4.7.1 Objectives

The main objective of the study is to conduct Rapid Environmental Impact Assessment for the proposed Two/Four laning of GHAZIPUR-BALLIA–UP/BIHAR STRETCH IN THE STATE OF UTTAR PRADESH**.**

4.7.2 Specification/Guidelines

The Environmental Impact Assessment study shall be carried out as per the requirement of the Ministry of Environment & Forests (MoEF), Environmental Guidelines for Roads, Rail and Highways Project, World Bank Operational Directive and Operational Policies and IRC Guidelines for Environmental Impact Assessment (EIA) of Highway Projects.

4.7.3 Methodology

The methodology to be adopted for the EIA study is shown below as flow chart and further detailed in the following paragraphs.

4.7.4 Data Collection

The data on different attributes of physical resources, ecological resources, quality of life values and human use values will be collected both from secondary & primary sources.

4.7.5 Secondary Data Collection

The published literature will be collected from different Govt. Organizations/ Institutions, NGOs etc. to assess the baseline environment. The aim will be to collect secondary information to the maximum extent possible.

4.7.6 Flora & Fauna

The information on flora like roadside plantation and fauna within the study area will be collected from the Forest Dept., Botanical survey of India, Zoological survey of India and through field verification. The information on wetland, grassland and other ecologically important areas will also be collected.

4.7.7 Geology and Soil

The information on geology and soil within the study area will be collected from Geological Survey of India.

4.7.8 Ground Water

The information on ground water i.e. depth of water table, yield etc. will be collected from the Central Ground Water Authority, Central Water Commission, Survey of India District Planning Maps etc.

4.7.9 Land use

The land use pattern within the study area in general and adjacent to the road in particular will be established through collection of maps/documents from Survey of India, Agriculture Department and Forest Dept. and through field verification.

4.7.10 Climate & Meteorology

The climate and meteorology data i.e. temperature, wind speed, wind direction, rainfall, relative humidity, cloud cover and cyclone will be collected from Meteorological Department.

4.7.11 Archaeological/Historical Site

The information on archaeological and historical places, if any, will be collected from Archaeological Survey of India, Dept. of Tourism etc.

4.7.12 Air and Water Quality

Available information on ambient air quality and water quality will be collected from Central Pollution Control Board (CPCB), Uttar Pradesh State Pollution Control Board, Reputed Research Laboratory and Universities.

4.7.13 Primary Data Collection

a. Field Reconnaissance Survey

Preliminary field survey will be undertaken to identify the critical issues and to examine different alignment options. The following information/documents will be collected during reconnaissance survey.

- Information on location, type and sensitivity of all critical natural habitats such as reserved/protected forest, wildlife sanctuaries, wild life migratory route across the road, wet lands, grass land, sacred groves etc.
- Information on location of schools, hospitals, religious, archaeological and historical places.
- Identification of air quality, noise level, water quality and soil quality monitoring stations as per BIS, CPCB, IRC and MoEF Guidelines.
- Details of roadside plantation i.e. Chainage-wise and girth size wise no. of trees.
- Information on industries i.e. pollution status, discharge point/disposal site of effluent/solid waste along the corridor, if any.
- Information on flora and fauna within the study corridor will be collected and verified in the field.

b. Environmental Impact Assessment

It will include the following:

- The collected primary and secondary data will be compiled to assess the existing baseline environmental condition.
- Prediction of impact
- The assessment of impact during construction and operation phase
- Suggestion of mitigation measures

4.8 SOCIAL IMPACT ASSESSMENT

The social impact assessment will be an attempt to ascertain negative or positive impact of the road on the existing social and cultural condition of people including inter and intra group dynamics, relationships, institutions, values, systems and potential changes. SIA contains two components:

- Study of impact due to acquisition of land and other property adjacent to the existing Right-of-Way (ROW) as part of widening of existing road;
- Study of impact due to realignment and bypasses, which leaves the ROW zone and follow a different route.

The main elements of SIA are:

- Social impact screening and assessment;
- Baseline social-economic surveys and census of the potentially affected population;

The social impact assessment and analysis also covers:

- Suggestion and cost-effective mitigation measures for adverse social impacts and rehabilitation of PAPs
- Conflict resolution mechanisms
- Identification and determination of significant social, cultural and economic issues requiring further studies and analysis
- Identification and appraisal of significant social risks to the project during its construction and operation and
- Estimation of quality of data, key data gaps and level of uncertainty of social impact prediction

Baseline Socio-Economic Survey:

- For the preparation of a draft entitlement framework for compensation of land and other assets which may need to be acquired for the project, following studies are proposed to be made on representative sample of road stretches
- Social, economic, cultural and demographic characteristics of potential project affected population and families
- Legal status of the project affected households and assets
- Identification of cultural properties, common properties and public assets being used by the project affected population
- Land usage and inventory of assets on the ROW and its legal boundary
- Assessment of various kinds of losses likely to be experienced by the PAPs/PAFs
- Valuation of assets and the compensation and
- Rehabilitation strategies, resettlement options and assessment of alternative sites

4.8.1 Methodology

The methodology for baseline socio-economic survey will be both qualitative and quantitative. Household interview schedules will be administered for collecting data from the sampled household through personal interview.

The surveyed data will be analyzed for assessing the impact of the loss of assets and resources on various categories of people and communities, irrespective of their legal rights under existing laws. The analysis also will cover customary-cultural practices, social capital and gender dimensions of access and use of resources.

4.9 ESTIMATION OF QUANTITIES AND PROJECT COSTS

Estimation of quantities and tentative costs will be prepared for the project and finalized in consultation with NHAI as per the requirements of Terms of Reference.

All the involved improvement works will be itemized using standard nomenclature for work items compatible with application of the MOST Specification for Road and Bridge Works. Quantities for each item will be worked out from the detailed drawings, and these will be computer-generated.

The Unit rates of all items of construction work will be analyzed as per the guidelines given in Standard Data Book of MORT&H. The basic rates of materials are obtained from the latest edition of Standard Schedule of Rates (SSR: 2016-17). Market rates are adopted for items for which, the rates are not available in SSR. The location of material quarries like gravel, sand, crushed aggregate will be obtained from the material investigations. The leads of different materials are obtained by drawing the lead chart. In respect of hourly hire and operating cost of various road construction machinery and equipment, rates given in MORT&H Standard Data Book and SSR are considered. For machinery and equipment not covered by these two, the prevailing market rates are considered. The labour rates are taken from SSR. Unit rates so arrived have been compared with reference to the rates of similar items in the ongoing projects under NHAI and are found comparable.

4.10 ECONOMIC ANALYSIS

The Economic analysis will be carried out and the benefit cost streams will be worked out for the project corridor by using HDM-IV. The Economic analysis will cover but not limited to the following aspects:

· Assesses the capacity of existing roads if any, and the effect of capacity constraints on vehicle operating costs (VOC);

· Calculation of VOCs for the existing road situation;

· Quantification of all economic benefits, including those from reduced congestion, travel distance, road maintenance cost savings, increased time saving and reduced incidence of road accidents; and

· Assessment of the maintenance intervention required for contracts.

· Quantification of benefits if the project is maintained under traditional PPP route and traditional procurement route using HDM-IV modeling.

· Estimation of the Economic Internal Rate of Return (EIRR) for the project over a 20/30-year period. Also, identification of the tradable and non-tradable components of projects costs and the border price value of the tradable components.

The economic analysis will be taken into account for all ongoing and future road and transport infrastructure projects and future development plans in the Corridor of Influence (CoI). The economic analysis will also take into account for all other developments – industrial, tourism etc. planned in the CoI.

4.11 FINANCIAL ANALYSIS

The financial analysis aspect is involved, when the work is to be taken up on BOT basis. The objective and methodology of Financial Analysis is described hereinafter.

The main objective of financial analysis is to find the likely returns to the investor. This covers aspects like financing through debt and equity, loan repayment, debt servicing, taxation, depreciation etc. The viability of the project is evaluated on the basis of cash flow analysis, where both costs and revenue have been indexed to take in to account the inflation.

Financial viability analysis will be done on the basis of financial model developed by the Consultant. The model projects the key financial statements of the investor over the concession period. Concession period of 15/20/30 years will be considered, and the growth rate of the traffic may be assumed at 5% per annum.

All investment costs and capital expenses will be identified in the year in which they are deemed to occur. A 5% inflation rate per annum will be applied to all cost and revenue items.

The construction is to be financed through both equity and loan. A Debt-Equity ratio of 70:30 would be appropriate as most financial institutions hesitate to lend at higher leverages and also in view of the fact that a high gearing invariably subjects projects to substantial financial risks. A 15-year period is proposed for construction loan repayment. The rate of interest considered will be in line with the prevailing lending rates of financial institutions. The actual financial parameters to be adopted in the analysis will be reviewed after gathering additional data from published sources and finalized in consultation with NHAI as per the TOR.

Depreciation of capital items will be calculated by using two methods, viz. the Written Down Value (WDV) Method and the Straight-Line Method (SLM). The WDV method favors income shielding and is, therefore, used only to calculate taxes payable by the

concessionaire. The rate permitted for a toll road enterprise, *viz*. 10% will be used in the analysis.

Tax holiday (100% tax exemption on profits and gains), as per Section 80-IA of Income Tax Act, will be available from such business for 10 consecutive assessment years out of 20 years beginning with the year in which undertaking or the enterprise develops and begins to operate any infrastructure facility or develops an industrial park or special economic zone or generates power or commences transmission or distribution of power or undertakes substantial renovation or modernization. The corporate tax rate adopted will be based on the latest Finance Bill.

The NPV and EIRR for the project will be calculated. It will undertake sensitivity analysis by identifying the most critical factors and determine their impact on EIRR, including varying project costs and benefits, implementation period, and combination of these factors. Risk analysis will be conducted by considering the possible values for key variables based on records and their occurrence probability.

Based on the above analysis consultant will give clear cut recommendation of the preferred structuring of the Package - mode of implementation under PPP – BOT (Toll)/ BOT (Annuity)/Hybrid Annuity mode/EPC mode or any other suitable model.

5. SOCIO ECONOMIC PROFILE

5.1 OVERALL APPROACH

The districts through which the project road passes are considered to be the primary project influence area. The existing highway of NH-31 passes through Ghazipur and Ballia districts. Therefore, the influence area of the project corridor, for the purpose of socio-economic analysis is considered with prime importance. The primary purpose of Socio-economic analysis is to provide an overview of the state's socioeconomic setup and the relative status of the project influence area within the state. Data to be considered include demographic aspects, macro-economic indicators and sectoral production of agriculture and allied activities, manufacturing, mining and service sectors including infrastructure. The profile provides the present scenario, the past performance and the prospective growth of the economy, population and urbanization. The profile depicts the spatial distribution of economic activities and provides basic inputs for estimating future growth in Transport demand, on the basis of prospective economic growth rates and transport demand elasticity. Secondary data available with different state government departments have been collected and analysed for preparation of socio-economic profile.

5.2 GENERAL FEATURES

The project passes through the state of Uttar Pradesh, situated in northern part of India. It is the most populous state in India and 4th largest area wise. The state covers an area of 243,290 square kilometres with a population of 199,581,477 according to 2011 census, which accounts for 16.16% of India. Uttar Pradesh has 75 districts, 18 revenue divisions, 14 municipal corporations, 165 municipalities, 52021 panchayats and 107452 villages.

As per 2011 census of India, the state had a population of 19,95,81,477 with a population density of 820/square km. The total population growth in this decade was 20.23 percent while in previous decade it was 25.80 percent. Out of total population of Uttar Pradesh, 22.27% of the population with 4,44,46,795 inhabitants live in urban regions and 77.73% of population with 15,51,34,682 inhabitants live in rural areas. There are 10,44,80,510 male and 9,53,31,831 female citizens. Children of age 0-6 constitutes 15.4% of the total population with 1,61,85,581 boys and 1,46,05,750 girls. Sex ratio of 898, less than the national average of 933 per 1000. Literacy rate in Uttar Pradesh for Urban regions was 75.14 percent in which males were 80.45% literate while female literacy stood at 60.96%. Gautam Buddha Nagar is the district with highest literacy rate of 80.12% and Bahraich district is the least educated district with a literacy rate of 46.48%.

5.3 DELINEATION OF PROJECT INFLUENCE AREA

The project road runs entirely through the districts of Ghazipur and Ballia. The project stretch of 130 km connects major towns of the districts like Ghazipur, Mohammadabad, Ballia and Bariya. Located in the eastern part of Uttar Pradesh, the project road mostly carries a mix of intra-state and inter-state traffic from the surrounding states like Bihar.

5.3.1 Ghazipur District

According to the 2011 census Ghazipur district has a population of 3,620,268 roughly equal to the nation of Lithuania or the US state of Oklahoma. Its headquarters are loacted in Ghazipur City. This gives it a ranking of 79th in India (out of a total of 640). Out of the total population males are 1,856,584 and females are 1,766,143. The area of the district is 3,378 sq. km and it constitute 1.82% of the population of Uttar Pradesh. It has a population density of 1,072 inhabitants per square kilometer (2,780/sq. km). Its population growth rate over the decade 2001-2011 was 19.26%. Ghazipur has a sex ratio of 951 females for every 1000 males and a literacy rate of 74.27% (higher than the national average of 74.04%). Male literacy is 85.77% and female literacy is 62.29%. 92.44% of the total population is rural and 7.56% is urban. Out of the total population of 3,622,727, rural population is 3,348,855 and urban population is 273,872. Average literacy of rural population is 73.62% and that of urban population is 82.05%.

Ghazipur is well connected with major cities by road, rail and air transport. Ghazipur Airport is situated in Ghazipur Road on Ghazipur-Mau road. Ghazipur is 76km far from Varanasi.

Table 5.1: Demographic Features of Ghazipur District

District: Ghazipur			
Total Area (sq. kms)	3378	Male population	1,856,584
Population Density (persons/sq. km.)	1072	Female population	1,766,143
Population Growth (%)	19.2	Rural population (%)	92.44%
Literacy rate (%)	71.8	Urban population (%)	7.56%
Total Population	3,620,268	Sex Ratio	951

Table 5.2: Socio-Economic Features of Ghazipur District

S.No	Item	Unit	Ghazipur
1	District Area	sq. km	3378
2	Tehsils	No.	6
3	Towns	No.	8
4	Villages	No.	3367
5	Households	No.	544,861
6	Decade Growth Rate	%	19.2
7	Main Workers	No.	766,881
8	Marginal Workers	No.	437,721
9	Non-workers	No.	2,415,666

5.3.2 Ballia District

Ballia district is the easternmost part of the Uttar Pradesh state and borders on Bihar State. It comprises an irregularly shaped tract extending westward from the confluence of the Ganga and the Ghaghra, the former separating it from Bihar in the south and the latter from Deoria and Bihar in the north and east respectively. The boundary between Ballia and Bihar is determined by the deep streams of these two rivers. It is bounded on the west by Mau, on the north by Deoria, on the north-east and south-east by Bihar and on the south-west by Ghazipur. The district lies between the parallels of 25º33' and 26º11' North latitudes and 83º38' and 84º39' East longitudes.

According to the 2011 census Ballia district has a population of 3,223,642, roughly equal to the nation of Mauritania or the US state of Iowa. This gives it a ranking of 108th in India (out of a total of 640). The district has a population density of 1,081 inhabitants per square kilometre (2,800/sq mi). Its population growth rate over the decade 2001-2011 was 16.73%. Ballia has a sex ratio of 933 females for every 1000 males, and a literacy rate of 73.82%.

Ballia is located 117km far from Azamgarh, the administrative capital of the district, 145 km far from Varanasi, the religious capital of Uttar Pradesh and 155 km distant from Gorakhpur city. Nearest airport is Lalbahadur Sastri International Airport, Varanasi.

Table 5.3: Demographic Features of Ballia District

District: Ballia				
Total Area (sq. kms)	2981		Male population	1,672,902
Population Density (persons/sq. km.)	1087		Female population	1,566,872
Population Growth (%)	17.4		Rural population (%)	90.61%
Literacy rate (%)	70.9		Urban population (%)	
Total Population	3,239,774		Sex Ratio	939

Table 5.4 Socio-Economic Details of Ballia district

S. No	Item	Unit	Ballia
1	District Area	sq. km	2981
2	Tehsils	No.	6
3	Towns	No.	11
4	Villages	No.	2361
5	Households	No.	478,420
6	Decade Growth Rate	%	17.4
7	Main Workers	No.	569,522
8	Marginal Workers	No.	449,961
9	Non-workers	No.	2,220,291

5.4 ECONOMY

The economy of Uttar Pradesh is the fourth largest economy in India after Maharashtra, Karnataka and Tamil Nadu. In 2016-17, Uttar Pradesh's GSDP was ☐12.37 lakh crore (US$190 billion). According to 2011 census report Uttar Pradesh have 22.3% urban population. Maharashtra have 5,08,18,259 urban population while Uttar Pradesh have 4,44,95,063. State have 7 cities with population more than one million. After partition in 2000, the new Uttar Pradesh state produces about 92% of the output of the old Uttar Pradesh state. According to Tendulkar committee 29.43%

population of Uttar Pradesh is poor in 2011-12 while Rangrajan committee gave the report of 39.8% poor for same period in state.

In 10th Five-year planning between 2002 and 2007 state registered 5.2% annual economic growth. In 11th Five-year planning between 2007 and 2012 state touched 7% annual economic growth. But after that it fell on 5.9% in 2012-13 and 5.1% in 2013-14 one of the lowest in India. The state's debt was estimated at 67 per cent of GDP in 2005. In 2012, the state was one of the highest receivers of overall remittances to India which stood at $0.1 billion (Rs. 3,42,884.05 crore), along with Kerala, Tamil Nadu, and Punjab.

Comparative Study of National and state income

Preliminary estimates of state income i.e., Net State Domestic Product (NSDP) at current price is estimated at Rs. 9762.97 billion in 2014-15 as compared to 8627.46 billion in 2013-14, showing a growth of 13.2% against 10.55% in the previous year.

Per capita state income (i.e. Per capita NSDP) at current prices is estimated at Rs. 40,373 in 2014-15 recording a growth rate of 11.37%, against 8.26% in the previous year.

5.5 TRANSPORT

The state has the largest railway network in the country and the sixth highest railway density. As of 2011, there were 8,546 km (5,310 mi) of rail in the state. Allahabad is the headquarters of the North Central Railway and Gorakhpur is the headquarters of the North-Eastern Railway. Other than Zonal Headquarters of Allahabad and Gorakhpur, Lucknow and Moradabad serve as divisional Headquarters of the Northern Railway Division. The railway stations of Lucknow NR, Kanpur Central, Varanasi Junction, Agra Cantt, Gorakhpurand Mathura Junction were included in the Indian Railways list of 50 world-class railway stations.

The state has a large, multimodal transportation system with the largest road network in the country. The state is well connected to its nine neighboring states and almost all other parts of India through the national highways. It boasts 42 national highways, with a total length of 4,942 km (9.6% of the total NH length in India). The Uttar Pradesh State Road Transport Corporation was established in 1972 to provide economical, reliable, and comfortable transportation in the state with connecting services to adjoining states and boasts as being the only State Transport Corporation that runs in profit in the entire nation. All cities are connected to state highways, and all district headquarters are being connected with four lane roads which carry traffic between major centres within the state. One of them is Agra Lucknow Expressway,

which is a 302 km (188 mi) controlled-access highway constructed by Uttar Pradesh Expressways Industrial Development Authority (UPEIDA) to reduce vehicular traffic in previously congested roads. This expressway is country's largest Greenfield Expressway which reduced the travel time between Lucknow and Agra from 6 hours to 3.30 hours. Other district roads and village roads provide villages accessibility to meet their social needs as also the means to transport agriculture produce from village to nearby markets. Major district roads provide a secondary function of linking between main roads and rural roads. Uttar Pradesh has the highest road density in India, (1,027 km per 1000 km2) and the largest surfaced urban-road network in the country (50,721 km).

The state has excellent civil aviation infrastructure with Chaudhary Charan Singh International Airport in Lucknow and Lal Bahadur Shastri International Airport in Varanasi, providing international service. and four domestic airports located at Agra, Allahabad, Gorakhpur and Kanpur. The Lucknow Airport is the second busiest airport in North India after the Indira Gandhi International Airport, New Delhi. The state has also proposed creating the Taj International Airport at Kurikupa near Hirangaon, Tundla in Firozabad district. An international Airport is also proposed at Kushinagar.

The Lucknow Metro is being constructed in the city of Lucknow as an alternative mode of transport. The capital city is witnessing a swift rise in the number of immigrants and this has called for the transformation of Public modes of transport.

5.6 INDUSTRY

UP has also witnessed rapid industrialization in the recent past, particularly after the launch of policies of economic liberalization in the country. As of March 1996, there were 1,661 medium and large industrial undertakings and 296,338 small industrial units employing 1.83 million persons. The per capita state domestic product was estimated at Rs 7,263 in 1997–98 and there has been visible decline in poverty in the state. Yet, nearly 40 percent of the total population lives below the poverty line. There are numerous types of minerals and many industries have come up based upon these minerals. There are a number of cement plants in Mirzapur in the Vindhya region, a bauxite-based aluminium plant in the Banda region and Sonbhadra region. In the hilly regions of the state many non-metallic minerals are found which are used as industrial raw materials. Coal deposits are found in the Singrauli region.

The state is poor in mineral resources. The only considerable deposits are of limestone in Mirzapur district. These are being extracted and are used largely in cement manufacture.

Uttar Pradesh has booming electronics industries, especially in UP-Delhi-NCR and

Lucknow-Kanpur Corridor. It produces almost all types of durables.

Cottage industries, such as handloom and handicrafts, have traditionally provided livelihood to a large number of people in the state: -

- Varanasi is a world-famous centre of handloom woven, embroidered textiles; the main products are Zari-embroidery and brocade-work on silk sarees. Lucknow is a centre of 'Chikan' embroidery, renowned for its grace and delicacy, a skill more than 200 years old. Uttar Pradesh produces about 15% of the total fabric production of the country, employs about 30% of the total workforce of artisans in India and is responsible for an annual production of about US$0,1 million in the state.
- The state has two major production centres of leather and leather products, with over 11,500 units; Agra and Kanpur are the key centres. About 200 tanneries are located in Kanpur.
- Moradabad is renowned for brass work and has carved a niche for itself in the handicraft industry throughout the world. Lately other products that are also produced here like iron sheet metalwares, aluminium artworks, wood works and glassware's have also become popular with the numerous foreign buyers and are therefore being exported in large quantities. On an average Moradabad exports goods worth Rs. 30–40 billion each year, which constitutes 40% of total exports from India under this category.
- Meerut is the biggest gold market of Asia. It is the biggest exporter of sports related items and music instruments of the country.
- Bulandshahr is renowned for Khurja Pottery worldwide. There are nearly 23 export oriented units and they are exported to foreign countries such as the United Kingdom, USA, Australia, New Zealand, United Arab Emirates, etc. Sikandrabad industrial area, developed by UPSIDC, has a large number of national and multinational companies working here successfully.

5.7 AGRICULTURE

Uttar Pradesh is a major contributor to the national food grain stock. In 2013-14 state produced 50.05 million tons of foodgrain which is 18.90% country's total production. Partly this is due to the fertile regions of the Indo-Gangetic plain and partly owing to irrigation measures such as the canals and tube-wells. Lakhimpur Kheri is a densely populated sugar producing district in the country. It has been the most common producer of food grains in India since the 1950s due to high-yielding varieties of seed, greater availability of fertilizers and increased use of irrigation [1].

Western Uttar Pradesh is more advanced in terms of agriculture as compared to the other regions in the state. Majority of the state population depends upon farming activities. Wheat, rice, pulses, oil seeds and potatoes are the major agricultural products. Sugarcane is the most important cash crop throughout the state. Uttar Pradesh is one of the most important state in India so far as horticulture is concerned. Mangoes are also produced in the state.

Uttar Pradesh supports about 15% of India's total livestock population. Of its livestock in 1961, 15% were cattle, 21% buffaloes, 13% goats and 8% other livestock. Between 1951 and 1956 there was an overall increase of 14% in the livestock population. There are about 8,000 km² of water area, including lakes, tanks, rivers, canals and streams. The fishing area in the state is over 2,000 km² and there are more than 175 varieties of fish.

5.8 MINERAL POTENTIAL

The State of Uttar Pradesh has a Long and Interesting history of Mining of Minerals. In the early days Copper, Lead, Iron ore and Placer Gold have been mined on a small scale in parts of Himalayas, Bundelkhand and South-Eastern districts. In addition Vindhyan Sand Stone as building and Mill Stone were also mined in the districts of Agra, Allahabad and Mirzapur.

Prior to 1900, the Copper ores were mined on a small scale in erstwhile Garhwal, however, the development of Modern Technology and decline in the prices also lead to the decline of small scale Mining. Mining activity during 1920 and 1930 further declined due to various reasons. The Geologists have been examining the ground for search of both Industrial and Metallic Mineral deposits which could be developed in relation to present day Technology and Economics. In the post independence period, this effort was considerably intensified with the creation of Directorate of Geology& Mining in 1955 and the State witnessed spurt in the mining activity with the development and setting up of Cement factory in Churk. The Silica Sand deposits near Shankargarh in Allahabad were mined to meet the increasing demand of the Glass and Foundry Industries. The activities in the traditional building stone industry also increased considerably. Through the continuous efforts of the exploration Geologists, mineral deposits like Soapstone, Diaspore, Pyrophyllite, Bauxite, Rock Phosphate, high grade limestone and Cement grade Limestone, Dolomite, Coal etc. could be evaluated and a vast potential for their expansion established.

5.9 FORESTS

Uttar Pradesh, with a geographical area of 2,40,928 km2 constitutes 7.3% of the total area of the country. It has 70 districts falling in two of the fourteen main

physiographic zones of India viz the Northern Plains or the vast Gangetic Plains having highly fertile alluvial soil including 64 districts and the Central Highlands or the smaller Southern hill plateau covering 10 districts. Agra Allahabad, Chandauli and Mirzapur fall partly in both zones. The main forest types in the state are Tropical Semi Evergreen (0.21%), Tropical Moist Deciduous (19.68%), Tropical Dry Deciduous (50.66%), Tropical Thorn (4.61%) and Littoral and Swamp forests (2.35%).

The recorded forest area in undivided U.P. in 1951 was 30,245 sq. km. Additional areas were notified gradually and by 1998-99 the forest cover went up to 51,428 sq. km. In 1999 Uttaranchal was separated from U.P. and Uttar Pradesh was left with only 16,888 sq.km. of recorded forest. The 2011 State of Forest Report reports the recorded forest area as 16,583 sq.km, a decline of 305 sq.km. of recorded forest area.

In terms of district wise forest cover, while the State of Forest Report for 2003 mentioned 10 districts with a forest cover less than 1%, the 2011 report indicated 11 districts. The new entrant here is Ghazipur which has shown a declining trend in forest cover from 2003 to 2011 (1.39% to 0.92%). Two of the districts Ballia and Moradabad are still below 1% but have shown an improvement over 2003, Azamgarh, Deoria, Mainpuri have exhibited a decline while Badaun, SantKabir Nagar, Sant Ravi Das Nagar and Varanasi have not reported any change.

According to Uttar Pradesh status of Environmental and Related issues, Uttar Pradesh has forest and tree cover of 21720 sq. km, which is 9.01% of its geographical area.

Table 5.5: Forest cover details of Uttar Pradesh state

S.No	Item	Area (Sq. Km)
1	State geographical area	240,298
2	Recorded forest area	16583
3	Forest cover	14338
4	Tree cover	7382
5	Forest and tree cover	21720
6	Forest and tree cover against geographical area	9.01%

Table 5.6: Position of forestry and wildlife sector in UP state as compared to India

S. No	Item	India	U.P.
1	Geographical area	32,87,263	2,40,928
2	Recorded forest area	7,69,538	16,583

S. No	Item	India	U.P.
a	Reserved forest	4,22,536	11,660
b	Protected forest	2,13,982	1,420
c	Unclassed forest	1,33,020	3,503
	Percentage recorded forest area	23.41%	6.88%
3	Forest cover	6,92,027	14,338
a	Very dense	83,471	1,626
b	Moderately dense	3,20,736	4,559
c	Open forest	2,87,820	8,153
	Percentage of forest cover	21.05%	5.95%
4	Tree cover	90,844	7,382
	Tree cover percentage	2.76%	3.06%
5	Total forest and tree cover	7,82,871	21,720
	Percentage of total forest and tree cover	23.81%	9.01%

5.10 RIVERS

A Fascinating network of Perennial rivers has shaped the culture of Uttar Pradesh and nurtured its populace like a loving mother for thousands of years that's why people worship and celebrate most of their festivals on the bank of these rivers. The main rivers are gangaes, Gomti, Gangi, Beson, Magai, Bhaisai, Tons and Karmnasa. The state is well drained by a number of rivers originating in either the Himalayas to the north or the Vindhya Range to the south. The Ganges and its main tributaries—the Yamuna, the Ramganga, the Gomati, the Ghaghara, and the Gandak rivers—are fed by the perpetual snows of the Himalayas. The Chambal, the Betwa, and the Ken, originating from the Vindhya Range, drain the southwestern part of the state before joining the Yamuna. The Son, also originating in the Vindhya Range, drains the southeastern part of the state and joins the Ganges beyond the state borders (in Bihar).

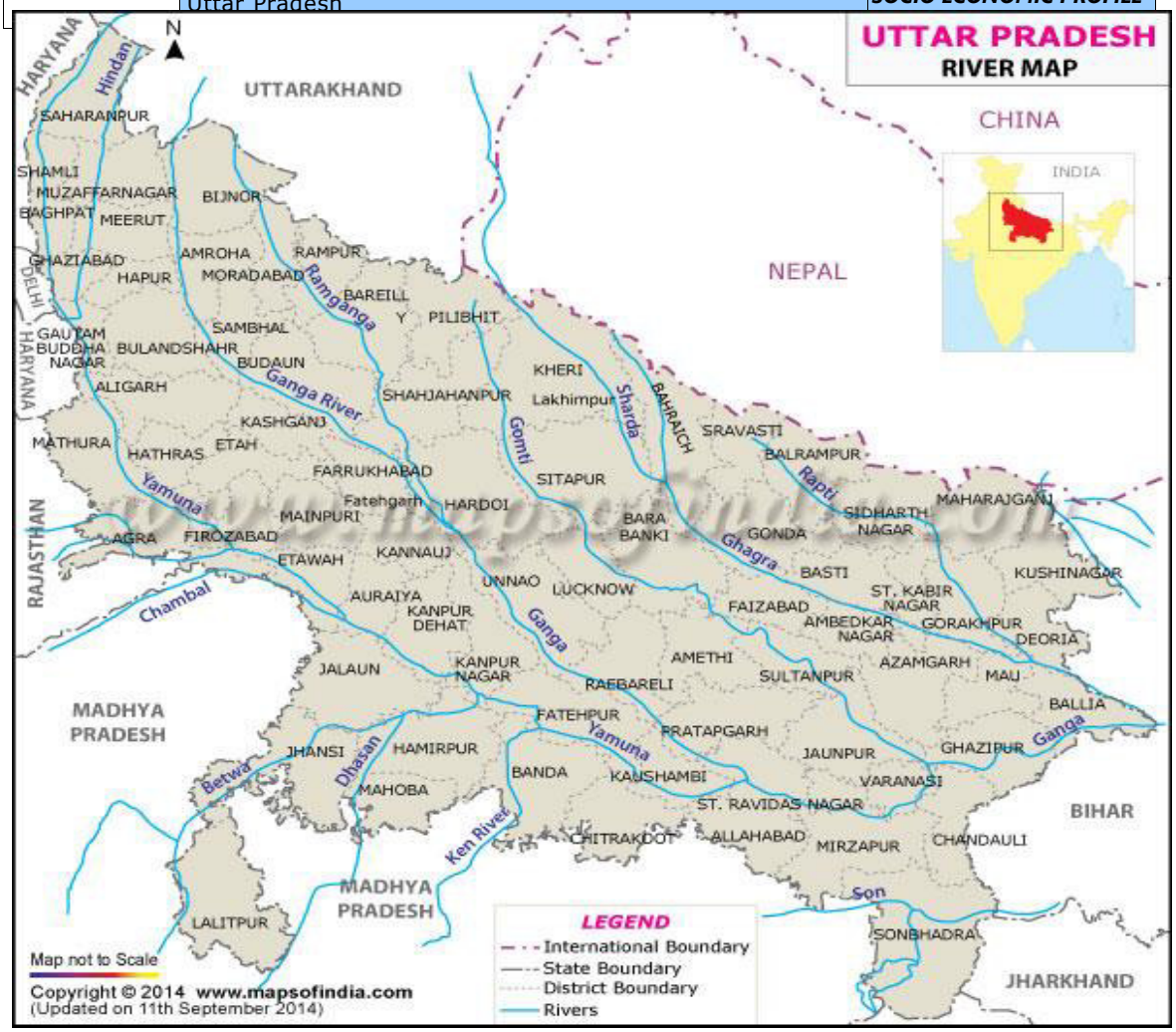


Figure 5.1: River map in Uttar Pradesh state

5.10.1 Ghazipur District

Ghazipur district is well flourished with many rivers flowing through it like Ganga, Gomti, Beson, Magai and Bhasai river. The River Ganges travels 90 K.M , Gomti 30 K.M , Gangi 50 K.M, Beson 95 K.M , Magai 25 K.M, Bhaisai 30 K.M and Tons river travel 20 K.M. The Gangaes and gomti flows from north-west to southeast in district. Ganges plays the important role in Transportation on the way from Allahabad to Calcutta for carrying goods through water. In British period the transportation of opium was carried to china from Ghazipur to Bay of Bengal. At That time The Steamers and Boats was running from Varanasi to Calcutta for Transportation of People and goods. In 1887 the famous poet Ravindra Nath Tagore came from Calcutta through Ganges. The brief description of the important rivers that flow through the project influence area are given below:

Ganga

The Ganges also Ganga is a trans-boundary river of Asia which flows through the

nations of India and Bangladesh. The 2,525 km (1,569 mi) river rises in the western Himalayas in the Indian state of Uttarakhand, and flows south and east through the Gangetic Plain of North India into Bangladesh, where it empties into theBay of Bengal. It is the third largest river in the world by discharge.

Gomti

Gomati River, also called Gumti, tributary of the Ganges (Ganga) River, central Uttar Pradeshstate, northern India. It rises in northern Uttar Pradesh about 32 miles (51 km) east of Pilibhit and is intermittent for the first 35 miles (56 km) of its course, becoming perennial after its junction with the Joknai. Below this point it flows generally southeastward for some 500 miles (800 km), receiving its only major tributary, the right-bank Sai River, near Jaunpur and emptying into the Ganges near Saidpur. It drains a basin of about 7,240 square miles (18,750 square km).

5.10.2 Ballia District

Ballia district is the easternmost part of the Uttar Pradesh state and borders on Bihar State. It comprises an irregularly shaped tract extending westward from the confluence of the Ganga and the Ghaghra, the former separating it from Bihar in the south and the latter from Deoria and Bihar in the north and east respectively. The boundary between Ballia and Bihar is determined by the deep streams of these two rivers. The brief description of the important rivers that flow through the project influence area are given below:

Ghaghara

Ghaghara, also called Karnali is a perennial trans-boundary river originating on the Tibetan Plateau near Lake Mansarovar. It cuts through the Himalayas in Nepal and joins the Sharda River at Brahmaghat in India. Together they form the Ghaghra River, a major left bank tributary of the Ganges. With a length of 507 kilometres (315 mi) it is the longest river in Nepal. The total length of Ghaghara River up to its confluence with the Ganges at Doriganj in Bihar is 1,080 kilometres (670 mi). It is the largest tributary of the Ganges by volume and the second longest tributary of the Ganges by length after Yamuna.

Tamsa

The Tamas River (also known as the Tons River) is a tributary of the Ganges flowing through the Indian states of Madhya Pradesh and Uttar Pradesh. The Tamas rises in a tank at Tamakund in the Kaimur Range at an elevation of 610 metres (2,000 ft). It flows through the fertile districts of Satna and Rewa. At the edge of the Purwa plateau, the Tamas and its tributaries form a number of waterfalls. The river receives

the Belan in UP and joins the Ganges at Sirsa, about 311 kilometres (193 mi) downstream of the confluence of the Ganges and Yamuna. The total length of the river is 264 kilometres (164 mi). It has a total drainage area of 16,860 square kilometres (6,510 sq mi).

Ganga

The Ganges also Ganga is a trans-boundary river of Asia which flows through the nations of India and Bangladesh. The 2,525 km (1,569 mi) river rises in the western Himalayas in the Indian state of Uttarakhand, and flows south and east through the Gangetic Plain of North India into Bangladesh, where it empties into theBay of Bengal. It is the third largest river in the world by discharge.

5.11 SOILS

The state has three distinct physiographic divisions from north to south viz. The Shiwaliks, the Gangetic plain and the Southern High lands, Plateaus, and Scarplands which are further divided into subunits given in the figure. The Project influence area that passes through Jaunpur and Ghazipur districts fall in Alluvial plains.

Figure 5.2: Physiological map of Uttar Pradesh state

This riverian plain is featureless, its monotony is broken by red-stone hillocks of Aravalli hills on the western part of Mathura district, whereas on micro level by the river bluffs, levees and dead arms of the river channels. There are, in addition extensive ravinous lands along the rivers Yamuna, Chambal, Sengar and Kuwari occurring in the districts of Agra, Etawah and Kanpur etc. Older alluvial plain (Bhanger) occupying relatively higher elevation and recent alluvial plain (Khadir), occupying relatively lower elevations. A plain which lies along the river courses and rivulets is known as active flood plain which is formed as a result of meandering

action of these rivers and rivulets.

5.12 LAND UTILIZATION

The overall picture regarding land use patterns in India constitutes divergent situations in regard to land use patterns across different states. In this part of Uttar Pradesh have already not very much suitable for agriculture. However, one pattern that was consistent almost all the districts is the increasing trend in land under non-agricultural use due to increasing urbanization and industrialization, this trend is inevitable. The land use system is highly dynamics which undergoes significant changes according to the changes socio-economic and natural environment. Transformation lands from different land use to agriculture to fulfill the demand of food, fuel, wood, fodder and timber and on the other hand increasing the non-agricultural land use means to development of urbanization and industrialization. The main causes for expansion of urban area in this area because of settlement and development of rural-urban fringe areas in the border districts of capital delhi area e.g. Ghaziabad, Gautam Buddha Nagar etc. Increasing population and dependent of agriculture are highly influence on agricultural and non-agricultural land use pattern. For development of urban areas and concentration on environment this regards Mics. Tree groves and garden are unchanged for social forestry and awareness. Also Western Uttar Pradesh is not very much uniform topography, in northern part is hilly mountain area, central and eastern part are upper ganga plain suitable for agriculture and in Sothern part are the desert area. Pasture and other grazing land are decreasing which influence for animal husbandry. Culturable waste land and barren land are decreasing due to increasing other than agricultural land. Current fallow land was increasing due to less concentration chemical fertilizer and irrigation.

Table 5.7: Land Utilization details of Uttar Pradesh State

Land Use	Area (in thousands) (ha)	Percentage
Total geographic area	24093	NA
Reporting area for land utilization	24170	100.00
Forests	1658	6.86
Not available for land cultivation	3268	13.52
Permanent pastures and other grazing lands	65	0.27

Land Use	Area (in thousands) (ha)	Percentage
Land under misc. tree crops and groves	374	1.55
Culturable Wasteland	440	1.82
Fallow lands other than current fallows	540	2.23
Current fallows	1408	5.83
Net area sown	16417	67.92

5.13 TOURISM

Situated in the northern part of India, bordering with the capital of India New Delhi, Uttar Pradesh is one of the most popular and an established tourist destination for both Indians and non-Indians alike in India. The most populous state of India, Uttar Pradesh contains a large number of historical monuments and places of religious significance. Geographically, Uttar Pradesh is very diverse, with Himalayan foothills in the extreme north and the Gangetic Plain in the centre. It is also home of India's most visited sites, the Taj Mahal, and Hinduism's holiest city, Varanasi. Kathak, one of the eight forms of Indian classical dances, originated from Uttar Pradesh. Uttar Pradesh is at the heart of India, hence it is also known as The Heartland of India. Cuisine of Uttar Pradesh like Awadhi cuisine, Mughlai cuisine, Kumauni cuisine are very famous not only in India but also many places abroad.

Uttar Pradesh is known for its rich culture and tradition. It is home to Ayodhya and Mathura birthplace of Lord Rama and Lord Krishna respectively. Uttar Pradesh attracts a large number of both national and international tourists. Taj Mahal, one of the New Seven Wonders of the World in Agra is also located in Uttar Pradesh.

There are different places one can visit in Uttar Pradesh. Agra, Jhansi, Lucknow and Meerut are historical cities famous for their monuments. Mathura, Vrindavan, Gokul, Varanasi, Ayodhya and Allahabad are holy cities for Hindus and Kushinagar and Sarnath are important Buddist places among the main four pilgrimage sites related to the life of Gautama Buddha. Noida is the most developed urban city of Uttar Pradesh.

Iron Ore is abundantly available in the neighboring Districts of Karnataka viz., Raichur, Bellary, which is suitable for setting up of Steel Plants. Due to availability of these resources already, many Sponge Iron units have come in the District and there is scope for mini steel plants.

6. DESIGN STANDARDS

6.1 GENERAL

Geometric design of the highway, except for cross sectional requirements, shall be in accordance with four lane manual IRC: SP:84-2019. Uniformity of design standards will be maintained throughout the length of Project Highway in accordance with Manual. All deficiencies in the existing highway geometry will be rectified to meet the minimum standards.

6.1.1 General Cross-Sectional Requirements

The design of cross section of the new four lane highway will take into account the following general requirements

i. The new four lane highway, as far as possible, shall fit into the existing section without rendering the existing road facilities, unless essential or required to fulfil other functional requirements.

ii. The developed cross sections for the carriageway as well as the service road will have operational safety in focus such as segregation, separation, turning radii, gradients etc. and provisions for various types of movements and manoeuvres like merge, diverge, weave etc. will be comprehensively considered and provided for.

iii. Provisions will be made in the cross-section for accommodating utilities both over as well as underground as the case may be. A 2.0 m wide strip of land at the extreme edge of ROW may be kept for accommodating utility services. Provisions contained in IRC:98-1997 will be followed to accommodate utility services for Project Highway in built up areas.

iv. As far as possible, uniformity of design standards will be maintained throughout the length of the Project Highway. In case of any change, it shall be affected in a gradual manner.

6.1.2 Design Speed

The design speed given in *Table-6.1* will be adopted for various terrain conditions as per IRC: SP:84-2019

Table-6.1: Design Speed

Nature of Terrain	Cross slope of the country (%)	Design speed (km/hr)	
		Ruling	Minimum
Plain & Rolling	Up to 25	100	80
Mountainous & Steep	More than 25	60	40

Short stretches (say less than 1 km) of varying terrain in the project stretch will not be taken into consideration while deciding the terrain classification for a given section of Project Highway.

In general, the ruling design speed will be adopted for geometric design of the highway. Only in exceptional circumstances, minimum design speed may be adopted where site conditions are extremely restrictive and adequate land width is not available. Abrupt changes in design speed will be avoided.

6.1.3 Right of Way

A minimum Right of Way (ROW) of 60m is considered throughout the project length.

6.1.4 Lane Width of Carriageway

The standard lane width of the project highway shall be 3.50m.

6.1.5 Median

For 4-lane road characteristics:

The median shall be either raised or depressed. The width of median is the distance between inner edges of carriageway. The type of median shall depend on the ROW. The minimum width of the median, subject to availability of ROW for various locations, shall be as in *Table–6.2*.

Table–6.2: Width of Median

Type of Section	Plain and Rolling Terrain		Mountainous and Steep terrain
	Raised *	Depressed	Raised *
Open country with isolated built up area	5	7	2.5
Built up area	2.5	NA	2.5
Approach to Grade separated structures	5	NA	2.5

**Including Kerb shyness of 0.5m on either side. In existing four lane reaches also minimum kerb shyness of 0.5m shall be maintained.*

- The median shall have suitably designed drainage system so that water does not stagnate in the median. All median drains will be of RCC type.
- In case of depressed median, a minimum 0.6 m width adjacent to carriageway in either direction is paved.
- As far as possible, the median will be of uniform width in a particular section of the Project Highway. However, where changes are unavoidable, a transition of 1 in 50

will be provided.

- In the case of depressed median, metal beam type (thrie-beam on one side) crash barriers will be provided on either side of the median.
- Suitable anti-glare measures such as plastic screens shall be provided to reduce headlight glare from opposite traffic.

6.1.6 Width of Shoulder

The shoulder width on either side of carriageway way is given below in *Table–6.3*.

Table – 6.3: Width of Shoulder

Type of Section	Width of Shoulder (m)								
	Plain and Rolling Terrain (Either Side)			Mountainous and Steep Terrain					
				Hill Side			Valley Side		
	Paved	Earthen	Total	Paved	Earthen	Total	Paved	Earthen	Total
Open Country with isolated built-up area	2.5	1.5	4.0	1.5	-	1.5	1.5	1.0	2.5
Built up area (2L)	2.5	-	2.5	0.25 + 1.5 (Raised)	-	1.75	0.25 + 1.5 (Raised)	-	1.75
Built up Area(4L)	-	-	-						
Approaches to Grade separated structures	2.5	-	2.5						
Approaches to Bridges	2.5	1.5	4.0						

Note: 2L-Two Lane, 4L – Four Lane

6.1.7 Roadway Width

The width of roadway shall depend upon the width of carriageway, shoulders and the median. On horizontal curves with radius from 75m to 100m, width of pavement and roadway shall be increased by 0.9m and on horizontal curves with radius up to 300m, width of pavement and roadway shall be increased by 0.6m.

6.1.8 Cross-fall

- The camber or cross-fall on straight sections of road carriageway and paved shoulders shall be 2.5% for bituminous surface and 2% for rigid pavement.
- The cross-fall for earthen shoulder is 0.5% steeper than that of carriageway subject to a minimum of 3.0%. On Super elevated sections, the earthen portion of the shoulder on the outer side of the curve shall be provided with reverse crossfall of 0.5% so that earth does not drain on the carriageway.

The cross-fall shall be uni-directional for each carriageway sloping towards the outer edge in straight stretches and towards lower edge on horizontal curves. The camber on the existing road shall be modified to uni-directional cross-fall.

6.2 GEOMETRIC DESIGN

Geometric design shall conform to IRC: SP:84-2019. All horizontal curves shall consist of circular portion flanked by spiral transitions at both ends.

While designing the alignment, the following general principles shall be kept in view:

Alignment should be fluent, and it should blend well with the surrounding topography.

On new roads, the curves should be designed to have largest practical radius, but in no case less than ruling value corresponding to ruling design speed.

As a normal rule, sharp curves should not be introduced at the end of long tangent since these can be extremely dangerous.

The curves should be sufficiently long, and they should have suitable transitions to have pleasing appearance.

Reverse curves shall be avoided as far as possible. Where unavoidable, sufficient length between two curves shall be provided for introduction of requisite transition curves.

Curves in the same direction, separated by short tangents known as broken back curves, should be avoided as far as possible.

To avoid distortion in appearance, the horizontal alignment should be coordinated carefully with the longitudinal profile.

Hair pin bends on hilly terrain should be avoided as far as possible.

6.2.1 Super-elevation

Super-elevation will be limited to 7%, if radius of curve is less than desirable minimum. It will be limited to 5%, if the radius is more than desirable minimum and also at section where Project Highway passes through an urban section or falls on a major junction.

6.2.2 Radii of Horizontal Curves

The minimum and absolute minimum radii of horizontal curves for various classes of terrain are given in *Table–6.4*.

Table–6.4: Minimum Radii of Horizontal Curves

Nature of Terrain	Desirable Minimum (m)	Absolute Minimum (m)
Plain and Rolling	400	250
Mountainous and Steep	150	75

6.2.3 Sight Distance

The safe stopping sight distance and desirable minimum sight distance for four lane divided carriageway for various design speeds are given in *Table-6.5*. The desirable values of sight distance will be adopted for new carriage way. As a minimum, safe stopping sight distance will be adopted for the improvement of the existing carriageway

Table-6.5: Safe Sight Distances

Design Speed (km/hr)	Safe Stopping sight distance (m)	Desirable minimum sight distance (m)
100	180	360
80	130	260
60	90	180
40	45	90

6.3 VERTICAL ALIGNMENT

The vertical alignment will provide for a smooth longitudinal profile. Grade changes will not be too frequent as to cause kinks and visual discontinuities in the profile. In this regard, directions given in IRC: SP:23-1983 will be kept in view.

6.3.1 Gradients

The ruling and limiting gradients are given in *Table-6.6*. Ruling Gradients will be adopted as far as possible. Limiting Gradient will be adopted in difficult situations, and for short lengths.

Table-6.6: Gradients

Nature of Terrain	Ruling Gradient	Limiting Gradient
Plain and Rolling	2.50%	3.30%
Mountainous	5.00%	6.00%
Steep	6.00%	7.00%

- Long sweeping vertical curves will be provided at all grade changes. These will be designed as square parabolas.
- Design of vertical curves and their coordination with horizontal curves, will be in accordance with the IRC: SP:23-1983

6.3.2 Lateral and Vertical Clearance at Underpasses

6.3.2.1 Lateral Clearance

- Full roadway width of the crossroad shall be carried through the vehicular underpass. The lateral clearance shall not be less than 12m.
- For Light Vehicular underpasses the lateral clearance shall not be less than 10.5 m including 1.5 m wide raised footpath on either side.

6.3.2.2 Vertical Clearance

- For Vehicular underpasses of 4-lane road characteristics, the vertical clearance at underpasses shall not be less than 5.0 m in non-urban areas and 5.5 m in urban areas
- For 4-lane road characteristics, the vertical clearance shall be a minimum of 5.5 m.
- For Light Vehicular underpasses the vertical clearance shall not be less than 4.0 m.

6.3.3 Lateral and Vertical Clearance at Overpasses

6.3.3.1 Lateral Clearance

- Full roadway width of the crossroad shall be carried through the overpass. Provision shall be made for future widening of Project Highway to 6-Lane with service roads.

6.3.3.2 Vertical clearance

- A minimum of 5.50m vertical clearance shall be provided at all points of carriageway of the Project Highway.

6.3.4 Service Roads

- In open country with isolated built up area, 7m width of service road shall be provided with 1.5m wide earthen shoulder

- In built up area, 7.5m wide carriageway (including kerb shyness of 0.25m on either side) with raised foot path or separator on either side shall be provided.

The following requirements as per IRC: SP:84-2019 shall be applied:

- Minimum design speed – 40 kmph
- Acceleration and Deceleration lanes:
- Length – Designed for differential speed of 60 kmph
- Width – 5.5m
- Taper at merge: 1 in 15 beyond design length
- Wherever required, provision for parking bays of length 20m and width 3m shall be provided along the service road

6.4 EMBANKMENT DESIGN

6.4.1 General

- The embankment height shall be measured with respect to the finished road levels. The following principles will be followed for fixing the road level:
- No section of the road is overtopped. The Top of subgrade shall be at least 0.6 m above ground level.
- The bottom of sub-surface is at least 1.0 m above the high flood level/ high water table/ pond level. However, in case of old roads where it may be difficult to fulfill this criterion without needing reconstruction or raising substantial length, the criteria may be relaxed depending on site conditions, ensuring that the bottom of sub-grade is 0.6m above High Flood Level (HFL). The HFL should be decided by intelligent inspections, local observations, enquiries and studying past records.

6.4.2 Structural Features and Design of Embankment

- Embankment will be designed to ensure the stability of the roadway and shall incorporate only those materials, which are suitable for embankment construction.
- Side slopes will not be steeper than 2H:1V and where necessary, the embankment will be retained by a retaining structure in accordance with specification.
- Where the embankment is to be supported on a weak stratum it will be necessary to specially design the embankment and adopt appropriate remedial/ ground improvement measures.
- High embankments (height 6 m or above) in all soils will be designed from stability considerations. For design of high embankments, IRC:75-2015 and MOSRTH –

Guidelines for Design of High Embankments may be referred to.

- The side slopes shall be protected against erosion by providing turfing/ vegetative cover, stone/cement concrete block pitching, geo-synthetics, gabion walls or any other measures depending on the height of the embankment, type of soil involved and susceptibility of soil to erosion as per IRC:56-1974. Pitching works on slopes shall be as per MOST specifications.

6.4.3 Use of Pond Ash for Embankment Construction

Where Pond ash is used for construction of embankment in pursuance of the instructions of the Ministry of Environment and Forests or otherwise, the embankment will be designed and constructed in accordance with IRC: SP:58-2001.

6.4.4 Roadway in Cutting

The road level shall be fixed, keeping in view the provisions of relevant IRC Codes.

6.5 PAVEMENT DESIGN

6.5.1 Flexible Pavement

Flexible pavement shall be designed in accordance with IRC:37-2018 for a minimum design period of 20 years or operation period, whichever is more. Stage construction will be permissible subject to the requirements specified below:

- Alternative strategies or combination of initial design, strengthening and maintenance can be developed by the concessionaire to provide the specified level of pavement performance over the operation period subject to satisfying the following minimum design requirements.
- The thickness of sub-base and base of pavement sections is designed for a minimum design period of 20 years and the initial bituminous surfacing for a minimum design period of 10 years.
- The pavement shall be strengthened by bituminous overlay as and when required to extend the pavement life to full operation period.

6.5.2 Rigid Pavement

- Rigid pavement shall be designed in accordance with IRC:58-2015 for a minimum design period of 30 years. Stage construction shall not be permitted.
- The Pavement Quality Concrete (PQC) shall rest of Dry Lean Concrete (DLC) sub-base of 150 mm thickness.
- Separation membrane shall be used between PQC and DLC as per clause 602.5 of MORTH specifications

- DLC shall meet minimum strength requirements as per IRC: SP:49 and shall extend beyond PQC by 0.75 m on either side.
- Below DLC layer, properly designed drainage layer GSB of 150 mm shall be provided throughout road width.

6.5.3 Design Traffic

- The design traffic shall be estimated in terms of cumulative number of standard axles (8160 kg) to be carried by the pavement during the design period.
- Initial daily average traffic flow shall be based on at least 7 days, 24 hr classified traffic counts. IRC: 9 may be used as guidance for carrying out the traffic census. Any likely change in traffic due to proposed improvement of the facility and/or future development plans, land use, shall be duly considered in estimating the design traffic.
- The design traffic for service roads shall be ten million standard axels respectively. The crust composition shall be provided accordingly

6.6 DRAINAGE DESIGN

Design and construction of surface and subsurface drains for highway drainage and drainage of structures shall be carried out in accordance with the requirements of Clause 309 of MORTH specifications, IRC: SP:42, IRC: SP:50 and IRC: SP:90.

- Selection of type of roadside drains shall be based on the magnitude and duration of flow. Longitudinal slope shall not be less than 0.3% for lined drains and 1% for unlined drains.
- In case of depressed median, longitudinal drain shall be provided to drain off water.
- In super elevation sections, covered longitudinal and cross drains shall be provided.

Drainage where embankment height is more than 6m:

- In embankments where height exceeds 6 m, special arrangement for protection of embankment slopes shall be essential in order to ensure that embankment slopes maintain their shape during monsoon season.
- Drainage arrangement shall include a system consisting of providing kerb with channel at the edge of the paved shoulders and provision of chute drains along the slopes at designed intervals with energy dissipation basin and protection of side channels by turfing or vegetation.
- Catch water drains shall be provided on hill slopes, if any, above cutting in trapezoidal shape with stone lining.
- Sub-base shall be extended across the shoulders for efficient internal drainage of pavement

- Suitable filter or granular material or geo textiles to act as filtration and separation layer shall be incorporated, wherever necessary, between the subgrade and sub-base to prevent clogging.
- Effective drainage shall be provided both longitudinally and transversely for structures. Transverse drainage shall be secured by means of suitable camber in the roadway surface. Longitudinal drainage shall be secured by means of scuppers, inlets, or other suitable means of sufficient size and numbers to drain the run off efficiently.
- When highway runs parallel to existing channels, adequate measures shall be taken in the form of bank protection and channel alignment to avoid water build up or stagnation against the highway slope endangering the pavement drainage.

6.7 DESIGN OF STRUCTURES

6.7.1 General

All structures shall be designed in accordance with the relevant Codes, Standards and Specifications, Special Publications and Guidelines of the Indian Roads Congress. All construction of bridges shall conform to MORTH Specifications for Road and Bridge Works.

6.7.2 Design Loading and Stresses

- The design loads and stresses shall be as per IRC:6-2014 appropriate for the width of carriageway, type and properties of stream, location, altitude, etc.
- All new structures shall be designed for the condition when footpath is used as carriageway. The footpath portion may be provided at the same level as the bridge carriageway in non-built-up areas, raised footpaths shall be provided in built-up areas.
- All the components of structures shall be designed for a service life of 100 years except appurtenances like crash barriers, wearing surface and rubberized components in expansion joints and elastomeric bearings

6.7.3 Width of Structures

- The width of the culverts shall be equal to roadway width of the approaches. The outer most face of railing/ parapet shall be in line with the outer most edge of shoulder.
- All new bridges shall have a footpath on left side of the traffic direction. The overall width of new bridges with a footpath on left side shall be same as the roadway width of approaches. The crash barrier shall be provided at the edge of the paved shoulders with 0.5m shy distance.
- If the width of widening, in case of existing bridges is 1.0m (0.5m on each side) or less,

the widening of the structure may be dispensed with and traffic shall be guided with the help of crash barriers in a transition of 1 in 20 on either side approaches.

6.7.4 Hydrology

The design discharge shall be evaluated for flood of 100-year return period.

6.7.5 Analysis of Design of Structures

All structures and their individual components will be analyzed and designed as per IRC:5-2015, IRC:22-2008, IRC:24-2010, IRC:78-2014 and IRC:83 (all parts) depending upon the type of structure/individual component proposed to be provided. The minimum cross-sectional dimensions of each component will be provided so as to satisfy the requirements specified in relevant IRC Code. The design will take into account long term durability, serviceability, constructability, construction methodology and environmental factors. All river training and protection works will be designed in accordance with IRC:89-1997.

6.7.6 Reinforced Earth Retaining Structures

Reinforced earth retaining structures shall not be provided for height more than 6 m unless otherwise specified, and near water bodies. Such structures should be given special attention in design, construction, ground improvement where necessary, maintenance and selection of System/System design. Local and global stability of the structure shall be ensured.

6.7.7 Rail-road Bridges

ROB/RUB shall be provided on all railway level crossings. In case the bridge is to be provided over an existing level crossing, 2-lane bridge shall be constructed. The horizontal and vertical clearances to be provided shall be as per requirement of railway authorities. In case of RUB, full roadway width as in the approaches shall pass below the bridge structure. Approach gradient shall not be steeper than 1 in 40 as per IRC: SP:73-2018.

6.8 TRAFFIC CONTROL DEVICES

6.8.1 Road Signs

- Three types of road signs *viz*., Mandatory, cautionary and Informatory shall be provided and guidelines given in IRC 67-2012, clause 800 of MORTH specifications shall be kept in view.
- All signs are placed on the left-hand side of the road. Where extra emphasis is warranted, they may be duplicated on the right-hand side as well.
- On non-kerb side, the extreme edge of the sign is 1.5m–2.0m from the edge of the carriageway. On kerb portion, it shall not be less than 60 cm from the edge of the kerb.

6.8.2 Road Markings

Provisions have been made for centre and edge road marking with thermo plastic paint as per MOST specification. This would help reduce road accidents. Road studs shall also be provided in addition to pavement marking for better visibility during night. Guidelines given in IRC 35 shall be used for providing these facilities.

6.8.3 Road Delineators

Provision of road delineators comprising of roadway indicators, hazard markers and object markers has been made in the design that shall conform to the recommendation made in IRC-79. Reflective Chevron signs at curves shall also be provided for.

6.8.4 Toll plaza

Toll Plaza shall be designed to permit the provision of toll lanes for a projected peak hour traffic of 20 years subject to a minimum number of 16 toll lanes including all other buildings and structures to be accommodated. Specifications given in IRC SP:84-2019 for layout and design of toll plaza shall be followed.

6.8.5 Safety Barrier

Safety barrier of rigid, flexible, or semi rigid type in accordance with MORTH guidelines/circular will be provided at following locations:

i. Where heights of embankment are 3 m or more

ii. Where embankment is retained by a retaining structure

iii. On valley side of highway in mountainous and steep terrain

iv. Between main carriageway and footpath in bridges

6.9 PROJECT FACILITIES

6.9.1 Pedestrian Facilities

- There shall be no pedestrian crossings across the carriageway. Facility for crossing the carriageway by the pedestrians shall be provided through pedestrian underpasses/FOB.
- Sidewalks wherever provided shall not be less than 1.5m.

6.9.2 Bus Bays

Busbays shall be located only near pedestrian underpass/ overpass locations. The layout and design of bus bays with shelters shall be as per the specifications given in IRC SP:84-2019.

6.9.3 Truck Lay byes

Truck laybyes, in general, shall be located near check barriers, interstate borders, places of conventional stops of the truck operators etc. The places shall be identified on the basis of field survey. Adequate space for facilities and future growth shall be allocated.

6.9.4 Rest Areas

Rest Areas with minimum facilities shall be provided keeping in view the expected peak hour traffic.

6.10 ENVIRONMENT IMPACT AND ASSESSMENT

State and Central Government guidelines including guidelines of Ministry of Environment and TOR requirements.

6.11 SOCIAL IMPACT ASSESSMENT

State and Central Government guidelines and TOR requirements.

6.12 ESTIMATION OF QUANTITIES AND PROJECT COST

MOST Standard Data book for analysis of rates and Standard Schedule of Rates for the current schedule of rates of State Government for the project area.

6.13 STANDARDS FOR AT-GRADE INTERSECTIONS

The standards proposed in IRC: SP:41-1994 "Guidelines for the Design of At-Grade Intersection in Rural and Urban Areas" will be applied.

6.14 PROJECT SPECIFIC MODIFICATIONS FROM STANDARDS

Any project specific deviations warranted from site constraints will be finalized in consultation with NHAI, Uttar Pradesh.

7. PROJECT PROPOSALS

7.1 General

The National Highways Authority of India (NHAI) is engaged in the development of the National highways in the state of Uttar Pradesh. As part of this endeavor, NHAI has decided to upgrade some of the existing National Highways in the State of UP to National Highway standard. It was also decided to take up the preparation of DPR for these highways which are being upgraded to National Highway Standard. The consultancy services for preparation of Feasibility Report cum Detailed Project Report (DPR) of 4 laning of Ghazipur Ballia – UP/Bihar section from Km 0.000 to 128.000 of NH-31 and Construction of 2/4 laning Flyover at Ballia (Chandra Shekhar Mod to Satish Chandra College). The New Greenfield alignment is proposed to four lane with Paved Shoulder at normal sections and Four laning with service roads at Underpass locations with proposed Right of way of 60m. The Consultant shall furnish land acquisition details as per revenue records/maps for further processing.

The Consultant shall study the possible locations and design of toll plaza. Wayside amenities required on tolled highway shall also be planned. The local and slow traffic may need segregation from the main traffic and provision of service roads and fencing may be considered, wherever necessary to improve efficiency and safety. Wherever required, consultant will liaise with concerned authorities and arrange all clarifications. Approval of all drawings including GAD and detail engineering drawings will be got done by the consultant from the Railways. However, if Railways require proof checking of the drawings prepared by the consultants, the same will be got done by NHAI and payment to the proof consultant shall be made by NHAI directly. Consultant will also obtain 'No Objection Certificate' from Ministry of Environment and Forest and incorporate the estimates for shifting of utilities of all types involved from concerned local authorities in the DPR. Consultant is also required to prepare all Land Acquisition papers (i.e. all necessary schedules as per L.A. act) for acquisition of land either under NH Act or State Act

The consultant shall prepare the Bid Documents, based on the feasibility report, due to exigency of the project for execution.

Consultant shall obtain all types of necessary clearances required for implementation of the project on the ground from the concerned agencies. The client shall provide the necessary supporting letters and any official fees as per the demand note issued by such concerned agencies from whom the clearances are being sought to enable implementation. The Proposed Greenfield Alignment stretch is presented in Figure-8.1

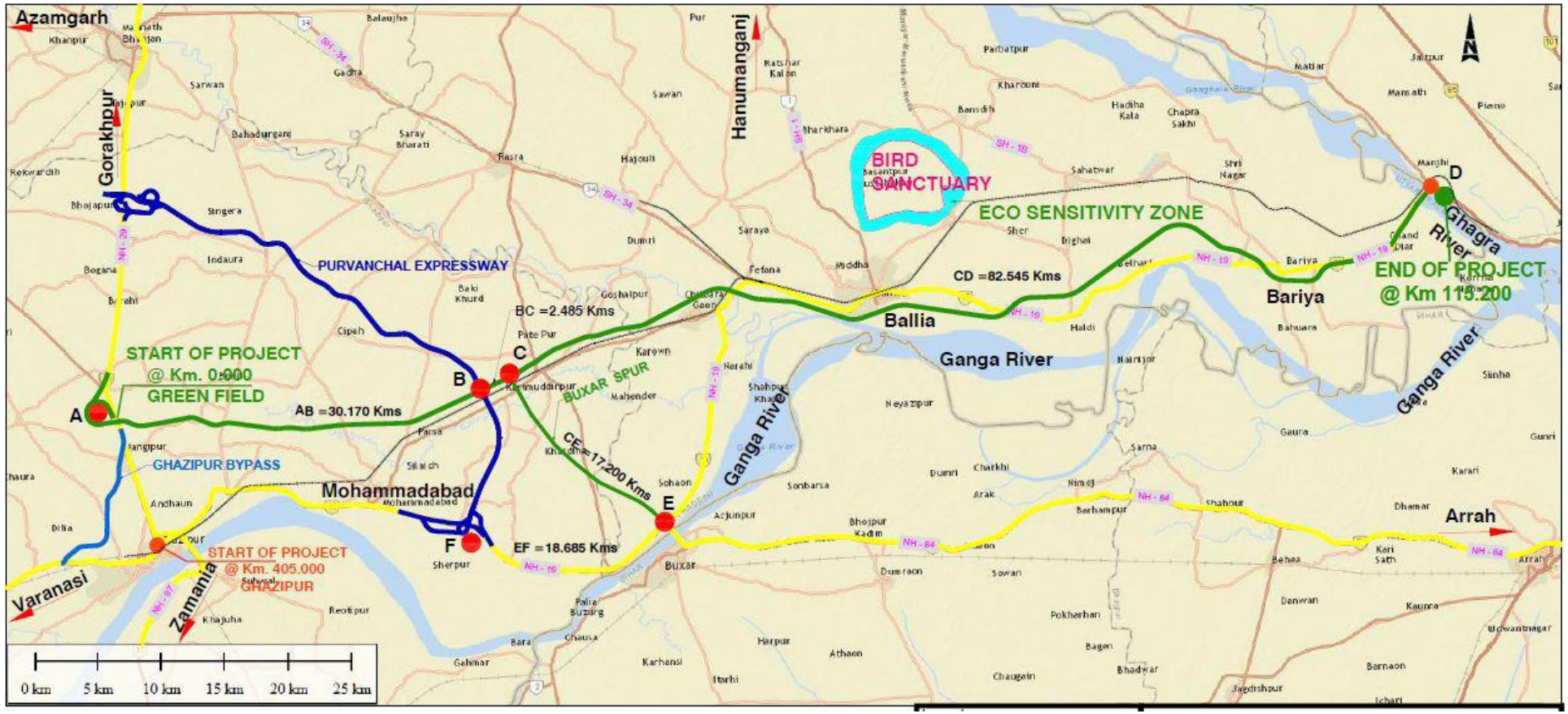


Figure 7.1 Map Showing Proposed Greenfield Alignment

7.2 Typical Cross Sections (TCS)

Based on the Geometric standards, traffic considerations and site conditions the following typical cross sections have been proposed.

S. No	TCS Type	TCS No
1	Typical Cross Section for 4 Lane Divided Highway (New Construction)	I
2	Typical Cross Section for 4 Lane LVUP/VUP Approach Section with Slip Road on Both Side	II
3	Typical Cross Section of VUP/LVUP at Deck Level (with Foot Path) (Both Side New Bridge For 4 -Lane Standard)	III
4	Typical Cross Section for 4 Lane Divided Highway with Depressed Median (Concentric Widening)	IV-A
5	Typical Cross Section for 4 Lane Divided Highway with Raised Median (Right Side widening)	IV-B
6	Typical Cross Section for 2Lane Cross section For Ramps	V
7	Typical Cross Section for Lane Loop/Ramp Approach Section	VI
8	Typical Cross Section for 2 lane Paved shoulder (New Construction)	VII
9	Typical Cross Section of Bridge/ ROB at Deck Level (With Foot Path) (Both Side New Bridge For 2 – lane Standard)	VIII
10	Typical Cross Section of Bridge at Deck Level (With Foot Path) (Both Side New Bridge For 4 – lane Standard)	IX-A
11	Typical Cross Section of Bridge at Deck Level (With Service /Slip Road) (Both Side New Bridge For 4 – lane Standard)	IX-B
12	Typical Cross Section for 4-Lane Divided Highway with Flush Median at High Embankment (New Construction)	X
13	Typical Cross Section 4-Lane LVUP/VUP Approach Section with Slip Road on Both Sides	X-A

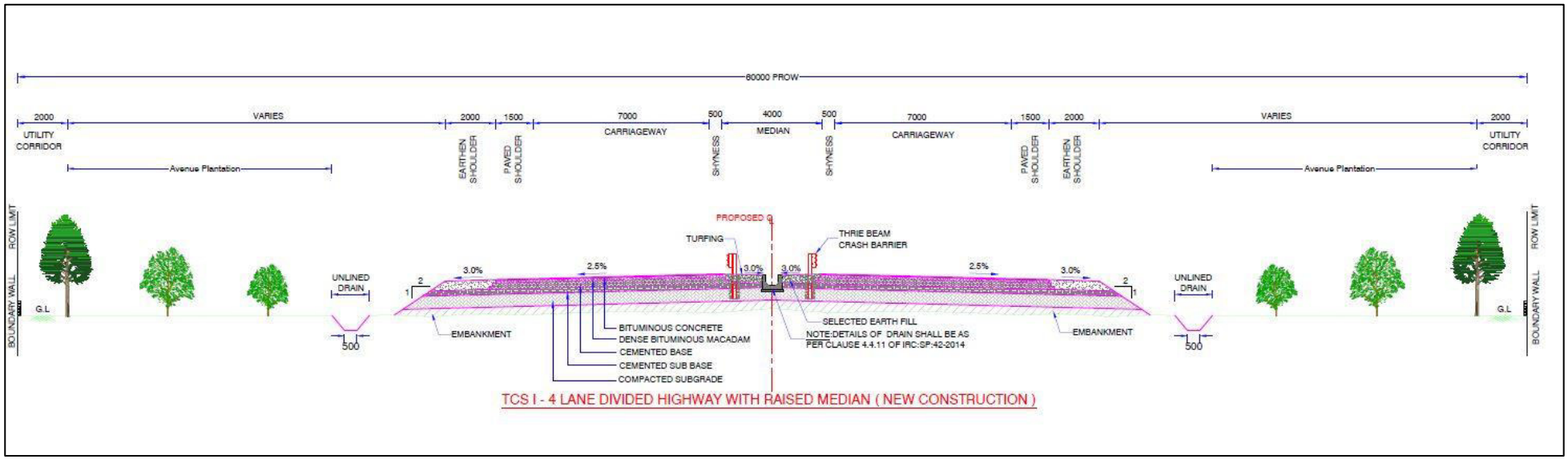


Figure I-4 Typical Cross Section for Lane Divided Highway (New Construction)

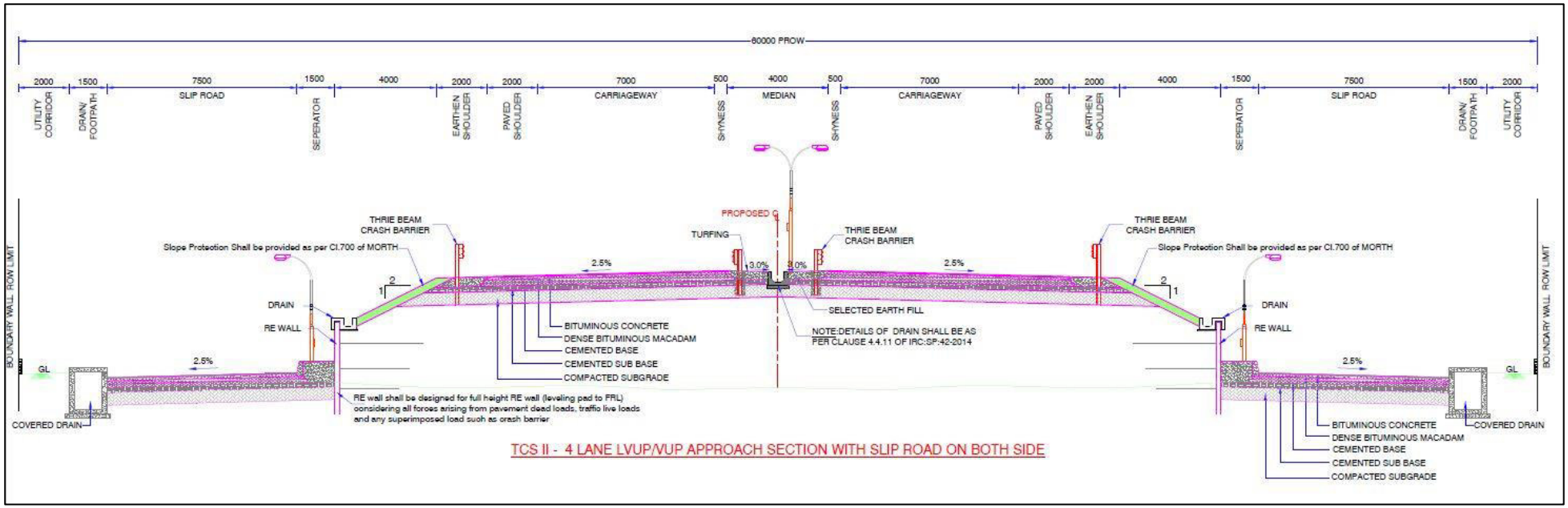


Figure II-4 Lane LVUP/VUP Approach Section with Slip Road on Both Side

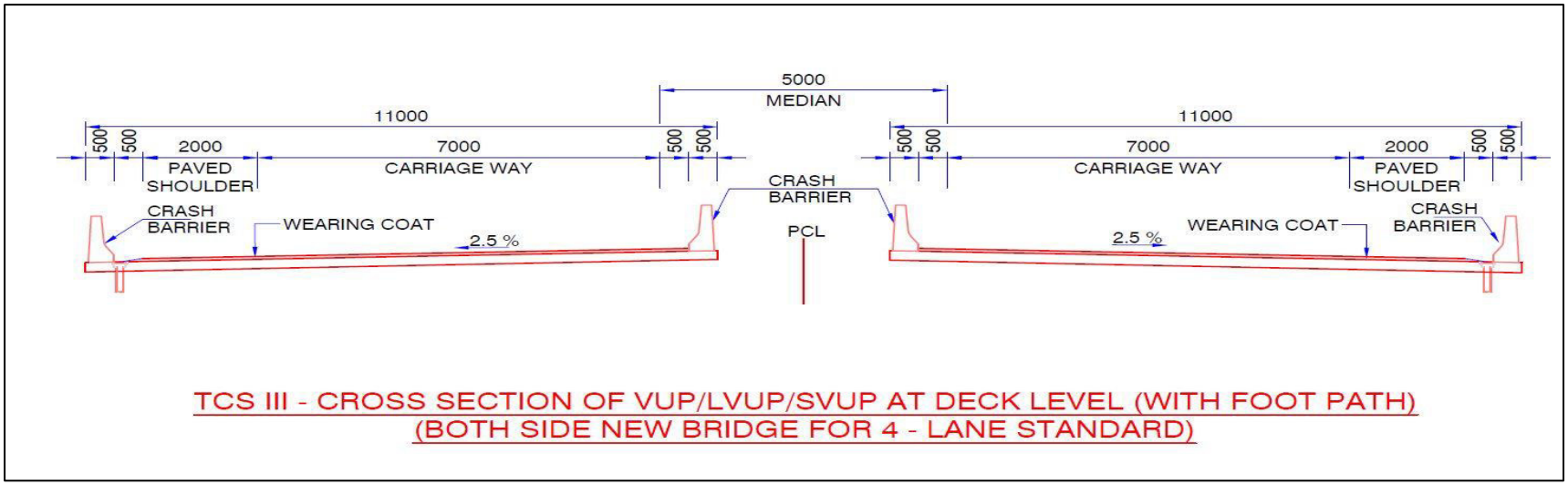


Figure III-4 Cross Section of VUP/LVUP at Deck Level (with Foot Path)

(Both Side New Bridge For 4 -Lane Standard)

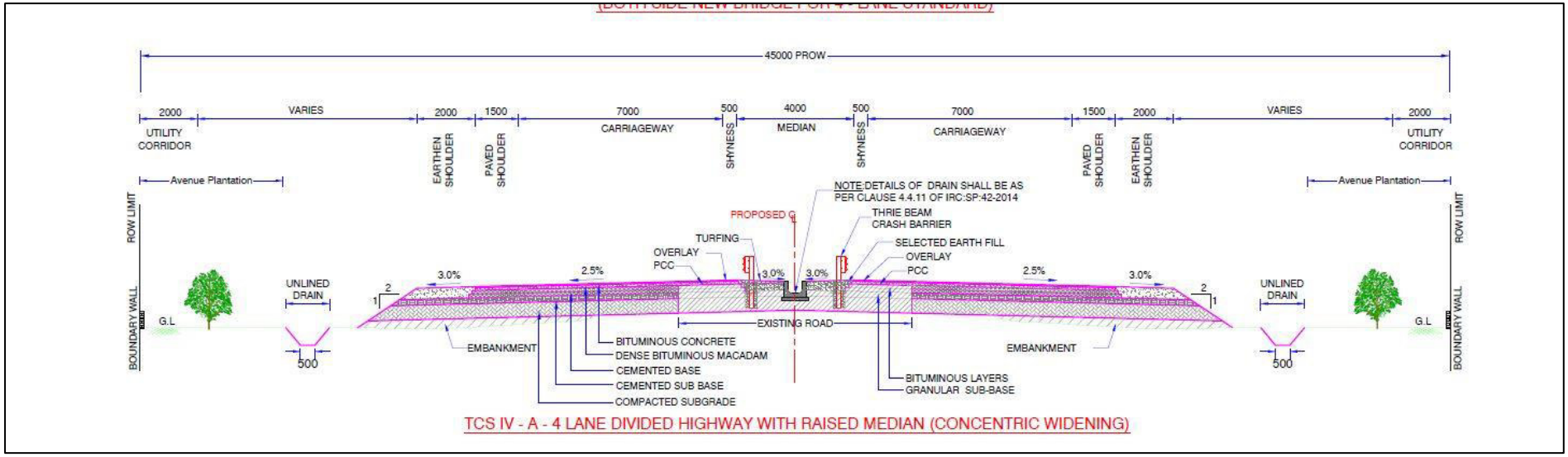


Figure IV-A-4 Lane Divided Highway with Raised Median (Concentric Widening)

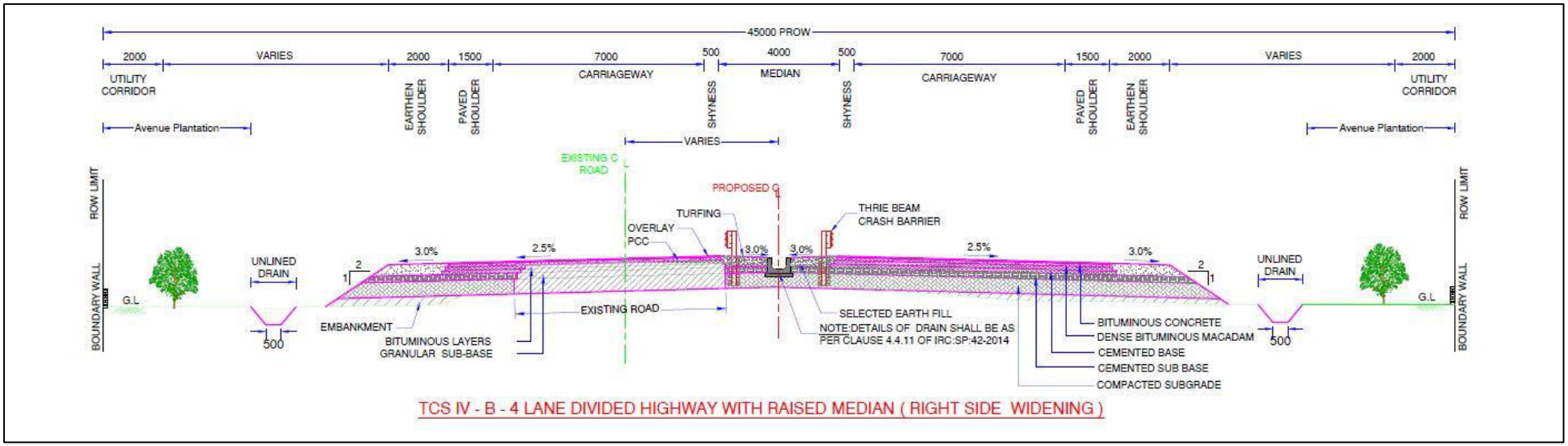


Figure IV-B-4 Lane Divided Highway with Raised Median (Right side Widening)

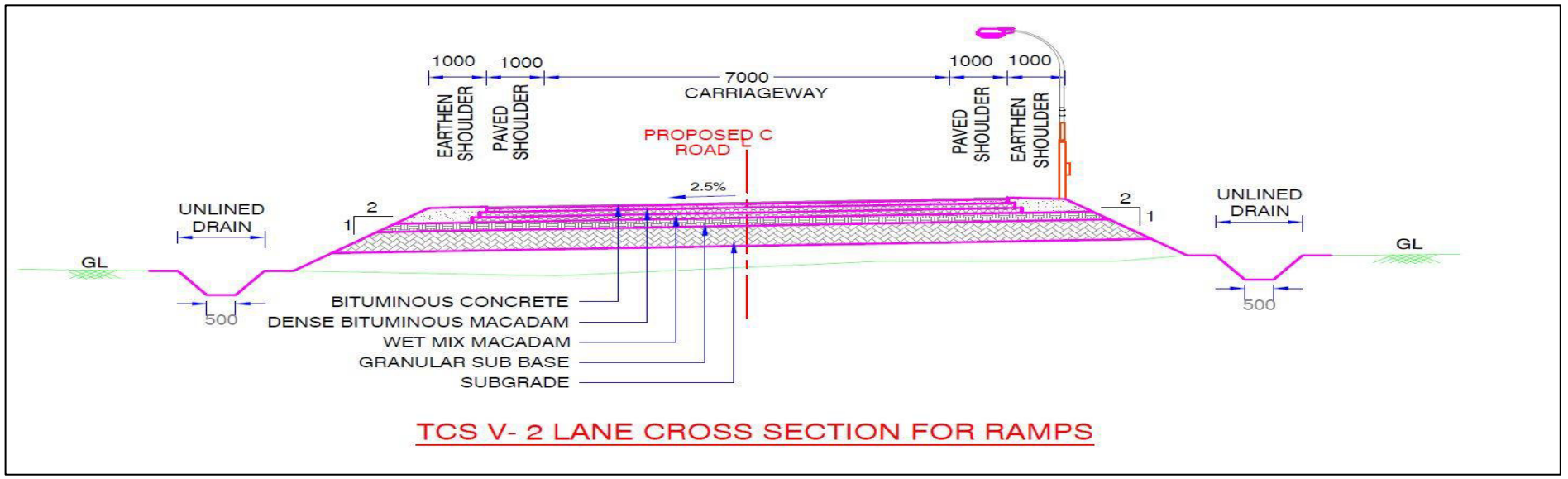


Figure V-2 Lane Cross Section for Ramps

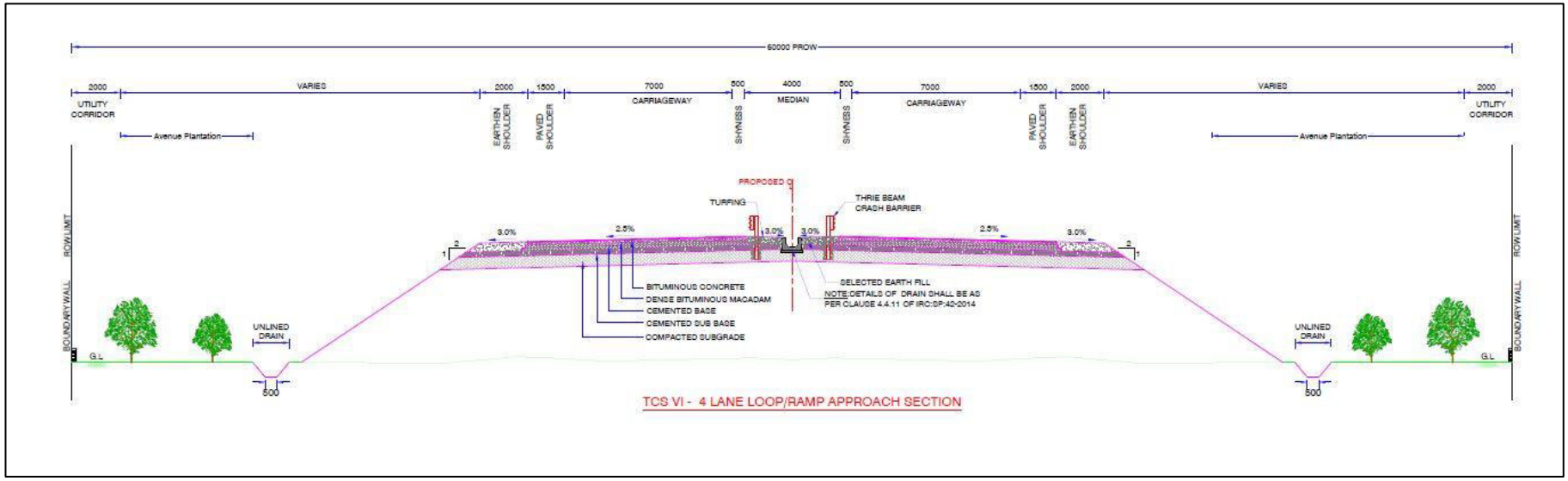


Figure VI-4 Lane Loop/Ramp Approach Section

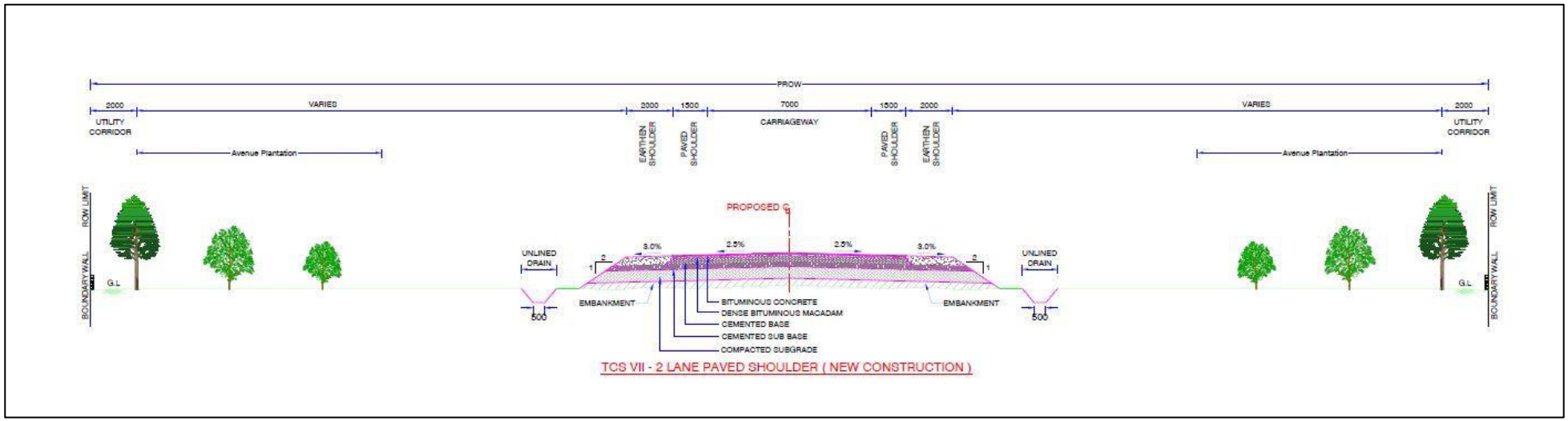


Figure VII-2 Lane Paved Shoulder (New Construction)

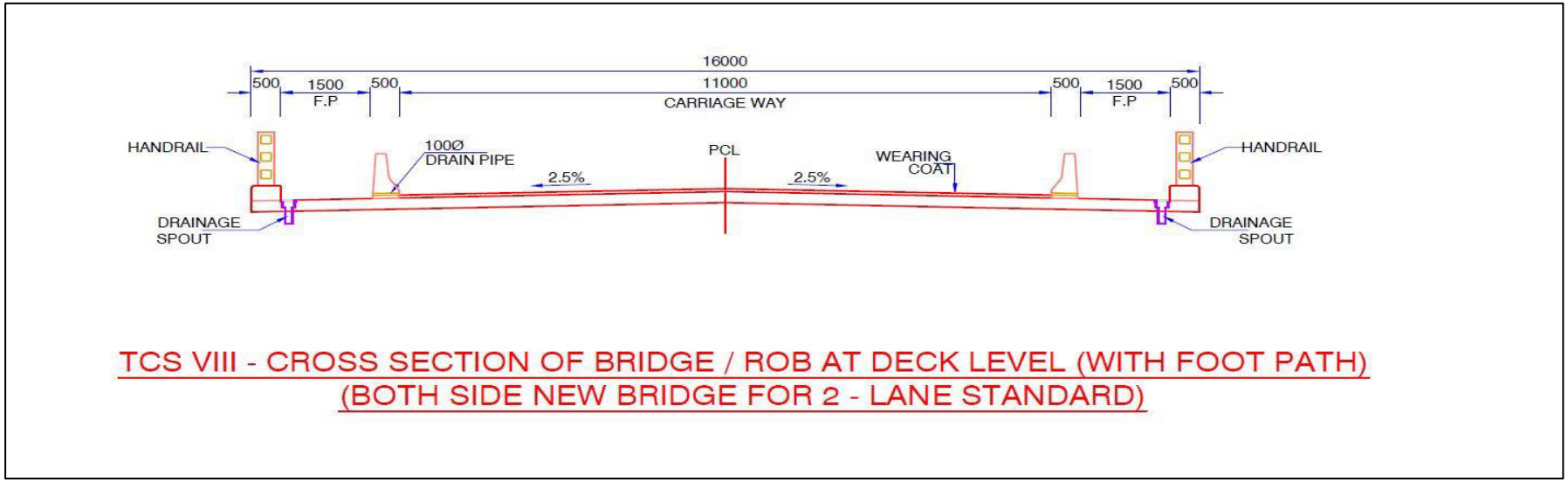


Figure VIII-Cross Section of Bridge/ ROB at Deck Level (With Foot Path)

(Both Side New Bridge For 2 – lane Standard)

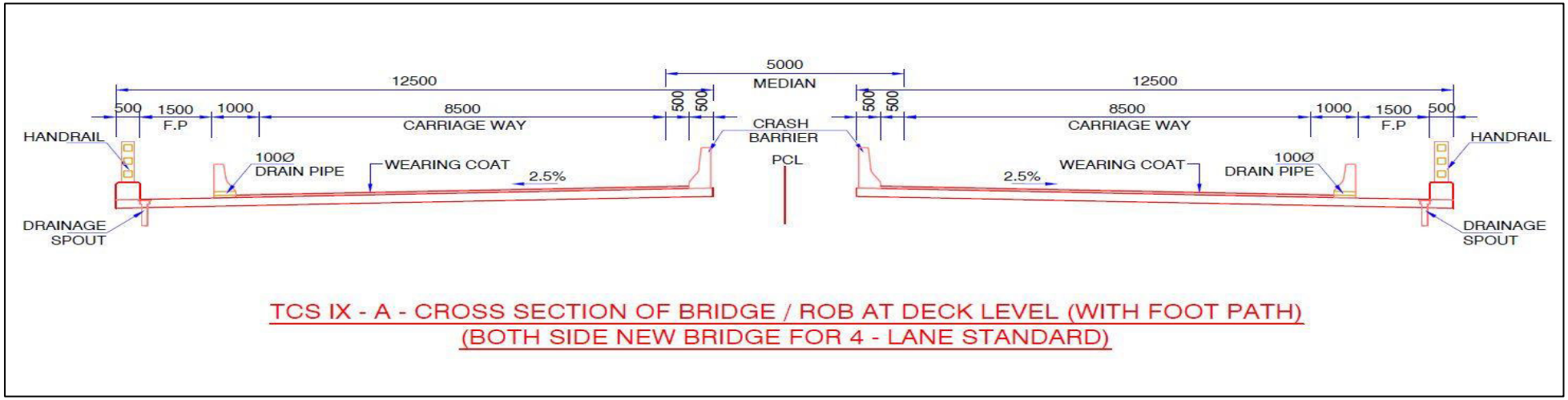
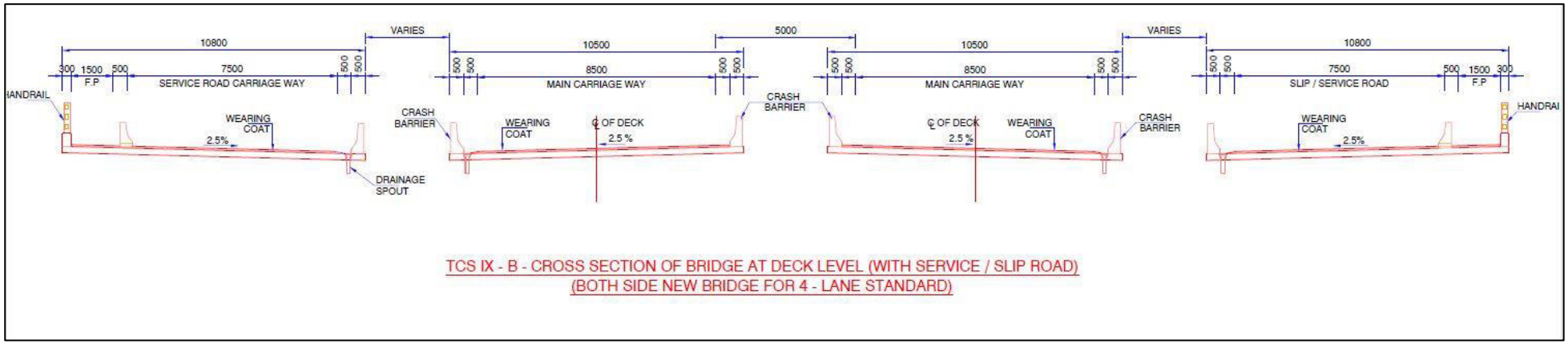


Figure IX-A-Cross Section of Bridge at Deck Level (With Foot Path)

(Both Side New Bridge For 4 – lane Standard)



TCS IX - B - CROSS SECTION OF BRIDGE AT DECK LEVEL (WITH SERVICE / SLIP ROAD)
(BOTH SIDE NEW BRIDGE FOR 4 - LANE STANDARD)

Figure IX-B-Cross Section of Bridge at Deck Level (With Service /Slip Road)

(Both Side New Bridge For 4 –Lane standard)

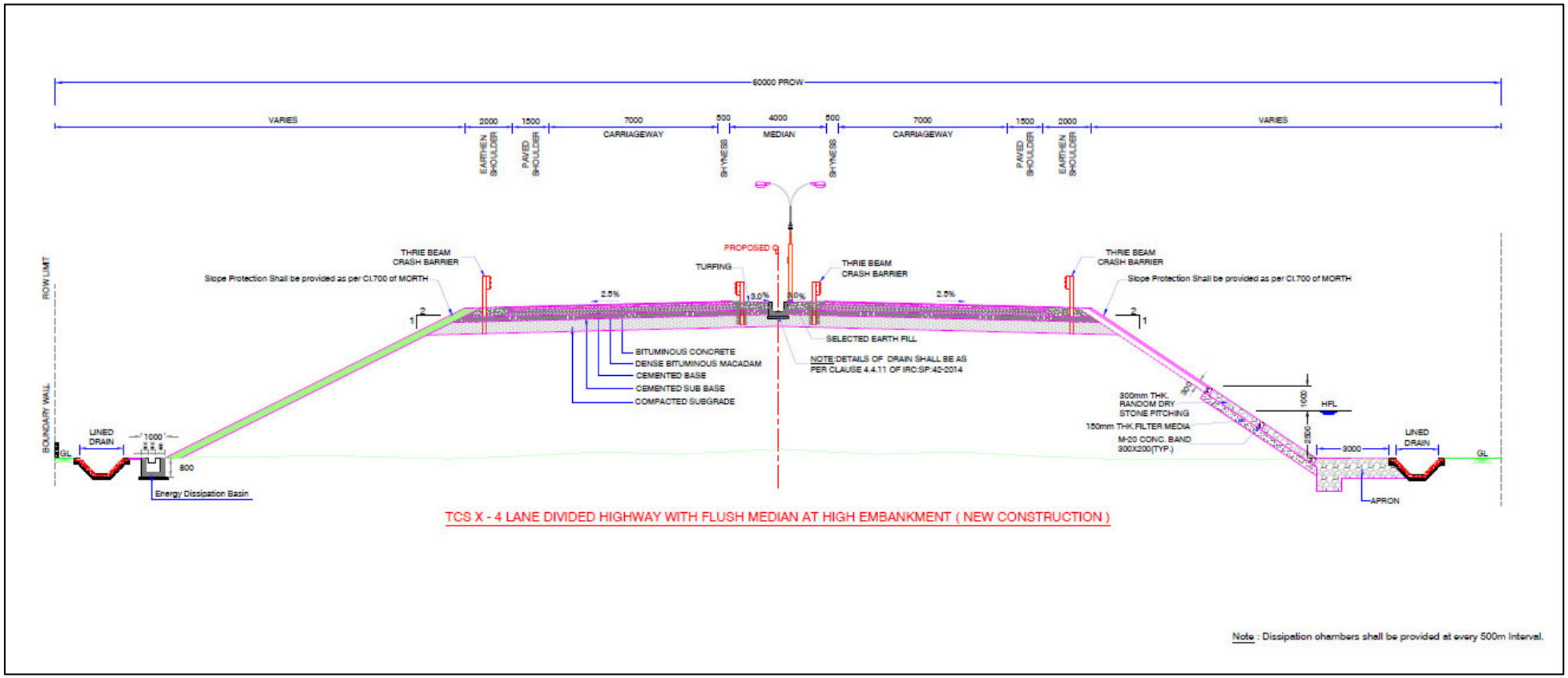


Figure X-Cross Section for 4-Lane Divided Highway with Flush Median at High Embankment

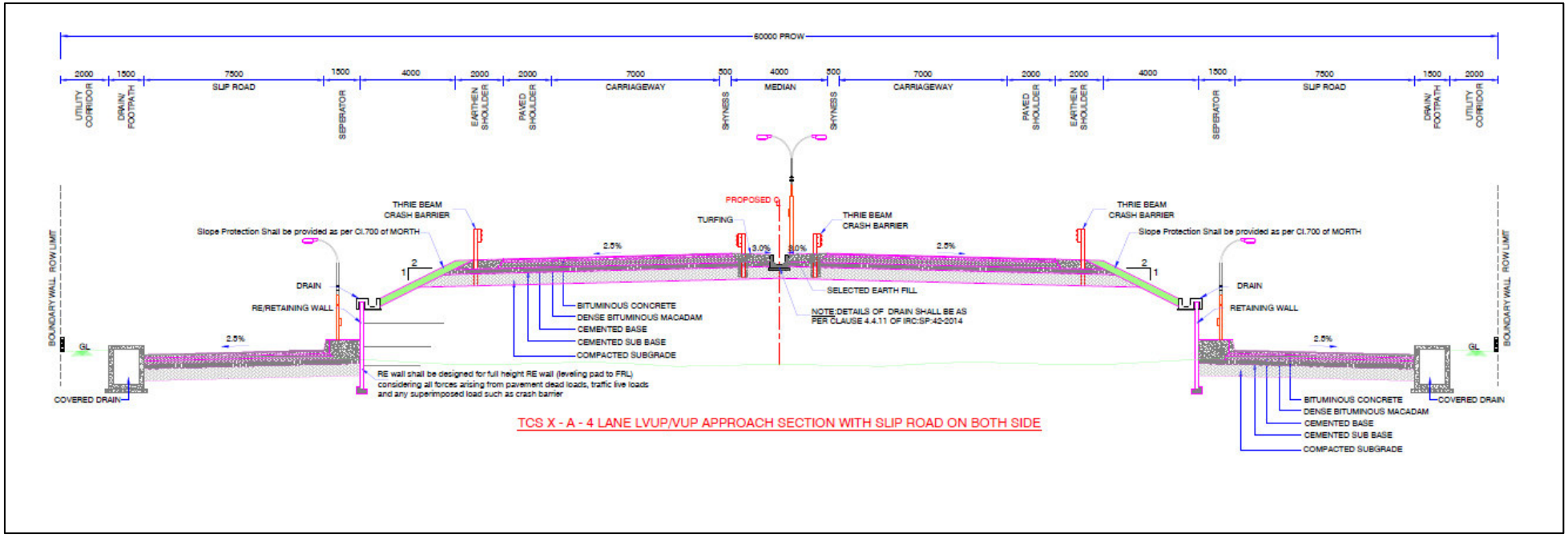


Figure XA-Cross Section for 4-Lane LVUP/VUP Approach Section with Slip Road on Both Side

7.3 Applicable Typical Cross Section

The project stretch under study has multidimensional facets in terms of geometry, pavement condition, existing utilities, religious structures, etc. and considering all these aspects the section-wise policy is adopted based on the initial investigations. The applicable typical cross-sections along the project corridor is summarized in *Table-7.1*

Table-7.1: Applicable TCS of Proposed

S. No	Design Chainage (km)		TCS Type	Length(km)
	From	To		
1	0.000	0.180	5	0.180
2	0.180	0.393	6	0.213
3	0.393	0.453	3	0.060
4	0.453	0.750	6	0.297
5	0.750	3.039	1	2.289
6	3.039	3.054	9A	0.015
7	3.054	3.695	1	0.642
8	3.695	3.707	3	0.012
9	3.707	7.106	1	3.399
10	7.106	7.118	3	0.012
11	7.118	8.540	1	1.422
12	8.540	8.950	2	0.410
13	8.950	8.970	3	0.020
14	8.970	9.390	2	0.420
15	9.390	12.301	1	2.911
16	12.301	12.313	3	0.012
17	12.313	17.050	1	4.737
18	17.050	17.065	9A	0.015
19	17.065	17.880	1	0.816
20	17.880	18.456	2	0.576
21	18.456	18.486	9B	0.030
22	18.486	18.900	2	0.414
23	18.900	21.547	1	2.647
24	21.547	21.559	3	0.012
25	21.559	23.390	1	1.831
26	23.390	23.777	2	0.387
27	23.777	23.807	9B	0.030
28	23.807	24.210	2	0.403
29	24.210	26.347	1	2.137
30	26.347	26.359	3	0.012
31	26.359	29.005	1	2.646
32	29.005	29.856	2	0.851

S. No	Design Chainage (km)		TCS Type	Length(km)
	From	To		
33	29.856	29.976	3	0.120
34	29.976	30.890	2	0.914
35	30.890	31.602	1	0.712
36	31.602	31.609	9A	0.007
37	31.609	34.370	1	2.762
38	34.370	34.763	2	0.393
39	34.763	34.783	9B	0.020
40	34.783	35.266	2	0.483
41	35.266	35.272	9A	0.006
42	35.272	36.416	1	1.144
43	36.416	36.423	9A	0.007
44	36.423	39.137	1	2.715
45	39.137	39.149	3	0.012
46	39.149	44.507	1	5.358
47	44.507	44.519	3	0.012
48	44.519	47.982	1	3.463
49	47.982	48.057	9A	0.075
50	48.057	49.715	1	1.659
51	49.715	49.725	9A	0.010
52	49.725	50.830	1	1.105
53	50.830	51.399	2	0.569
54	51.399	51.485	9A	0.086
55	51.485	51.777	1	0.292
56	51.777	51.807	3	0.030
57	51.807	52.240	2	0.433
58	52.240	53.720	1	1.480
59	53.720	53.730	9A	0.010
60	53.730	54.394	1	0.664
61	54.394	54.406	3	0.012
62	54.406	57.721	1	3.315
63	57.721	57.733	3	0.012
64	57.733	58.000	1	0.267
65	58.000	63.977	10	5.977
66	63.977	63.992	9A	0.015
67	63.992	64.265	10	0.273
68	64.265	64.285	3	0.020
69	64.285	69.219	10	4.934
70	69.219	69.239	9A	0.020
71	69.239	70.147	10	0.908
72	70.147	70.197	9A	0.050

S. No	Design Chainage (km)		TCS Type	Length(km)
	From	To		
73	70.197	70.302	10A	0.105
74	70.302	70.332	3	0.030
75	70.332	70.810	10A	0.478
76	70.810	73.425	1	2.615
77	73.425	73.475	9A	0.050
78	73.475	73.530	1	0.055
79	73.530	74.154	10A	0.624
80	74.154	74.184	3	0.030
81	74.184	74.755	2	0.571
82	74.755	77.426	1	2.671
83	77.426	77.438	3	0.012
84	77.438	79.290	1	1.852
85	79.290	79.701	2	0.411
86	79.701	79.721	3	0.020
87	79.721	80.130	2	0.409
88	80.130	81.969	1	1.839
89	81.969	81.979	9A	0.010
90	81.979	82.174	1	0.195
91	82.174	82.186	3	0.012
92	82.186	84.606	1	2.420
93	84.606	84.618	3	0.012
94	84.618	86.471	1	1.853
95	86.471	86.498	9A	0.027
96	86.498	88.880	1	2.382
97	88.880	88.895	9A	0.015
98	88.895	89.655	1	0.761
99	89.655	89.667	3	0.012
100	89.667	91.165	1	1.498
101	91.165	91.225	9A	0.060
102	91.225	92.277	1	1.052
103	92.277	92.289	3	0.012
104	92.289	95.773	1	3.484
105	95.773	95.785	3	0.012
106	95.785	96.960	1	1.175
107	96.960	97.504	2	0.544
108	97.504	97.534	3	0.030
109	97.534	98.020	2	0.486
110	98.020	99.000	1	0.980
111	99.000	99.404	2	0.404
112	99.404	99.424	3	0.020

S. No	Design Chainage (km)		TCS Type	Length(km)
	From	To		
113	99.424	99.840	2	0.416
114	99.840	101.983	1	2.143
115	101.983	101.995	3	0.012
116	101.995	103.340	1	1.345
117	103.340	103.855	2	0.515
118	103.855	103.885	3	0.030
119	103.885	104.260	2	0.375
120	104.260	107.600	4A	3.340
121	107.600	109.011	1	1.411
122	109.011	109.018	9A	0.007
123	109.018	109.600	1	0.582
124	109.600	110.123	4A	0.523
125	110.123	110.151	9A	0.028
126	110.151	112.100	4A	1.949
127	112.100	112.900	4B	0.800
128	112.900	113.450	1	0.550
129	113.450	114.610	9A	1.160
130	114.610	114.822	1	0.212
131	114.822	114.836	3	0.014
132	114.836	115.460	4B	0.624

Table-7.2: Applicable TCS of Proposed-Buxar Spur

S. No	Design Chainage		TCS Type	Length
	From	To		
1	0.000	0.550	7	0.550
2	0.550	0.635	8	0.085
3	0.635	1.670	7	1.035
4	1.670	1.680	8	0.010
5	1.680	2.400	7	0.720
6	2.400	2.420	8	0.020
7	2.420	17.275	7	14.855

7.4 Proposed Structures

7.4.0 Interchanges

Considering future traffic requirements and joining of other NHs, interchanges are proposed at following locations.

Table 7.3 List of Interchanges

S. No.	Design Chainage	Type of Structure	Crossing/Joining of NH	Type of Junction
01	0+000	Trumpet	NH-29	T
02	29+900	Double Trumpet	Purvanchal Expressway	+

7.4.1 Vehicle Under Passes

Underpasses are provided at locations where roads such as National Highways, State Highways & Major District Roads etc. are intersected with project corridor and also locations where movement of local traffic is observed. A total of 31 underpasses (14 – VUP's, 17-LVUP's) are proposed which are tabulated as follows.

Table 7.4 List of Underpasses with dimensions

S. No	Design Chainage (Km)	Pro Span Arrangement(m)	Type of Structure	Proposed Structure	Remarks
1	0+423	2 x 30.0 X 5.5	Flyover	PSC I-Girder	New
2	3+701	1 x 12.0 x 4.0	LVUP	Box Type	New
3	7+112	1 x 12.0 x 4.0	LVUP	Box Type	New
4	8+960	1 x 20.0 x 5.5	VUP	RCC T-Girder	New
5	12+307	1 x 12.0 x 4.0	LVUP	Box Type	New
6	18+471	1 x 20.0 (Exp) + 1 x 10.0 (Exp)	VUP cum stream	RCC T-Girder	New
7	21+553	1 x 12.0 x 4.0	LVUP	Box Type	New
8	23+792	1 x 20.0 (Exp) + 1 x 10.0 (Exp)	VUP cum stream	RCC T-Girder	New
9	26+353	1 x 12.0 x 4.0	LVUP	Box Type	New

S. No	Design Chainage (Km)	Pro Span Arrangement(m)	Type of Structure	Proposed Structure	Remarks
10	29+916	4 x 30 x 5.5	Flyover	PSC I-Girder	New
11	34+773	1 x 20.0 x 5.5	VUP cum stream	RCC T-Girder	New
12	39+143	1 x 12.0 x 4.0	LVUP	Box Type	New
13	44+513	1 x 12.0 x 4.0	LVUP	Box Type	New
14	51+792	1 x 30.0 x 5.5	VUP	PSC I-Girder	New
15	54+394	1 x 12.0 x 4.0	LVUP	Box Type	New
16	57+727	1×12.0 x 4.0	LVUP	Box Type	New
17	64+271	1×12.0 x 4.0	LVUP	Box Type	New
18	70+317	1 x 30.0 x 5.5	VUP	PSC I-Girder	New
19	74+169	1 x 30.0 x 5.5	VUP	PSC I-Girder	New
20	77+432	1 x 12.0 x 4.0	LVUP	Box Type	New
21	79+711	1 x 20.0 x 5.5	VUP	RCC T-Girder	New
22	82+180	1 x 12.0 x 4.0	LVUP	Box Type	New
23	84+612	1 x 12.0 x 4.0	LVUP	Box Type	New
24	89+661	1 x 12.0 x 4.0	LVUP	Box Type	New
25	92+283	1 x 12.0 x 4.0	LVUP	Box Type	New
26	95+779	1 x 12.0 x 4.0	LVUP	Box Type	New
27	97+519	1 x 30.0 x 5.5	VUP	PSC I-Girder	New
28	99+414	1 x 20.0 x 5.5	VUP	RCC T-Girder	New
29	101+989	1 x 12.0 x 4.0	LVUP	Box Type	New
30	103+870	1 x 30.0 x 5.5	VUP	PSC I-Girder	New

S. No	Design Chainage (Km)	Pro Span Arrangement(m)	Type of Structure	Proposed Structure	Remarks
31	114+829	1 x 14.0	VUP	-	R & W

7.4.2 Culverts

Based on the given data from Reconnaissance, Preliminary, Hydraulic surveys a total of 56 box culverts and 34 pipe culverts proposed along the alignment are tabulated as follows.

Table 7.5 Details of Culverts – Greenfield Alignment

Sr. No.	Design Chainage (Km)	Proposed Span Arrangement(m)	Type of Structure	Proposal Type
1	1+020	1 x 2.0	Box Culvert	New
2	1+457	1 x 2.0	Box Culvert	New
3	2+097	1 x 1.20	Pipe Culvert	New
4	2+331	1 x 3.0	Box Culvert	New
5	2+669	1 x 3.0	Box Culvert	New
6	3+329	1 x 4.0	Box Culvert	New
7	3+534	1 x 3.0	Box Culvert	New
8	3+705	1 x 3.0	Box Culvert	New
9	4+240	1 x 3.0	Box Culvert	New
10	5+542	1 x 2.0	Box Culvert	New
11	7+008	1 x 2.0	Box Culvert	New
12	7+117	1 x 2.0	Box Culvert	New
13	7+318	1 x 1.20	Pipe Culvert	New
14	7+480	1 x 20.0	Pipe Culvert	New
15	7+750	1 x 2.0	Box Culvert	New
16	8+800	1 x 3.0	Box Culvert	New
17	8+950	1 x 2.0	Box Culvert	New
18	9+159	1 x 1.20	Pipe Culvert	New
19	9+300	1 x 1.20	Pipe Culvert	New
20	9+882	1 x 1.20	Pipe Culvert	New
21	10+065	1 x 1.20	Pipe Culvert	New
22	10+120	1 x 2.0	Box Culvert	New
23	10+206	1 x 1.20	Pipe Culvert	New
24	10+439	1 x 1.20	Pipe Culvert	New
25	11+458	1 x 1.20	Pipe Culvert	New
26	11+766	1 x 2.0	Box Culvert	New
27	12+107	1 x 1.20	Pipe Culvert	New

Sr. No.	Design Chainage (Km)	Proposed Span Arrangement(m)	Type of Structure	Proposal Type
28	13+216	1 x 1.20	Pipe Culvert	New
29	14+368	1 x 2.0	Box Culvert	New
30	14+920	1 x 2.0	Box Culvert	New
31	15+060	1 x 2.0	Box Culvert	New
32	15+411	1 x 4.0	Box Culvert	New
33	15+742	1 x 3.0	Box Culvert	New
34	16+070	1 x 2.0	Box Culvert	New
35	16+500	1 x 3.0	Box Culvert	New
36	17+872	1 x 1.20	Pipe Culvert	New
37	19+197	1 x 2.0	Box Culvert	New
38	19+590	1 x 1.20	Pipe Culvert	New
39	19+992	1 x 5.0	Box Culvert	New
40	20+940	1 x 2.0	Box Culvert	New
41	22+052	1 x 5.0	Box Culvert	New
42	24+990	1 x 3.0	Box Culvert	New
43	26+409	1 x 1.20	Pipe Culvert	New
44	26+761	1 x 2.0	Box Culvert	New
45	28+089	1 x 1.20	Pipe Culvert	New
46	32+870	1 x 2.0	Box Culvert	New
47	33+320	1 x 1.20	Pipe Culvert	New
48	34+331	1 x 1.20	Pipe Culvert	New
49	35+576	1 x 1.20	Pipe Culvert	New
50	35+545	1 x 2.0	Box Culvert	New
51	36+836	1 x 1.20	Pipe Culvert	New
52	36+944	1 x 5.0	Box Culvert	New
53	37+849	1 x 1.20	Pipe Culvert	New
54	38+062	1 x 1.20	Pipe Culvert	New
55	38+269	1 x 1.20	Pipe Culvert	New
56	39+700	1 x 1.20	Pipe Culvert	New
57	39+925	1 x 1.20	Pipe Culvert	New
58	41+068	1 x 2.0	Box Culvert	New
59	44+735	1 x 5.0	Box Culvert	New
60	45+502	1 x 1.20	Pipe Culvert	New
61	48+542	1 x 1.20	Pipe Culvert	New
62	48+900	1 x 1.20	Pipe Culvert	New
63	50+010	1 x 1.20	Pipe Culvert	New
64	50+460	1 x 2.0	Box Culvert	New
65	52+280	1 x 2.0	Box Culvert	New
66	52+884	1 x 3.0	Box Culvert	New
67	54+151	1 x 2.0	Box Culvert	New

Sr. No.	Design Chainage (Km)	Proposed Span Arrangement(m)	Type of Structure	Proposal Type
68	55+269	1 x 5.0	Box Culvert	New
69	55+528	1 x 2.0	Box Culvert	New
70	55+606	1 x 4.0	Box Culvert	New
71	57+448	1 x 2.0	Box Culvert	New
72	58+247	1 x 1.20	Pipe Culvert	New
73	59+637	1 x 2.0	Box Culvert	New
74	62+647	1 x 5.0	Box Culvert	New
75	64+247	1 x 2.0	Box Culvert	New
76	64+327	1 x 4.0	Box Culvert	New
77	66+637	1 x 3.0	Box Culvert	New
78	77+442	1 x 1.20	Pipe Culvert	New
79	80+750	1 x 1.20	Pipe Culvert	New
80	81+567	1 x 3.0	Box Culvert	New
81	82+667	1 x 2.0	Box Culvert	New
82	84+605	1 x 2.0	Box Culvert	New
83	93+367	1 x 2.0	Box Culvert	New
84	94+797	1 x 2.0	Box Culvert	New
85	95+137	1 x 1.20	Pipe Culvert	New
86	99+434	1 x 2.0	Box Culvert	New
87	101+963	1 x 1.20	Pipe Culvert	New
88	105+813	1 x 4.0	Box Culvert	D & R
89	107+140	1 x 2.0	Box Culvert	D & R
90	110+825	1 x 3.0	Box Culvert	D & R

Table 7.6 Details of Culverts – Buxar Spur

Sr. No.	Design Chainage (Km)	Proposed Span Arrangement(m)	Type of Structure	Proposal Type
1	1+114	1 x 2.0	Box Culvert	New
2	4+610	1 x 2.0	Box Culvert	New
3	6+263	1 x 2.0	Pipe Culvert	New
4	10+032	1 x 2.0	Box Culvert	New
5	13+490	1 x 3.0	Box Culvert	New
6	15+388	1 x 2.0	Box Culvert	New
7	16+508	1 x 3.0	Box Culvert	New
8	17+003	1 x 1.2	Pipe Culvert	New

Sr. No.	Design Chainage (Km)	Proposed Span Arrangement(m)	Type of Structure	Proposal Type
9	17+129	1 x 2.0	Box Culvert	New

7.4.3 Additional new bridges

New bridges at the following locations on the Project Highway shall be constructed.

Table 7.7 Details of Major & Minor Bridges – Greenfield Alignment

Sr. No.	Design Chainage (Km)	Prop Span Arrangement	Type of Structure	Proposed Type
1	3+046	1 x 15.0	MIB	New
2	17+057	1 x 15.0	MIB	New
3	31+605	1 x 7.0	MIB	New
4	35+269	1 x 6.0	MIB	New
5	36+419	1 x 7.0	MIB	New
6	48+000	3 x 25.0	MJB	New
7	49+720	2 x 5.0	MIB	New
8	53+730	2 x 5.0	MIB	New
9	63+984	1 x 15.0	MIB	New
10	69+229	1 x 20.0	MIB	New
11	70+172	2 x 25.0	MIB	New
12	73+450	2 x 25.0	MIB	New
13	81+974	2 x 5.0	MIB	New
14	86+484	1 x 15.0+ 1 x 12.0 x 4.0	MIB cum LVUP	RCC-T Girder
15	88+887	1 x 15.0	MIB	New
16	91+195	2 x 30.0	MJB	New
17	109+014	1 x 7.0	MIB	

Sr. No.	Design Chainage (Km)	Prop Span Arrangement	Type of Structure	Proposed Type
18	110+137	3 x 9.38	MIB	Retained
19	114+043	3 x 65.5 + 15 x 64.8	MJB	Retained

Table 7.8 Details of Major & Minor Bridges – Buxar Spur

Sr. No.	Design Chainage (Km)	Prop Span Arrangement	Type of Structure	Proposed Type
1	1+676	1 x 8.0	MIB	New
2	2+410	2 x 15.0	MIB	New

7.5 Proposed structures

7.5.1 Proposed ROBs and RUBs

There are no RUBs in the project corridor. ROB's proposed along the project stretch are tabulated below.

Table 7.9 Details of ROB'S

S.No	Design Chainage (Km)	Proposed Span Arrangement (m)	TCS Type	Remarks
1	51+442	1 x 20.0 + 1 x 46.0 + 1 x 20.0	ROB cum Drain	Greenfield
2	0+592	1 x 20.0 + 1 x 36.0 + 1 x 20.0	ROB	Buxar Spur

7.6 Rest Areas

There are no existing rest areas in the project stretch.

7.7 Truck Lay Byes

Local consultations were held at the places of petty repair shops, restaurants/dhaba etc. and subjective opinion of the drivers regarding necessity of truck lay bye was gathered. Truck Lay-byes would consist of deceleration and acceleration lane with central parking area. Sufficient working area and space for roadside establishments such as repair shops, vulcanizing shops, service center, spare parts shops, telephone booth and light refreshments with first aid facilities may be provided. Few trucks were observed to be parked on the roadside that hinders the mainstream of traffic on the project corridor.

Table–7.10: Location of Truck Lay bye

S. No	Existing Chainage (Km)	Design Chainage (Km)	Remarks
1	-	14.000	Both Sides
2	-	83.500	Both Sides

7.8 Bus Shelters:

Table–7.11: Location of Bus shelters

S. No	Existing Chainage (Km)	Design Chainage (Km)	Side	Village
1	-	8.860	LHS	Chak Ajam
2	-	9.060	RHS	Chak Ajam
3	-	18.370	LHS	Fakkrabad
4	-	18.570	RHS	Fakkrabad
5	-	23.692	LHS	Parsa
6	-	23.892	RHS	Parsa
7	-	29.816	LHS	Sher
8	-	30.016	RHS	Sher
9	-	34.673	LHS	Lathudih
10	-	34.873	RHS	Lathudih
11	-	51.692	LHS	Ekoni
12	-	51.892	RHS	Ekoni
13	-	70.217	LHS	Harlal
14	-	70.417	RHS	Jinari

S. No	Existing Chainage (Km)	Design Chainage (Km)	Side	Village
15	-	74.069	LHS	Oujha Kacchua
16	-	74.269	RHS	Oujha Kacchua
17	-	79.611	LHS	Bharkoka
18	-	79.811	RHS	Bharkoka
19	-	97.419	LHS	Bairiya
20	-	97.619	RHS	Bairiya
21	-	99.314	LHS	Bairiya
22	-	99.514	RHS	Bairiya
23	523.400	103.770	LHS	Sonabarsa
24	523.600	103.970	RHS	Sonabarsa
25	534.600	114.700	LHS	Bahoran Tola
26	534.800	114.900	RHS	Bahoran Tola

The layout of bus-bay is designed based on the standards of IRC SP:84 & IRC 80.

7.9 Toll Plaza:

Toll plaza location is one of the most important aspects of this project. It becomes all the more important for 4-laned sections of national highways in India where tolling is being implemented by means of an open tolling system, with limited control on access. Toll Plaza should be located at such places so as to capture all the traffic to avoid any leakage of revenue.

The key factors that govern the optimum location of toll plaza are:

Minimum traffic diversion from project road to surrounding road network

Revenue collection

Local issues and local tollable traffic

Compatibility with National Highways Act

Engineering issues

Land availability

Considering the above factors, one toll plaza is proposed as per the and the design standards shall conform to IRC: SP:84-2019. The toll revenue has been calculated considering the proposed toll plaza at the following location as shown below.

Table-7.12: Location of Toll Plaza

Stretch	No of Toll Plazas	No. of Lanes	
		Entry	Exit
Ghazipur –Ballia-UP/Bihar	1@ km.5+000	7+1	7+1
	2@ km. 65+000		

Adequate land for toll plaza for the provision of toll lanes including all other buildings and structures shall be acquired.

Table 7.13 Summary details of Structures

S. No	Type	Greenfield Alignment	Buxar Spur
1	Flyovers	2	0
2	VUP	12	0
3	LVUP	17	0
4	SVUP	0	0
5	ROB	1	1
6	Box Culverts	56	8
7	Pipe Culvert	34	1
8	Minor Bridge	16	2
9	Major Bridge	3	0
	Total	**141**	**12**

8.0 TRAFFIC DEMAND ASSESSMENT

8.1 GENERAL

An accurate estimate of the traffic that is likely to use the project road is very important as it forms the basic input in planning, design, operation and financing. A thorough knowledge of the travel characteristics of the traffic likely to use the Project road as well as other major roads in the influence area of the study corridor is essential for future traffic estimation. The estimation of revenue through toll collection is important to assess the financial viability of the project and to finalize the financial covenants for the concession agreement. Hence, detailed traffic surveys were carried out to assess the baseline traffic characteristics on the project road. This chapter deals with the traffic studies undertaken and the analysis there after.

8.2 LOCATION OF THE PROJECT

National Highway – 19 (new NH-31) starts at an intersection on NH – 29 in Ghazipur in the state of Uttar Pradesh and ends in Patna in Bihar. The highway traverses through various places like Ghazipur, Ballia in Uttar Pradesh and Manjhi, Chappara, Sonapur, Hajipur and Patna in the state of Bihar.

The project stretch starts at Ghazipur in the state of Uttar Pradesh and ends at UP/Bihar border on Ganga bridge.

It traverses through plain terrain and with a mixed land use of residential, agricultural and forest. The project corridor passes through rural, urban and semi urban areas such as Ghazipur, Mohammadabad, Bharouli, Phephna, Ballia, Haldi and Bariya. The project corridor traverses mostly through the districts of Ghazipur and Ballia in the state of Uttar Pradesh. The index map showing project stretch is shown in Figure-8.1.

Table-8.1: Details of the Project stretch

S. No	Project Highway	Design Chainage (Km)		Remarks
		From	To	
1	Ghazipur to Manjhi Ghat UP/ Bihar Border	0.000	115.600	Greenfield Alignment
2	Buxar Spur	0.000	17.800	-

Table-8.2: Location and Chainage of the Project stretch

Design Chainage		Geo-Coordinates	
From (Km)	**To (Km)**	**Start**	**End**
Ghazipur 0.000	UP/Bihar Border 115.460	Lat: 25°40'42.01"N Long: 83°32'58.26"E	Lat: 25°49'19.75"N Long: 84°35'24.42"E
Bathor 0.000	Buxar 17.300	Lat: 25°42'17.36"N Long: 83°51'27.70"E	Lat: 25°35'56.53"N Long: 83°58'42.07"E

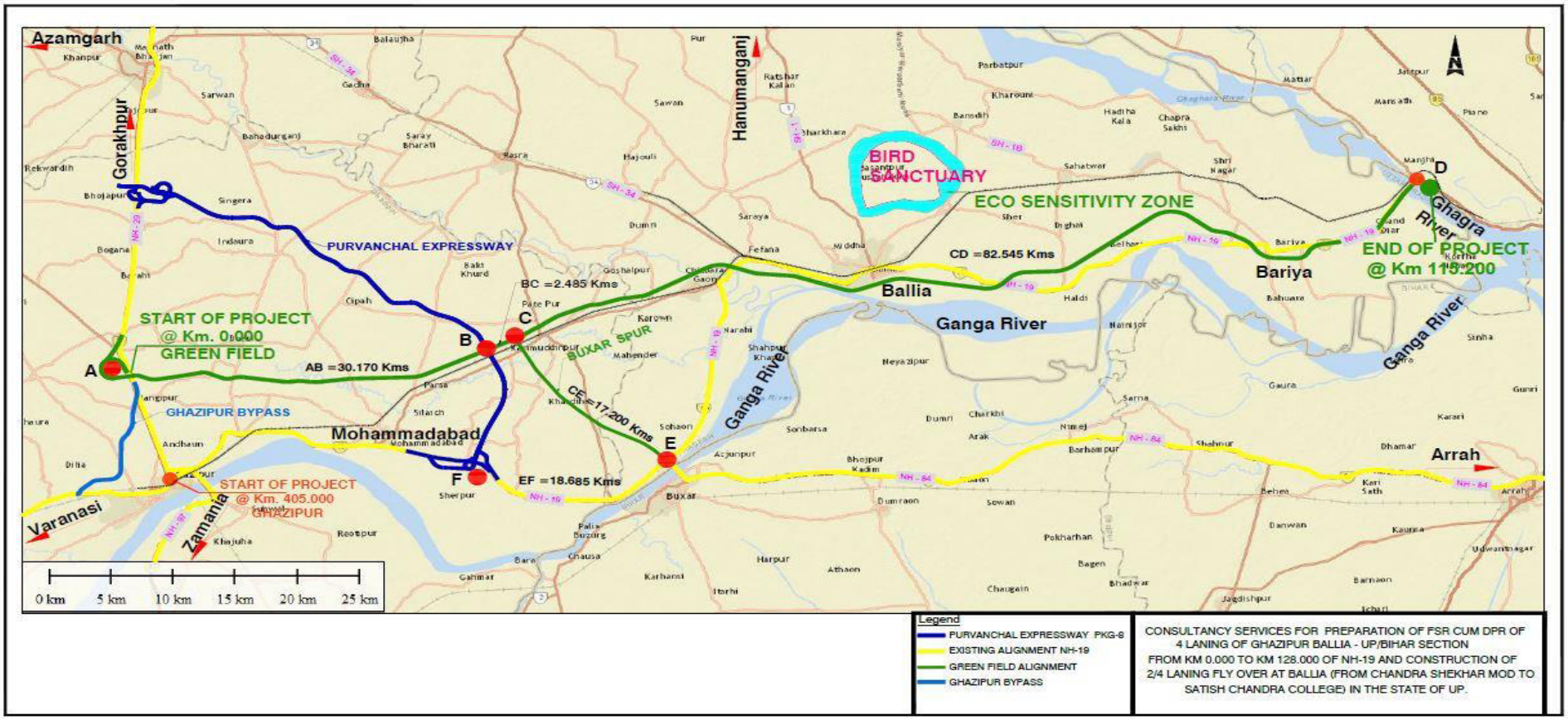


Figure-8.1: Index Map of Project Stretch

8.3 OBJECTIVES

The primary objectives of the traffic studies undertaken were to:

- ✓ Determine characteristics of traffic movement and to establish base year traffic.
- ✓ Determine travel pattern as well as type and weight of commodities carried by goods vehicles.
- ✓ Capacity assessment and recommendation for road widening based on demand forecast.
- ✓ Determine Vehicle Damage Factors to assist in pavement design.

8.4 SCOPE

The scope of traffic study includes the analysis of the primary data collected from traffic surveys. Vehicle Damage Factor is assessed from the Axle Load Survey to design pavement layers. To determine the capacity, level of service and pavement composition along the project corridor, the following parameters are assessed:

- ✓ Average Daily Traffic, Annual Average Daily Traffic, Peak Hour Factor and Seasonal Correction Factor of the Base Year
- ✓ Traffic Growth Rates
- ✓ Axle load survey
- ✓ Turning Moment volumes

8.5 TRAFFIC SURVEYS

During the reconnaissance survey, the existing road network was studied. As per the details given in TOR, mid-block sections were identified for carrying out traffic surveys and all other locations of traffic surveys were finalized as per TOR. Traffic Surveys Planning Schedule is presented in *Table-8.3*.

Table-8.3: Traffic Survey Schedule

S.No	Type of Survey	Location	Chainage (km)	Duration of Survey	Date of Survey
1	Classified Traffic Volume Counts	Near Sultanpur	419.000	4 Days	5-01-2021 to 08-01-2021
2		Near Bariya	526.000		
6	Turning Movements	Phephna (4-arm Junction)	473.100	24 hours	05-01-2021
7		Junction with NH 84 (Bharouli chowk	451.100		06-01-2021

S.No	Type of Survey	Location	Chainage (km)	Duration of Survey	Date of Survey
		Junction)			
14	Axle Load Survey	Near Sultanpur	419.000	24 hours	05-01-2021
17		Near Bariya	526.000		06-01-2021

The Automatic Classified Traffic Volume Count (ATCC) surveys were conducted at two strategic points, i.e., at Km 419.000 (near Sultanpur) and Km 526.000 (near Bariya) for four consecutive days. The surveys were conducted using Pneumatic tubes and video graphic methods. Turning movement surveys were conducted for a period of 24 consecutive hours at two locations, i.e., at Km 451.570 (Bharouli chowk Junction) and at Km 473.100 (Phephna Junction) where the project corridor intersects with other national and state highways.

Axle load Survey were conducted at four locations i.e., at Km 419.000 (near Sultanpur) and 526.000 (near Bariya).

A map showing the project stretch with all the traffic survey locations is shown in the *Figure-8.2*.

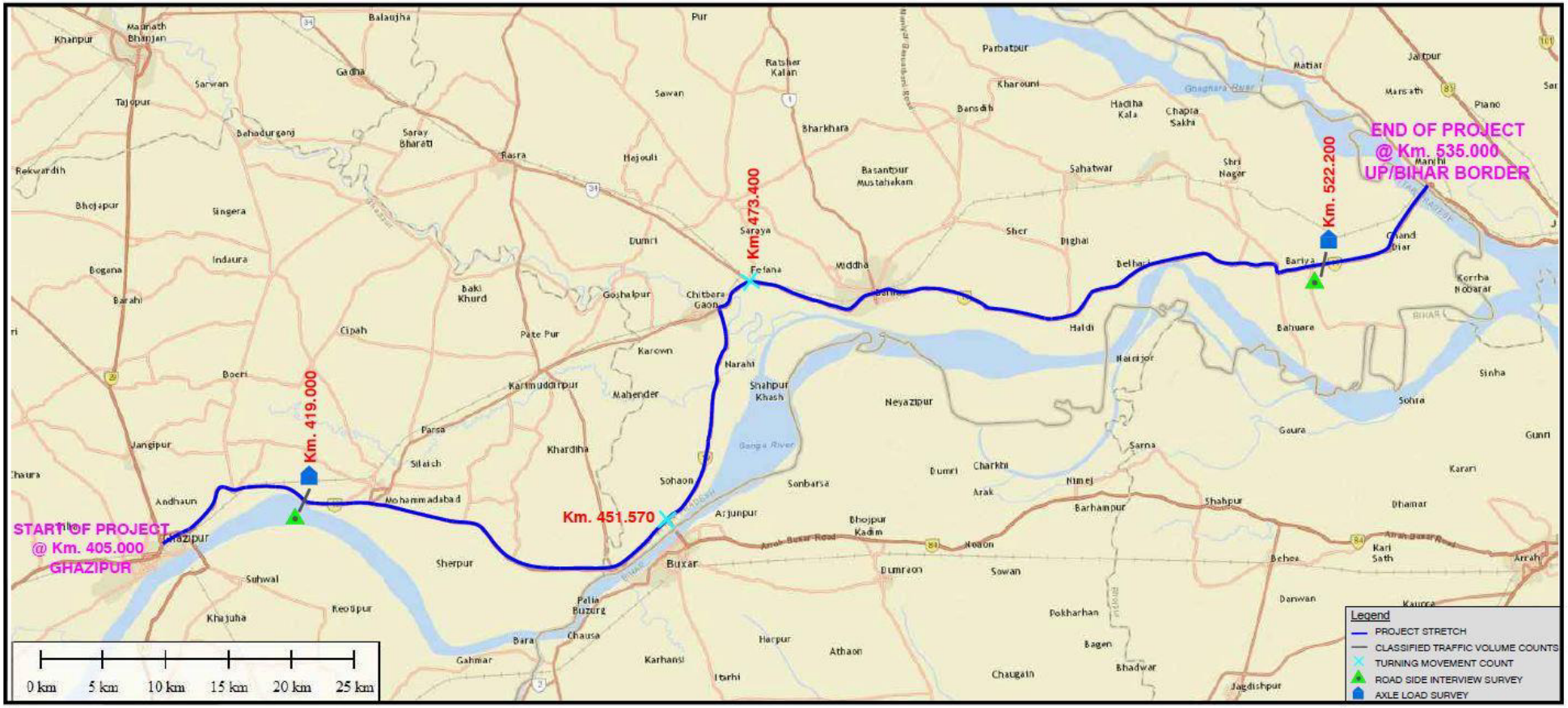


Figure-8.2: Map showing Traffic Surveys Locations

8.5.1 Methodology of Traffic Surveys

- Classified Traffic Volume Count (CTVC) survey was carried out by using Automatic Traffic Counter and Classifier (ATCC) System.
- Pneumatic Tube Detectors and video graphic methods were adopted to carry out classified traffic volume count survey.
- Continuous 24-hour traffic volume count survey was conducted for 7 days along the project stretch. The survey was conducted in accordance with the guidelines provided by IRC: 9-1972.The vehicles were broadly classified into motorized passenger vehicles, motorized goods vehicles and non-motorized vehicles. These groupings have further been sub-divided to reflect the present-day traffic pattern more realistically.
- Axle load surveys were conducted for 24 hours in each survey location. Different truck types were selected on random sampling basis including empty vehicles.
- Turning movement surveys were conducted for 24 hours in each survey location. One day turning movement count has been taken on all the legs of the junctions.

Figure-8.3: Automatic Traffic Classifier and Counter been installed

Table-8.4: Passenger Car Unit Factors*

Vehicle Type	Equivalent PCU factors	ADOPTED PCUs	Vehicle Type	Equivalent PCU factors
Two Wheelers	0.5		Two Axle	3
Three Wheelers	1		Three Axle	3
Car / Jeep / Van	1		Multi Axle	4.5
Car (Yellow Board)	1		Heavy Earth Moving	4.5
Tata Magic	1		LCV/ LGV	1.5
RTC Bus	3		Mini LCV	1
Private Bus	3		Tractor	1.5
School Bus	3		Tractor with trailer	4.5
College Bus	3		Cycle	0.5
Minibus	1.5		Cycle Rickshaw	2
Three-Wheeler (Goods)	1		Animal Drawn	8

Source: IRC:64-1990

8.5.2 Average Daily Traffic (ADT)

The Average Daily Traffic (ADT) is obtained from the Classified Traffic Volume Count to determine the characteristics of traffic movement and to establish base year traffic demand on the project corridor. The data collected from primary and secondary sources were recorded in worksheets, compiled, checked and corrected before further proceeding for analysis. Traffic data analysis has been carried out, to understand the traffic characteristics and travel pattern in the study area and to provide basic input for pavement design. Average Daily Traffic (ADT) for two Classified Traffic Volume locations are given in *Table-8.5*. The detailed calculations are presented in ***Annexures-I(a), I(b)***

Table-8.5: ADT at Survey Locations

Vehicle Type		Km 419.000	Km526.000
Two Wheelers		7550	2007
Three Wheelers		623	337
Car		1544	694
Tata Magic		8	8
RTC Bus		59	12
Private Bus		55	58
Mini Bus		0	1
School/ College Bus		1	1
Two Axle		137	162
Three Axle		367	285
Multi Axle		425	292
Heavy Earth Moving		4	9
Light Commercial		90	102
Mini LCV		376	332
Tractor		14	13
Tractor with Trailer		13	13
Three Wheeler (Goods)		0	0
Bicycle		1151	15
Cycle Rickshaw		7	7
Animal Drawn		8	9
Government Exempted		38	38
Vehicles	Motorised	11304	4364
	Non Motorised	1166	31
	Total Traffic	12464	4395
	Tollable Traffic	3062	1953
PCU	Motorised	10394	5583
	Non Motorised	654	101
	Total Traffic	11048	5677
	Tollable Traffic	5852	4099

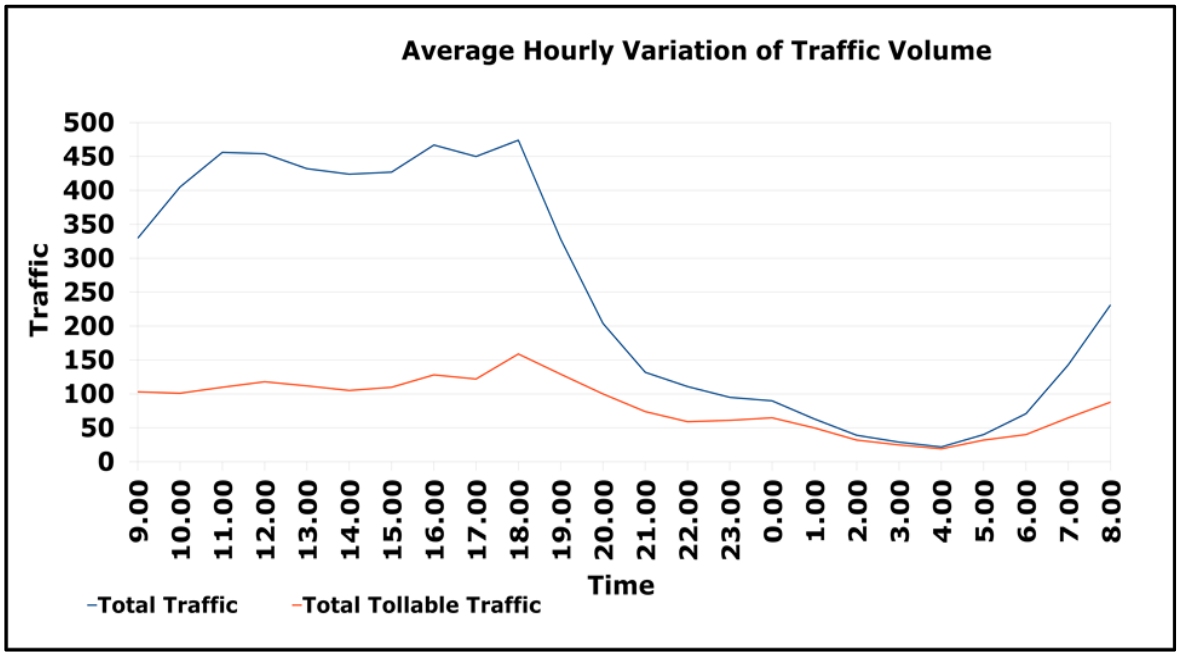


Fig: 8.5.1 Average Hourly Traffic Variation at Km 419.000, Sultanpur

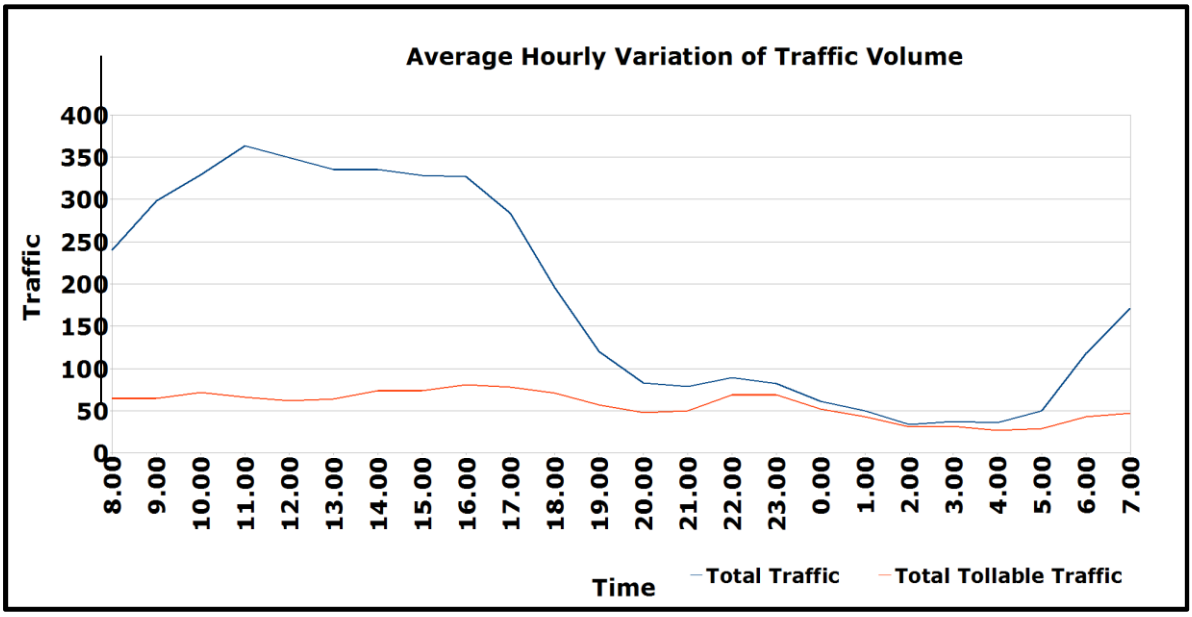


Fig: 8.5.5 Average Hourly Traffic Variation at Km 526.000, Bariya Village

It can be observed that the total hourly traffic varies uniformly across all the survey locations. Peak traffic was observed between 10:00 hrs – 17:00 hrs. Traffic was observed to be very low between 00:00 hrs – 04:00 hrs.

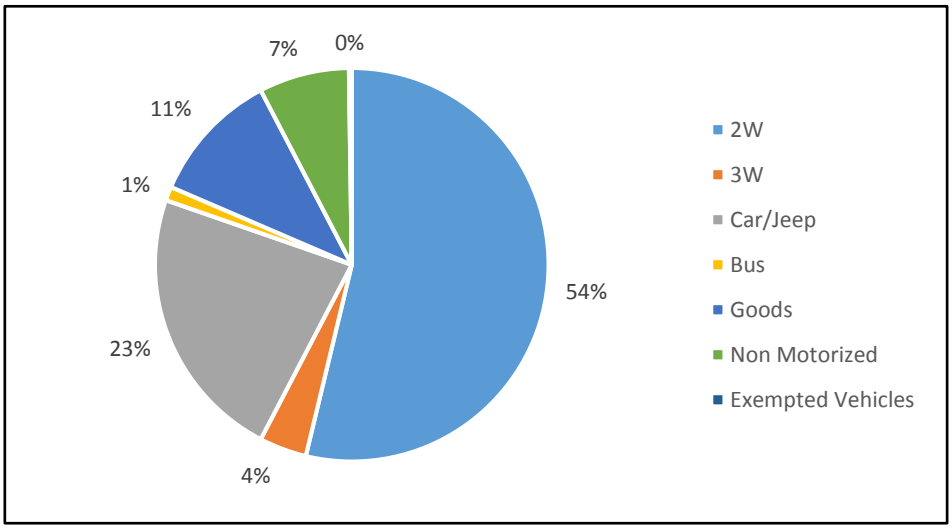


Fig:8.6.4 @Km 483.000

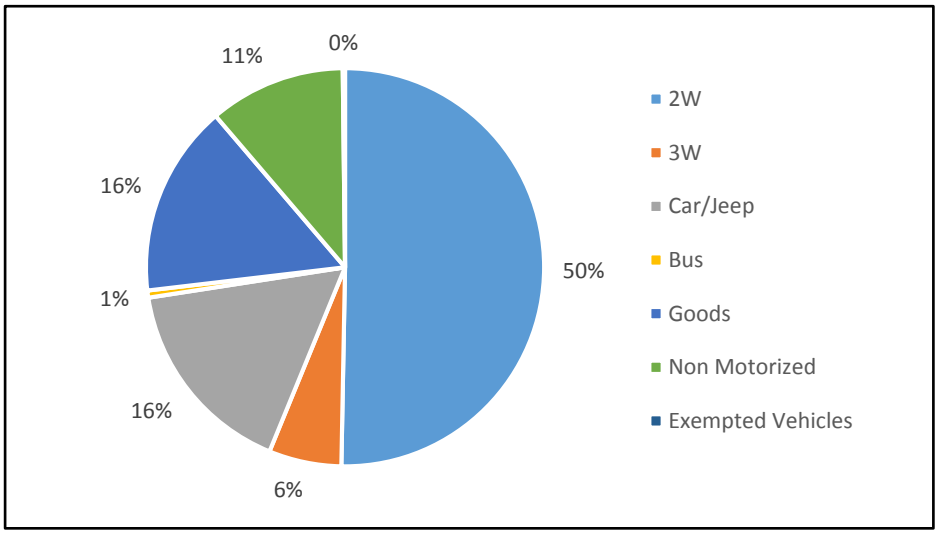


Fig:8.6.5 @Km 526.000

Fig:8.6 Modal Split of ADT at all TVC locations

Total average daily traffic at Km 419.000 was observed to be higher when compared with the other locations. Commercial and Passenger traffic was found to be high at Km 419.000. Higher car traffic at Ballia (Km 419.000) indicates the urban influence of Ballia. In all the locations, two wheelers were observed to be higher than rest of the modes.

8.5.3 Seasonal Correction Factor

Monthly sales data from the fuel stations located on the project corridor were collected to estimate the Seasonal Correction Factor (SCF). The SCF is applied to the vehicular traffic volume of ADT to obtain the Annual Average Daily Traffic (AADT) and it is later converted to PCU's. The factor is calculated based on the month of survey conducted, i.e., November 2020, was applied to the ADT to determine the AADT.

Table-8.6: Average Seasonal Variation Factors (SVF)

S.No.	Section	Petrol	Diesel
1	Ghazipur-Ballia	1	1
2	Ballia-UP/Bihar Border	1	1

8.5.4 Annual Average Daily Traffic (AADT)

The Annual Average Daily Traffic (AADT) at each of the survey location is obtained by multiplying the Average Daily Traffic (ADT) with the Seasonal Correction Factor. The AADT for the year 2020 at survey locations are calculated and tabulated in the below*Table-8.7*. The detailed calculations are presented in ***Annexure-I(a), I(b).***

Table-8.7: AADT at Survey Locations

Vehicle Type	Km 419.000	Km526.000
Two Wheelers	7550	2007
Three Wheelers	623	337
Car	1544	694
Tata Magic	8	8
RTC Bus	59	12
Private Bus	55	58
Mini Bus	0	1
School/ College Bus	1	1
Two Axle	137	162
Three Axle	367	285
Multi Axle	425	292
Heavy Earth Moving	4	9
Light Commercial	90	102

Vehicle Type		Km 419.000	Km526.000
Mini LCV		376	332
Tractor		14	13
Tractor with Trailer		13	13
Three Wheeler (Goods)		0	0
Bicycle		1151	15
Cycle Rickshaw		7	7
Animal Drawn		8	9
Government Exempted		38	38
Vehicles	Motorised	11304	4364
	Non Motorised	1166	31
	Total Traffic	12464	4395
	Tollable Traffic	3062	1953
PCU	Motorised	10394	5583
	Non Motorised	654	101
	Total Traffic	11048	5677
	Tollable Traffic	5852	4099

Table-8.8: Peak Hour Proportion (PHP) at Survey Locations

S.No.	Volume Count Location	Count	PHV	Peak Hour	PHP (%)
1	Km 419.000	4 Days	1825	7:00-8:00	14.64
2	Km 526.000	4 Days	380	11:00-12:00	8.64

8.5.5 Axle Load Survey and Analysis

Axle load surveys were conducted at Sultanpur, & Bariya. Axle load Survey was conducted for all the commercial vehicles (Trucks and LCV) in a normal weekday in both the directions (24 hours in each direction). The vehicles were selected randomly for axle load measurement, ensuring suitable sample for each category of commercial vehicles consisting of overloaded and empty vehicles.

The Vehicle Damage Factor (VDF) is an index characterizing the traffic loading for a highway and is defined as a multiplier for converting the number of commercial vehicles of different axle loads to Standard Axle Loads (SAL). Equivalency factor (EF) is normally worked out by using the Fourth Power Rule derived by AASHTO and approved by CRRI.

With the help of equivalency factors and frequency distribution of axle loads, Equivalent Axle Loads (EAL) were computed.

VDF = Total EAL / Number of vehicles weighed

The sample size for the survey is presented in the below.

Table-8.9: Axle Load Survey Sample Size at Km 419.000, Sultanpur

Ghazipur to Ballia				Ballia to Ghazipur			Both Directions		
Vehicle type	TVC	Axle load veh.	% Sample	TVC	Axle load veh.	% Sample	TVC	Axle load veh.	% Sample
LCV	45	35	77.78	29	25	86.2	74	60	81.08
2 Axle	32	26	81.25	28	13	46.4	60	39	65.00
3 Axle	87	66	75.86	92	59	64.1	179	125	69.83
M Axle	47	19	40.43	45	30	66.7	92	49	53.26
Mini LCV	367	152	41.42	308	142	46.1	675	294	43.56

Table-8.10: Axle Load Survey Sample Size at Km 526.000, Bariya

Ballia to Manjhighat				Manjhighat to Ballia			Both Directions		
Vehicle type	TVC	Axle load veh.	% Sample	TVC	Axle load veh.	% Sample	TVC	Axle load veh.	% Sample
LCV	57	29	50.9	70	64	91.43	127	93	73.23
2 Axle	33	12	36.4	36	21	58.33	69	33	47.83
3 Axle	121	81	66.9	127	113	88.98	248	194	78.23
M Axle	178	107	60.1	174	118	67.82	352	225	63.92
Mini LCV	247	149	60.3	246	165	67.07	493	314	63.69

The VDF calculated for different categories of commercial vehicles are as shown in the *Table- 8.30.*and the detail calculations are presented in ***Annexures-III(a), III(b), III(c) & III(d).***

Table-8.11: Vehicle Damage Factor obtained from Axle Load Survey

Location	Direction	2 Axle	3 Axle	MAV	LCV
Km 419.000, Sultanpur	Towards Ballia	3.27	9.48	11.10	1.47
	Towards Ghazipur	0.71	0.68	2.28	0.61
	Towards Ghazipur	3.75	5.13	8.52	1.15
Km 526.000, Bariya	Towards Manjhighat	4.01	6.19	10.63	2.68
	Towards Ballia	2.11	6.20	6.04	0.60

Table-8.12: Goods Composition at Km 419.000, Sultanpur

Commodity	2 Axle (%)	3 Axle (%)	MAV (%)	LCV (%)	Mini LCV (%)
Food grains and pulses	13.04	8.39	2.94	8.33	3.64
Cash crops	0.00	0.00	0.00	0.00	0.00
Vegetables and Fruits	15.22	9.79	2.94	3.33	5.67
Processed Food Items	0.00	2.10	0.00	0.00	0.81
Packed Food Items	0.00	0.00	0.00	3.33	2.02
Fishery, Poultry and Animal feed	2.17	2.80	0.00	3.33	4.45
Building Materials	0.00	21.68	32.35	3.33	6.07
Industrial Raw Materials	4.35	1.40	0.00	0.00	0.81
Consumer Goods	6.52	16.08	29.41	16.67	13.36
Fertilisers, chemicals and Pharmaceuticals	0.00	0.00	0.00	0.00	0.00
Machinery and Automobiles	10.87	1.40	2.94	0.00	2.02
Petroleum Products	0.00	0.00	0.00	0.00	0.40
Parcel Goods	0.00	1.40	0.00	0.00	4.05
Empty	34.78	32.17	26.47	38.33	37.25
Industrial Outputs	0.00	2.80	0.00	8.33	4.05
Liquor and Cooldrinks	6.52	0.00	0.00	0.00	0.40
Passenger	6.52	0.00	2.94	15.00	14.98

Table-8.13: Goods Composition at Km 526.000, near Bariya

Commodity	2 Axle (%)	3 Axle (%)	MAV (%)	LCV (%)	Mini LCV (%)
Food grains and pulses	4.88	3.36	4.52	0.00	1.93
Cash crops	0.00	0.00	0.90	0.00	0.00
Vegetables and Fruits	9.76	13.03	9.05	11.34	10.22
Processed Food Items	4.88	2.94	4.07	2.06	2.21
Packed Food Items	0.00	0.84	0.00	2.06	0.28
Fishery, Poultry and Animal feed	2.44	3.78	1.36	4.12	1.66
Building Materials	9.76	16.81	17.19	10.31	7.73
Industrial Raw Materials	2.44	0.84	0.45	0.00	0.28
Consumer Goods	17.07	3.78	8.60	12.37	7.73

Commodity	2 Axle (%)	3 Axle (%)	MAV (%)	LCV (%)	Mini LCV (%)
Fertilisers, chemicals and Pharmaceuticals	2.44	2.10	1.36	1.03	0.55
Machinery and Automobiles	0.00	0.42	0.90	0.00	1.38
Petroleum Products	0.00	2.52	1.36	2.06	0.55
Parcel Goods	9.76	6.72	6.79	2.06	11.60
Empty	26.83	35.29	33.94	45.36	44.75
Industrial Outputs	7.32	3.36	5.88	6.19	1.93
Liquor and Cooldrinks	0.00	1.68	0.00	0.00	0.55
Passenger	2.44	2.52	3.62	1.03	6.63

It is observed that the percentage of goods vehicles plying empty on the project stretch are on the higher side. The empty vehicles are moving towards Sonbhadra & Mirzapur through the project stretch which are high in metal quarries. It is also observed that various batching plants are present around the teekha junction, which is also one of the reasons for observing the movement towards teekha junction with building materials.

8.5.6 Turning Movement Survey

The mid-block traffic volume count station as defined in *Table–8.3* of this report have been located to capture the pattern of the traffic plying on the project stretch. Apart from these traffic volume counts, for the study of the road network around the project corridor, two junctions have been identified for the turning movement surveys. The traffic pattern is considerably influenced by these junctions, either in case of passenger vehicles or goods or both also. 1 day turning movement counts have been taken on all the legs of these junctions. The traffic volume levels and their characteristics at these intersections are presented in *Table-8.14 & 8.15*. The leg wise classified traffic volume counts are presented in ***Annexure-V(a), V(b).***

8.5.7 Turning Bharauli Chowk Junction at km. 451+200

Bharauli Chowk intersection is a one of the major 3-legged intersection formed by connecting the roads from Narainpur road, Teekha, Buxar road. Summary of intersection traffic each direction wise in-terms of volume in numbers and PCUs are given below.

Table – 8.14: Bharauli Chowk Junction traffic each direction wise

TIME	LEG1 (Teekha)		LEG2 (Buxar)		LEG3 (Narainpur)		INTERSECTION	
	TOTAL		TOTAL		TOTAL		TOTAL	
	Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs

TIME		LEG1 (Teekha)		LEG2 (Buxar)		LEG3 (Narainpur)		INTERSECTION	
		TOTAL		TOTAL		TOTAL		TOTAL	
		Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs
8:00	9:00	1105	869	755	623	932	761	2792	2253
9:00	10:00	1253	981	938	785	905	740	3096	2505
10:00	11:00	1342	971	1030	806	950	784	3322	2560
11:00	12:00	1564	1159	1135	869	1083	858	3782	2885
12:00	13:00	1431	1047	1229	934	1168	887	3828	2867
13:00	14:00	1167	876	795	663	1028	851	2990	2389
14:00	15:00	1283	902	1026	785	1171	919	3480	2605
15:	16:00	1603	1189	1284	1041	1253	996	4140	3225
16:00	17:00	1240	897	1114	871	992	782	3346	2549
17:00	18:00	1304	917	1076	822	1036	805	3416	2543
18:00	19:00	1172	899	942	766	848	730	2962	2394
19:00	20:00	1114	818	888	701	790	602	2792	2120
20:00	21:00	820	579	585	423	627	473	2032	1474
21:00	22:00	522	366	433	319	435	327	1390	1012
22:00	23:00	253	207	145	133	250	203	648	543
23:00	0:00	191	172	117	120	190	164	498	456
0:00	1:00	105	107	110	117	99	109	314	333
1:00	2:00	126	132	95	100	113	111	334	342
2:00	3:00	101	105	79	72	68	70	248	246
3:00	4:00	125	115	95	85	94	76	314	275
4:00	5:00	122	117	111	108	97	90	330	314
5:00	6:00	185	179	136	137	109	101	430	416
6:00	7:00	253	210	142	145	217	173	612	527
7:00	8:00	455	339	308	301	419	320	1182	959
Total		18836	14145	14568	11721	14874	11927	48278	37792

8.5.8 Phephna Junction at km. 473+100

Phephna intersection is a one of the major 4-legged intersection formed by connecting the roads from Barauli road, Trikalpur, Rasra and Baliya road. Summary of intersection traffic each direction wise in-terms of volume in numbers and PCUs are given below.

Table – 8.15: Phephna Junction traffic each direction wise

TIME		LEG1 (Balliya)		LEG2 (Barauli)		LEG3 (Rasra)		LEG 4 (To Trilakpur)		INTERSECTION	
		TOTAL		TOTAL		TOTAL		TOTAL		TOTAL	
		Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs
8:00	9:00	1030	849	1024	912	907	781	421	485	3382	3026
9:00	10:00	1299	992	1219	1029	1041	834	481	441	4040	3295
10:00	11:00	1356	1057	1200	928	1083	894	527	427	4166	3305
11:00	12:00	1386	1088	1350	1067	1177	927	495	497	4408	3577

TIME		LEG1 (Balliya)		LEG2 (Barauli)		LEG3 (Rasra)		LEG 4 (To Trilakpur)		INTERSECTION	
		TOTAL		TOTAL		TOTAL		TOTAL		TOTAL	
		Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs
12:00	13:00	1336	1046	1360	1054	1201	988	475	489	4372	3576
13:00	14:00	1373	1100	1371	1090	1188	1011	490	552	4422	3752
14:00	15:00	1411	1099	1304	1037	1250	977	545	606	4510	3718
15:00	16:00	1381	1047	1010	839	1080	918	505	436	3976	3239
16:00	17:00	1062	803	975	750	872	712	403	369	3312	2634
17:00	18:00	922	756	907	821	745	667	426	527	3000	2770
18:00	19:00	1119	913	813	747	851	753	363	451	3146	2863
19:00	20:00	818	685	704	672	650	649	282	400	2454	2405
20:00	21:00	616	538	401	487	379	431	180	278	1576	1733
21:00	22:00	307	336	271	365	146	269	182	298	906	1266
22:00	23:00	268	335	251	386	122	267	133	235	774	1222
23:00	00:00	167	260	163	311	103	198	127	237	560	1005
00:00	01:00	133	212	158	348	109	278	112	215	512	1052
01:00	02:00	133	219	129	267	100	238	98	173	460	896
02:00	03:00	125	237	119	287	113	284	109	224	466	1031
03:00	04:00	161	286	174	414	156	380	129	270	620	1349
04:00	05:00	143	237	212	468	192	491	153	327	700	1522
05:00	06:00	156	224	236	463	246	511	172	325	810	1522
06:00	07:00	218	301	251	499	349	628	200	377	1018	1804
07:00	08:00	292	408	305	523	397	628	244	365	1238	1923
Total		**15109**	**11970**	**7252**	**8998**	**7252**	**8998**	**7252**	**8998**	**46764**	**39893**

Table–8.16: Traffic Volume Characteristics at Intersections

Chainage	Type of Junction	Total Traffic Volume (PCUs)	Peak Hour	Peak Hour Traffic (PCUs)
Km 451.200	3 legged	37792	15:00 to 16:00	4140
Km 473.100	4 legged	66556	14:00 to 15:00	2725

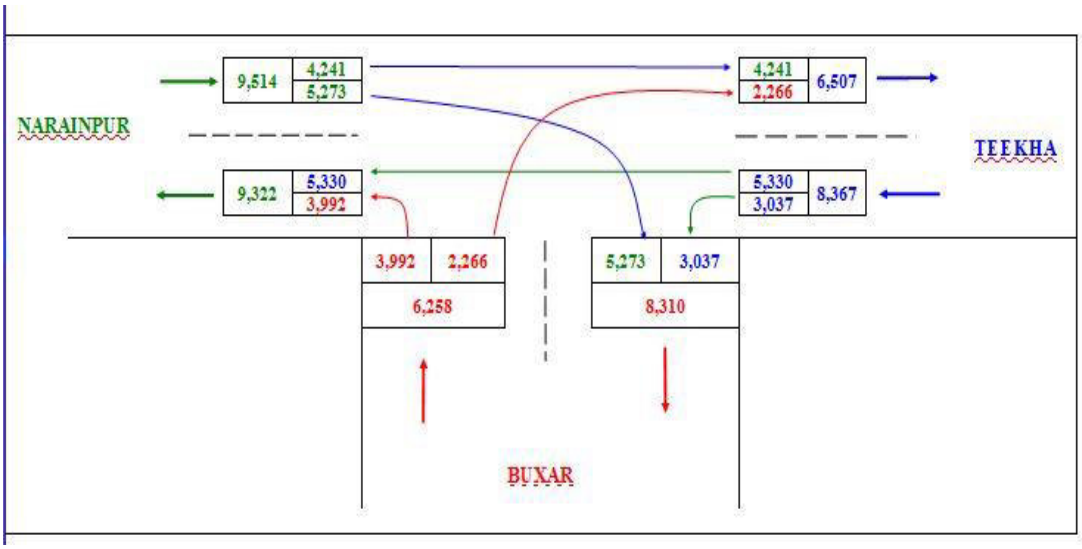


Fig: 8.10 Turning movements @Km. 451.200

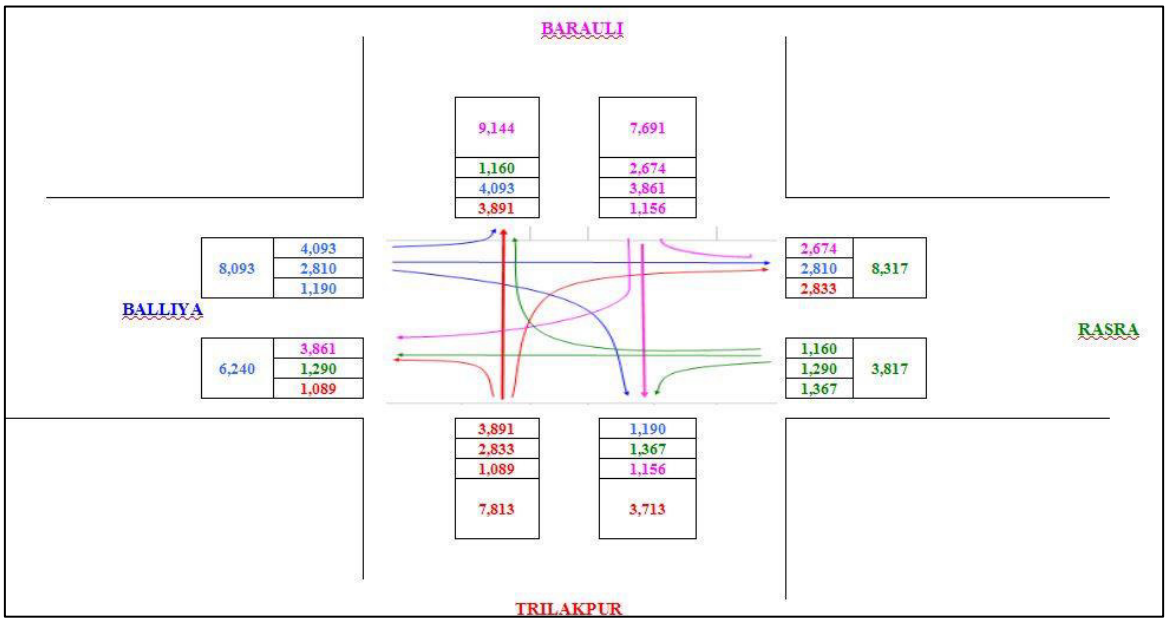


Fig: 8.12 Turning movements @ Km. 473.400

8.6 TRAFFIC FORECAST

For forecasting the traffic in future, it is essential to estimate different components of traffic *viz*., normal traffic, induced traffic, diverted traffic and developmental traffic.

Normal Traffic: Normal traffic is that traffic which would pass along the proposed highway. The growth of traffic is normally estimated based on past and envisaged future growth trend of traffic around the project influence area. However, as the proposed stretch is a green field project, this component of traffic on project stretch is considered as nil and can be ignored.

Generated Traffic: Generated traffic is defined as auxiliary traffic that occurs in response to the road investment. The proposed expressway will attract trips from other routes, modes and encourages longer and frequent travel. This additional traffic volumes likely to be generated on project stretch after its inaugural is known as Generated Traffic. It is classified into Induced traffic and Diverted traffic.

Diverted Traffic: Diverted traffic is the proportion of traffic on existing road network, around the project influence area, which tends to make a shift in route as well as mode to the proposed stretch. As the project stretch provides more attractive options to commuters along the existing roads in the form of reduced travel distance, reduced travel time, savings in vehicle operating costs, savings in toll and value of time, significant segment of traffic opts to ply on proposed stretch. This component of attracted traffic is considered as Diverted traffic which can be both positive and negative.

Induced Traffic: Provision of proposed stretch will reduce the travel time of commuters. This further increases their frequency of travel and total vehicle-kilometers. Considerable proportion of diverted traffic on project stretch tends to make more trips on stretch which increases the total traffic volume. This component is treated as Induced traffic.

Developmental Traffic: Provision of a greenfield stretch provides immense opportunities for development of influential areas. Development is augmented by investment in various sectors like industrial, commercial, real estate, tourism etc. This in turn generates notable quantity of traffic volume which is often termed as Developmental traffic. Such component contributes significantly to the future traffic volumes along the project corridor.

"The projected traffic on project stretch is arrived by summing up the different components of traffic as discussed above giving due diligence to future investments and respective developments for different time horizons"

8.7 TRAFFIC FORECAST

8.7.1 METHODOLOGY

The past motor vehicle registration data at the state level provides a valuable indication regarding the trends in the traffic growth and presents a dependable tool for estimating future growth rates in different categories of vehicles. A more rational method will be to establish a relationship between the socio-economic variables such as Population, Net State Domestic Product (NSDP) and Per-Capita Income (PCI) on the one hand and the past registration data of different categories of vehicles on the other to determine the elasticity of transport demand with respect to different categories of vehicles. According to IRC: 108 - 2015, an econometric model could be derived in the form:

$$\mathbf{Log_e P = A_0 + A_1 Log_e (E.I)}$$

Where:

P = number of vehicles of any particular category;

E.I = Economic Indicator such as NSDP, Per-capita income or Population;

A_0 = Constant;

A_1 = Regression coefficient (Elasticity value).

Based on future economic growth prospects in terms of income growth, per-capita growth and population growth, the future traffic growth rate by vehicle type are estimated by suitably adjusting the elasticity values.

8.7.2 SECONDARY DATA COLLECTION

The analysed traffic data from the primary surveys and processed data from secondary sources pertaining to the project stretch together provide basic input for design, future projection of traffic. It is observed from the number plate data, that Maharashtra state registered vehicles constitute majority of the vehicles, following secondary information like statistical data, economic indicators and vehicle registration data (past traffic data) of Uttar Pradesh has been collected as shown in *Tables – 8.17*.

Table–8.17: Vehicle registration & Economic Indicators

	Rationalised Vehicle Registration Data (Based on the Regression analysis)							Growth Rate of Economic Indicators for Uttar Pradesh			
S.No.	Year	2W	3W	Car	Bus	Goods	Tractor	GSDP	PCI	Population	NSDP
1	2007	-	-	-	-	-	-	-	-	-	-
2	2008	11%	11%	11%	2%	12%	7%	6.99	5.63	1.79	7.60
3	2009	10%	10%	10%	2%	10%	7%	6.58	4.31	1.76	6.22
4	2010	9%	9%	9%	2%	9%	6%	7.86	6.09	1.73	7.99

5	2011	8%	8%	8%	2%	9%	6%	5.58	3.60	1.70	5.41
6	2012	8%	8%	7%	2%	8%	6%	5.78	3.45	1.67	5.22
7	2013	7%	7%	7%	2%	7%	5%	4.95	3.21	1.65	4.96
Average yearly growth rate (%)		**8.9%**	**8.6%**	**8.5%**	**2.3%**	**9.2%**	**6.3%**	**6.29%**	**4.38%**	**1.72%**	**6.23%**

8.7.3 TRAFFIC GROWTH RATE

The most important parameter, on which the future forecast of traffic depends, is the Growth rate. However, for a small stretch where most of the traffic neither originates nor ends within the stretch, growth potential of the origin and destination (Zone of Influence) need to be assessed to arrive at the growth potential of the stretch. It is ideal to identify future growth potential of each zone for goods and passenger movements and for each category of vehicles separately.

8.7.4 ESTIMATION OF GROWTH RATES

To arrive at a realistic and rational assessment of growth factor, efforts have been made to collect various secondary data and statistical information. The growth factor derived from past traffic data on the stretch supplemented by registration trend and the statistical parameters would have been the ideal method. However, due to irregular, erratic and insufficient past traffic data available, the derivation of elasticity and growth factors was based on registration data of vehicles and the economic parameters.

The growth trend has been derived for the following categories of vehicles:

Pv = Passenger Vehicles (Car, jeep, Taxi, Van, etc.)

T = Trucks (Mini LCV, LCV, 2 Axle, 3 Axle and M Axle)

B = Bus, Minibus

The following steps have been adopted to derive the elasticity and growth factors

- Growth rate of registered vehicles in zone of influence is found out.
- Growth rates of NSDP/GSDP, Per Capita Income and population are obtained.
- For passenger vehicles and buses, number of registered vehicles has been regressed with population data of the state.
- For trucks, number of registered trucks has been regressed with NSDP of the state for intra-state movement and GDP for inter-state movement.

- Mean value of average growth rate of registered vehicles and the growth rate obtained by regression analysis for all categories have been found out at state level for trucks.
- For passenger vehicles and buses, the mean growth rate of registered vehicular growth rate and that from regression analysis have been adopted.

The projected growth rates for different category of vehicles for revenue calculations are presented in *Table-8.18*, as shown below and the detailed calculations are given in ***Annexure-VI.***

Table–8.18: Projected Growth Rates

Projected Growth Rates in UP								
S.No.	**Period**	**2W**	**3W**	**Car**	**Car (Y)**	**Goods**	**Bus**	**Mini Bus**
1	2017-2019	6.00%	6.00%	6.00%	6.00%	7.00%	5.00%	5.00%
2	2019-2024	5.50%	5.50%	5.50%	5.50%	6.50%	4.50%	4.50%
3	2024-2029	5.00%	5.00%	5.00%	5.00%	6.00%	4.00%	4.00%
4	2029-2034	4.50%	4.50%	4.50%	4.50%	5.50%	3.50%	3.50%
5	2034-2039	4.00%	4.00%	4.00%	4.00%	5.00%	3.00%	3.00%
6	>2039	3.50%	3.50%	3.50%	3.50%	4.50%	2.50%	2.50%

The Consultants took into consideration the past growth of vehicular registration data, existing traffic scenario and various growth indices with respect to socio-economic development of project region. Based on the future developmental prospects of project region and as per the codal standards growth rate for all vehicle types, Consultants recommend a realistic uniform growth rate of 5% across all vehicle modes as shown in *Table 8.19*.

Table–8.19: Adopted Growth Rates

Adopted Growth Rates								
S.No.	**Period**	**2W**	**3W**	**Car**	**Car (Y)**	**Goods**	**Bus**	**Minibus**
1	2017-2019	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
2	2019-2024	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
3	2024-2029	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
4	2029-2034	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
5	2034-2039	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
6	>2039	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%

8.8 FORECASTED TRAFFIC

The proposed project stretch is assumed to commence its operations from year 2022. Total traffic expected on the project stretch is arrived as the summation of diverted traffic, induced traffic and developmental traffic. The growth rates suggested in ***Table-8.18 & 8.19*** have been considered in calculating the forecasted traffic volume. ***Table-8.21*** provides the section-wise forecasted traffic till the year 2050.

8.8.1 Traffic Assignment

It is assumed that traffic on existing roads will be diverted to greenfield stretch, hence total traffic plying on existing stretch is assumed to be diverted on proposed stretch. However, Traffic from Purvanchal Expressway is expected to divert on to project stretch. The proportion of traffic expected to use proposed stretch is as given below.

Table–8.20: Assigned Traffic

Vehicle Type	Percentage of Traffic Expected to use Project Stretch (%)	Traffic at km 419+000	Assigned Traffic onto project Stretch
2W	20	7550	9060
3W	20	623	747
Car	20	1544	1851
Bus	20	115	138
Minibus	20	0	0
Tata Magic	20	8	10
LCV	20	90	109
Mini LCV	20	376	457
2 Axle	20	137	165
3 Axle	20	367	441
Multi Axle	20	429	515

8.9 CAPACITY AND LOS ANALYSIS

The Capacity of a facility is defined as the maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point or uniform section of the lane or roadway during a given time period under prevailing roadway, traffic and control conditions. By comparing the present traffic volume with the capacity of existing highways, their adequacy or deficiency can be assessed. Improvements and changes in the geometric features, junction features, traffic control devices and traffic management measures can be planned if capacity studies are considered.

The Highway Capacity Manual has introduced the concept of "Level of Service" to denote the level of facility one can derive from a road under different operating conditions and traffic volumes. It is defined as a qualitative measure describing the operational conditions within a traffic stream and their perception by motorists. The level of service for urban and suburban roads can be related to the flow conditions, average overall travel speed, load factor at intersections, peak hour factor and service volume to capacity ratio. National and State Highways in rural areas are normally designed for LOS B giving a design service volume of 40000 PCUs per day for 4 lane divided carriageway and 60000 PCUs per day for 6 lane divided carriageway based on level of service criteria with a V/C ratio less than 0.5. If we go for V/C ratio criteria, we can go up to LOS C with V/C ratio of up to 0.7.

Further, the Ministry has recently decided to take up 4-laning once the traffic is beyond 10,000 PCU’s per day.

Table–8.21: Projected Traffic at Km 419.000, Sultanpur

Year	PASSENGER TRAFFIC									GOODS TRAFFIC									NON-MOTORIZED			Total Traffic volume in numbers	Total tollable traffic volume in numbers	Total Traffic in PCU's	Tollable Traffic in PCU's	V/C Ratio	Recommendation based on V/C ratio
	2W	3W	Car / Jeep	Car Yellow Board	Tata Magic	RTC Bus	Private Bus	Minibus	School	2 Axle	3 Axle	Multi Axle	Oversized	LGV/ LCV	Mini LCV	Tractor	Tractor with trailer/ Others	3W GOODS	Cycle	Cycle Rickshaw	Animal Drawn						
2020	9177	757	1821	56	10	72	67	0	1	167	446	517	5	109	457	16	15	0	1198	7	8	14951	3727	13303	7111	0.17	4-lane
2021	9636	795	1912	59	10	75	70	0	1	175	468	542	5	115	480	16	15	0	1210	7	8	15649	3913	13939	7467	0.17	4-lane
2022	10118	835	2007	62	11	79	74	0	1	184	492	570	5	121	504	17	16	0	1222	7	8	16382	4109	14607	7840	0.18	4-lane
2023	10624	877	2108	65	11	83	77	0	1	193	516	598	6	127	529	17	16	0	1234	8	9	17151	4314	15308	8232	0.19	4-lane
2024	11155	920	2213	68	12	87	81	0	1	202	542	628	6	133	556	18	16	0	1246	8	9	17958	4530	16043	8644	0.20	4-lane
2025	11713	966	2324	71	12	92	85	0	2	213	569	659	6	140	583	18	17	0	1259	8	9	18805	4756	16815	9076	0.21	4-lane
2026	12298	1015	2440	75	13	96	90	0	2	223	598	692	7	147	612	19	17	0	1271	8	9	19693	4994	17625	9530	0.22	4-lane
2027	12913	1066	2562	79	14	101	94	0	2	234	628	727	7	154	643	19	18	0	1284	8	9	20626	5244	18475	10006	0.23	4-lane
2028	13559	1119	2690	83	14	106	99	0	2	246	659	763	7	162	675	20	19	0	1297	8	9	21604	5506	19368	10507	0.24	4-lane
2029	14237	1175	2825	87	15	111	104	0	2	258	692	801	8	170	709	21	19	0	1310	8	9	22631	5781	20304	11032	0.25	4-lane
2030	14948	1233	2966	91	16	117	109	0	2	271	727	841	8	178	744	21	20	0	1323	8	9	23709	6070	21287	11584	0.27	4-lane
2031	15696	1295	3114	96	17	123	114	0	2	285	763	884	8	187	782	22	20	0	1336	8	9	24840	6374	22319	12163	0.28	4-lane
2032	16481	1360	3270	100	17	129	120	0	2	299	801	928	9	196	821	22	21	0	1350	8	9	26027	6693	23403	12771	0.29	4-lane
2033	17305	1428	3433	105	18	135	126	0	2	314	841	974	9	206	862	23	21	0	1363	8	9	27273	7027	24539	13409	0.31	4-lane
2034	18170	1499	3605	111	19	142	132	0	2	330	883	1023	10	217	905	24	22	0	1377	8	10	28580	7379	25733	14080	0.32	4-lane
2035	19078	1574	3785	116	20	149	139	0	3	346	927	1074	10	227	950	25	23	0	1391	8	10	29952	7748	26986	14784	0.34	4-lane
2036	20032	1653	3975	122	21	157	146	0	3	364	974	1128	11	239	998	25	23	0	1404	9	10	31393	8135	28300	15523	0.35	4-lane
2037	21034	1736	4173	128	22	164	153	0	3	382	1022	1184	11	251	1048	26	24	0	1418	9	10	32904	8542	29681	16299	0.37	4-lane
2038	22086	1822	4382	135	23	173	161	0	3	401	1074	1243	12	263	1100	27	25	0	1433	9	10	34491	8969	31130	17114	0.39	4-lane
2039	23190	1914	4601	141	25	181	169	0	3	421	1127	1305	12	276	1155	28	26	0	1447	9	10	36157	9417	32650	17970	0.41	4-lane
2040	24350	2009	4831	148	26	190	177	0	3	442	1184	1371	13	290	1213	28	26	0	1461	9	10	37905	9888	34247	18868	0.43	4-lane

Year	PASSENGER TRAFFIC									GOODS TRAFFIC									NON-MOTORIZED			Total Traffic volume in numbers	Total tollable traffic volume in numbers	Total Traffic in PCU's	Tollable Traffic in PCU's	V/C Ratio	Recommendation based on V/C ratio
	2W	3W	Car / Jeep	Car Yellow Board	Tata Magic	RTC Bus	Private Bus	Minibus	School	2 Axle	3 Axle	Multi Axle	Over sized	LGV/ LCV	Mini LCV	Tractor	Tractor with trailer/ Others	3W GOODS	Cycle	Cycle Rickshaw	Animal Drawn						
2041	25567	2110	5073	156	27	200	186	0	3	464	1243	1439	14	305	1273	29	27	0	1476	9	10	39740	10383	35923	19812	0.45	4-lane
2042	26845	2215	5326	164	28	210	196	0	4	487	1305	1511	14	320	1337	30	28	0	1491	9	10	41666	10902	37682	20802	0.47	4-lane
2043	28188	2326	5593	172	30	220	205	0	4	511	1370	1587	15	336	1404	31	29	0	1506	9	10	43688	11447	39529	21843	0.49	4-lane
2044	29597	2442	5872	180	31	231	216	0	4	537	1439	1666	16	353	1474	32	30	0	1521	9	11	45810	12019	41468	22935	0.35	6-lane
2045	31077	2564	6166	189	33	243	226	0	4	564	1511	1749	16	370	1548	33	31	0	1536	9	11	48037	12620	43503	24081	0.36	6-lane
2046	32631	2693	6474	199	35	255	238	0	4	592	1586	1837	17	389	1625	34	32	0	1551	9	11	50376	13251	45639	25286	0.38	6-lane
2047	34262	2827	6798	209	36	268	250	0	5	622	1665	1929	18	408	1706	35	33	0	1567	10	11	52830	13914	47882	26550	0.40	6-lane
2048	35975	2969	7138	219	38	281	262	0	5	653	1749	2025	19	429	1792	36	33	0	1583	10	11	55407	14609	50237	27877	0.42	6-lane
2049	37774	3117	7495	230	40	295	275	0	5	685	1836	2126	20	450	1881	37	34	0	1598	10	11	58112	15340	52709	29271	0.44	6-lane
2050	39663	3273	7870	242	42	310	289	0	5	720	1928	2233	21	473	1975	38	36	0	1614	10	11	60951	16107	55304	30735	0.46	6-lane

9. PAVEMENT DESIGN

9.1 Introduction

The design of pavement i.e., calculating the total crust thickness depends on mainly two factors Viz. total cumulative repetitions of standard axle loads for the design life and the strength of sub-grade soils (CBR).

The total cumulative repetitions of standard axles is in turn, a function of the annual average daily traffic (AADT) and applicable growth rate (r) of vehicles for forecasting the traffic after a certain period and Vehicle Damage Factor (VDF) for converting the mixed volume of traffic in terms of standard axle load repetitions. Further, lane distribution factor is applied to account for the vehicle load distribution across the width of pavement depending on the available carriageway width.

9.2 Pavement Design Objective

The Objective is to determine the total thickness of the pavement structure as well as thickness of individual structural layer components. Design strength of pavement must be adequate to support the projected traffic loading throughout the design period.

9.3 Design Guidelines

a) Clause 5.3 of "Manual of Specifications and Standards for Two laning of Highways through Public Private Partnership by – IRC:SP:84-2019" states that "new pavements shall be designed in accordance with IRC:37(flexible) and rigid pavements shall be designed in accordance with the method prescribed in IRC:58". Strengthening of existing pavement shall be determined based on FWD method (IRC: 115-2014) and the design traffic as per the relevant code of IRC.

b) Clause 5.4.1 of IRC: SP:84-2019, states that "Flexible pavement shall be designed for a minimum design period of 15 years or operation period, whichever is more. Stage construction shall not be permitted.

It is a common phenomenon in Indian Roads that the road requires a functional overlay every 5 years, even if the pavement is designed for 15 years.

c) Clause 5.4.2 of IRC: SP:84-2019, states:

i) Rigid pavement shall be designed for a minimum design period of 30 years. The stage construction shall not be permitted.

ii) The Pavement Quality Concrete (PQC) shall rest over Dry Lean Concrete (DLC)

sub-base of 150mm thickness.

iii) A separation membrane shall be used between the PQC and DLC as per clause 602.5 of MORTH Specifications.

iv) The DLC shall meet the minimum cement and compressive strength requirement as prescribed in IRC: SP: 49. The DLC shall extend beyond the PQC by 0.75 m on either side.

v) Below DLC layer, a properly designed drainage layer GSB of 150 mm thickness shall be provided throughout the road width. It shall be designed to obtain a drainage coefficient of not less than 30 m per day.

9.4 PRELIMINARY INVESTIGATIONS

9.4.1 Pavement Investigation

The design consultants have undertaken the following pavement investigations to assess the condition of the existing pavement along with the quality of the materials that have been incorporated in construction. Pavement has been investigated subjectively as well as objectively at suitable interval where necessary, for its structural and functional performance. Following investigations were carried out for the project stretch.

- Condition survey by visual inspection
- Test Pit investigations
- Geotechnical investigation of subgrade
- Benkelman Beam Deflection Test

9.4.2 Visual Condition Survey

Visual condition survey was conducted to identify the surface defects namely cracks, rut depth etc to classify the pavement in terms of its surface condition as per IRC-81. The results of the condition survey is presented separately in Road Inventory and Condition Report. However, the criteria followed the summary of the project stretches is presented below. Basically rut depth and % cracks criteria is as per IRC-81 and the roughness criteria is as per IRC-SP-30.

Pavement Condition	Roughness (mm/km)	Rut depth (mm/km)	Cracks (%)
Excellent	< 2000	< 0	0
Good	2000 to 2500	0 to 10	0
Fair/Average	2500 to 3500	10 to 20	<20

Pavement Condition	Roughness (mm/km)	Rut depth (mm/km)	Cracks (%)
Poor	3500 to 4000	>20	>20
Very poor/Reconstruction	> 4000		

Finally, it was observed that the pavement in the entire project is varies from good to fair condition. The condition of the pavement and the percentages of different distresses has been presented below.

Table-9.1: Pavement Condition of the Project stretch

Pavement Condition	Percentage of Road Length
Good	59.23
Fair	11.74
Poor	29.03
Very Poor	0.00

9.4.3 Existing Pavement Composition

Test pits were dug at the junction of pavement and shoulder at every 1.0 km interval for in-situ testing of sub grade materials and recording pavement composition. The average thickness of the pavement layers as observed at site is given below:

Table-9.2: Existing Pavement Crust Composition (mm)

S. No	Chainage (Km)	Side	Thickness Of BT(BC+DBM)	Granular Base Layer (WMM/WBM)	Subbase (GSB/ Boulders)	Total
1	523.000	RHS	120	250	100	470
2	524.000	LHS	120	250	100	470
3	525.000	RHS	150	300	100	550
4	526.000	LHS	150	300	100	550
5	527.000	RHS	150	300	100	550
6	528.000	LHS	-			*376
7	529.000	RHS	150	300	100	550
8	530.000	LHS	150	300	100	550
9	531.000	RHS	150	300	100	550
10	532.000	LHS	150	300	100	550

Note: *As per the inventory data by E.E NH Division-PWD, Ghazipur

9.4.4 Soil Investigations

a) Soil Classification:

The sub-grade soil along the project corridor generally consists of clayey sand, silty

sand and inorganic clays.

b) CBR of Subgrade soils:

Soaked and un soaked CBR tests were conducted at FDD & NMC on all the sub grade soil samples taken from each test pit. It was observed that the soaked CBR varies from 2.0% to 18.0% and unsoaked CBR varies from 4.0% to 28.0%. Following table presents the detail of sub-grade.

Table-9.3: Existing Pavement Sub-grade CBR

S.No.	Chainage (Km)	Side	Grain Size Analysis (%)					IS Classification	Atterberg Limits			FSI (%)	Core Cutter		Soaked CBR (%)
			Gravel	Coarse Sand	Medium Sand	Fine sand	Fines		LL %	PL %	PI %		FDD (g/cc)	NMC (%)	
1	523+000	RHS	0.5	0.4	0.9	89.0	9.2	SP-SM	NP	NP	NP	0	1.62	1.69	12
2	524+000	LHS	1.7	1.2	1.7	26.7	68.7	ML	NP	NP	NP	0	1.57	5.81	3
3	525+000	RHS	3.2	1.3	3.4	15.5	76.6	CI	35	16	19	30	1.65	14.63	5
4	526+000	LHS	1.7	0.4	0.9	11.0	86.0	CL	33	18	15	20	1.83	7.96	9
5	527+000	RHS	1.5	0.4	0.5	14.5	83.1	CI	35	15	20	30	1.74	12.91	8
6	529+000	LHS	2.4	0.6	1.0	34.4	61.6	CL	25	17	8	10	1.62	5.04	4
7	530+000	RHS	0.8	0.3	0.6	66.8	31.5	SM	NP	NP	NP	0	1.67	3.41	10
8	531+000	LHS	1.5	0.8	0.9	59.2	37.6	SM	NP	NP	NP	0	1.70	3.55	11
9	532+000	RHS	5.1	1.9	2.7	39.2	51.1	ML	NP	NP	NP	10	1.71	4.16	6

c) CBR of Borrow area soils:

Soaked CBR tests were conducted at MDD and OMC on the samples collected from borrow areas. It was observed that the soaked CBR varies from 4% to 20%. The following table presents the detail of borrow material.

Some of the borrow areas fall under the category of CH, satisfies the requirements of Clause 305 of Section 300 but fails to meet the density requirements as per Table 300-1 of MORT&H and hence the same shall not be used as Subgrade material.

S.No	Type of work	Maximum Laboratory dry unit weight when tested as per IS: 2720(Part 8)
1	Embankments up to 3metres height, not subjected to extensive flooding	Not less than 15.2 kN/cu.m
2	Embankments exceeding 3 metres height or embankments of any height subject to long periods of inundation	Not less than 16.0 kN/cu.m
3	Subgrade and earthen shoulders/verges/backfill	Not less than 17.5 kN/cu.m

Table-9.4: Test results of Borrow Area

S.No.	Chainage	Side	Grain Size Analysis					IS Classification	Atterberg Limits			FSI (%)	Soaked CBR (%)
			Gravel	Coarse Sand	Medium Sand	Fine sand	Fines		LL %	PL %	PI %		
1	51+800	RHS	0.60	0.30	0.32	54.70	44.10	SM	NP	NP	NP	0	12
2	51+800	RHS	0.00	0.00	0.17	6.40	93.40	CI	35	23	12	60	12
3	34+800	RHS	0.00	0.00	0.13	2.00	97.90	CL	34	20	14	0	12
4	51+800	RHS	0.00	0.00	1.25	6.60	92.10	CL	33	18	15	24	12
5	51+800	RHS	0.00	0.00	0.13	1.60	98.30	CI	35	23	12	0	9
6	51+800	RHS	0.00	0.00	0.00	0.40	99.60	CH	52	22	30	9	4
7	51+800	RHS	0.00	0.00	0.08	30.70	69.20	CL	28	16	12	0	13
8	51+800	RHS	0.50	0.40	0.76	6.00	92.30	CI	42	20	22	9	9
9	51+800	RHS	0.30	0.10	0.32	49.60	49.70	SC	28	16	12	0	20
10	51+800	RHS	0.50	0.30	1.86	41.30	56.00	CI	43	21	22	9	10
11	51+800	RHS	0.00	0.00	0.04	19.50	80.50	ML	NP	NP	NP	9	9
12	48+400	LHS	0.70	1.10	1.84	14.70	81.70	CL	32	18	14	0	11
13	48+400	LHS	0.00	0.40	1.13	4.50	94.00	CL	30	16	14	0	11
14	50+500	LHS	1.50	0.90	1.11	8.60	87.90	CL	32	17	15	9	11
15	23+800	RHS	1.30	2.60	2.68	4.60	88.80	CI	38	18	20	9	11
16	8+900	RHS	0.00	0.00	0.10	5.90	94.00	CL	33	20	13	0	16
17	18+500	RHS	0.00	0.00	0.25	1.00	98.70	CI	43	20	23	0	7
18	23+800	RHS	0.30	0.70	0.80	11.40	86.80	CL	30	17	13	10	11
19	51+800	LHS	0.80	2.80	2.78	6.50	87.10	CI	38	16	22	8	10

S.No.	Chainage	Side	Grain Size Analysis					IS Classification	Atterberg Limits			FSI (%)	Soaked CBR (%)
			Gravel	Coarse Sand	Medium Sand	Fine sand	Fines		LL %	PL %	PI %		
20	64+300	LHS	0.00	0.30	0.24	3.20	96.30	CL	30	20	10	0	10
21	64+300	LHS	0.00	0.00	0.00	28.70	71.30	ML	NP	NP	NP	0	11
22	64+300	LHS	0.00	0.40	0.72	2.10	96.80	CI	41	19	22	8	7
23	64+300	LHS	0.00	0.60	0.76	8.90	89.70	CL	29	18	11	0	10
24	70+600	LHS	0.00	0.00	0.00	0.80	99.20	CI	44	21	23	30	5
25	72+900	LHS	0.00	0.10	0.33	20.70	78.90	CL	32	18	14	10	10
26	74+200	RHS	0.00	0.00	0.33	7.60	92.10	ML	NP	NP	NP	0	7
27	97+500	RHS	0.00	0.00	0.60	13.80	85.60	CL	34	18	16	9	10
28	109+700	LHS	0.20	0.10	0.45	24.60	74.70	ML	NP	NP	NP	0	12

d) Design CBR:

The CBR of borrow material is varying from 4 to 20%. Considering the fact that the contractor executing the works may opt for alternative sources than studied here-in, a lower value of 10% is adopted in the pavement design.

9.4.5 Benkelman Beam Deflection Survey

Benkelman Beam deflection survey is carried out for evaluating residual strength of the existing pavement and assessing the strengthening requirements for the pavement. BBD test have been conducted as per C.G.R.A method described in IRC: 81-1997.

Since the existing highway is of two-lane carriageway, it was assumed that each of the km stretch as homogeneous section and decided to have BBD deflection measurements at 20 observation points for every km length of the stretch. For better understanding of the pavement structural strength, BBD test was conducted such that, 10 observations were taken on LHS and the remaining 10 observations were taken on RHS of the carriageway in staggered manner. However, the stretches showing distress with excessive rutting, potholes and ravelling were identified and rejected for BBD test as they do not reflect the correct deflection values. Two teams with complete set of equipment and accessories were engaged to take the deflection observations all along the project stretch. Following procedure was adopted during the test as per IRC:81.

Marking for BBD Test

(i) BBD observation points were marked at a distance of 0.9 m from BT edge (pavement edge).

(ii) Two more similar points were taken at distances of 2.7 m and 9.0 m longitudinally from the first point at same transverse distance of 0.9 m from pavement edge and marked with paint. The three points thus marked became a set of points for one observation location.

(iii) The process of marking set of three points at an interval of 50 m for 10 observation points along the LHS and 10 observation points along the RHS along the project stretch is repeated.

After marking the deflection observation points the studies shall be carried out in the following steps:

- The truck is loaded with a rear axle load of 8170 kg and the rear dual tyre is set to inflation pressure of 5.6 kg/cm^2
- The truck was slowly driven parallel to the edge and stopped such that the left side rear dual wheel is centrally placed over the first point for deflection measurement.
- The probe end of the Benkelman Beam is inserted between the gap of dual wheel and placed exactly over the deflection observation point, ensuring that the probe touches the pavement surface.
- The initial dial gauge reading (Do) is noted when the dial gauge reading is stationary (or) when the rate of change of pavement deflection is less than 0.025 mm per minute. Both the needles of dial gauge are set to zero-zero before fitting it to BBD instrument and locked. The readings of both the needles of dial gauge and noted down in specified format. (The least count of the large needle is 0.01 mm and that of small needle is 1.0 mm)
- After taking initial reading, the truck is moved forward slowly through a distance of 2.7 m from the point and stopped.
- When the rate of recovery of pavement is less than 0.025 mm per minute the intermediate dial gauge reading (Di) is noted down.
- The truck is drived forward through a further distance of 9.0 m and the final dial gauge reading (D_f) is noted down, when the rate of recovery of the pavement is less than 0.025 mm per minute.
- The three deflection dial readings D_o, D_i and D_f forms a set of readings at one deflection point under consideration.
- Similarly the truck is moved forward to the next deflection observation point, such that insertion of the probe of Benkelman Beam and procedure of noting the set of three deflection observations shall be exactly the same as explained above and repeated the same procedure at all deflection observation points.
- The temperature of pavement surface is also recorded with the help of thermometer by making a hole of 10-mm diameter, 45 mm deep in existing B.T surface filled with Glycerol.
- Variability of deflections in a given section was considered for detecting spots where extra deflection measurements have been made. For this

purpose, highest and lowest values in a group of ten was compared with mean value. Wherever the highest or lowest values differ from the mean by more than one third of the mean then extra deflection measurements were made at 25m on either side of point where high or low values are observed.

Corrections and Analysis

Following corrections were applied to the BBD test observations during its analysis:

1. The pavement temperature and seasonal variation in climate influence the deflections measured by the Benkelman Beam.
2. Pavement temperature is recorded once for every hour by inserting a thermometer in a hole approximately 45 mm deep and 10 mm diameter filled with glycerol drilled in the pavement. Correction shall be applied to the deflection measured in accordance with the procedure described in IRC: 81-1997, if the observed temperature is different from 35^0C.
3. Seasonal correction was also applied using the moisture correction factors for different type of soils given in IRC: 81-1997. PI and field moisture content of the subgrade are established from test pits excavated simultaneously along with the BBD tests.
4. The mean and standard deviation for ten consecutive points in each section was computed after applying temperature and seasonal variation corrections. Finally, the characteristic deflections were determined as follows:

Characteristic Deflection = Mean deflection + 2 x Standard Deviation

Delineation of Homogeneous Sections:

The delineation of homogenous sections was completed using the characteristic deflection values. In this approach, the characteristic deflection data for each one-kilometer length of the project were used to conduct the "cumulative difference approach" analysis. Using this approach, which is outlined in the American Association of State Highway and Transportation Officials (AASHTO) Pavement Design Guide Appendix J (Analysis Unit Delineation by Cumulative Differences), the road was divided into various homogenous sections. The deflections values in each homogenous section were then pooled and the characteristic deflection calculated. This value was designated as the representative characteristic deflection for that homogenous pavement section.

This method is a relatively powerful & analytical one, when the nature of the measurements involves delineating homogeneous units with different mean value levels. The suggested approach provides as advantage in delineating scattered characteristics and shows a high level of efficiency as evidenced by practical applications. The results presented are expected to serve as a basis for enhancing quality control criteria in the construction, as well as in the maintenance stage.

By using the calculated Characteristics Deflection in the Cumulative Difference method, the entire project road is divided into homogeneous section and detailed calculations are provided in **Appendix-9.2**.

Table-9.5: Homogeneous Sections (Km)

S.No.	Existing Ch. From(km)	Existing Ch. To(km)	Length	Characteristic Deflections (mm)
1	523.800	535.000	11.200	1.55
Total Length (km)			**11.200**	

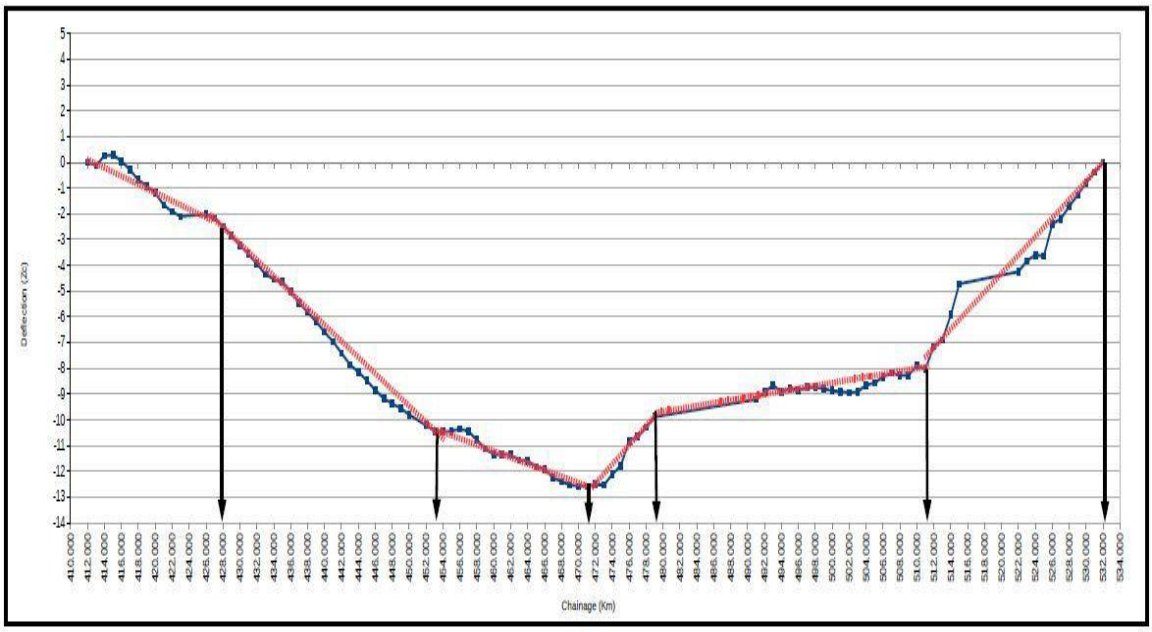


Figure-8.1: Homogeneous Sections based on BBD Test

9.5 Traffic Surveys

The classified Traffic Volume Count (TVC) Survey in each direction have been carried out at 3 locations, i.e. at Km. 476.000, Km. 483.000 & Km. 526.000 by trained personnel, round the clock for 7 days and 3 days @Km. 483.000.

Axle Load surveys have been conducted at 2 locations for package-2 namely at Km.

476.000 & Km. 526.000 for 24 hours. Further secondary economic data such as population, Net State Domestic Product (NSDP) and Per Capita Income (PCI) was used along with vehicle registration data to infer likely growth rates.

IRC:SP:84-2019 states that a minimum of 5% growth rate to be adopted for pavement design. So the calculations were made taking the growth rates inferred subject to a minimum value of 5%. However, Terms of Reference (TOR) stated the use of a uniform growth rate of 5%. So design is done based on both the inferred as well as uniform growth rates. Following Tables shows the various inputs that are considered for pavement design.

9.5.1 Base Year Traffic (AADT)

For the purpose of the pavement design, commercial vehicles of laden weight more than 3 tonnes has been considered. Such vehicles consisted of Buses, LCV's, 2 Axle trucks, 3 Axle trucks and Multi Axle Trucks. The summary of AADT of commercial vehicles considered for pavement design is given below.

Table 9.6: Annual Average Daily Traffic (AADT base year 2020)

Vehicle Type	Km419.000 Sultanpur	Km 526.000 Ibrahimbagh
Bus	114	72
2 Axle Truck	137	162
3 Axle Truck	367	285
Multi Axle Truck	428	301
LCV & Minibus	90	103
Tractor with Trailers	13	13
Total	**1149**	**936**

9.5.2 Axle Load Surveys

The Vehicle Damage Factor (VDF) is an index characterizing the traffic loading for a highway and is defined as a multiplier for converting the number of commercial vehicles of different axle loads to Standard Axle Loads (SAL). Equivalency Factor (EF) is normally worked out by using the Fourth Power Rule derived by AASHTO. With the help of equivalency factors and frequency distribution of axle loads, Equivalent Axle Loads (EAL) are computed as:

VDF = Total EAL/Number of Vehicles weighed.

The standard axle loads, and the legal axle loads considered while calculating the equivalency factors for various axles are furnished below.

S. No.	Type of Axles	Standard Load (KN)	Legal Load (KN)
1	Single Axle (Single Wheel)	65	66
2	Single Axle (Dual Wheel)	80	102
3	Tandem Axle (Dual Wheel)	148	190
4	Tridem Axle (Dual Wheel)	224	240

Axle load surveys were conducted for package-2 at Km. 476.000 & Km. 526.000. This survey was conducted for 1 normal day in both directions of traffic simultaneously with volume count of commercial vehicles (Trucks and LCV). The random selection of vehicles for axle load measurement was done, ensuring suitable sample for each category of commercial vehicles consisting of overloaded and empty vehicles. The distribution of sample by commodity type is presented below.

Table – 9.7 (a): Distribution of Sample by Commodity at Km 419.000

Code	Commodity	2 AT		3 AT		MAT		LCV	
		Towards Ballia	Towards Ghazipur	Towards Ballia	Towards Ghazipur	Towards Ballia	Towards Ghazipur	Towards Ballia	Towards Ghazipur
1	Food grains and pulses	13.04	16.13	11.45	3.70	13.17	8.33	10.81	14.29
2	Cash crops	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	Vegetables and Fruits	0.00	0.00	16.67	0.00	10.53	2.78	2.70	3.90
4	Processed Food Items	0.00	0.00	0.00	1.85	0.00	0.00	0.00	0.00
5	Packed Food Items	0.00	0.00	0.00	0.00	2.63	0.00	2.70	0.00
6	Fishery, Poultry and Animal feed	0.00	0.00	2.08	0.00	7.89	0.00	2.70	0.00
7	Building Materials	0.00	3.23	3.13	2.78	2.63	11.11	2.70	11.69
8	Industrial Raw Materials	0.00	0.00	4.17	0.00	7.89	2.78	2.70	2.60
9	Consumer Goods	17.39	12.90	12.50	4.63	18.42	0.00	8.11	10.38
10	Fertilisers, chemicals, Pharmaceuticals	0.00	0.00	1.04	0.93	5.26	11.11	0.00	0.00
11	Machinery and Automobiles	4.35	3.23	1.04	0.00	0.00	0.00	0.00	0.00
12	Petroleum Products	26.09	0.00	5.21	0.93	5.26	0.00	5.41	0.00

Code	Commodity	2 AT		3 AT		MAT		LCV	
		Towards Ballia	Towards Ghazipur	Towards Ballia	Towards Ghazipur	Towards Ballia	Towards Ghazipur	Towards Ballia	Towards Ghazipur
13	Parcel Goods	4.35	16.12	4.17	12.04	15.79	5.56	18.92	5.19
14	Empty	34.78	45.16	38.54	73.14	10.53	52.77	43.25	49.35
15	Industrial Outputs	0.00	3.23	0.00	0.00	0.00	5.56	0.00	1.30
16	Liquor and Cooldrinks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30
	Total	100	100	100	100	100	100	100	100

Table – 9.7 (b): Distribution of Sample by Commodity at Km 526.000

Code	Commodity	2 AT		3 AT		MAT		LCV	
		Towards Ballia	Towards Manjhi Ghat	Towards Ballia	Towards Manjhi Ghat	Towards Ballia	Towards Manjhi Ghat	Towards Ballia	Towards Manjhi Ghat
1	Food grains and pulses	0.00	8.33	0.88	6.17	1.70	9.35	3.13	0.00
2	Cash crops	0.00	0.00	0.00	1.23	0.85	2.80	1.56	0.00
3	Vegetables and Fruits	9.52	16.67	0.00	25.93	0.00	12.15	6.25	24.14
4	Processed Food Items	0.00	0.00	0.00	0.00	0.00	0.93	1.56	3.45
5	Packed Food Items	0.00	0.00	1.80	0.00	0.00	0.00	3.13	0.00
6	Fishery, Poultry and Animal feed	14.29	0.00	4.42	2.47	0.85	4.67	1.56	3.45
7	Building Materials	19.05	8.33	36.28	4.94	22.88	18.69	4.69	0.00
8	Industrial Raw Materials	14.29	8.33	6.19	0.00	22.03	6.54	0.00	0.00
9	Consumer Goods	4.76	0.00	2.65	18.52	0.00	17.76	10.94	31.02
10	Fertilizers, chemicals, Pharmaceuticals	9.52	0.00	0.88	2.47	0.00	4.67	0.00	3.45
11	Machinery and Automobiles	0.00	0.00	0.00	0.00	0.00	0.00	3.13	6.90
12	Petroleum Products	0.00	0.00	1.77	0.00	0.00	0.93	0.00	3.45
13	Parcel Goods	4.76	25.00	0.88	2.47	0.00	1.87	3.11	6.90
14	Empty	23.81	33.34	44.25	35.80	51.69	19.64	59.38	17.24
15	Industrial Outputs	0.00	0.00	0.00	0.00	0.00	0.00	1.56	0.00

Code	Commodity	2 AT		3 AT		MAT		LCV	
		Towards Ballia	Towards Manjhi Ghat	Towards Ballia	Towards Manjhi Ghat	Towards Ballia	Towards Manjhi Ghat	Towards Ballia	Towards Manjhi Ghat
16	Liquor and Cooldrinks	0.00	0.00	0.00	0.00	0.00	0.00	1.55	0.00
	Total	100	100	100	100	100	100	100	100

The VDF calculated for different categories of commercial vehicles are shown below and the detailed analysis is presented in Traffic Report.

Table 9.8: Vehicle Damage Factor (VDF)

S. No.	Mode	Km 419.000		Km 526.000	
		To Ballia	To Ghazipur	To Ballia	To Ghazipur
1	2 Axle	2.56	3.75	2.11	4.01
2	3 Axle	5.81	5.13	6.20	6.19
3	M axle	11.50	8.52	6.04	10.63
4	LCV	1.28	1.15	0.60	2.68

9.5.3 Traffic Growth Rates

Past trends in the growth rates of traffic intensity along the project corridor provide a valuable clue to the likely future traffic growth rates. But in most cases, the past traffic data from statistical department is inconsistent and cannot be taken as a basis for future traffic growth rate. Alternatively, the motor vehicle registration data at the state level during the recent past provides more consistent information regarding the trends in traffic growth and thus presents a better tool for estimating future growth rates of different categories of vehicles. A more rational method is to establish a relationship between the socio-economic variables such as population, Net State Domestic Product(NDP) and Per-capita income(PCI) on one hand and the past registration data of different categories of vehicles on the other to determine the Elasticity of Transport Demand with respect to different categories of vehicles. The computed traffic growth rates & the adopted growth rate for design are furnished below.

Table 9.9 (a): Computed Traffic Growth Rates (%)

S. No.	Period	Buses	Trucks			
			2 Axle	3 Axle	M Axle	LCV
1	2020-2024	5.00%	7.00%	7.00%	7.00%	7.00%
2	2025-2029	4.50%	6.50%	6.50%	6.50%	6.50%
3	2030-2034	4.00%	6.00%	6.00%	6.00%	6.00%
4	2035-2039	3.50%	5.50%	5.50%	5.50%	5.50%
5	2039-2044	3.00%	5.00%	5.00%	5.00%	5.00%
6	>2044	2.50%	4.50%	4.50%	4.50%	4.50%

The consultant collected and reviewed past vehicle registration data as well other growth indices with respect to socio-economic development of project region. Keeping in view of current traffic scenario, future development prospects of region and as per clause 5.5.4 of IRC: SP:84:2019, the consultant recommends a realistic uniform growth rates of 5% for all modes of vehicles till the end of the concessionaire period.

Table 9.9 (b): Adopted Traffic Growth Rates (%)

S. No.	Period	Buses	Trucks			
			2 Axle	3 Axle	M Axle	LCV
1	2020-2024	5.00%	7.00%	7.00%	7.00%	7.00%
2	2025-2029	5.00%	6.50%	6.50%	6.50%	6.50%
3	2030-2034	5.00%	6.00%	6.00%	6.00%	6.00%
4	2035-2039	5.00%	5.50%	5.50%	5.50%	5.50%
5	2039-2044	5.00%	5.00%	5.00%	5.00%	5.00%
6	>2044	5.00%	5.00%	5.00%	5.00%	5.00%

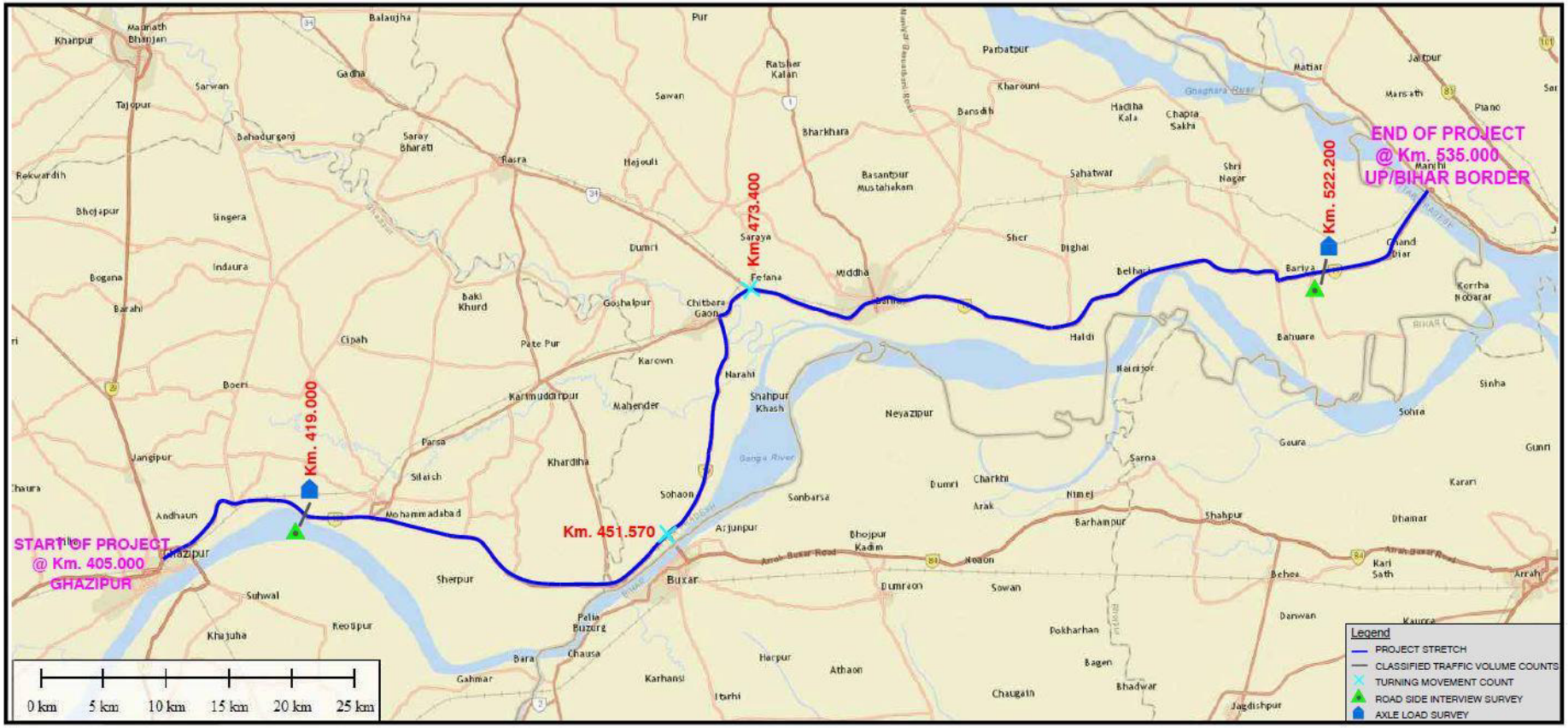


Figure-9.2: Traffic Location Map

9.5.4 Million Standard Axles (MSA)

Design traffic in terms of Million Standard Axles has been determined at 3 locations based on traffic homogeneous sections, where volume count and axle load surveys were conducted.

The traffic loading in terms of the cumulative number of standard axles for the given period has been computed using the following relationship.

$$N = 365 * [(1+r)^n - 1] * A * D * L * F / r$$

Where,

N: The cumulative number of standard axles to be catered for in the design in terms of msa.

A: Initial traffic in the year of completion of construction in terms of the number of commercial vehicles per day

L: Lane Distribution Factor (0.50) {As per IRC:37-2018clause 4.5.1 (ii)}

D: Directional Distribution Factor (1.0)

n: Design Life in years

r: Annual Growth rate of commercial vehicles.

F: Vehicle Damage Factor

The above said traffic parameters and VDF for individual vehicles have been used for the computations of cumulative million standard axles.

Summary of the MSA has been furnished below and detailed calculations are provided in **Appendix-9.1**.

Table-9.10: Million Standard Axles (MSA)

S. No.	Chainage. km	Location	Direction	5 Y MSA	10 Y MSA	15 Y MSA	20 Y MSA	30 Y MSA
1	Km. 419.000	Sultanpur	Towards Ballia	7.97	18.14	31.11	47.68	95.80
			Towards Ghazipur	1.42	3.24	5.56	8.53	17.13
			Adopted	10	20	35	50	100
2	Km. 526.000	Ibrahimabad	Towards Manjhighat	3.99	9.24	16.09	24.85	47.17
			Towards	3.03	7.19	12.63	19.58	37.29

S. No.	Chainage. km	Location	Direction	5 Y MSA	10 Y MSA	15 Y MSA	20 Y MSA	30 Y MSA
		Uparwar	Ballia					
			Adopted	5	10	20	30	50

**As per clause 5.4.1 of IRC: SP:84-2019, pavement shall be designed for a minimum of 20 MSA.*

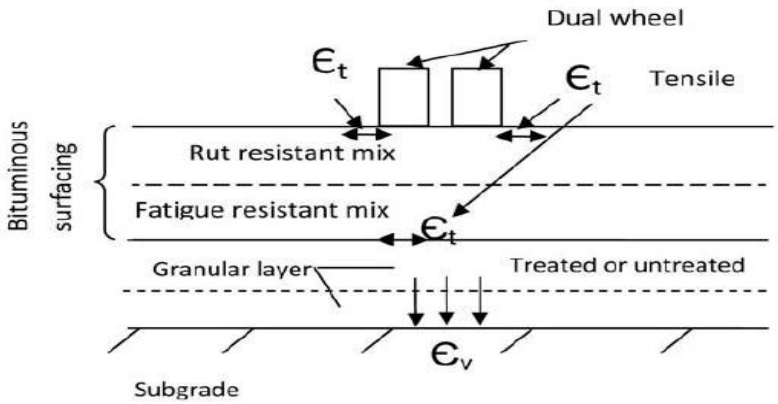
A design traffic of 20 MSA has been considered for all the homogeneous sections.

9.6 Preliminary Design of Flexible Pavement

9.6.1 General

The flexible pavement is modeled as an elastic multilayer structure. Stresses and strains at critical locations are computed using linear layered elastic model. The stress - strain analysis software IITPAVE has been used for the computation of stress and strain in flexible pavements as mentioned below.

- Horizontal Tensile Strain at bottom of bituminous layer, which can cause fatigue failure of bituminous layer.
- Vertical Compressive Strain at the top of sub grade, which can cause rutting failure of pavement layers.
- Horizontal Tensile Strain at bottom of Cement treated base, which can cause fatigue failure of cement treated layer.



The flexible pavement has low flexural strength and hence layers reflect the deformation of the lower layers/subgrade on to the surface layer after the withdrawal of wheel load. To control the deflections in the subgrade so that no permanent

deflections results the pavement thickness is so designed that the stresses on the subgrade soil are kept within its bearing power. Loading of bituminous pavement requires the stiffest layers to be placed at the surface with successive weaker layers down to subgrade.

For the purpose of structural design, only the number of commercial vehicles of laden weight of 3 tonnes or more and their axle loading will be considered.

9.6.2 Fatigue Model

Due to repetition of loads, tensile strain develops cracks at the bottom of bituminous layers which is a problem for long term serviceability. The phenomenon is called fatigue of the bituminous layer and the number of load repetitions in terms of standard axles that causes fatigue denotes the life of the pavement. Two fatigue equations are considered, one in which the computed strains in by termed as 80% reliability level and the other corresponding to 90% reliability level. The 80% reliability equation is used for the pavement where VG30 grade bitumen is used and 90% reliability equation is used for the pavement where VG40 grade of bitumen is used. The two equations for the conventional bituminous mixes designed by Marshall method are given below:

$$\mathbf{Nf = 2.21 \times 10\text{-}4 \times (1/E_t)^{3.89} \times (1/M_R)^{0.854} \text{ ---------1 (80\% Reliability)}}$$

$$\mathbf{Nf = 2.021 \times 10\text{-}4 \times (1/E_t)^{3.89} \times (1/M_R)^{0.854} \text{ ---------2 (90\% Reliability)}}$$

Nf = Fatigue life in number of standard axles

E_t = Maximum tensile strain at the bottom of Bituminous layer.

M_R = Resilient Modulus of the Bituminous layer

The equation 2 is modified by considering 90% reliability with air voids around 3% and the volume of bitumen about 13%.

9.6.3 Rutting Model

Rutting is the permanent deformation in pavement usually occurring longitudinally along the wheel path. The rutting may partly be caused by deformation in the subgrade and other non-bituminous layers which would reflect to the overlying layers to take a deformed shape. The 80% reliability equation is used for the pavement where VG30 grade bitumen is used and 90% reliability equation is used for the

pavement where VG40 grade bitumen is used. The rutting model considers the vertical strain in subgrade and the two equations are given below by considering 80% & 90% reliability.

$$N = 4.1656 \times 10^{-8} \times (1/Ez)^{4.5337} \text{ ---------3 (80\% Reliability)}$$

$$N = 1.41 \times 10^{-8} \times (1/Ez)^{4.5337} \text{ ---------4 (90\% Reliability)}$$

N = Number of cumulative standard axles to produce 20 mm rutting.

Ez = Maximum Vertical subgrade strain (micro strain)

9.6.4 Pavement Layers

In accordance with IRC 37:2018 for the following base and sub-base options are available.

- Granular base and sub-base.
- Cementitious bases and sub-bases with a crack relief layer of aggregate interlayer below bituminous surfacing.
- Cementitious bases and sub-bases with SAMI in between bituminous surfacing and the cementitious base layer for retarding the reflection cracks into the bituminous layer.
- Cemented base and granular subbase with crack relief interlayer of aggregate above Cemented base.
- Bituminous surfacing over treated RAP and cemented subbase

Stage construction is not permitted when we are using cemented base and sub-bases according to the guidelines of the code as it may lead to cracking of the stabilized layer leading to failure of the pavement. Hence, the consultants adopting Granular Base & Granular Sub-base for main carriageway pavement with stage construction.

9.6.4.1 Sub-base layer:

The sub-base layer serves three functions like to protect the sub-grade from over stressing, to provide a platform for the construction traffic and to serve as drainage and filter layer.

Material passing through 0.425 mm (425 micron), LL & PI shall not more than 25 and 6 %. Material shall have a minimum 10% fines value of 50 KN when tested in compliance with BS:812. The water absorption value (as per IS 2386) of the coarse

aggregate shall be less than 2%, if not soundness test shall be carried out as per IS 383. 100% sample should pass through 75mm sieve and only 3-10% sample should pass through 0.075mm sieve for all the three grades. When coarse graded subbase is used as a drainage layer, Loss Angels abrasion value should be less than 40, so that there is no crushing during the rolling and the permeability is retained. The sub-base should be composed of two layers, the lower layer forms the separation/filter layer to prevent intrusion of sub grade soil into the pavement and upper layer forms the drainage layer to drain away any water that may enter through surface cracks.

Strength Parameter: Resilient Modulus (M_{Rgsb})

M_{Rgsb}= 0.2 X h^ (0.45) X $M_{R\ subgrade}$, where h is thickness of subbase layer in mm.

M_R value of subbase is dependent on M_R value of subgrade since weaker subgrade does not permit higher modulus of the upper layer because of deformation under loads.

$M_{R\ subgrade}$ = 10 X CBR if Subgrade CBR is <=5

$M_{R\ subgrade}$ = 17.6 X (CBR)^0.64 if Subgrade CBR is >5

9.6.4.2 Base layer:

Base layer consists of WMM, WBM, Crusher run macadam, reclaimed concrete etc. Relevant specifications of IRC/MORTH are to be adopted for the construction.

Strength Parameter: Resilient Modulus ($M_{R\ granular}$)

When both sub-base and base layers are made up of unbound granular layers, the composite resilient modulus of the granular subbase and base are as follows:

$M_{R\ granular}$= 0.2 X $h^{0.45}$ X $M_{R\ subgrade}$,

where h is combined thickness of subbase and base layers in mm.

9.6.4.3 Bituminous layers (Binder and Surface)

Binder layer consists of DBM and BM are to be adopted for construction. It is act like as load distribution and supporting layer.

Strength Parameter: Resilient Modulus ($MR_{BC/DBM}$)

The strength of bituminous mix based on extensive laboratory testing of Resilient Modulus Test. Based on the study data of India, IRC:37-2018recommended resilient modulus for different mix types and temperatures are given below.

Mix Type	Temperature °C				
	20	25	30	35	40
BC and DBM for VG30 bitumen	3500	3000	2500	1700	1250
BC and DBM for VG40 bitumen	6000	5000	4000	3000	2000
BC and DBM for Modified bitumen	5700	3800	2400	1650	1300
BM with VG30 bitumen	-	-	-	700	-

9.6.5 Flexible pavement design for new carriage way

Pavement design is carried out in accordance with IRC 37:2018 for Granular base and sub-base. The standard designs given in plate-7 of IRC:37-2018 specify the minimum thickness and specifications of various component layers for the given traffic in terms of cumulative standard axles and the subgrade CBR. The required pavement composition according to IRC:37-2018 is as given below:

Table – 9.11: Option-1: Conventional Pavement Composition details

Reach		Eff. CBR (%)	Design Life in Years	MSA	Bitumen Grade	Crust Composition in mm				
From (Km)	To (Km)					BC	DBM	WMM	GSB	Total
0.000	104.260	10	20	50	VG-40	40	105	250	200	595

Table – 9.12: Option-2: Cemented Base & Subbase with Crack Relief Interlayer of Aggregate

Reach		Eff. CBR (%)	Design Life in Years	MSA	Bitumen Grade	Crust Composition in mm					
From (Km)	To (Km)					BC	DBM	Agg. In. layer	CT-B	CT-SB	Total
0.000	104.260	10	20	50	VG-40	40	60	100	100	200	500

Table – 9.13: Option-3: Cemented Base & Subbase with SAMI Interface layer

Reach		Eff. CBR (%)	Design Life in Years	MSA	Bitumen Grade	Crust Composition in mm					
From (Km)	To (Km)					BC	DBM	SAMI	CT-B	CT-SB	Total
0.000	104.260	10	20	50	VG-40	40	60	SAMI	140	200	440

Table – 9.14: Option-4: Foamed Bitumen/Bitumen Treated RAP/Aggregates Over Cemented Sub-base

Reach		Eff. CBR (%)	Design Life in Years	MSA	Bitumen Grade	Crust Composition in mm				
From (Km)	To (Km)					BC	DBM	Treated RAP	CTSB	Total
0.000	104.260	10	20	50	VG-40	40	65	100	200	405

Table – 9.15: Option-5: Cemented Base & Granular Subbase with Crack Relief Interlayer of Aggregate

Reach		Eff. CBR (%)	Design Life in Years	MSA	Bitumen Grade	Crust Composition in mm					
From (Km)	To (Km)					BC	DBM	Agg. In. layer	CT-B	GSB	Total
0.000	104.260	10	20	50	VG-40	40	60	100	160	200	560

Table – 9.16: Option-6: Granular Base & Cement Treated Sub-Base

Reach		Eff. CBR (%)	Design Life in Years	MSA	Bitumen Grade	Crust Composition in mm				
From (Km)	To (Km)					BC	DBM	WMM	CTSB	Total
0.000	104.260	10	20	50	VG-40	40	70	150	200	460

9.7 Overlay Design for Existing Carriageway

The design of overlays for the existing pavement has been done taking in to account the strength of the existing pavement based on detailed pavement investigations including BBD test. The strengthening requirements for the existing pavement have been worked out based on IRC guidelines considering average deflection values for design homogeneous sections.

The overlay has been determined as per IRC:81-1997 and details of various layer thicknesses applicable for overlay for each homogeneous section are given below.

Table – 9.17: Overlay Design

Reach		Characteristic Deflection (Dc)	Design Life	MSA	Crust Composition in mm		
From	To				BC	DBM	Total
104.260	115.460	1.17	15 Y	20	40	50	90

*As per fig.9 Overlay Thickness Design Curve in IRC:81-1997

9.8 Service road, Paved Shoulder, Bus bays & Truck lay byes

8.8.1 Design of Shoulders

Paved Shoulder: The shoulder would be useable during all seasons of the year and hence as per Clause 5.10 of IRC: SP:84-2019, the crust composition and specification of paved shoulder shall be same as of the main carriageway.

Earthen Shoulder: Earthen shoulder shall be covered with 150 mm thick layer of granular material confirming to the requirements given in Clause 401 of MORTH specifications.

9.9 Recommendation for Pavement Option

It is recommended to construct **Cement Treated Base & Cement Treated Subbase with SAMI Interlayer** for the entire stretch.

10. PRELIMINARY ENVIRONMENTAL IMPACT ASSESSMENT

10.1 Introduction

The National Highways Authority of India (NHAI) is engaged in the development of the National highways in the state of Uttar Pradesh. The consultancy services for preparation of Feasibility Report cum Detailed Project Report (DPR) of 4 laning of Ghazipur Ballia – UP/Bihar section from Km 0.000 to 128.000 of NH-19 and Construction of 2/4 laning Flyover at Ballia (Chandra Shekhar Mod to Satish Chandra College) was awarded to Aarvee Associates.

The Letter of Acceptance was communicated vide letter No. NHAI/Tech/NH-19/Pkg-I/2016/103661 dated 31st July,2017. The Agreement for consultancy services was concluded with NHAI on 04/09/2017.Letter of commencement was issued vide letter No. NHAI/Tech/NH-19/Pkg-I/DPR/2016/105592 dated 08.09.2017. Final DPR for the existing road "Special Repair and Maintenance work from Ghazipur to UP/Bihar border NH-31 from Km 405 to Km 535 including construction of New MJB at Km 412.130 and rehabilitation of MJB at Km 533 on EPC mode" submitted vide our letter no. AA/HW/NHAI/2114/18-19/9105 dated 26.03.2019. As per the directions from project authorities, the alignment proposals were reviewed in view of the MoRTH Circular No. NH-15017 / 21 / 2018 – P & M dated 26.02.2018. The greenfield alignment option including comparison table showing the cost comparison of widening of the existing alignment option via-a-via widening of was prepared and the same was reviewed at various levels and it was decided that green field alignment with spur providing connectivity to Buxar was approved during the meeting held in Ministry under the Chairmanship of Secretary and the Minutes of Meeting were communicated vide letter No. NHAI/Tech/ NH-19/Ghazipur-Ballia/ DPR/2016/122312 dated 13.08.2018.

The District Administration of Ballia held public consultations regarding the proposed elevated flyover and communicated their decisions vide MoM dated 1393/ 14 – 1 dated 20.10.2018. The MoM inter-alia state that widening of the existing road to four lane standards would serve the traffic problems in Ballia town and elevated flyover is not required since construction of the said flyover would result in acquisition of land and structures for the purpose of flyover.

Public consultation meeting on the project alignment was held in the office of District Magistrate Ballia on 05.09.2018 wherein the committee recommended that the bypass alignment for Ballia be considered on the south side. This will require modification of the alignment approved earlier in a length of approximately 38.50 km.

The said modification was reviewed during the meeting held on 08.12.2018 at NHAI HQ, New Delhi under the chairmanship of Member (P) and agreed by Member. Variation with financial implication for new Greenfield alignment was approved from RO, Varanasi vide letter no. NHAI/UP (E)/GM (T)/NH-19/Ghazipur-Ballia/DPR/14 dated 27.10.2020. Accordingly, the Inception & Alignment report for the approved Greenfield alignment were prepared and submitted vide our letter no. AA/HW/NHAI/2114/20-21/2820 & 2966 dated 06.11.2020 & 16.11.2020.

Table-10.1: Project Details for Greenfield Alignment

S. No	Project Highway	Design Chainage (Km)		Remarks
		From	To	
1	Ghazipur to Manjhi Ghat UP/ Bihar Border	0.000	115.600	NH-31
2	Buxar Spur	0.000	17.800	-

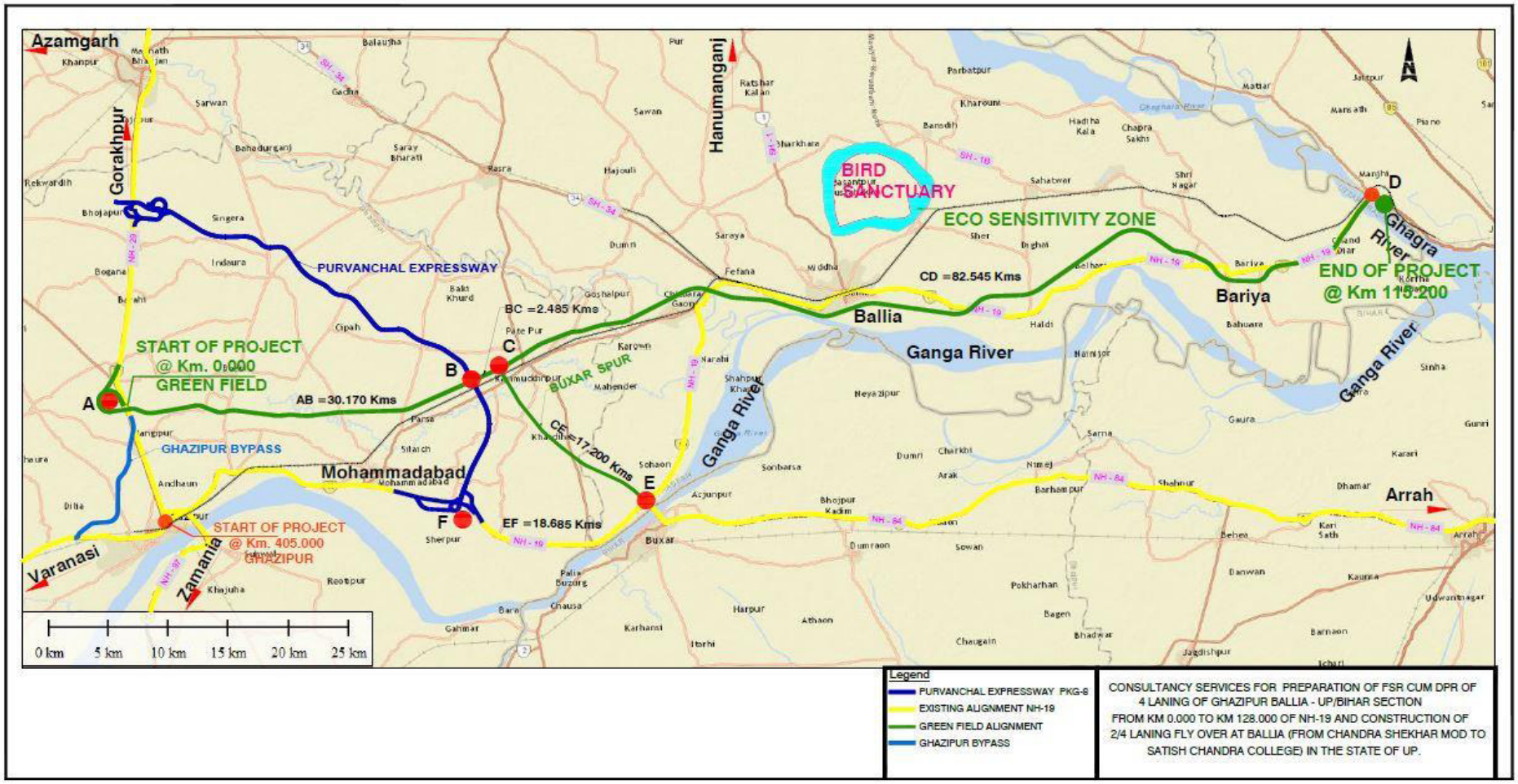


Figure 10.1: Index Map

10.2 Project Description

The highway project is a Greenfield Alignment passing through Ghazipur and Ballia districts of UP/Bihar. The total length of the highway is 115.460 km. It traverses mostly through plain terrain and a mixed land use of residential and agricultural can be seen throughout the corridor. Details of the project stretch are given in Table 10.2

Table 10.2: Project Stretch Details

S. No	Stretch	Length	Major Settlements	District(s)
1	Stretch from Ghazipur Ballia–UP/Bihar Section	115.460 km	Ghazipur, Muhammadabad, Ballia, Ramgarh, Bairiya	Ghazipur and Ballia in UP, Saran in Bihar
2	Buxar Spur	17.300km	Bathor, Ramghar, kumkumpatti	Ghazipur and Ballia

10.2.1 Terrain

Terrain is classified by the general slope of the country across the highway alignment. Based on this criterion, the entire project stretch traverses predominantly through Plain terrain (70%) followed by Rolling terrain (30%).

10.2.2 Abutting Land use

In terms of land-use, majority of adjoining lands were observed to be used for agriculture purposes and the rest is built up and barren land. Important crops grown along the project stretch are Wheat and Sugarcane. Moderately built-up areas and a mix of fast and slow traffic characterize this corridor. Different types of residential/ commercial structures (Permanent/Semi permanent) are noticed in the built-up section.

10.2.4 Cross Drainage Works

As a part of upgrading of the project, it is required to make an assessment of existing structures with regards to their adequacies to ensure that they meet the objectives of the project. List of existing cross drainage structures along the project stretch are shown below from Table 10.4 and Table 10.5

Table 10.3: Major Bridges (Existing)

S.No.	Chainage (Km)	Span (m)
1	532.100	32+2x64+31x32

Table10.4: Minor Bridges (Existing)

S.No.	Chainage (Km)	Span(m)
1	529.100	3x9.38

Summary of Existing Cross Drainage Structures:

- Major Bridges = 1
- Minor Brides = 1

10.2.5 Settlements

The project stretches passes through Ghazipur, Nasirpur, Chandrashekhar Mod, Ballia, Bairaya major settlements in project stretch. The complete list of villages abutting the project stretch is shown below in Table-10.5

Table 10.5: Major settlement in project stretch

S. No	Village Name	Chainage (Km)		Length (km.)
		From	To	
1	Hridaypur	0.000	0.570	0.570
2	Saraibandi	0.570	0.750	0.180
		0.860	1.025	0.165
3	Nasirpur	0.750	0.860	0.110
		1.025	1.450	0.425
4	Dadi Kala	1.450	1.635	0.185
5	Khazapur	1.635	2.015	0.380
6	Dhobha	2.015	2.500	0.485
7	Ramdoopur	2.500	2.550	0.050
8	Mirzapur Mafi	2.550	3.050	0.500
9	Bhikharipur	3.050	3.550	0.500
10	Manpur	3.550	4.280	0.730
11	Tikari	4.280	5.335	1.055
12	Sathipur	5.335	6.070	0.735
13	Bisunpur Datta	6.070	6.210	0.140

S. No	Village Name	Chainage (Km)		Length (km.)
		From	To	
14	Newada	6.210	6.295	0.085
15	Subhakarpur	6.295	7.950	1.655
16	Akhatiyarpur	7.950	8.530	0.580
17	Chak Ajam	8.530	9.200	0.670
18	Raibanpah	9.620	9.660	0.040
19	Badhui khurd	9.200	9.620	0.420
20	Chak Niamtulla	9.660	10.100	0.440
21	Badhui Buzurg	10.100	10.210	0.110
22	Thanaipur	10.210	10.860	0.650
23	Hardia	10.860	11.880	1.020
24	Rasoolpur ahmad	11.880	12.605	0.725
25	Said chak	12.605	13.090	0.485
26	Abbaspur	13.090	13.335	0.245
27	Baluwa Mu. Nonhara	13.335	14.935	1.600
28	Lalapur adai	14.935	15.400	0.465
29	Sukhpura	15.400	17.050	1.650
30	Todarpur Urf Partap pur	17.050	17.575	0.525
31	Fakkrabad	17.575	18.065	0.490
		18.315	18.575	0.260
32	Sakatpur Bareji	18.065	18.315	0.250
		18.575	19.970	1.395
33	Paharipur	19.970	21.550	1.580
34	Gajraj Gadaipur	21.550	22.100	0.550
35	Parsa	22.100	24.370	2.270
36	Indrapur	24.370	24.885	0.515
37	Tarapur	24.885	25.560	0.675
38	Faizullapur	25.560	26.670	1.110

S. No	Village Name	Chainage (Km)		Length (km.)
		From	To	
39	Mahmoodpur irf dodadih	26.670	26.900	0.230
40	Bagend	26.900	27.550	0.650
41	Rampur	27.550	28.740	1.190
42	Raipur M. Rajapur	28.740	28.790	0.050
43	Padraw	28.790	29.580	0.790
44	Sher	29.580	30.510	0.930
45	Baddopur	30.510	30.560	0.050
46	Bathor	30.560	31.800	1.240
47	Dilawaalpur	31.800	32.340	0.540
48	New urf uchadih	32.340	32.600	0.260
49	Chandkur	32.600	32.850	0.250
50	Karimuddinpur	32.850	34.150	1.300
51	Baijnathpur	34.150	34.200	0.050
52	Lathudih	34.200	34.870	0.670
53		34.985	35.150	0.165
	Jayantipur	34.870	34.985	0.115
54	Chak gareeb	35.150	35.450	0.300
55	Vishambharpur Aarzai Maafi	35.450	35.610	0.160
56	Karkatpur Mu.utraon	35.610	36.250	0.640
		36.450	36.580	0.130
57	Karkatpur Mauja	36.250	36.450	0.200
58	Vishambharpur panjum	36.580	36.820	0.240
59	Bisambarpur Panjam	36.820	37.030	0.210
60	Vishambharpur-Part-3	37.030	37.240	0.210

S. No	Village Name	Chainage (Km)		Length (km.)
		From	To	
61	Bibipur Khas	37.240	37.350	0.110
62	Bharaouli Kalan	37.350	37.820	0.470
63	Patar	37.820	39.230	1.410
64	Tajpur	39.230	39.500	0.270
		39.650	40.750	1.100
65	Patar	39.500	39.650	0.150
66	Bhediausar	40.750	41.070	0.320
67	Kajichak	41.070	41.480	0.410
68	Gopalchak	41.480	41.910	0.430
69	Bharauli Ala	41.910	42.350	0.440
70	Sahapur	42.350	43.200	0.850
71	Lakra	43.200	43.550	0.350
72	Badhwalia	43.550	43.800	0.250
73	Awagilwa	43.800	44.250	0.450
74	Hardarpur	44.250	45.550	1.300
75	Tikapur	45.550	47.050	1.500
76	Basaratpur	47.050	48.050	1.000
77	Sultanpur	48.050	49.750	1.700
78	Kotwari	49.750	50.390	0.640
79	Kurchunda Mu. Singhpur	50.390	50.780	0.390
80	Kalyanpur	50.780	50.930	0.150
81	Kurchunda Ekoni	50.930	51.250	0.320
82	Ekoni	51.250	52.200	0.950
83	TeteDad	52.200	52.400	0.200
84	Teekha	52.400	52.600	0.200
85	Teekha	52.600	53.850	1.250
86	Cheruia	53.850	53.900	0.050
87	Bairiya	53.900	54.220	0.320
88	Bhawarkol	54.220	54.550	0.330
89	Narhi	54.550	55.250	0.700

S. No	Village Name	Chainage (Km)		Length (km.)
		From	To	
90	Gangahara	55.250	56.250	1.000
		56.350	56.890	0.540
91	Vaina	56.250	56.350	0.100
92	Baghe Ji	56.890	57.350	0.460
93	Sagarapalli	57.350	58.980	1.630
94	Daraopur	58.980	59.350	0.370
95	Kaap Nasirabad	59.350	59.670	0.320
96	Sharfuddinpur Mu	59.670	60.200	0.530
97	Devariyakurdh	60.200	60.390	0.190
98	Mubarakpur	60.390	60.730	0.340
99	Khap Khori Pakar	60.730	60.890	0.160
100	Parsipatti	60.890	61.190	0.300
101	Maldepur	61.190	61.280	0.090
102	Haibatpur	61.280	62.120	0.840
103	Bijaipur	62.120	63.280	1.160
104	Bankata	63.280	63.800	0.520
		63.850	64.120	0.270
105	Makhdumhi	63.800	63.850	0.050
106	Bedua	64.120	64.420	0.300
107	Hirpur	64.420	65.050	0.630
108	Neori Taluka Jamuaon	65.050	65.110	0.060
109	Chandanapur	65.110	65.280	0.170
110	Kanspur	65.280	65.550	0.270
111	Jamuwa	65.550	65.950	0.400
112	Moorki	65.950	66.770	0.820
113	Jamun	66.770	67.430	0.660
114	Kishun Nagar	67.430	68.180	0.750
115	Mohan Chhapra	68.180	68.390	0.210

S. No	Village Name	Chainage (Km)		Length (km.)
		From	To	
116	Nagwa	68.390	69.950	1.560
117	Harlal Chhapra	69.950	70.310	0.360
118	Jinari	70.310	71.600	1.290
119	Mafi Janari	71.600	71.870	0.270
120	Bhel Sarh	71.870	73.300	1.430
121	Urgasenpur	73.300	73.330	0.030
		73.450	73.650	0.200
122	Bhimpatti	73.330	73.450	0.120
123	Oujha Kacchua	73.650	74.380	0.730
124	Kachha Khas	74.380	75.350	0.970
125	Rampur Titihi	75.350	76.530	1.180
126	Pochhari	76.530	77.130	0.600
127	Pindari	77.130	78.100	0.970
128	Sihakhund	78.100	79.100	1.000
129	Bharkoka	79.100	80.690	1.590
130	Kathal	80.690	80.920	0.230
131	Mudadih	80.920	81.450	0.530
		82.070	84.130	2.060
132	Laakhpur	81.450	82.070	0.620
133	Belhari	84.130	85.700	1.570
134	Malikpura Mu. Jagchhapra	85.700	86.340	0.640
135	Dudaila	86.340	87.150	0.810
136	Khajuhati	87.150	87.910	0.760
137	Raghunathpur	87.910	88.800	0.890
138	Kanchanpur	88.800	89.590	0.790
139	Kewa	89.590	90.350	0.760
140	Mansing Chapra	90.350	91.000	0.650
141	Cherdih	91.000	92.250	1.250
142	Moon Chhupra	92.250	97.030	4.780

S. No	Village Name	Chainage (Km)		Length (km.)
		From	To	
143	Bairiya	97.030	97.450	0.420
144		98.460	100.800	2.340
145	Tengarahi	97.450	98.460	1.010
146	Sonabarsa	100.800	105.920	5.120
147	Ibrahimabad Uparwar	105.920	108.850	2.930
148	Chanddiar	108.850	109.850	1.000
		112.100	113.290	1.190
149		109.850	112.100	2.250
150		113.290	114.550	1.260
151	Bahoran Tola	114.550	114.890	0.340
		115.200	115.460	0.260
152		114.890	115.200	0.310

Table 10.1: Major settlement in project stretch – Buxar Spur

S. No	Village Name	Chainage (km)	
		From	To
1	Bathor	0.000	0.050
2	Chandpur	0.050	0.350
3	Karimuddin pur	0.350	2.450
4	Kotiya Kodartal	2.450	3.250
5	Deoria	3.250	4.500
6	Maragupur	4.500	5.050
7	Musur Dewa	5.050	5.750
8	Khardiha	5.750	7.250
9	Bhushula	7.250	8.430
10	Muktapur Urf Charkha	8.430	8.730
11	Murera Bhuzurg	8.730	9.450
12	Shah pur	9.450	10.000
13	Basnia	10.000	11.050
14	Tetarpur Mutkle Dularpur	11.050	11.250
15	Tetarpur Kalan	11.250	12.600
16	Ramgarh	12.600	13.850
17	Kamal Pur	13.850	14.550
18	Jajar Kalsa	14.550	14.600
19	Kurmidi	14.600	15.780

S. No	Village Name	Chainage (km)	
		From	To
20	Chintamanpatti	15.780	16.470
21	Kumkum Patti	16.470	17.280

Figure 10.2: Built-up Areas

There are no ROB's/RUB's present in the stretch.

Table 10.2: ROB along Project Stretch

S.No.	Railway	Crossing	Chainage	Location	Type
Nil					

Table 10.3: Railway Crossing along Project Stretch

S.No.	Railway Crossing	Chainage (Km)	Location	Type
Nil				

10.2.7 Existing Geometrics

The existing geometric alignment of the project stretch might have been designed as per State Highway standards and may not meet the present standards of a National Highway. The design is deficient in sight distance, curve radii and super elevation at few locations. Further, there are several curves near village limits which might require improvement.

10.2.8 Carriageway

The existing carriageway details are shown in Table 10.4.

Table 10.4: Existing Carriageway Details

S.No.	From km	To km	Existing Pavement Configuration	Existing Width (m)	Remarks
1	523.600	535.300	Two Lane	7m	In Built-up Locations varying from 7 – 10 m

10.2.9 Pavement

Flexible pavement is observed throughout the project stretch except the riding quality/pavement condition varies from good to fair along the entire stretch with very few sections of the road showing various types of distresses such as Raveling, Potholes, undulations and cracks.

10.2.10 Right of Way

The existing Right of Way (RoW) varies between 15m to 20m along the corridor. RoW pillars was not found along the project stretch. The precise RoW details will be ascertained from the revenue records to clarify on the exact land available for construction. Land acquisition plans would be prepared to have uniform ROW in accordance with NHAI guidelines. Additional land acquisition will be proposed as per project requirements and in accordance with TOR/ NHAI guidelines.

10.2.11 Scheme of Widening

To accommodate Two/Four lane with paved shoulders within available ROW, concentric widening may be advisable. However, final decision regarding scheme of widening will be taken after finalization of geometric design considering different parameters such as right of way availability, presence of utilities, sensitive structures, economics and other considerations.

10.2.12 Utilities

The project road has utilities that come in the way of the proposed upgradation scheme. The Electric lines are observed to be nearly at a distance of 5-10m from road edge and crossing of High Transmission lines observed along the project corridor. In most of the locations the electrical poles are within the Right of Way which should be relocated. High Transmission towers and sub-stations are observed to be away

from Right of Way in the project stretch.

10.2.13 Additional Land Acquisition

Additional land acquisition may become necessary for the following, subject to the improvement proposals made after a detailed study:

- Bus bays and Truck lay-byes
- Underpasses with Slip roads
- Service Roads at Urban Locations
- Proposed bypasses
- Realignment sections
- Toll Plazas
- Rest areas
- ROB's

10.2.14 Technical Assessment of Existing Road

I. The Project road is mostly composed of flexible pavement throughout the project stretch.

II. The existing carriageway of the project is of 2 & 4 lane with paved shoulder of width 1.5 m on both sides with median openings varying from 1 to 3m.

III. The existing road condition varies from Good to fair, except at some locations where the condition is poor.

IV. The surface condition of the pavement varies from good to fair condition. Pavement distresses were observed in the form of Longitudinal, Block, Map cracking, ravelling and pot holes.

V. The Earthen Shoulders condition varies from good to poor on both sides of the road. It is observed that at some particular locations, there is material loss of shoulders on both sides.

VI. Unlined drains exist almost entire length of the project stretch. Some are partially functioning and some are totally blocked.

VII. The pavement has few structural failures which can be attributed to the

insufficient compaction of the Sub-grade and Sub-base layers.

10.3 Preliminary Environmental Assessment

This Report describes the proposed work plan related to environmental aspects and makes desirable modifications keeping in view the requirement of the Project Road. Standard methods / procedures will be adopted during environmental monitoring analysis and report preparation. The exact sampling locations and number will be finalized during field studies. However, tentative sampling number is provided at this stage. The methodology for carrying out the study and specifications pertaining to environment to be adopted in this project are as follows:

10.3.1 Objectives

The major objective of this study is to establish present environmental condition along the project corridor through available data/ information supported by field studies to evaluate the impacts on relevant environmental attributes due to the construction & operation of the proposed project; to recommend adequate mitigation measures to minimize/ reduce adverse impacts and to prepare an Environmental Management Plan (EMP) for timely implementation of the mitigation measures to ensure that the project will result in a high quality and safe road to users in a sustainable and environment-friendly manner. An Environmental Impact Assessment (EIA) study basically includes:

- Establishment of the present environmental scenario;
- Study of the specific activities related to the project;
- Evaluation of the potential environmental impacts;
- Undertake an analysis of alternatives by bringing in environmental considerations into the upstream stages of sub-project planning and design;
- Preparation of Environmental Management Plan that specifies the measures to mitigate adverse impacts and enhance positive impacts of the sub-project on the environment, along with the monitoring, capacity building and institutional arrangements.

10.3.2 Need for Environment Impact Assessment

Highway developmental activities should be planned and executed after considering the potential environmental impacts. To minimize these adverse impacts that may be created by highway development projects, the techniques of Environmental Impact

Assessment (EIA) become necessary. Identification and assessment of potential environmental impacts should be an integral part of the project life cycle. It should commence early in the planning process of the project to enable a full consideration of alternatives and to avoid later delays and complications.

10.3.3 Legal and Environmental Clearance Requirements

The increase of environmental concerns has necessitated appropriate tools to protect the environment. India has developed a fairly comprehensive regulatory framework to address environmental and social concerns in relation to development projects. Its wide-ranging enactments cover almost all major issues that need to be addressed in the course of development of infrastructure from a social and environmental perspective. This section describes the institutional set-up and key legislation pertaining to environmental issues.

Institutional Framework

The Ministry of Environment, Forest and Climate Change (MoEF&CC) to serve as the focal point in the administrative structure for the planning, promotion and coordination of environmental and forestry programmes. The Ministry of Environment and Forests (MoEF) has been renamed recently in the year 2014 as Ministry of Environment and Forest and Climate Change (MoEF&CC). The MoEF&CC has overall authority for the administration and implementation of government policies, laws and regulations related to the environment, including conservation, environmental assessment, sustainable development and pollution control. MoEF&CC identifies the need to enact new laws and amend existing environmental legislation when required, in order to continue to conserve and protect the environment. At the state level, the MoEF&CC authority is implemented by the Department of the Environment and the Department of Forest.

In 1976, the 42nd Constitutional Amendment created Article 48A and 51A, placing an obligation on every citizen of the country to attempt to conserve the environment. As a result, a number of laws related to environmental conservation were passed to strengthen existing legislation. Environment (Protection) Act, 1986 is the landmark legislation as it provides for the protection of environment and aims at plugging the loopholes in the other related acts.

The Government of India through specific legislation regulates the environmental management system in India. The Ministries / Statutory Bodies responsible for ensuring environmental compliance by project proponents include:

- The Ministry of Environment & Forests and Climate Change (MoEF&CC)
- Central Pollution Control Board (CPCB)
- Uttar Pradesh Pollution Control Board (UPPCB)
- Department of Environment in the States

10.4 Applicability of International, National and State Environmental Norms

The proposed highway development project is attracting various International, National, State, and World Bank environmental laws, rules and regulations. These regulations and rules are helpful in impact mitigation and improvement of the environment. The environmental assessment study will be carried out as per the requirement of the National/State/World Bank environmental guidelines. The applicability of the regulatory norms is given in Table 5.10

Table 5.10: Applicability of Environmental Regulatory Norms for the Project

Project	Project Components	Applicability of Environmental Laws, Policies and Notifications	Remarks
4 laning of Ghazipur Ballia – UP/Bihar section from Km. 0.000 to 128.000 of NH-19 and Construction of 2/4 laning Flyover at Ballia (Chandra Shekhar Mod to Satish Chandra College) in the State of Uttar Pradesh	• Right of Way • Land Acquisition • Protected Social Forestry throughout the Right of Way (RoW) • Quarries • Borrow Areas • Establishment of Hot Mix Plants and Batch mix Plants • Sensitive Locations (Schools, hospitals, etc,.) • Archaeological Sites	The Environment (Protection) Act, 1986 and further notifications issued under this Act.	Any act during implementation causing damage to environment. As per the Environment (Protection) Act (EP) 1986, ambient noise levels are to be maintained as stipulated by the Central Pollution Control Board (CPCB) for different categories of areas like, commercial, residential and silence zones, etc., during sub-project construction and operation. Section -3 (2)(iii & iv).
		Water (Prevention and Control of Pollution) Cess Act, 1977 including Rules	Applicable to all activities, which discharge effluents as a result of process or operations. Section 3 (2)(a) of the Act and Cess to the Govt. of India as per Table -I & II for consumption of
		Water (Prevention and Control of Pollution) Act, 1974 – as amended in 1978 & 1988.	

Project	Project Components	Applicability of Environmental Laws, Policies and Notifications	Remarks
			water for domestic, commercial and industrial purposes.
		Forest (Conservation) Act, 1980 – as amended in 1988.	Applicable if the project involves any activities in the reserved forests, village forests, protected forests and other areas as declared by the state Government. Forest Conservation Act – Chapter –2.4 and Chapter –3.0.
		The Ancient Monuments and Archaeological Sites and Remains Act, 1958, as amended in 2010. Ancient Monuments and Archaeological Sites and Remains Rules, 1959.	Applicable if the project involves any activities in the close proximity (less than 200m) of Ancient Monuments and Archaeological Sites
		Wildlife Protection Act, 1972, amended thereof. The Wildlife (Protection) Rules, 1995.	The act prohibits picking, uprooting, damaging, destroying, acquiring any specified plant from any forest land. It bans the use of injurious substances, chemicals, explosives that may cause injury or endanger any wildlife.
		Coastal Regulation Zone (CRZ) Notification 1991 as amended till January 2011	Not Applicable
		The Hazardous Wastes (Management And Handling) Rules, 1989 and subsequent amendments thereof till date.	Materials such as heavy metals, toxic inorganic, oils, emulsions, spent chemicals and Metal-finishing wastes emanating during construction and operation shall be stored and disposed of as per the Rules. Rule 17, 18 & 19 of the

Project	Project Components	Applicability of Environmental Laws, Policies and Notifications	Remarks
			Act.
		The Public Liability Insurance Act, 1991.	Act enables the people to access legal aid to claim compensation in the event of an accident occurred while handling any hazardous substance. So insurance needs to be taken up by the project implementing agencies or contractors. PLI Act: Act 6 of 1991 as amended by Act 11 of 1992.
		Ministry of Environment Forests & Climate Change (MoEF&CC) EIA Notification (New) issued on 14th September, 2006 and subsequent amendments thereof till date.	Project will attract the Environmental Clearance from MoEF since the stretch is greater than 100 Kms in length The EIA Report has to be prepared as per the World Bank guidelines
		World Bank Operational Directive and Operational Policies for Environmental Impact Assessment OP:4.01, OP 4.04:Natural Habitats, OP 4.36: Forests, OP 4.11: Operational Policy on cultural property and OP 4.12: Involuntary Resettlement for roads & highways projects.	Applicable in preparation of Environmental assessment report, protection of cultural property, forest clearances etc.
		Noise Pollution (Regulation and Control) Rules, 2000	Applicable Under Rule 3(1) & 4 (1) - Clause 2, 3 & 6.
		Land Acquisition Act 1894 Land Acquisition Act 1989 & RFCTLARR Act, 2013.	Applicable. To set out rules for the acquisition of land by Government.

Project	Project Components	Applicability of Environmental Laws, Policies and Notifications	Remarks
		Motor Vehicles Act, 1988 Rules of Road Regulations, 1989	Applicable. To enforce highway codes during construction and operation.

A brief description of the relevant laws is given below:

EIA Notification, 2006

This is the Indian Government's Guidelines for environmental impact assessment governing all of the development interventions that takes place within the boundaries of India. EIA notification was issued by Ministry of Environment, Forests and Climate Change (MoEF&CC) in 2006. Under this EIA Notification, the projects listed in Schedule-1 of the Notification require prior environmental clearance. The objective of the notification is to formulate a transparent, decentralized and efficient regulatory mechanism to:

- Incorporate necessary environmental safeguards at planning stage
- Involve stakeholders in the public consultation process
- Identify developmental projects based on impact potential instead of the investment criteria

As per EIA Notification, 2006 and amendment thereafter, "Expansion of National Highways greater than 100 Km involving additional Right of Way or land acquisition greater than 40 m on existing alignment and 60 m on re-alignments or bypasses" may require clearance from EAC, MoEF&CC. As per Honorable Supermen court's direction, 10 km radius from the boundary of wildlife sanctuary will be considered as eco-sensitive zone till the actual radius of the Eco-sensitive zone around the wildlife sanctuary boundary is notified by the state government. The MDR and ODRs do not come in the purview of EIA Notification, 2006.

Forest (Conservation) Act, 1980:

This Act is of particular significance in case the project corridors require acquisition of forest land outside the RoW of the road corridors as a result of the rehabilitation work proposed. The Indian Forest Act (1927) was amended in 1980 in an attempt to check the rapid deforestation occurring throughout India and the Forest (Conservation) Act, 1980 came into existence. At the state level, the government was empowered to

declare reserves and protected forest and was also given the authority to acquire land for extension and preservation of the forests. An advisory Committee was formed to supervise compliance, within other government departments. In December 1996, a Supreme Court Judgment further defined the types of forests to be protected. The Ministry of Environment and Forests in their Corrigendum to Part II, Section 3, Sub-section (i) of Forest (Conservation) Amendment Rules, 2004 issued vide G.S.R. 107(E) dated 9th February, 2004, which explains the procedure for application for diversion of forests land depending on the area involved as follows:

- The proposal involving forest land upto 40 hectares shall be forwarded by the concerned State Government along with its recommendations, to the Chief Conservator or Forests or the Conservator of Forests of the Regional Office of the Ministry of Environment and Forests Government of India.
- The Chief Conservator of Forests/ Conservator of Forests of the Regional Office shall within a period of 45 days of the receipt of the proposal from concerned, decide the diversion of proposal upto 5 Ha.
- If the forest land is more than 5 and upto 40 hectare, The Chief Conservator of Forests/ Conservator of Forests of the Regional Office process, scrutinize and forward diversion proposal along with the recommendations, if any, to Ministry of Environment and Forests, New Delhi for obtaining decision of the Central Government and inform the State Government and the User Agency concerned.
- The proposal involving more than 40 ha of forest area, shall be forwarded by the concerned State Government along with its recommendations, to the Ministry of Environment and Forests, New Delhi

Guidelines For Diversion of Forest Land for Widening or Realignment of Road

As per Forest (Conservation) Act, the roadside plantation within the ROW notified as protected forests for management purposes will need approval from the Central Government under Forest (Conservation) Act, 1980.

The Regional Offices shall be competent to finally dispose of all such proposals irrespective of the area, preferably within 30 days from the date of receipt of the proposal. While the approval, in place of normal provisions for compensatory afforestation, the Regional Offices will stipulates a condition that for every tree cut at least two trees should be planted.

However, if the decision is not ordered by the concerned Regional Office within 30 days of the receipt of fully completed application, the Central Government / State may proceed with the widening/modernization under intimation to the local State Forest Department and Central Government.

All the cases for forest clearance are now required to be applied online on the MoEF&CC website. From there the application will be forwarded to the Nodal Officer of respective state for further processing of application. The user agency will submit the proposal in the prescribed format through the State Forest Department to the concerned Regional Office of the Ministry.

Wild Life Protection Act, 1972:

The Wildlife Protection Act, 1972 has allowed the government to establish a number of National Parks and Sanctuaries over the past 25 years, to protect and conserve the flora and fauna of the state.

The Water (Prevention and Control of Pollution) Act, 1974:

The act resulted in the establishment of the Central and State level Pollution Control Boards whose responsibilities include managing water quality and effluent standards, as well as monitoring water quality, prosecuting offenders and issuing licenses for construction and operation of any facility. This will include generation of liquid effluent during construction of road from civil engineering activities or from domestic activities in workers colony. There are specific penalties for violation, which include imprisonment for responsible officials.

The Air (Prevention and Control of Pollution) Act, 1981:

The act empowers Central and State Pollution Control Boards for managing air quality and emission standards, as well as monitoring air quality, prosecuting offenders and issuing licenses for construction and operation of any facility. Air quality includes noise level standards. There are specific penalties for violation, which include imprisonment for responsible officials. This act has notified National Ambient Air Quality Standard for different regions e.g. Industrial, Residential and Sensitive. Air quality during construction and operation phases will be guided by this specific act.

Environment (Protection) Act, 1986:

This act was passed as an overall comprehensive act "for protection and improvement of environment" Under this act rules have been specified for discharge/emission of effluents and different standards for environmental quality. These include Ambient Noise Standard, Emission from Motor Vehicles, Mass Emission

standard for Petrol Driven Vehicles, General Effluent Standards etc. especially important for road project.

Fly ash Notification, 2016:

According to the Notification No. S.O. 763 (E), dated 14.09.1999 and its amendment thereafter on 27.08.2003 and notification S.O. 2804 (E) dated 3rd November 2009 by Ministry of Environment and Forests, it is mandatory to use fly ash within a radius of 300 kilometers of Thermal Power Plant. No agency, person or organization shall within a radius of 300 kilometers of Thermal Power Plant undertake construction or approve design for construction of roads of flyover embankments in contravention of the guidelines/ specification issued by the Indian Road Congress (IRC) as contained in IRC specification No. SP: 58: 2001. Any deviation from this direction can only be agreed to a technical reasons if the same is approved by Chief Engineer (Design) or Engineer-in-chief of the concerned agency or organization or on production of certificate of "Pond ash not available" from the Thermal Power Plant(s) located within 100 kilometers of the site construction. This certificate shall be provided by TPP within two working days from the date of making request for fly ash.

Soil required for top or side cover of embankment of roads or flyovers shall be excavated from the embankment site and it is not possible to do so, only the minimum quantity of the soil required for the purpose shall be excavated from soil borrow area. In either case, the topsoil should be kept or stored separately. Voids created due to soil borrow area shall be filled up with ash with proper compaction and covered with top soil kept separately as mentioned above. No agency, person or organization shall within a radius of 100 kilometers of coal or lignite based Thermal Power Plant allow reclamation and compaction of low lying areas with soil. Only pond ash shall be used for compaction. They shall also ensure that such reclamation and compaction is done in accordance with the bye-laws, regulation and specification laid down by Authorities.

All agencies undertaking construction of roads or fly over bridges including Ministry of Shipping Road Transport and Highways (MoSRTH), National Highways Authority of India (NHAI), Central Public Works Department (CPWD), State Public Works Department and other State Government Agencies, shall within three months from the 1st day of September 2003 make provision in their documents, schedules of approved materials and rates as well as technical documents; including those related to soil borrow area or pits.

Make necessary specifications/guidelines for road or fly over embankments that are not covered by the specification laid down by the Indian Road Congress (IRC).

World Bank Safeguard Policies
Environmental Assessment – OP 4.01 Requirements:

Operational Policy 4.01 (OP 4.01) is one of the ten safeguard policies of the World Bank, which provides the Environmental Assessment (EA) guidance for the lending operations. The OP 4.01 requires the borrower to screen projects upstream in the project cycle for potential impacts. Thereafter, an appropriate EA approach to assess, minimize, enhance and mitigate potentially adverse impacts is selected depending on nature and scale of project. The EA needs to be integrated in the project development process such that timely measures can be applied to address identified impacts. The policy requires consultation with affected groups and NGOs to recognize community concerns and the need to address the same as part of EA.

Cultural Property – OP 4.11 Requirements:

The World Bank's Operational Policy Note 4.11 aims at preserving and avoiding the elimination of structures having archaeological (prehistoric), paleontological, historical, religious and unique natural values. Projects that could significantly damage non-replicable cultural properties are declined for funding and the Bank will in turn assist protection and enhancement of cultural properties encountered in the project rather than leaving that protection to chance.

Natural Habitats – OP 4.04 Requirements:

Operational Policy 4.04 sets out the World Bank's policy on supporting and emphasizing the precautionary approach to natural resource management and ensuring opportunities for environmentally sustainable development. As per this policy, projects that involve significant conversion or degradation of critical natural habitats are not supported by the Bank. Projects involving non critical habitats are supported if no alternatives are available and if acceptable mitigation measures are in place.

Forests – OP 4.36 Requirements:

OP 4.36 sets out specific policy on protection of forests through consideration of forest related impacts of all investment operations, ensuring restrictions for operations affecting critical forest conservation areas, and improving commercial forest practice through use of modern certification systems. The policy requires consultation with local people, the private sector and other stakeholders in forest

area.

Involuntary Resettlement OP 4.12:

This policy describes Bank policy and procedures on involuntary resettlement as well as the conditions the borrowers are expected to meet in operations involving resettlement. The objective of the Bank's policy is to ensure that populations displaced by a project also benefit from the project and that livelihood and standards of living are improved, or at, least restored to earlier levels.

Indigenous People OP 4.20 Requirements:

The World Bank policy on indigenous peoples, OP/BP 4.20, Indigenous Peoples, underscores the need for Borrowers and Bank staff to identify indigenous peoples, consult with them, ensure that they participate in, and benefit from Bank-funded operations in a culturally appropriate way- and that adverse impacts on them are avoided, or where not feasible, minimized or mitigated.

As per the World Bank's Environmental Safeguard policy, the project coordinating entity or implementing institution carries out Environmental Assessment (EA) during the preparation of each proposed sub-project according to country requirements and the requirements of this policy. The Bank appraises and recommends to strengthen the capabilities of the coordinating entity or the implementing institution to (a) screen sub-projects, (b) obtain the necessary expertise to carry out EA, (c) review all findings and results of EA for individual sub-projects, (d) ensure implementation of mitigation measures (including, where applicable, an EMP), and (e) monitor environmental conditions during project implementation. If the Bank is not satisfied that adequate capacity exists for carrying out EA, all Category A sub-projects and, as appropriate, Category B sub-projects including any EA reports are subject to prior review and approval by the Bank.

The purpose of conducting an environmental assessment (EA) is to identify environmental and social consequences of the proposed sub-projects or components, in order to:

- Ensure the identification of potential environmental issues and social concerns early in the implementation of a proposed project to incorporate necessary safeguards in project design in order to prevent potential adverse impacts by determining appropriate mitigation and compensation measures;
- Minimize risks and enhance positive impacts/benefits;

- Avoid delays and extra costs which may subsequently arise due to unanticipated environmental problems;
- Identify the potential for maximizing environmental resources management and socio-economic benefits to local communities within the scope of the sub project.
- The EA should cover physical-chemical, biological, socio-economic and cultural issues that are likely to arise during upgrading and widening of roads safety risks and appurtenance structures and associated activities as appropriate.

The World Bank has classified the type of projects into following categories depending on the extent of the impact on environment:

(i) Category A: A proposed project is classified as Category A, if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. Such project requires full EIA study.

(ii) Category B: A proposed project is classified as Category B if its potential adverse environmental impacts on human populations or environmentally important areas— including wetlands, forests, grasslands, and other natural habitats—are less adverse than those of Category A projects. These impacts are site-specific; few if any of them are irreversible; and in most cases mitigatory measures can be designed more readily than for Category A projects.

(iii) Category C: A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required for a Category C project.

(iv) Category FI: A proposed project is classified as Category FI if it involves investment of Bank funds through a financial intermediary, in sub projects that may result in adverse environmental impacts.

Thus for Category-A project detail Environmental Assessment would be required. For the project requiring Environmental Clearance from the MoEF&CC, detailed Environmental Impact Assessment would be required in accordance with the Environmental Impact Assessment Notification, 2006 and amended thereafter. For Category-B projects site specific EA is required and a generic environmental management plan (EMP) would be required to be prepared for such project. For Category C projects no study beyond environmental screening is required.

Statutory Clearance for Borrow area and stone quarry

Mining of minor minerals such as sand, gravel, clay, marble and other stones will not be allowed in the country without the approval of the Central government. The Honorable Supreme Court, vide its order dated 27.02.2012 in I.A.No.12-13 of 2011 in SLP (C) No.19628-19629 of 2009 titled Deepak Kumar etc. Vs. State of Haryana & Ors. has inter alia ordered that leases of minor mineral including their renewal for an area less than 5 ha be granted by the State / Union Territory only after getting environment clearance (EC) from the Ministry of Environment, Forests and Climate Change (MoEF&CC). In order to ensure compliance of the aforesaid order of the Hon'ble Supreme Court, MoEF&CC issued an OM No.L-11011/47/2011-IA.II(M) dated 18.05.2012 stating inter alia that all mining projects of minor minerals including their renewal, irrespective of the size of the lease would require prior EC and that the projects of minor minerals with lease area less than 5 ha would be treated as Category "B" as defined in EIA Notification, 2006 and will be considered by the respective State Environment Impact Assessment Authorities (SEIAAs) notified by MoEF&CC and following the procedure prescribed under the EIA Notification, 2006. The mining projects having more than 5 Ha of lease area will be categorised as Category A project and will be appraised by Central Committee of MoEF&CC.

Regarding the borrow area for ordinary soil, the Contractor has to obtain environmental clearance from State Environmental Impact Assessment Authority (SEIAA) of MoEF&CC in compliance to the Supreme Court's order and MoEF&CC conditions vide their circular no. L-11011/47/2011-IA.II(M) dated 20th June, 2013. If the area of a borrow area is less than 5 Ha then this will be treated as Category-B-2 Project and will be appraised and approved based of only Form-1. No EIA study will be required for such area. However if the size of the borrow area is more than 5 Ha then it will be categorized as "Category-B1" and therefore will require EIA study, based on which the SEIAA will give clearance for the same.

Applicability of Clearances:
Environmental Clearance

Environmental Impact Assessment (EIA) Notification issued on 14th September 2006 (amended) by the MoEFCC, Govt., of India and as per the amended Notification of the MoEF on 22nd August 2013 on Highway projects. New, expansion or modernization of any activity falling within the 32 categories of developmental and industrial activities shall be undertaken in any part of India only after it has been accorded environmental clearance by the MoEF in accordance with the procedures specified in the notification. Among the 32 categories listed in Schedule -1 of

Notification, the proposed "Improvement and Upgradation of Balia-Azamgarh and from Jaunpur to Khuthan stretch (approved "In Principle" for declaration as National Highway) in the State of Uttar Pradesh" project will not attract the Environmental Clearance from MoEF since the stretch is bi-furcated into multiple packages and not greater than 100 Kms in length (See Box -1).

As per the amended Notification on 22nd August, 2013, the highways improvement/ up gradation project of this magnitude needs to prepare the EIA/EMP report as per the model ToR given in MoEF website in order to safeguard the interests of the environment and it will also acts as an environmental guide to the Project Proponent & Environment Interested Groups/ NGOs. The World Bank operational policies also suggest having an environmental assessment and management frame work in all the development projects.

Box -1:

Categorization of projects and activities

i) All projects and activities are broadly categorized into two categories – Category A and Category B

ii) Category A: Expansion of National Highways greater than 30m involving additional right of way greater than 20m involving land acquisition.

ii) Category B: All State Highway Projects & State Highway expansion projects in hilly terrain (above 1000m AMSL)

iii) & / or ecologically sensitive areas.

iv) All projects or activities included as Category 'A' shall require prior environmental clearance from the Central Government in the MOEF on the recommendations of an Expert Appraisal Committee (EAC).

v) All projects or activities included as Category 'B' will require prior environmental clearance from the State/Union territory Environment Impact Assessment Authority (SEIAA).

Amended Notification:

As per the amended Notification of the MoEF & CC on 22nd August 2013 on Highway projects - "Expansion of National Highways greater than 100 Km involving additional Right of Way or land acquisition greater than 40 m on existing alignment and 60 m on re-alignments or bypasses" may require clearance from EAC, MoEF & CC.

The proposed highway upgradation / improvement project needs to get approvals from Uttar Pradesh Pollution Control Board (UPPCB) are i.e., No Objection Certificates (NOC), Consent for Establishment (CFE) and Consent for Operation (CFO) for establishment and operation of Hot mix plants, batch mix plants, quarries etc. during the construction phase of the project.

Forest Clearance

Forest (Conservation) Act, 1980 (amended in 2003) enacted by Government of India, restricts the de-reservation of forests for use of non-forest purposes. According to the Act, State Government requires prior approval of GoI for the use of forest land

for non-forest purposes (means the breaking up or clearing of any forest land) or for assigning least to any private person or agency not controlled by government. The Forest (Conservation) Rules, 2003 issued under this Act, provide specific procedures to be followed for conversion of forest land for non-forest purposes.

Limited sub-projects may require acquisition of forest land. The forest land conversion will follow the "Guidelines for Diversion of Forest Lands for Non-Forest Purpose" under Forest (Conservation) Act, 1980. Compensatory afforestation is one of the most important conditions stipulated for diversion of forest land. The conditions of forest diversion proposals are summarized in Table 10.6.

Table 10.6: Conditions of Forest Diversion Proposals

S. No	Condition of Forest Diversion	Submission of Proposal and seeking permission from
1	Diversion of forest land for small development and public utility projects upto 5 hectares	State Government may authorize the Nodal Officer or any other Officer to submit the proposals directly to the Regional Offices.
2	Diversion of forest land up to 40 hectares and proposals for clearing of naturally grown trees for reforestation	Central Zone, Regional Office of the MoEF&CC, Lucknow.
3	All other proposals (> 40 hectares)	The Secretary, Ministry of Environment & Forests, Government of India.

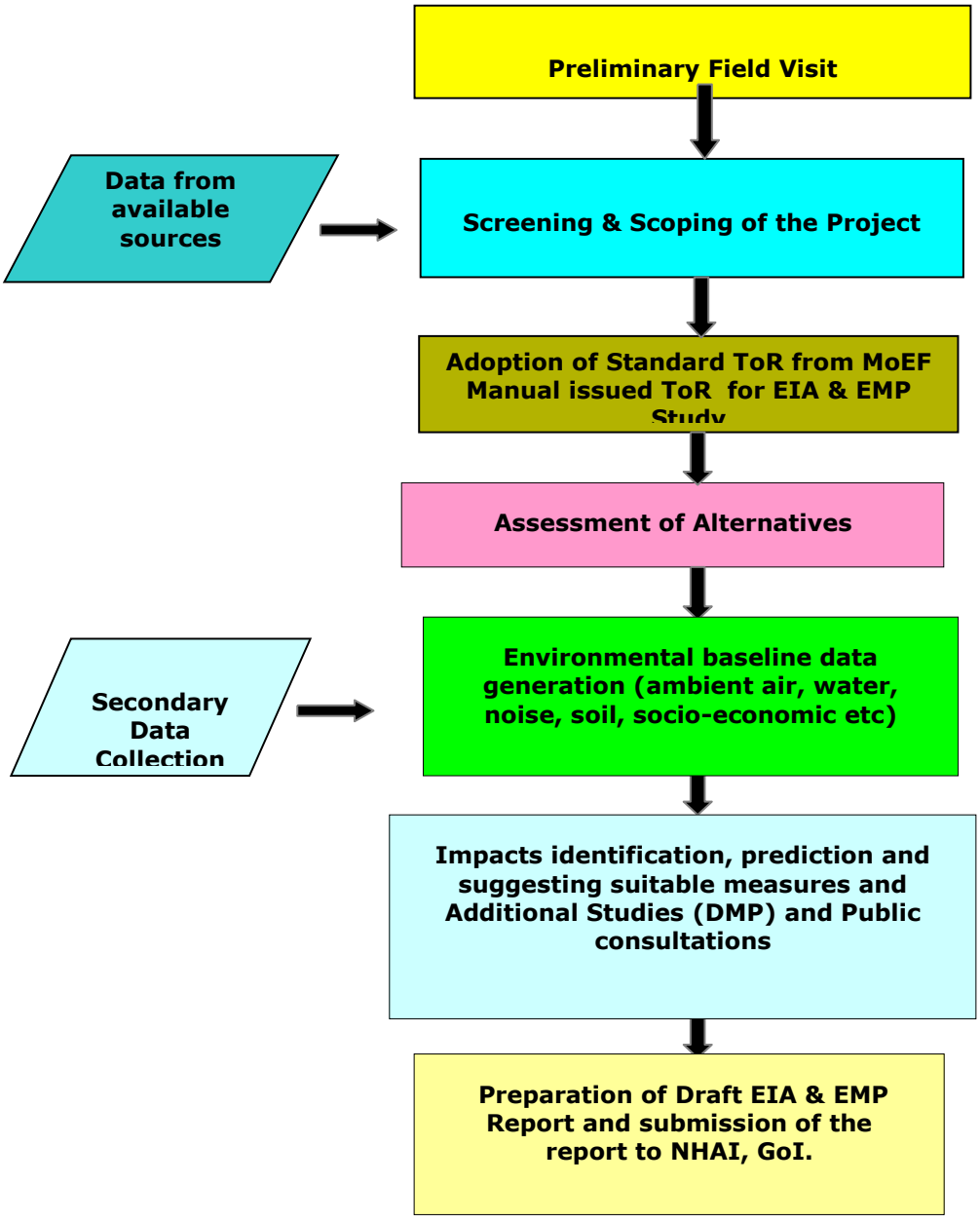
The other conditions of Forest diversion are:

- Compensatory afforestation is compulsory for conversion.
- Afforestation will be done over an equivalent area of non-forest land.
- As far as possible, the non-forest land for compensatory afforestation should be identified contiguous to or in the proximity of Reserved Forest or Protected Forest. If non-forest lands are not available in the same district other non-forest land may be identified elsewhere in the state.
- Where non-forest lands are not available, compensatory afforestation may be carried out over degraded forest twice in extent to the area being diverted.
- Conversion of forest lands that are part of National Parks/Sanctuaries and Tiger Reserve areas (notified under Indian Wildlife (Protection) Act, 1972) is not permitted. In exceptional case, the State Government requires consent of the National Board of Wildlife for obtaining approval of the State Legislature for de-notification of the area as a sanctuary.

- Cutting of trees in non-forest land, irrespective of land ownership, also requires permission from the State Forest Department. Afforestation to the extent of two trees per each tree felled is mandatory.

10.4.1 Methodology to be adopted for EIA study

The methodology to be adopted for the EIA study is shown below as Flow chart in **Figure 10.*3***.



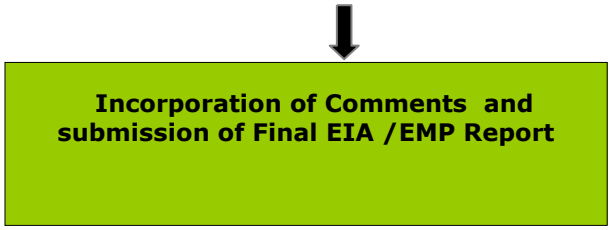


Figure 10.3: Flow Chart showing the EIA methodology

10.4.2 Scope of Environmental Impact Assessment (EIA) Study

The EIA/EMP report encompasses the findings of the study to identify, predict and evaluate the likely impacts due to the proposed activity and suitable measures to mitigate and minimize the adverse impacts and ameliorate environmental quality in the surrounding region. The environmental safety concerns which can be internalized in the project planning and implementation stages have been identified and suitable measures needed are elicited as Environmental Management Plan (EMP).

Detailed baseline data collection prior to project implementation is under progress for air, noise, water, land, biological and socio-economic environment within the project area. The baseline data for pre-project environmental status will be presented along with identification, prediction and evaluation of impacts due to project activities.

The published literature will be collected from different Govt. Organizations / Institutions, NGOs etc. to assess the baseline environment. The aim will be to collect secondary information to the maximum extent possible. The information on flora like road side plantation and fauna within the study area will be collected from the Forest Dept., Botanical survey of India, Zoological survey of India and through field verification. The information on wetland, grassland and other ecologically important areas will also be collected.

The information on geology and soil within the study area will be collected from Geological Survey of India. The information on ground water i.e. depth of water table, yield etc. will be collected from the Central Ground Water Authority, Central Water Commission, Survey of India.

District Planning Maps etc. The land use pattern within the study area in general and adjacent to the road in particular will be established through collection of

maps/documents from Survey of India, Agriculture Department and Forest Dept. and through field verification.

The climate and meteorology data i.e. temperature, wind speed, wind direction, rainfall, relative humidity, cloud cover and cyclone will be collected from Meteorological Department. Available information on ambient air quality and water quality will be collected from Central Pollution Control Board (CPCB), Uttar Pradesh Pollution Control Board, Reputed Research Laboratory and Universities. The information on archaeological and historical places, if any, will be collected from Archaeological Survey of India, Dept. of Tourism etc.

Primary/Secondary Data Collection

A) Field Reconnaissance Survey

- Preliminary field survey will be undertaken to identify the critical issues and to examine different alignment options. The following information/documents will be collected during reconnaissance survey.
- Information on location, type and sensitivity of all critical natural habitats such as reserved/protected forest, wild life sanctuaries/ wild life migratory route across the road, wet lands, grass land, sacred groves etc.
- Information on sensitive such as location of schools, hospitals, religious, archaeological and historical places.
- Assessment of air quality, noise level, water quality and soil quality monitoring stations as per BIS, CPCB, IRC and MoEF Guidelines.
- Details of roadside plantation i.e. Chainage wise and girth size wise no. of trees.
- Information on industries i.e. pollution status, discharge point/disposal site of effluent/solid waste along the corridor, if any.
- Information on flora and fauna within the study corridor will be collected and verified in the field.

B) Environmental Impact Assessment

It will include the following:

- The collected primary and secondary data will be compiled to assess the existing baseline environmental condition.
- Prediction of significant impacts

- The assessment of impact during construction and operation phase
- Suggestion of mitigation measures

10.4.3 Generic Structure of EIA report

In terms of the EIA Notification of the MoEFCC dated 14th September 2006, the generic structure of the EIA document shall be as under:

1. Introduction
2. Project Description
3. Approach & Methodology
4. Environmental Regulatory Framework
5. Analysis of Alternatives (Technology and Site)
6. Description of the Environment
7. Anticipated Environmental Impact & Mitigation Measures
8. Environmental Management Plan
9. Environmental Monitoring Plan
10. Environmental Cost Estimates
11. Summary & Conclusions
12. Disclosure of Consultants engaged

10.5 Baseline Environmental Conditions

The description of environment presents the Baseline Environmental Status of the project area in terms of its physical, micro-meteorological, chemical, biological, Social and cultural description. The baseline data would help to establish the pre-project environmental status in the project corridor. The possible impacts due to proposed activity will be predicted based on the quantification of project activities.

For the study area, primary Environmental baseline data will be collected by M/s. Aarvee Associates, Hyderabad through laboratory Recognized by Ministry of Environment & Forests, Government of India who will be engaged for the field study of air, water, noise, soil etc. The environmental attributes will be covered for the study include ambient air quality, ground and surface water quality, noise levels, land environment including soil quality, land-use pattern, forest cover, biological environment, socio-economic and health status of the population, demography and

quality of life. The primary and secondary data of the stated parameters are being collected and analyzed as per the MoEF EIA Manual for Highways, 2010. References adopted from MoEF EIA Manual for Highways are tabulated in Table 10.7. The Details of monitoring station of different environmental attributes is given in Table 10.8.

Table 10.7: References adopted from MoEF EIA Manual for Highways

S. No	Characteristics	No. of Monitoring Stations	Selection of the parameters
1	Micro-meteorological data (The wind velocity, wind direction and wind rose, rainfall, temperature and relative humidity)	1	EIA Guidance Manual for Highways – Prepared by MoEF, 2010 (Page – 17, Section 4.4: Air Environment) • Meteorological data covering maximum and minimum wind speed, wind direction, rain fall, relative humidity and temperature for atleast 10 years period should be presented from the nearest meteorological station
2	Ambient Air Quality Monitoring (Particulate Matter (size less than 10µm) or PM10, Particulate Matter (size less than 2.5µm) or PM2.5, Sulphur dioxide (SO2), Oxides of Nitrogen (NOX), Carbon Monoxide and Hydrocarbons)	6	EIA Guidance Manual for Highways – Prepared by MoEF, 2010 (Page – 17, Section 4.4: Air Environment) • Baseline data for the parameters – particulate matter size less than 10µm or PM10 µg/m3, particulate matter size less than 2.5µm or PM2.5 µg/m3, Sulphur dioxide (µg/m3), nitrogen dioxide (µg/m3) and carbon monoxide (µg/m3) in the study area should be generated for one season other than monsoon as per CPCB norms.
3	Water Quality Monitoring – Surface and Ground water (Physico-Chemical, bacteriological and heavy metals analysis)	23	EIA Guidance Manual for Highways – Prepared by MoEF, 2010 (Page – 17, Section 4.3: Water Environment) • Details of surface water bodies within right of way and within 500mts from the right of way should be documented along with the present usage. • The samples should be collected and analyzed as per the standard procedures
4	Noise Quality Monitoring (Leq day, Leq night, Leq min, and Leq max)	15	EIA Guidance Manual for Highways – Prepared by MoEF, 2010 (Page – 17, Section 4.5: Noise Environment) • While selecting the monitoring locations specific importance is to be given for sensitive environmental receptors like thickly populated areas, hospitals, schools, wildlife corridors etc.

S. No	Characteristics	No. of Monitoring Stations	Selection of the parameters
			• Hourly monitoring of noise levels (Leq) should be recorded for 24 hours by using integrated noise meter. Noise standards have been designated for different types of land use, i.e. residential, commercial, industrial areas and silence zones as per the Noise Pollution (Regulation and Control) Rules 2000
5	Soil Quality Monitoring (Physico-Chemical and heavy metals analysis)	6	EIA Guidance Manual for Highways – Prepared by MoEF, 2010 (Page – 17, Section 4.2: Land Environment) • The soil profile of the highway alignment should be presented based on the soil series maps of National Bureau of Soil Survey and Land Use. • The suggested parameters for soil analysis are pH, Electrical conductivity, sand (%), silt (%), clay (%), texture, moisture retention capacity (%), infiltration rate (mm/hour), bulk density (gm/ cc), porosity (%), organic matter (%), nitrogen (mg/1000g), potassium (mg/1000g), phosphorous (mg/1000g), sulphates and sodium sulphates.

Table 10.8: Details of dfferent Envriomental attributes monitoring stations

Sampling ID	Lattitude (North)	Longitude (East)	Location Name
Micro Meteorological			
MM	25.7575858750365	84.1459752445573	Ballia
Ambient Air Quality Monitoring			
AQ1	25.5901571284286	83.5771763788741	Ghazipur
AQ2	25.6140386372571	83.7571510186977	Mohammadabad
AQ3	25.565012191814	83.9350855521908	Narainpur – Sarai Kota
AQ4	25.7575343996102	84.1458355231544	Ballia
AQ5	25.7797338869784	84.3983415210006	Yadavnagar
AQ6	25.8085920466198	84.5706671742556	Ramgarh
Noise Quality Monitoring			
NQ1	25.5902491689303	83.5786988699982	Ballia
NQ2	25.6263876290468	83.6369585632145	Bharsouta

Sampling ID	Lattitude (North)	Longitude (East)	Location Name
NQ3	25.6139017211879	83.7569916653583	Ramgarh
NQ4	25.6005390091811	83.8162507955699	Baria
NQ5	25.564929288219	83.9353660808441	Thekaha
NQ6	25.5988866215926	83.9786959334447	Bahoran
NQ7	25.7024860261598	84.0201499324475	Salarpur
NQ8	25.7574661222067	84.1456988119051	Ghazipur
NQ9	25.7379404485633	84.2992193846162	
NQ10	25.7790029611131	84.398333328575	Ghazipur
NQ11	25.7668562843034	84.473105704152	Mohammadabad
NQ12	25.7799611127278	84.5551088284675	Narainpur – Sarai Kota
NQ13	25.8247554820285	84.587049202127	Ballia
NQ14	25.5659753367197	83.9066140955887	Ramgarh
NQ15	25.5970676626527	83.5948724758407	Yadavnagar
Surface water Quality Monitoring			
SW1	25.5872218333333	83.5807942222222	Ghazipur
SW2	25.6292460591458	83.6274724468772	Borsia
SW3	25.6162291111108	83.6932401944445	Sultanpur
SW4	25.614724677807	83.7513752759127	Mohammadabad
SW5	25.5997812816322	83.8147401201041	Parahladpur
SW6	25.5644929026776	83.935267881417	Narainpur – Sarai Kota
SW7	25.5658459968264	83.9443457604972	Sarai Kota
SW8	25.6010898038494	83.9790501387325	kumkum patti
SW9	25.6994448127674	84.0214116017379	Bairiya
SW10	25.7573585489418	84.1446959737991	Ballia
SW11	25.7382594749769	84.3027175571648	Bharsouta
SW12	25.775522527775	84.3795480555555	Bullapur
SW13	25.7742974722373	84.4079680645232	Keharpur
SW14	25.7788888888889	84.5522222222222	Thekaha
SW15	25.8187113169082	84.5822542295282	Bahoran
SW16	25.5871959376134	83.6044960810483	Jamalpur
SW17	25.7563709105088	84.0321785478919	Sahas Pur
Ground Water Quality Monitoring			
GW1	25.5901961428941	83.5774466237501	Ghazipur

Sampling ID	Lattitude (North)	Longitude (East)	Location Name
GW2	25.6141697625644	83.7568011788303	Chak Faridot Sarasan
GW3	25.564461802331	83.9345878535339	Mohammadabad
GW4	25.7574194376598	84.1465962806589	Parahladpur
GW5	25.7793347933481	84.3982276197811	Narainpur – Sarai Kota
GW6	25.8084580068033	84.5708432423457	kumkum patti
Soil Quality Monitoring			
S1	25.5905562873933	83.5774385183405	Ghazipur
S2	25.6133266171273	83.7578005307295	Mohammadabad
S3	25.5651165767814	83.9365155116291	Narainpur – Sarai Kota
S4	25.7563283205081	84.1355418283502	Ballia
S5	25.7793366704982	84.3970751815361	Ramgarh
S6	25.8076609743882	84.570426478643	Yadavnagar

10.5.1 Climatic Conditions

The climate of the region is characterized as humid sub-tropical with dry winter. The climate, wind and wave pattern are governed by the annually changing monsoons and transition periods between them dividing the year into four seasons. Meteorological seasons defined by Indian Meteorological Department (IMD) are given in Table 10.9.

Table 10.9: Seasons of the region

Season	Months	Characteristics
Winter	January-February	Cool season of the year
Pre Monsoon	March-May	Hottest part of the year, occurrence of dust storms
Southwest Monsoon	June-September	Characterized by predominantly SW winds. Generally strong and persistent winds prevail.
Post Monsoon	October-December	Characterized by predominantly NE winds. Fair weather with the variable winds

Temperature

Temperature varies from 0 to 46°. High temperatures of around 50°C have been recorded in some parts of Uttar Pradesh. Given such a wide range of temperature fluctuations in most parts of the state, it can lead to either cold waves or heat waves

both resulting in substantial loss of life and economy.

Relative Humidity

There is low relative humidity of around 20% and dust-laden winds blow throughout the season. In summers, hot winds called loo blow all across the state of Uttar Pradesh.

Floods & Droughts

Floods are a known hazard of Uttar Pradesh due to overflowing of its main rivers like Ganga, Yamuna, Ramganga, Gomti, Sharda, Ghaghra, Rapti and Gandak. Major flood management efforts have been undertaken to mitigate the risk. Most of these floods occur due to the Monsoon rains and overflowing of rivers during the rainy periods. Year 2010 witnessed one such year of flooding in Uttar Pradesh.

Shortage of rain during the highly variable Monsoon season can cause droughts in Uttar Pradesh leading to severe loss to man and property. The recurrence of a major deficiency in annual rainfall follows a 6–8 years cycle in Eastern Uttar Pradesh whereas in Western Uttar Pradesh it is a 10 years cycle.

Rainfall

The normal annual rainfall of the state is 947.4 mm and it ranges from 710 mm to 1750 mm during 40 years. The tarai foot hill receives heavy rainfall while in south part rainfall decreases. The large percentage of the annual rainfall over the state is received during June to September. The winter rainfall is received during December to February that is more in North-West part of the Uttar Pradesh. As regards the precipitation trend in the South West and South Eastern part of the state, it ranges from 672 to 1381 mm.

Seismic Zone of The Study Area

The project stretch according to the seismic zoning of India falls under zone III of moderate damage risk zone. Historically, parts of this project stretch have not experienced seismic activity.

10.5.2 Air Environment

Standard methods / procedures will be adopted during environmental monitoring analysis and report preparation. After a preliminary reconnaissance of the study region and taking into account the meteorological (predominant wind directions, wind speed), topographic conditions, major settlements & its traffic volume and details on existing industrial activities in the study region, 1 Micro-Meteorology station and different stations will be identified to carry out Ambient Air Quality Monitoring (AAQM)

in the study area spread over 105.400 Km. The parameters are being monitored in the study area are PM10, PM2.5, SO2, NO2, CO and HC. The monitoring results will be described with reference to the NAAQ Standards, 2009 and will be presented in draft EIA & EMP (Draft Feasibility) Report.

Methodology to be Adopted

In assessing the environmental impact, collection and interpretation of baseline data is of prime importance. The primary data for the study period is being collected for 24 hourly, twice a week for all the 4 weeks as per national guidelines. The criteria followed for selecting the AAQM stations is recommended by IS: 5182 and CPCB.

They are:

- The sampling station had free exposure so that it did not collect air from stagnant pockets.
- It was not obstructed by large structures including hills.
- The sampling point was not directly influenced by any local source of emission.
- It was located at a minimum height of 1.5 m from the ground level.

Monitoring and Analytical Procedure

Ambient air quality was monitored for the presence of contaminants existing in the air. In order to evaluate and quantify the air pollution problem, measurements are being carried out for various air pollutants mentioned above. This data will be used not only to evaluate the air quality in the study region but also as the basis to develop programs aiming at preventing the spread of pollutants leading to a risk to human health and general environment. Fine Dust Samplers (FDS) were used for ambient air sampling of selected parameter. The method for the selected parameter are based on the methods recommended by IS: 5182.

10.5.3 Water Environment

Selected physico – chemical parameter along with bacteriological indicators of pollution will be used for describing the baseline status of water environment. Generation of baseline data for water quality covers sources of ground and surface water. The Assessment of water quality in the study area includes

- Surface water quality (IS 2296)
- Ground water quality (IS 10500)

Surface Water Quality

During the study period multiple samples will be collected for assessing the water quality. These were identified considering proximity to the project site, their activities and depending upon its utility by the people in the region. The samples are being collected at this stage.

Surface water samples will be analysed for Temperature, pH, Turbidity, EC, Colour, TSS, TDS, Odour, DO, BOD, COD, TKN, Total Hardness, Sodium, Potassium, Calcium, Magnesium, Ammonia, Chloride, Sulphate, Phosphate, Nitrate, Fluoride, Surfactants, Dissolved Iron, Copper, Zinc, Manganese, Arsenic, Lead, Mercury, Boron, Chromium, Phenols, Cadmium, Total Coliform, Faecal Coliform. The detail analysis will be given after approval of Preliminary EIA Report.

Ground Water Quality:

Ground Water is one of the main sources of water in the project corridor for domestic, commercial and other irrigation use hence the rate of extraction of ground water is at a massive scale. For assessing the ground water quality in the study area, multiple samples will be collected from the identified bore wells/ dug wells. Selection of samples considered as per the utilization of the people along the proposed widening and improvement project.

Ground water samples will be analysed for Temperature, pH, Turbidity, EC, Colour, TSS, TDS, Odour, DO, BOD, COD, TKN, Total Hardness, Sodium, Potassium, Calcium, Magnesium, Ammonia, Chloride, Sulphate, Phosphate, Nitrate, Fluoride, Surfactants, Dissolved Iron, Copper, Zinc, Manganese, Arsenic, lead, Mercury, Boron, Chromium, Phenols, Cadmium, Total Coliform, Faecal Coliform. The detail analysis will be given after approval of Preliminary EIA report.

10.5.4 Noise Environment

Keeping in view of the proposed improvement and widening project, noise monitoring will be carried out at various locations. The locations will be selected based on land use pattern, traffic intersections and diversions along the existing alignment. Precision integrating sound level meter having statistical unit with digital display will be used for ambient noise level monitoring in the present study. The noise quality monitoring is planned and executed as per Protocol for Ambient Level Noise Monitoring. Noise monitoring for 24 hours is being carried out at each location during

the study period. Noise monitoring locations and noise levels recorded i.e., Leq day, Leq night, Lmin and Lmax to be presented.

The Central Pollution Control Board has specified ambient noise levels for different land use for day and night times. Importance was given to the timing of exposure and areas designated as sensitive. The National ambient noise level standards are given below.

Area Code	Category	Limits in Decibels (dB(A))	
		Day Time	Night Time
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silence Zones	50	40

The monitored samples are being analysed with respect to concerned national standards for the respective categories.

10.5.5 Land Environment

As part of the land environment, soil quality is being studied in detail and the same will be presented after approval of Preliminary EIA report.

10.5.6 Soil Quality

The soil samples of different area along the project stretch will be collected at different locations for assessing the physic-chemical characteristics of the soil in the project area. The quality parameters will include pH, Electrical conductivity, sand, silt, clay, texture, moisture retention capacity, infiltration rate, bulk density, porosity, organic matter, Nitrogen, potassium, phosphorous, Pb, iron and organic carbon.

10.5.7 Landuse Pattern

The proposed highway project stretch traverses predominantly through plain terrain (70%) followed by rolling terrain (30%). The predominant soils identified in the study area are Shallow red gravelly clay, Moderately deep red gravelly loamy soils and Moderately deep red calcareous clay soils. The objectives of land use studies are:

- To determine the present land use pattern.

- To determine the temporal changes in land use pattern over a period.
- To analyse the impact on land use due to proposed site in the study area.

10.6 Socio-economic Environment

The study area is falling under Ghazipur and Ballia districts in state of Uttar Pradesh. The socio-economic features of the districts as per Census 2011 is given in Table 10.10.

Table 10.10: Socio-economic Features of Study Area

S. No	Parameters		Ballia District	Ghazipur District
1	Population		32,39,774	36,22,727
2	Males		16,72,902	17,66,143
3	Females		15,66,872	18,56,584
4	Population Growth (2001-2011)		16.73%	19.26%
5	Literacy rate	Total	70.90%	74.27%
		Male	81.5%	85.77%
		Female	59.8%	62.29%
6	Geographical area		1981 km2	3378 km2
7	Sex ratio (no. of females per 1000 males)		933	951
8	Urban Population		3,04,109	2,73,872
9	No. of Tehsils		1	6
10	Density of Population		1081/km2	1072/km2

10.7 Anticipated Environmental Impacts and Mitigation Measures

The rehabilitation and upgrading of the existing road to 2/4-lane with paved shoulders exhibit a symbiotic relationship between the environment and development with both positive and negative and reversible and irreversible impacts. The present chapter will be suggesting the analysis of the impacts in the proposed rehabilitation and up-gradation project and suggested mitigative measures. The Flow Chart showing the Itinerary of assessment, evaluation & interpretation of impact, prediction of impacts and suggesting suitable measures in **Figure 10.*4***. The project specific impacts assessed will be described in draft EIA & EMP after approval of Preliminary EIA report.

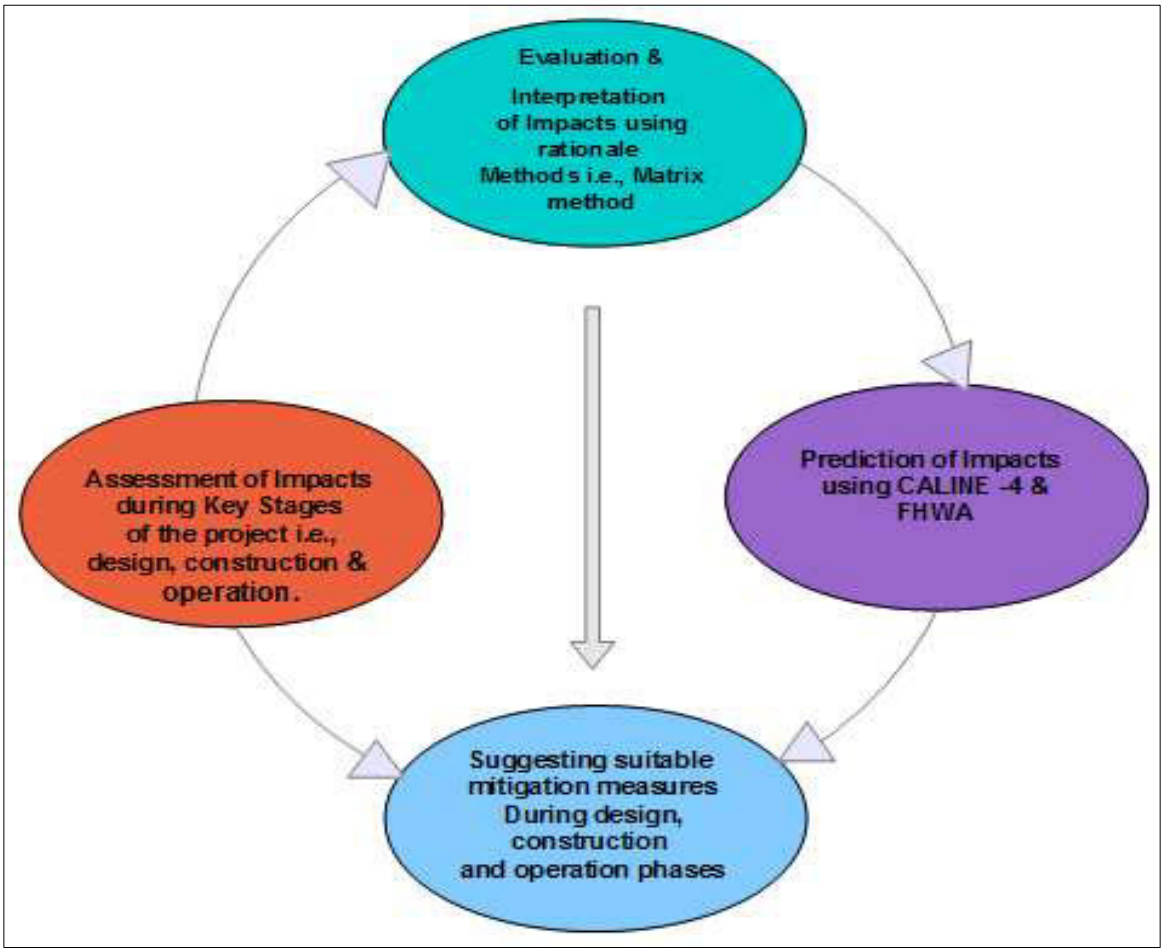


Figure 10.4: Itinerary of Assessment of Impacts and Mitigation Measures

10.7.1 Assessment of Impacts in Key Stages of the Project

The rehabilitation and upgrading of the existing road to 2/4-lane with paved shoulders projects can have impacts or cause impacts in three specific situations as follows:

- Impacts due to Project Design,
- Impacts during Construction, and
- Impacts during Operational stage.

10.7.2 Impacts due to Project Design

The engineering design of the road will be finalized by considering all environmental safeguards. The project envisages natural drainage network, roadways which will have marginal negative impacts of temporary and localized in nature. Land acquisition for road development is minimal of less than 10m. Rehabilitation and upgrading of the existing road is unavoidable and may lead to loss of livelihood for

very few project affected peoples.

10.7.3 Impacts during Construction Stage

The construction stage is one of the critical stage of the project which may pose maximum impact on the environment. The major impacts associated in this stage from site clearance to the final BT Stage of the main carriageway will be identified and the appropriate mitigation measures are being suggested.

10.7.4 Impacts during Operation Stage

The proposed project can harmonize with the surrounding environment and serve multiple users with the following positive impacts.

- To relieve traffic congestion on towns /cities along the proposed stretch.
- To provide effective linkage to Uttar Pradesh.
- To Increase access to markets, jobs, education, and health services.

However, some of the negative impacts are also associated in this stage. The major impacts envisaged in this stage are increasing of traffic resulting an increase of air as well as noise pollution. To minimise the impacts an appropriate mitigative measures will be suggested.

10.8 Evaluation and Interpretation of The Impacts

Matrix method will be adopted for the evaluation of impacts. Based on the scoping of the areas and the work being proposed the following key issues were evaluated for this project.

- Preservation of aesthetic and landscape of the area to the possible extent.
- Effective restoration of Burrow areas and quarries.
- Evaluation of Environmental Quality
- Tree removal and tree plantation.
- Sanitation and waste disposal.
- Road safety.
- Protection of flora and fauna.
- Afforestation

The outcome of the results will be interpreted. The interpreted values will be helpful for the decision makers to take appropriate decision in right time.

10.9 Prediction of The Impacts

As discussed earlier, the major impacts associated with this project are air and noise. The air quality due to vehicular movement is predicted using the CALINEPro software and to predict the cumulative noise impacts, a Federal Highways Administration (FHWA) Noise Model will be adopted. The air and noise impacts are aimed to predict the future impacts for "Without and With Project Scenario" by using the traffic study report.

10.10 Suggesting suitable Mitigation Measures

The mitigation measures are highlighted for the following key issues in the project.

- Soil quality (Top soil, soil erosion etc)
- Solid waste or muck disposal
- Air quality
- Water quality (wetlands, water bodies, groundwater etc)
- Noise quality
- Biological Environment (Flora, fauna, tree plantation and enumeration)
- Socio-economic quality of life
- Safety and health aspects during construction and operation phase.

10.11 Environmental Management Plan

The Environmental Management Plan (EMP) states the procedure in which the project proponent would carry out the implementation of the mitigation measures and ensure compliance with environmental regulations that are binding on the project. The EMP also specifies the organizational requirements and institutional strengthening necessary for sound environmental management of the project. The major components of the EMP are:

- EMP Implementing Agency
- Monitoring of the EMP implementation
- Training on Environmental management
- Budget for EMP implementation.

The project specific EMP with budgetary provisions will be given after approval of Preliminary EIA Report.

10.11.1 EMP Implementing Agency

The Project Proponent will establish an Environmental Management Cell (EMC) to supervise and implement the mitigation measures as documented in the EMP. This EMC must also be adequately empowered to discharge the responsibilities as outlined in the EMP. To ensure smooth implementation of EMP the project proponent will have to collaborate with various government agencies like Public Works Department, Revenue Department, State Pollution Control Board, State Forest Department, Police Department and other allied departments.

10.12 Monitoring of EMP Implementation

The EMP will primarily be implemented by the Project Proponent and Civil Contractor. However, for an effective implementation of EMP, the current project will be monitored two level monitoring. The first one is internally by top management of Contracting Company and the second one by the National Highways wing under the R&B, Govt. of Uttar Pradesh. The EMC constituted by Contracting Company shall be the prime agency for monitoring all the activities during construction and operation phases. National Highways wing under the R&B or supervision consultant appointed by R&B shall supervise all activities and accordingly advise the Contracting Company to improve on areas where any shortcomings are observed. The EMC shall provide all the monitoring results to National Highways wing under the R&B. National Highways wing under the R&B shall keep a record of all information and shall suggest suitable measures to be adopted by Contracting Company if any aspect is found to be deviating from the stipulated values/ standards. Monitoring shall be carried out during construction and operation phase.

10.13 Budget for EMP Implementation

The design and construction of the project involves a number of items such as resettlement & rehabilitation, erosion prevention, rehabilitation of borrow areas, tree plantation, safety signage etc., which are included in the contract cost. Only those items that are not covered under the budget for construction will be shown in the EMP implementation budget.

The main components are as follows:

- Setting up of Environment Management Cell
- Tree Plantation
- Environmental monitoring during construction and operation phases

- Conducting awareness programmes
- Capacity building and training during construction and operation phases.

11.0 INITIAL SOCIAL IMPACT ASSESSMENT

11.1 INTRODUCTION

The National Highways Authority of India (NHAI) is engaged in the development of the National highways in the state of Uttar Pradesh. As part of this endeavor, NHAI has decided to upgrade some of the existing National Highways in the State of UP to National Highway standard. It was also decided to take up the preparation of DPR for these highways which are being upgraded to National Highway Standard. The consultancy services for preparation of Feasibility Report cum Detailed Project Report (DPR) of 4 laning of Ghazipur Ballia – UP/Bihar section from Km 0.000 to 128.000 of NH-31 and Construction of 2/4 laning Flyover at Ballia (Chandra Shekhar Mod to Satish Chandra College) was awarded to Aarvee Associates.

The Letter of Acceptance was communicated vide letter No. NHAI/ Tech/ NH-19/ Pkg-I/ 2016/ 103661 dated 31st July 2017. The Agreement for consultancy services was concluded with NHAI on 04/09/2017. Letter of commencement was issued vide letter No. NHAI/ Tech/ NH-19/Pkg-I/DPR/2016/105592 dated 08.09.2017.

Final DPR for the existing road "Special Repair and Maintenance work from Ghazipur to UP/Bihar border NH-31 from Km 405 to Km 535 including construction of New MJB at Km 412.130 and rehabilitation of MJB at Km 533 on EPC mode" submitted vide our letter no. AA/HW/NHAI/2114/18-19/9105 dated 26.03.2019. As per the directions from project authorities, the alignment proposals were reviewed in view of the MoRTH Circular No. NH-15017 / 21 / 2018 – P & M dated 26.02.2018. The greenfield alignment option including comparison table showing the cost comparison of widening of the existing alignment option via-a-via widening of was prepared and the same was reviewed at various levels and it was decided that green field alignment with spur providing connectivity to Buxar was approved during the meeting held in Ministry under the Chairmanship of Secretary and the Minutes of Meeting were communicated vide letter No. NHAI/Tech/ NH-19/Ghazipur-Ballia/ DPR/2016/122312 dated 13.08.2018.

The District Administration of Ballia held public consultations regarding the proposed elevated flyover and communicated their decisions vide MoM dated 1393/ 14 – 1 dated 20.10.2018. The MoM inter-alia state that widening of the existing road to four lane standards would serve the traffic problems in Ballia town and elevated flyover is not required since construction of the said flyover would result in acquisition of land

and structures for the purpose of flyover.

Public consultation meeting on the project alignment was held in the office of District Magistrate Ballia on 05.09.2018 wherein the committee recommended that the bypass alignment for Ballia be considered on the south side. This will require modification of the alignment approved earlier in a length of approximately 38.50 km. The said modification was reviewed during the meeting held on 08.12.2018 at NHAI HQ, New Delhi under the chairmanship of Member (P) and agreed by Member. Variation with financial implication for new Greenfield alignment was approved from RO, Varanasi vide letter no. NHAI/UP (E)/GM (T)/NH-19/Ghazipur-Ballia/DPR/14 dated 27.10.2020. Accordingly, the Inception & Alignment report for the approved Greenfield alignment were prepared and submitted vide our letter no. AA/HW/NHAI/2114/20-21/2820 & 2966 dated 06.11.2020 & 16.11.2020.

11.2 PROJECT ROAD DESCRIPTION

The Greenfield project highway starts at Km.0.000 near Hridaypur, Sarai Bandi on NH-29 Ghazipur- Gorakhpur road at Km 84.800 (NH-29 Chainage) and ends on NH-19 Bahoran Tola village in Bihar of Raghunathpur- Chappra Road. The total project highway traverses in the Ghazipur and Ballia and Saran districts. It traverses mostly through plain terrain and a mixed land use of residential and agricultural can be seen throughout the corridor.

S. No	Project Highway	Design Chainage (Km)		Remarks
		From	To	
1	Ghazipur to Manjhi Ghat UP/Bihar Border	0.000	115.600	NH-31
2	Buxar Spur	0.000	17.800	

11.3 EXISTING CHARACTERISTICS OF THE ROAD

The part of project corridor where existing stretch is being used is of 2 lane undivided carriageway varying from 7 meter to 10 meters. A major stretch of existing road is two lanes with 7m width. The paved shoulder of 1.5m width was observed in some parts of the corridor. A large chunk of adjoining land is found to be used for agricultural purposes followed by built-up sections. Major part of project stretches traverses through plain terrain.

11.4 LAND USE PATTERN

In project area, the land use is characterized by agricultural lands, barren, built up area, forest, plantation and water bodies. The built-up area is characterized by residential structures, commercial units, bus shelter, government offices, school, Panchayat office and Kiosks etc. With regard to land use pattern, a major track of land is used for agricultural purposes followed by built-up area and barren/Open land. Wheat and Sugar cane and millets are widely cultivated along the project roads.

11.5 REVENUE VILLAGES/ SETTLEMENTS ALONG THE ROAD

The existing road passes through 173 (152- Greenfield Alignment + 21 Buxar Spur) villages/settlements and also passes through some congested built-up locations which make through traffic very slow and dangerous. In this connection, alternative alignments are proposed. The list of villages along with chainages is given in Table 11.2.

Table 11.2: List of Villages along the Project Road – Greenfield Alignment

S. No	Village Name	Chainage (Km)		Length (km.)
		From	To	
1	Hridaypur	0.000	0.570	0.570
2	Saraibandi	0.570	0.750	0.180
		0.860	1.025	0.165
3	Nasirpur	0.750	0.860	0.110
		1.025	1.450	0.425
4	Dadi Kala	1.450	1.635	0.185
5	Khazapur	1.635	2.015	0.380

S. No	Village Name	Chainage (Km)		Length (km.)
		From	To	
6	Dhobha	2.015	2.500	0.485
7	Ramdoopur	2.500	2.550	0.050
8	Mirzapur Mafi	2.550	3.050	0.500
9	Bhikharipur	3.050	3.550	0.500
10	Manpur	3.550	4.280	0.730
11	Tikari	4.280	5.335	1.055
12	Sathipur	5.335	6.070	0.735
13	Bisunpur Datta	6.070	6.210	0.140
14	Newada	6.210	6.295	0.085
15	Subhakarpur	6.295	7.950	1.655
16	Akhatiyarpur	7.950	8.530	0.580
17	Chak Ajam	8.530	9.200	0.670
18	Raibanpah	9.620	9.660	0.040
19	Badhui khurd	9.200	9.620	0.420
20	Chak Niamtulla	9.660	10.100	0.440
21	Badhui Buzurg	10.100	10.210	0.110
22	Thanaipur	10.210	10.860	0.650
23	Hardia	10.860	11.880	1.020
24	Rasoolpur ahmad	11.880	12.605	0.725
25	Said chak	12.605	13.090	0.485
26	Abbaspur	13.090	13.335	0.245
27	Baluwa Mu. Nonhara	13.335	14.935	1.600
28	Lalapur adai	14.935	15.400	0.465
29	Sukhpura	15.400	17.050	1.650
30	Todarpur Urf Partap pur	17.050	17.575	0.525
31	Fakkrabad	17.575	18.065	0.490
		18.315	18.575	0.260
32	Sakatpur	18.065	18.315	0.250

S. No	Village Name	Chainage (Km)		Length (km.)
		From	To	
	Bareji			
		18.575	19.970	1.395
33	Paharipur	19.970	21.550	1.580
34	Gajraj Gadaipur	21.550	22.100	0.550
35	Parsa	22.100	24.370	2.270
36	Indrapur	24.370	24.885	0.515
37	Tarapur	24.885	25.560	0.675
38	Faizullapur	25.560	26.670	1.110
39	Mahmoodpur irf dodadih	26.670	26.900	0.230
40	Bagend	26.900	27.550	0.650
41	Rampur	27.550	28.740	1.190
42	Raipur M. Rajapur	28.740	28.790	0.050
43	Padraw	28.790	29.580	0.790
44	Sher	29.580	30.510	0.930
45	Baddopur	30.510	30.560	0.050
46	Bathor	30.560	31.800	1.240
47	Dilawaalpur	31.800	32.340	0.540
48	New urf uchadih	32.340	32.600	0.260
49	Chandkur	32.600	32.850	0.250
50	Karimuddinpur	32.850	34.150	1.300
51	Baijnathpur	34.150	34.200	0.050
52	Lathudih	34.200	34.870	0.670
53		34.985	35.150	0.165
	Jayantipur	34.870	34.985	0.115
54	Chak gareeb	35.150	35.450	0.300
55	Vishambharpur Aarzai Maafi	35.450	35.610	0.160
56	Karkatpur	35.610	36.250	0.640

S. No	Village Name	Chainage (Km)		Length (km.)
		From	To	
	Mu.utraon			
		36.450	36.580	0.130
57	Karkatpur Mauja	36.250	36.450	0.200
58	Vishambharpur panjum	36.580	36.820	0.240
59	Bisambarpur Panjam	36.820	37.030	0.210
60	Vishambharpur-Part-3	37.030	37.240	0.210
61	Bibipur Khas	37.240	37.350	0.110
62	Bharaouli Kalan	37.350	37.820	0.470
63	Patar	37.820	39.230	1.410
64	Tajpur	39.230	39.500	0.270
		39.650	40.750	1.100
65	Patar	39.500	39.650	0.150
66	Bhediausar	40.750	41.070	0.320
67	Kajichak	41.070	41.480	0.410
68	Gopalchak	41.480	41.910	0.430
69	Bharauli Ala	41.910	42.350	0.440
70	Sahapur	42.350	43.200	0.850
71	Lakra	43.200	43.550	0.350
72	Badhwalia	43.550	43.800	0.250
73	Awagilwa	43.800	44.250	0.450
74	Hardarpur	44.250	45.550	1.300
75	Tikapur	45.550	47.050	1.500
76	Basaratpur	47.050	48.050	1.000
77	Sultanpur	48.050	49.750	1.700
78	Kotwari	49.750	50.390	0.640
79	Kurchunda Mu. Singhpur	50.390	50.780	0.390
80	Kalyanpur	50.780	50.930	0.150

S. No	Village Name	Chainage (Km)		Length (km.)
		From	To	
81	Kurchunda Ekoni	50.930	51.250	0.320
82	Ekoni	51.250	52.200	0.950
83	TeteDad	52.200	52.400	0.200
84	Teekha	52.400	52.600	0.200
85	Teekha	52.600	53.850	1.250
86	Cheruia	53.850	53.900	0.050
87	Bairiya	53.900	54.220	0.320
88	Bhawarkol	54.220	54.550	0.330
89	Narhi	54.550	55.250	0.700
90	Gangahara	55.250	56.250	1.000
		56.350	56.890	0.540
91	Vaina	56.250	56.350	0.100
92	Baghe Ji	56.890	57.350	0.460
93	Sagarapalli	57.350	58.980	1.630
94	Daraopur	58.980	59.350	0.370
95	Kaap Nasirabad	59.350	59.670	0.320
96	Sharfuddinpur Mu	59.670	60.200	0.530
97	Devariyakurdh	60.200	60.390	0.190
98	Mubarakpur	60.390	60.730	0.340
99	Khap Khori Pakar	60.730	60.890	0.160
100	Parsipatti	60.890	61.190	0.300
101	Maldepur	61.190	61.280	0.090
102	Haibatpur	61.280	62.120	0.840
103	Bijaipur	62.120	63.280	1.160
104	Bankata	63.280	63.800	0.520
		63.850	64.120	0.270
105	Makhdumhi	63.800	63.850	0.050
106	Bedua	64.120	64.420	0.300

S. No	Village Name	Chainage (Km)		Length (km.)
		From	To	
107	Hirpur	64.420	65.050	0.630
108	Neori Taluka Jamuaon	65.050	65.110	0.060
109	Chandanapur	65.110	65.280	0.170
110	Kanspur	65.280	65.550	0.270
111	Jamuwa	65.550	65.950	0.400
112	Moorki	65.950	66.770	0.820
113	Jamun	66.770	67.430	0.660
114	Kishun Nagar	67.430	68.180	0.750
115	Mohan Chhapra	68.180	68.390	0.210
116	Nagwa	68.390	69.950	1.560
117	Harlal Chhapra	69.950	70.310	0.360
118	Jinari	70.310	71.600	1.290
119	Mafi Janari	71.600	71.870	0.270
120	Bhel Sarh	71.870	73.300	1.430
121	Urgasenpur	73.300	73.330	0.030
		73.450	73.650	0.200
122	Bhimpatti	73.330	73.450	0.120
123	Oujha Kacchua	73.650	74.380	0.730
124	Kachha Khas	74.380	75.350	0.970
125	Rampur Titihi	75.350	76.530	1.180
126	Pochhari	76.530	77.130	0.600
127	Pindari	77.130	78.100	0.970
128	Sihakhund	78.100	79.100	1.000
129	Bharkoka	79.100	80.690	1.590
130	Kathal	80.690	80.920	0.230
131	Mudadih	80.920	81.450	0.530
		82.070	84.130	2.060
132	Laakhpur	81.450	82.070	0.620
133	Belhari	84.130	85.700	1.570

S. No	Village Name	Chainage (Km)		Length (km.)
		From	To	
134	Malikpura Mu. Jagchhapra	85.700	86.340	0.640
135	Dudaila	86.340	87.150	0.810
136	Khajuhati	87.150	87.910	0.760
137	Raghunathpur	87.910	88.800	0.890
138	Kanchanpur	88.800	89.590	0.790
139	Kewa	89.590	90.350	0.760
140	Mansing Chapra	90.350	91.000	0.650
141	Cherdih	91.000	92.250	1.250
142	Moon Chhupra	92.250	97.030	4.780
143	Bairiya	97.030	97.450	0.420
144		98.460	100.800	2.340
145	Tengarahi	97.450	98.460	1.010
146	Sonabarsa	100.800	105.920	5.120
147	Ibrahimabad Uparwar	105.920	108.850	2.930
148	Chanddiar	108.850	109.850	1.000
		112.100	113.290	1.190
149		109.850	112.100	2.250
150		113.290	114.550	1.260
151	Bahoran Tola	114.550	114.890	0.340
		115.200	115.460	0.260
152		114.890	115.200	0.310

Table 10.1: Major settlement in project stretch – Buxar Spur

S. No	Village Name	Chainage (km)	
		From	To
1	Bathor	0.000	0.050
2	Chandpur	0.050	0.350
3	Karimuddin pur	0.350	2.450
4	Kotiya Kodartal	2.450	3.250
5	Deoria	3.250	4.500
6	Maragupur	4.500	5.050
7	Musur Dewa	5.050	5.750
8	Khardiha	5.750	7.250
9	Bhushula	7.250	8.430
10	Muktapur Urf Charkha	8.430	8.730
11	Murera Bhuzurg	8.730	9.450
12	Shah pur	9.450	10.000
13	Basnia	10.000	11.050
14	Tetarpur Mutkle Dularpur	11.050	11.250
15	Tetarpur Kalan	11.250	12.600
16	Ramgarh	12.600	13.850
17	Kamal Pur	13.850	14.550
18	Jajar Kalsa	14.550	14.600
19	Kurmidi	14.600	15.780
20	Chintamanpatti	15.780	16.470
21	Kumkum Patti	16.470	17.280

11.6 SCOPE OF SERVICES

As far as possible, the construction of road shall be carried out within the proposed right of way. The tract of alignment necessitates land acquisition. However, in urban locations of Gazipur, Muhammadabad, Ballia town where widening of existing road to four lanes with configuration is not possible hence bypass proposal is considered. While finalizing the road alignment efforts have been made by adopting appropriate engineering designs, to minimize resettlement impacts. To minimize displacement and to reduce disruption of livelihoods 7 bypasses have been proposed.

11.7 PURPOSE OF THE SOCIAL IMPACT ASSESSMENT STUDY

Social assessment study is generally carried out to identify critical locations and issues that need to be studied further in detail for impact assessment, mitigation measures and management plan. In socio economic point of view, the identified areas directly served by the project road delineate the broad and immediate picture of influence area.

The primary purpose of social assessment is to provide an overview of socio-economic setup and the relative status of the project influence area within the state. Data considered include physical, biological, demographic aspects, macro-economic indicators and sectoral production of agriculture and allied activities, manufacturing, mining and service sectors including infrastructure. Secondary data available with various government departments are collected and analysed for preparation of the socio-economic profile.

11.8 OBJECTIVE OF THE STUDY

The objective of the survey is to generate an inventory of social impacts on the likely to be affected people by the project. The project impacts were identified through a series of exercises including social screening during early project preparation stage and informal public consultations with villagers and road users. The screening on each road section focuses on:

- identification of social issues such as involuntary resettlement;
- current usage of land in proposed ROW;
- potential impact of the proposed project on productive resources, natural resources, common property resources and social infrastructures;
- social, economic, cultural and demographic characteristics of the potential project affected population;
- identification and special need analysis of vulnerable groups, ethnic minorities and SC/STs among the population;
- consultation with the Project affected people

11.9 METHODOLOGY

Approach and methodology mainly consist of quantitative and qualitative tools and techniques. The study was conducted in two phases.

11.9.1 PHASE – I: PRE-SURVEY ACTIVITIES

11.9.1.1 Collection and review of project literature

This phase intends to familiarize with the concerned and important stakeholders to identify and collect the available literature and to scope the activities. This involved two-pronged approach (a) discussions with Project Implementing Authorities and other concerned, b) collection of available relevant project literature. Consultations were held with concerned revenue officials and local people to establish the ownership of land. Literature review and consultations formed the basis for identification of stakeholders.

11.9.1.2 Rapid reconnaissance survey to familiarize field activities

In addition to review and consultations, rapid preliminary field visits were conducted as part of ground truthing exercise. It provided the elementary idea about field research preparation and helped for pilot testing of schedules and checklists.

PHASE II: SURVEY ACTIVITIES

11.9.2.1 a) Identification of Structures

The social team conducted an identification of structures within 22.5 meter on either side of the existing central line of the project road. The database with respect to likely to be affected structures within proposed ROW will be used later to identify structures during census survey. The present survey includes comprehensive examination of people's assets, important cultural or religious sites, and common property resources. All the affected properties belonging to both titleholders and non-titleholders shall be incorporated in Detailed Project Report. The required volume of land and structures with location, size, geometry, type of construction, name of the owner(s), address etc. shall also be covered.

b) Consultations

The informal consultations were undertaken with villagers for dissemination of information about the alignments and the need of bypasses. In identification stage the discussions centred on the mapping of the social issues related to the project

stretch and thereby understand the concerns and aspirations of the people on proposed bypasses. The informal meeting also facilitated to make a rapport with likely to be affected APs in the proposed bypass villages and built up location.

Though the road passes through number of villages/ settlements but the socio-economic profile across this whole stretch of 130 Kms has lot of uniformity. The issues emerged out of consultative process are also quite common with minor variations. The focus on the likely to be project affected people, dependants, impact on livelihood and likely losses of property were central theme of our consultation programmes.

11.10 PROJECT IMPACTS

The initial social assessment study ascertains the likely magnitude of impact on live and livelihood of the people due to land acquisition. The proposed road necessitates land acquisition from current owners/users. The construction of road project will have significant positive impacts, but they may simultaneously also bring negative impacts on nearby communities, if proper precaution is not taken during design and implementation stage of the project. Acquisition of land may cause social disruption and economic loss for project affected persons (APs) and their families. It is, therefore, important that disturbances and losses of APs due to project are minimized through proper planning. The Resettlement Action Plan needs a broad and comprehensive study and that will be incorporated in subsequent reports. While finalizing the road alignment efforts has to be made by adopting appropriate engineering designs, to minimize resettlement impacts.

Social impacts can be positive or negative. The negative impact may affect the employment, income, production, way of life, culture, community, environment, health and well-being, personal and property rights, and fears and aspirations of the people. In this regard, the social impact assessment for the proposed road will be an attempt to ascertain negative or positive impact on the existing social and cultural condition of people including inter and intra group dynamics, relationships, institutions, values systems and potential changes.

11.10.1 Extent of Land Acquisition

As per our initial assessment, the proposed project road would require both private and government land of approx. 850 hectares. With regard to upgradation and

improvement of existing alignment, an additional 35-meter RoW is required to accommodate various features of the proposed road. Of the total required land for the project, approx. 850 hectares needs to be acquired for the proposed bypasses/realignment. The scope of land acquisition in the project road sections includes a) a minimum 45m RoW is required for upgradation of road as per IRC Guideline b) 60m at greenfield Alignment.

Table 11.3: Land Requirement for the Proposed Project Road

S. No.	Project Component	Length in Kilometer	Land to be acquired in Hectare
1	Greenfield Alignment	104.260	850.000
2	Widening of the existing road	11.200	
	Total	**115.460**	**850.000**

Source: Land Acquisition Plan, Aarvee Associates

The exact number of likely to be affected households and thereby magnitude of impact can be determined after the completion of survey. All the affected properties belonging to legitimate owners shall be incorporated in the subsequent reports.

11.11.2 Religious Structures Along the Project Stretch

During impact assessment survey, 2 religious structures adjacent to the existing road were identified. Almost all likely affected religious structures were observed within a distance of 5-10 m from the edge of the shoulder.

With utmost care and innovative engineering techniques some prominent medium or large religious structures need to be saved either from demolition or relocation. Proper provision must be considered for relocating these structures before the implementation of the project to avoid land acquisition conflict and communal problems.

Table 11.4: List of Religious Structures

S. No.	Chainage	Side	Type
1.	526.100	RHS	Temple
2.	530.200	RHS	Temple

11.12 LEGAL POLICIES AND RESETTLEMENT FRAMEWORKS

11.12.1 Principles and Policies needs to be adopted for the Project

The core involuntary resettlement principles for this project are: (i) land acquisition, and other involuntary resettlement impacts will be avoided or minimized exploring all viable alternative project designs; (ii) where unavoidable, time-bound resettlement action plan (RAP) will be prepared and APs will be assisted in improving or at least regaining their pre-project standard of living;(iii) Consultation with APs on compensation, disclosure of resettlement information to APs, and participation of in planning and implementing sub-projects will be ensured; (iv) payment of compensation to APs for acquired assets at replacement rates; (v) payment of compensation and resettlement assistance prior to the construction contractor taking physical acquisition of the land and prior to the commencement of any construction activities.

11.12.2 Minimization of Social Impacts

According to the broad principle mentioned above, an appropriate decision by engineering, environmental and social impact assessment teams has to be taken to avoid land acquisition from fertile lands, religious places, graveyard and also in congested built up locations (which would save both displacement and livelihoods as well as excessive costs).

11.12.3 Rehabilitation and Relocation of PAPs

Restoring livelihood for project affected people is an important task in resettlement plan. The required support shall be extended to the affected households during relocation and a time bound, fair & just entitlements shall also be given to the people to compensate and regain their pre-project level status.

11.12.4 The Right To Fair Compensation And Transparency In Land Acquisition, Rehabilitation And Resettlement Act,2013

The 1894 Land Acquisition Act was repealed, and a new comprehensive legislation was brought in Parliament and it came to effect on 1st January 2014. This Central Act ensures, in consultation with institutions of Local Self-Government and Gram Panchayats established under the Constitution, a humane, participative, informed and transparent process of land acquisition for industrialization, development of essential infrastructural facilities and urbanization with the least disturbance to the

owners of the land and other affected families and provide just and fair compensation to the affected families whose land has been acquired or proposed to be acquired or are affected by such acquisition and make adequate provisions for such affected persons for their rehabilitation and resettlement and ensuring that the cumulative outcome of compulsory acquisition should be that the affected persons become partners in development leading to an improvement in their post-acquisition social and economic status and for matters connected therewith or incidental thereto.

The provisions of this Act Under Section 2(1) relating to land acquisition, compensation, rehabilitation and resettlement, shall apply, when the appropriate government acquires land for its own use, hold and control, including for Public Sector Undertakings and for public purpose. Under LARRA- 2013 for land acquisition for various types of project, provisions of consent have been inbuilt to secure the interest of the stakeholders. As far as National Highways project is concerned [when the appropriate government acquires land for infrastructural projects under Section-2 (1) (B) (Vii)] consent is not required.

Table 11.5: Consent requirements for project as per types and sites

Protect Type + Area	Consent	
	Landowners and Tenants	Gram Sabha/ Panchayat/ Autonomous District Council
Public + Non-Scheduled Area	Not required	Not required
Public + Scheduled Area	Not required	Required
PPP + Non-Scheduled Area	Required (70%)	Not required
PPP + Scheduled Area	Required (70%)	Required
Private + Non-Scheduled Area	Required (80%)	Not Required
Private + Scheduled Area	Required (80%)	Required

Source: LARR Act-2013, Ministry of Law and Justice

The LARRA, 2013 provides a framework for facilitating land acquisition in India. LARRA, 2013 enables the State Government to acquire private land for public purposes. With regard to land acquisition for the proposed alignment, the state government of Andhra Pradesh has to follow this LARR Act. For provision of

compensation and other applicable entitlements it is bound to abide by the guiding principles laid down under Schedule- I and II of the Act.

11.13 Scheduled Caste and Scheduled Tribes Orders (Amendment) Act, 2002

The Act provides for the inclusion in the lists of Scheduled Tribes (ST), of certain tribes or tribal communities or parts of or groups within tribes or tribal communities, equivalent names or synonyms of such tribes or communities, removal of area restrictions and bifurcation and clubbing of entries; imposition of area restriction in respect of certain castes in the lists of Scheduled Castes (SC) and the exclusion of certain castes and tribes from the lists of SCs and STs.

11.14 Various Provisions Under LARR Act-2013

Table: 11.6 – THE LAND ACQUISTION, REHABILATATION AND RESETTLEMENT ACT,2013

1. LAND ACQUISITION
In case of land acquisition, the amount of compensation to be determined is that of the value of the land +100 percent Solatium+12 percent additional market value from the date of notification to taking over the possession or award whichever is higher. **Market value of land as mentioned under section 26 of LARRA Act-2013 needs to be multiplied by the radial factor (based on the distance of project from urban area as notified by the appropriate government- e.g multiplication of 2 in Rural area and Multiplication of 1 in Urban area) plus value of assets attached to land or building (mentioned in Section 29 of LARRA Act-2013) Plus Solatium (solatium includes 100% market value multiplied by 2 plus value of assets in Rural area and multiplied by 1 plus value of assets in urban area)**
2. PROVISION OF HOUSING UNITS IN CASE OF DISPLACEMENT
If a **house is lost in rural areas, a constructed house shall be provided as per the Indira Awas Yojana specifications.** If a **house is lost in urban areas, a constructed house shall be provided, which will be not less than 50 sq mts in plinth area.** The benefits listed above shall also be extended to any affected family which is without homestead land and which has been residing in the area continuously for a

period of not less than three years preceding the date of notification of the affected area which has been involuntarily displaced from such area:

Provided that any such family in urban areas which opts not to take the house offered, shall get a one-time financial assistance for house construction, which shall not be less than one lakh fifty thousand rupees:

Provided further that if any affected family in rural areas so prefers, the equivalent cost of the house may be offered in lieu of the constructed house:

Provided also that no family affected by acquisition shall be given more than one house under the provisions of this Act.

Explanation- The houses in urban areas may, if necessary, be provided in multi-storied building complexes

3. CHOICE OF ANNUITY OR EMPLOYMENT

The appropriate Government shall ensure that the affected families are provided with the following options:

(a) where jobs are created through the project, **mandatory employment at a rate not lower than the minimum wages** provided for in any other law for the time being in force, to at least one member per affected family in the project or arrange for a job in such other project as may be required; or

(b) onetime **payment of five lakhs rupees** per affected family; or

(c) annuity policies that shall pay not **less than two thousand rupees per month per family for twenty years,** with appropriate indexation to the Consumer Price Index for Agriculture Labourers.

4. SUBSISTENCE GRANTS

The appropriate Government shall ensure that the affected families are provided with the following options:

Given monthly subsistence allowance equivalent to **three thousand rupees per month for a period of one year** from the date of award. In addition to this

amount, the scheduled castes and the scheduled Tribes displaced from Scheduled Areas shall receive an **amount equivalent to fifty thousand rupees.**

5. TRANSPORTATION COST

The appropriate Government shall ensure that the affected families are provided with the following options:

Each affected family which is displaced shall get a onetime financial assistance of **fifty thousand rupees** as transportation cost for shifting of the family, building materials, belongings and cattle.

6. CATTLE SHED/ PETTY SHOPS COST

Each affected family having cattle or having a petty shop shall get one-time financial assistance of such amount as the appropriate Government may, by notification, specify subject to a **minimum of twenty-five thousand rupees** for construction of cattle shed or petty shop as the case may be.

7. ONE TIME GRANTS TO ARTISAN, SMALL TRADERS AND OTHERS

Each affected family of an artisan, small trader or self-employed person or an affected family which owned non-agricultural land or commercial, industrial or institutional structure in the affected area, and which has been involuntarily displaced from the affected area due to land acquisition, shall get one-time financial assistance of such amount as the appropriate Government may, by notification, specify subject to a **minimum of twenty-five thousand rupees.**

8. ONE TIME RESETTLEMENT ALLOWANCE

Each affected family shall be given a one-time "Resettlement Allowance" of fifty thousand rupees only.

9. STAMP DUTY REGISTRATION

(1). **The stamp duty and other fees payable for registration** of the land or house allotted to the affected families **shall be borne by the Requiring Body.**

(2). The land for house allotted to the affected families shall be free from all

encumbrances.

(3). The land or house allotted may be in the joint names of wife and husband of the affected family.

10. PROVISION OF INFRASTRUCTURAL AMENITIES

1. Roads within the resettled villages and an all weather road link to the nearest pucca road, passages and easement rights for all the resettled families be adequately arranged.

2. Proper drainage as well as sanitation plans executed before physical resettlement.

3. One or more assured sources of safe drinking water for each family as per the norms prescribed by the Government of India.

4. Provision of Drinking water for cattle.

5. Grazing land as per proportion acceptable in the State.

6. A reasonable number of Fair price Shops

7. Panchayat Ghars, as appropriate.

8. Village level Post Offices, as appropriate, which facilities for opening saving accounts.

9. Appropriate seed-cum-fertilizer storage facility if needed.

10. Efforts must be made to provide basic irrigation facilities to the agricultural land allocated to the resettled families if not from the irrigation project, then by developing a cooperative or under some Government scheme or special assistance.

11. All new villages established for resettlement of the displaced persons shall be provided with suitable transport facilities which must include public transport facilities through local bus services with the nearby growth centres/ urban localities.

12.Burial or cremation ground, depending on the caste communities at the site and their practices.

13. Facilities for sanitation, including individual toilet points.

14. Individual single electric connections(or connection through non-conventional sources of energy like solar energy), for each household and for public lighting.

15.Anganwadi's providing child and mother supplemental nutritional services.

16. School as per the provisions of the right of children to Free and Compulsory Education Act, 2009 (35 of 2009);

17. Sub-health centre within two kilo metres range.

18. Primary Health Centre as prescribed by the Government of India.

19. Playground for children.

20. One community centre for every hundred families.

21. Places of worship and chowpal/tree platform for every fifty families for community assembly, of numbers and dimensions consonant with the affected area.

22. Separate land must be earmarked for traditional tribal institutions.

23. The forest dweller families must be provided, where possible, with their traditional rights on non-timber forest produce and common property resources, if available close to the new place of settlement and, in case any such family can continue their access or entry to such forest or common property in the area close to the place of eviction, they must continue to enjoy their earlier rights to the aforesaid sources of livelihood.

24. Appropriate security arrangements must be provided for the settlement, if needed.

25. Veterinary service centre as per norms.

11.SPECIAL PROVISIONS FOR SCHEDULED CASTE AND SCHEDULED TRIBES

(1) In case of a project involving land acquisition on behalf of a Requiring Body which involves involuntary displacement of the Scheduled castes or the Scheduled Tribes families, a Development plan shall be prepared, in such form as may be prescribed, laying down the details of procedure for settling land rights due but not settled and restoring titles of tribals on alienated land by undertaking a special drive together with land acquisition.

(2) The Development Plan shall also contain a programme for development of alternate fuel, fodder and non-timber forest produce resources on non-forest lands within a period of five years sufficient to meet the requirements of tribal communities as well as the Scheduled castes.

(3) The concerned Gram Sabha or the Panchayats at the appropriate level in the Scheduled Areas under the Fifth Schedule to the Constitution or , as the case may be, Councils in the Sixth Scheduled Areas shall be consulted in all cases of land acquisition in such areas, including acquisition in case of urgency, before issue of a notification under this Act, or any other Central Act or a State Act for the time being in force as per the Provisions of the Panchayats (Extension to the Scheduled Areas) Act, 1996 (40 of 1996) and other relevant laws.

(4) In case of land being acquired from members of the Scheduled Castes or the Scheduled Tribes, at least one-third of the compensation amount due shall be paid to the affected families at the outset as first installment and the rest shall precede the taking over of the possession of the land.

(5) The Scheduled Tribes affected families shall be resettled preferably in the same Scheduled Area in a compact block, so that they can retain their ethnic, linguistic and cultural identity.

(6) The resettlement areas predominately inhabited by the Scheduled castes and the Scheduled Tribes shall get land, to such extent as may be decided by the appropriate Government, free of cost for community and social gatherings.

(7) In case of a project involving land acquisition on behalf of a Requiring body, the affected families belonging to the Scheduled Castes and the Scheduled Tribes

resettled out of the district of acquisition will get twenty-five percent. Higher monetary benefits under Rehabilitation and Resettlement Scheme.

(8) Any alienation of tribal lands or lands belonging to members of the Scheduled Castes in disregard of the laws and regulations for the time being in force shall be treated as null and avoid; and in the case of acquisition of such lands, the rehabilitation and resettlement benefits shall be available to the original tribal land owners or land owners belonging to the Scheduled Castes.

(9) The affected Scheduled Tribes, other traditional forest dwellers and the Scheduled castes families having fishing rights in a river or pond or dam in the affected area shall be given fishing rights in the reservoir area of the irrigation or hydel projects.

(10) Where the affected Scheduled Castes and Scheduled Tribes are relocated outside of the district then they shall be paid an additional twenty-five percent. Rehabilitation and Resettlement benefits to which they are entitled in monetary terms along with a one-time entitlement of fifty thousand rupees.

11.15 ENTITLEMENT MATRIX

The broad entitlement matrix comprising the R & R compensation and assistance is presented below. The titleholder APs will receive compensation for land and assets, as decided by the competent authority. The titleholders are entitled to receive compensation for land/assets at replacement cost, R & R assistance and allowances as well as exempted from fees and other charges. They should be given advance notice to harvest non-perennial crops, or compensation for lost standing crops. They will have the right to salvage material from existing structures.

The LARR-2013, represents a significant milestone in the development of a systematic approach to address resettlement issues in India and closes significantly the gap between Indian national policies and operational policy of the World Bank/ADB. The Act gives directives for the acquisition of land in the public interest and even provides assistance under R & R provision for landless, agricultural labours, tenants, sharecropper, dependents and those who reside preceding three years prior to land acquisition for their loss of livelihood/income.

11.16 SOCIO ECONOMIC PROFILE OF PROJECT STATE AND DISTRICTS

11.16.1 Uttar Pradesh

The state of Uttar Pradesh is situated in Northern part of India and surrounded by Tibet and Nepal in the North, Madhya Pradesh in the South, Haryana, Delhi and Rajasthan in the West and Bihar in the East.

Uttar Pradesh has always played a significant role on the political map of India. Rural class structure in UP is very unequal, distinguished by the presence of a class of big landowners and large number of poor's.

Demography

The population of the state is overwhelmingly rural which constitutes around 131.6 million of the total while the urban population constitutes only 34.5 million. There are 35 cities in the state with a population of one lakh or more and only six cities i.e. Kanpur, Lucknow, Varanasi, Allahabad, Agra and Meerut are in the list of million plus population cities. Administratively UP is divided into 70 districts, ranging in area from 1000 square kilometers to over 7000 square kilometers and in population from 7 lakhs to 4.9 million.

Uttar Pradesh is primarily an agrarian economy with more than 60 per cent of the population depends on agriculture for their livelihood. The state is the largest producer of food grain in India and offers a diverse agro climatic condition which is conducive for agricultural production. Uttar Pradesh is known for its highest contribution to nation 's sugarcane basket. However, the state offers excellent investment opportunities for industrial development.

Uttar Pradesh is the most populous state in India with a population of 199,812,341 people as per Census 2011 and a land area of 2,40,928 sq. km. According to Census 2011 one sixth of the world 's population lives in India and one–sixth of India 's population lives in Uttar Pradesh. According to Census 2011, male population constitutes 52.41 percent and female's population is recorded 47.59 percent. Presently, Uttar Pradesh covers 2.43 lakh sq. km. and accounts for 7.3 per cent of total area of the country.

The important demographic characteristics of UP and India have shown that the

average annual exponential growth rate in the state is at 1.85 per cent than that in the country (1.64 per cent) as a whole (Census 2011).

The population density in the state according to Census 2011 was 828 persons per sq. km., which is much higher than figure of 382 persons per sq. km for the country as a whole (Census 2011). Population growth has also remained high in the past decades. Sex ratio of UP state is 912 which is below national average of 940 as per census 2011.

Literacy Ratio

Uttar Pradesh had a literacy rate of 69.72 per cent in 2011, which is lower than that of national level. During the decade 2001-2011, there has been an increase by around 13 per cent points in the literacy level in the state. The literacy rate for males stands at 79.24 percent and for females at 59.26 percent in 2011 census.

Economy

Uttar Pradesh is one of the fastest developing states in India and has shown a healthy growth path during the last decade. The average real Gross State Domestic Product (GSDP) of the state has grown at around 6 per cent during 2002-2011 and has augmented more than twofold fromRs.1, 82,885 crores in 2002 to Rs. 3, 91,952 crores in 2011. Tertiary sector contributes a significant share of around 49 per cent in the GSDP followed by primary and secondary sector at around 28 per cent and 24 per cent respectively during 2011. It may be noted that the share of primary sector has declined marginally from around 30 per cent during 2006 to around 28 per cent in 2011, while share of secondary sector has remained stagnant at around 24 per cent during the same period.

The state 's economy, primarily being agricultural, is undergoing a gradual change with a decline in the share of agriculture and an increase in the share of the services sector.

State Income

State Domestic Product (SDP) in Common Parlance know ad "State Income" is a measure in monetary terms of the volume of all goods and services produced during

a given period of time within the geographical boundaries of the state, accounted without duplication. This is the most important single economic indicator used to measure the growth and study the structural changes taking place in the economy. SDP estimates over a period of time reveal the extent and direction of the changes in the level of economic development. Sectoral composition of SDP gives an idea about the relative position of different sectors in the economy over a period of time, which not only indicates the real structural changes taking place in the economy, but also facilitates in formulation of the plans for overall economic development.

The Per Capita Net State Domestic Product, also Known as per capita income, is used to determine both the absolute and relative performance of the state economy. It is also considered as an important tool to measure the regional disparities. The state is the third major state economics and it contributes about 8.24 percent to the GDP at National level during the year 2013-14, though the state's share to India's population is about 16.50 percent. For the Twelfth Five Year plan, a very high growth target of 10 percent has been set for Uttar Pradesh by Planning commission Government of India. The State economy has been measured in terms of the Gross State Domestic Product (GSDP) at factor cost at constant prices as well as at Current prices. This is the most important single economic dictator used to measure the growth and to study the structural changes taking place in the economy.

Gross State Domestic Product (GSDP) at factor cost at constant (2004-05) prices in 2009-10 has been estimated at Rs.294836 crore as against Rs. 276677 crore in 2008-09 registering a growth of 6.6 percent during the year. At current prices, GSDP at factor cost in 2009-10 has been estimated at Rs. 491302 crore as against Rs. 412151 crores in 2008-09, registering a growth of 19.2 percent during the year. The higher growth in the economy during the year 2009-10 can be mainly attributed to manufacturing electricity, construction and communication sectors, which have contributed 11 to 35 percent growth during 2009-10 at constant (2004-05) prices.

Agriculture

Agriculture is one of the most significant sectors of the economy of Uttar Pradesh with two third of the workforce of the state dependent on agriculture for their livelihood. The state is the largest producer of food grain in India and offers diverse ago climatic conditions which are conducive for agricultural production. The major

crops grown in the state are paddy, wheat, sugarcane, potato, mustard, groundnut, gram, pea and lentil. The state is well established for the export of rice, mangoes, vegetables and potatoes. The state has set up as many 485 fruits and vegetable processing units. Uttar Pradesh has implemented ―e-Croupall‖ model to tackle the challenges faced by the sector through delivering of valued service to the customers.

Western Uttar Pradesh is more advanced in terms of agriculture as compared to the other regions in the state. Majority of the state population depends upon farming activities. Wheat, rice, pulses, oil seeds and potatoes are the major agricultural products. Sugarcane is the most important cash crop throughout the state. Uttar Pradesh is one of the most important state in India so far as horticulture is concerned.

Small Scale Industries

The small-scale industries constitute an important segment of the state economy in terms of employment generation, source of foreign exchange earnings and exports. The favorable government policies coupled with availability of large pool of human resource makes the state one of the best locations for setting up SSI units within the state. The state has set up 679703 units, which has generated employment for 2742766 persons and has attracted investment of more than Rs. 12000 crore6. The state has proposed to set up 33000 units in the annual budget of 2011-12 which would create employment opportunities for 1.3 lakhs persons of the state. Uttar Pradesh has initiated several schemes for the development of SSIs, such as Transport Assistance Scheme, Technology Up-gradation Scheme and has introduced Single Table System for providing prompt and quick solutions to the entrepreneurs in the state. In addition to this, the state has also implemented Market Development Assistance Scheme to facilitate marketing of products of Khadi and Village industries.

Employment Scenario

Employment generation and income expansion is key to the development process of an economy. The unemployment rate in the state stands at around 8.2 per cent (2010) which is better in comparison to the national average of 9.4 per cent. The state has performed better in comparison to other big states like Rajasthan, Punjab, Haryana at 18 per cent, 10.5and 8.7 per cent respectively. The performance of the

state on the front of employment generation is described as (1) As per NSS 61st round 2004-05 proportion of casual workers declined during 1999-00 and 2004-05. (2) Share of self-employed increased significantly. (3) Share of public sector employees in the organized sector declined from 80 per cent in 1991 to 76 per cent in 2008. Table 3.15 reveals that the employment opportunities were continuously declining in public as well as private sectors in the state. However, there has been a marginal increase in private sector employment since 2007, but the organized sector revealed a declining trend.

Infrastructure

Infrastructure is generally defined to encompass the physical framework of facilities through which goods and services are provided to the people. The genesis of the expansion of physical and social infrastructure is financial infrastructure. A study sponsored by the Twelfth Finance Commission has prepared a composite index of infrastructure at the state level using variables related to transport index in which UP's rank is 11th and in terms of communication its rank is 12th, but in terms of power its rank is 15th. The gap in value of index is, however, large in case of communication and power. In UP not only the availability of infrastructure is inadequate, its quality is poor and management deficient.

Economic Infrastructure

Infrastructure plays a vital role in driving industrial, economic and social growth. To develop a strong economy, Uttar Pradesh has been making serious and conscious efforts in the development of infrastructure and inviting private participation on a large scale. Noida offers excellent infrastructural facilities for setting up industrial, educational and residential projects and has been ranked one of cities, where it takes minimum time to start a business. The proximity to national capital is an additional advantage for the state. Various PPP projects have been undertaken in the sectors like expressways, roads, energy, transportation, education, urban rejuvenation etc.

The state offers an extensive road network which plays a significant role in the economic development and helps in encouraging trade thereby promoting wide markets of various products and enable exploitation of economies of scale. Uttar Pradesh is a land locked territory and road connectivity to all major commercial

centers is first class. The state has set up Uttar Pradesh State Road Transport Corporation (UPSRT) to provide an economical, reliable and comfortable transport in the state. The state has implemented various mega road projects under PPP such as 1047 Kms long 8-lane Ganga Expressway along the course of great river Ganga, joining far east with national capital, a 165km long 6 lane Yamuna expressway to provide fast access to the city of Taj Mahal and a network of expressways are in the pipeline. An amount of Rs.6775 crore has been earmarked in the state budget of 2011-12, to be spent on construction and maintenance of roads and bridges which is around 17 per cent higher than previous year.

Table 11.7.: Road Infrastructures in Uttar Pradesh State

Roads	Length in Km.
National Highways	6681
State Highways	7957
Major district roads	7307
Other district roads and village roads	329215
Total	**35116**

Source: PHD Research Bureau

U.P has a fairly large network of roads running into 2,76,782 km. including rural roads. The road density in the state is relatively low in terms of areas as well as population as compared to more developed states of the country. Presently, the state has 169.8 km. road per lakh of population with road density of 100 sq. km. area. Thus, among 26 states, of the country U.P ranks 11th in terms of road density and 23rd in terms of road density per lakh of population. UP 's coverage (30.8 km.) is better than the national level (23.7 km.) but poorer than best performing states like Punjab (92.2 km.) and hence on this count the UP's rank is 6th among major states. Significantly, the quality of roads in the state is generally below laid down standards and it has been observed that 541 sq. km. of the total road length is surfaced or pucca road.

11.17 SOCIO-ECONOMIC PROFILE OF PROJECT INFLUENCED DISTRICTS

11.17.1 Demographic Profile of Project Districts

The project influence area of two districts is spread over 6358 sq. km. with a population of 6860042 i.e. (3.43%) of state population, according to 2011 census.

The proportion of district population of Ghazipur to state population was recorded highest i.e 1.81 percent with 3620268 population while Ballia district population stood with 1.62 percent as second populous project district.

About 91.5 % project district population live in rural areas and 9.5 % reside in urban pockets. It shows that the level of urbanization in project district is very low compared to state as well national average.

There is a rapid increase in the density of population in project districts during the decade of 2001-2011. Ballia district has recorded the highest density of population with 1087 persons per sq. km. in project district.

Human development means increased capabilities of people that enable them to access larger opportunities in life. In the context of HDI in PIA districts, Ghazipur tops the position.

In Gender Empowerment Measure (GEM) Ghazipur district also scales the height of success among the project districts. GEM measures whether women and men are able to actively participate in economic and political life and in decision making. While Gender Development Index (GDI) focuses on expansion of capabilities, GEM is concerned with the use of those capabilities to take advantage of the opportunities in life. While political freedoms, participating in community and physical security are important parameters for measuring the value and position of women in the society.

Ghazipur district tops in sex ratio with 952 females per 1000 males in PIA districts. The demographic and socio-economic characteristics of both project districts are presented in Tables – 11.8 and 11.9 below.

Table 11.8: Demographic Profile of Project Influenced Area (PIA) - 2011 Census

District	Population			% of District Pop. to State Population	% Urban population to Total District population	Population Density (Person / sq.km)
	Total	Rural	Urban			
Ballia	3239774	2935665	304109	1.62	9.39	1087

Gazipur	3620268	274360	3345908	1.81	7.58	1072
Uttar Pradesh	**199812341**	**155317278**	**44495063**	**-**	**-**	**829**

Source: Primary Census Abstract, Census 2011

11.17.2 Literacy Profile in PIA Districts

The project districts have registered impressive growth in literacy in comparison to other districts of Uttar Pradesh state. With regard to literacy, Ghazipur district occupies first position (71.78 %) whereas Ballia district records low with (70.94 %). The male and female category of literacy rate in both project districts is higher than that of Uttar Pradesh state.

Table 11.9: Socio- Economic Details of Project Districts

S. No	Item	Unit	Ballia	Ghazipur	UP
1	**Population**	No.	3239774	3620268	199812341
2	Male	No.	1672902	1855075	104480510
3	Female	No.	1566872	1765193	95331831
4	**Sex ratio** (Female per 1000 males)	No.	937	952	912
5	Population Growth Rate	%	17.31	19.18	20.23
6	**Literacy Rate**	%	70.94	71.78	67.68
7	Male Literacy	%	81.49	82.80	72.28
8	Female Literacy Rate	%	59.75	60.29	57.18
9	Geographical Area	Sq. Km.	2981	3377	240928

Source: Primary Census Abstract, Census 2011, Zila Sankhyakiya Patrika, Govt. of Uttar Pradesh – 2014-15

11.17.3 Land Use Pattern in Project District

As per the land utilization statistics of 2013-14, the total land area of project districts is 6.32 lakh hectares, out of which the area under forest cover is 0.002 lakh hectares, constituting 0.03 percent of the geographic area. Nearly,74.47 percent area is under cultivation (4.70 lakh hectares), 15.3 percent land is put to non-agricultural uses (0.97 lakh hectares), 1.99 percent is barren and uncultivable (0.12 lakh hectares). Land use under various categories is indicated in the following table.

Table – 11.10 : Land Use Pattern in Project Districts- 2013-14

S. No.	Land Utilization Particulars	Unit	Ballia	Ghazipur
1	Total Area	Hectare	299265	333214
2	Total Forest Area	Hectare	81	121
3	Barren & Uncultivable Land	Hectare	9486	3144
4	Land put to Non-Agricultural Usage	Hectare	47122	50030
5	Net Area Sown	Hectare	216978	254006
6	Net Irrigated Area	Hectare	179825	219568

Source: Zila Sankhyakiya Patrika, Govt. of Uttar Pradesh – 2014-15

11.17.4 Road Network

The district's road network consists of National Highways, State Highways, Major District Roads, Other District Roads being maintained by Public Works Department of the state. Uttar Pradesh has the largest network of National Highways in Northern India. The total road length in two project districts under PWD is 7389 kilometers. The district and rural road constitute a major chunk covering 6494 km. followed by important road of district 355 km., national highways 308 km. and state highways 232 km. The national highways cover 213 km. in Ghazipur district is the highest length in project district. For better connectivity with the national highways system in the state, the state government has proposed additional lengths of new national highways, to strengthen the road network in the state.

Table 11.11: Road Length in Project Districts under PWD- 2013-14

District	National Highways	State Highways	Important Roads of District	Other district and Rural Roads	Total Length
Ballia	95	160	105	2589	2949
Ghazipur	213	72	250	3905	4440
Total	**308**	**232**	**355**	**6494**	**7389**

11.18 BALLIA DISTICT PROFILE

Ballia is the eastern most district of Uttar Pradesh covering an area of 2981 sq.km, lies in between 25º33' and 26º11' North latitudes and 83º38' and 84º39' East longitudes with total population of 3239774 as per 2011 census.

The district is bounded on north by Ghagra river and in south by Chhoti Sargu and

Ganga river. The entire district forms an interfluves zone of Ghagra & Ganga river and possesses plain flat topography. The boundary between Ballia and Bihar is determined by the deep streams of these two rivers. The irrigation in the district takes place by Dharighat Lift Irrigation canal and Tubewells. The average rainfall of the district is 983 mm with 41.5o C highest and 5.4o C minimum average normal temperature. The irrigation in the district is done both by pump canals and tubewells.

There are three major cropping seasons in the district, kharif, rabi and zaid. With more than 80 % cultivated area being irrigated, the agricultural potential of the district can be rated as high as 2.39 lakh cultivators and 3.18 lakh agricultural laborers are involved in this sector. Sugarcane and wheat are the main crop, a thorough study into its cultivation as prevalent in the district would reveal the important gaps required to be addressed to realize the full potential.

The major cropped area of the district Balia is covered by wheat (39%), paddy (34.30%) and other crops (25%) including vegetables and pulses crops. Paddy and wheat are predominantly cultivated in the irrigated areas. Paddy is mainly grown in kharif season. In some pockets sugarcane and potato are sown as commercial crops.

The main problem in this district is related to irrigation during summer as the ratio of irrigated area to net cropped area is 82% and out of which 97.4% is through surface water and rest 33.8% is by groundwater.

There are a large percentage of farmers who are small and marginal. This is unique situation, pointed towards uneconomic and inviable land holdings.

Table 11.12: District profile of Balia at a glance

	Particulars	Characteristics	Value
1	**Area**		
	1.1	Geographical Area (Sq. Km.)	
	1.2	Forest (ha)	NIL
	1.3	Net sown area (000 ha)	217.8
	1.4	Area sown more than once (000 ha)	126
	1.5	Total cropped area (000 ha)	348

	Particulars	Characteristics	Value
	1.6	Cropping intensity (%)	162.9
	1.7	Fallow land (ha)	15587
	1.8	Land not available for cultivation (ha)	9195
2	**Administrative**		
	2.1	No. of blocks	17
	2.2	No. of villages inhabited and electrified	1221 villages electrified out of 1792
	2.3	No. of villages with potable water supply	1792 (100%)
3	**Rainfall**		
	3.1	Normal	1014
	3.2	Actual (2005)	484
	3.3	Actual (2006)	497
4	**Agro-climatic region and zone**		Upper Gangetic plains region of the Northen plains and Mid plains zone
5	**Population (000)**		
	5.1	Total	2761.62
	5.2	Male	1413.77
	5.3	Female	1347.85
	5.4	Population below poverty line	1284.63 (46.60%)
6	**Literacy (%)**		
	6.1	Total	58.88
	6.2	Male	73.15
	6.3	Female	43.92
7	**Credit infrastructure**		
	7.1	Nationalized bank branches	80
	7.2	Regional Rural Banks	117
	7.3	Cooperative Banks	24
	7.4	Cooperative and Village Development Bank	04
8	**Agricultural & allied work forces**		
	8.1	Cultivator	239509
	8.2	Agricultural laborers	318446

	Particulars	Characteristics	Value
	8.3	Artisans	22599
	8.3	Household/cottage industries	20700
	8.4	Allied agro activities	3200
	8.5	Other workers	134678
9	**Irrigation (000 ha)**		
	9.1	Net irrigated area (ha)	168823
	9.2	By channels (ha)	24140
	9.3	By wells (ha)	8738
	9.4	Tube wells (ha)	135499
	9.5	Other sources	446

Source: Statistical Magazine; Govt. of U.P.

Kharif, Rabi and Zaid are the three major cropping seasons in the district. The major cropped area of the district is covered by wheat (39%), paddy (34.30%) and other crops (25%) including maize, barley, masoor, arhar and potato. Sugarcane is the main cash crop. Agro-climatic conditions of the district are suitable for commercial cultivation of fruits, flowers, and tuber crops, medicinal and aromatic plants.

Agro-climatic conditions of the district are suitable for commercial cultivation of fruits like mango, papaya, guava and vegetable crop like tomato, parwal, brinjal, satputia, flowers like rose, gladiolous, tuber crops e. g. potato, sweet potato, suran, spices like garlic, chilli, turmeric and dry land horticulture crops like ber and aonla. Agro-economic conditions of the district are also suitable for large scale production of mushrooms and commercial bee keeping.

11.19. Ghazipur District Profile

Ghazipur, a district of eastern Uttar Pradesh, was constituted as a separate district in 1818. The city of Ghazipur is the district headquarters. Ghazipur is famous for production of unique Rose Scented Spray called 'Gulab Jal' and for the tomb of famous Viceroy of British India Lord Cornwallis who died here and his tomb is being conserved by Archeological Survey of India. The "Government Opium and Alkaloid works" situated in Ghazipur city is the biggest opium factory of Asia.

Ghazipur district forms the eastern part of the Varanasi Division. It lies between the

parallels of 25° 19' and 25° 54' North latitude and 83° 4' and 83° 58' East longitude. This location is 67.50 Meter above the sea level. The length of district from East to West is 90 Km. and width from North to South is 64 Km. River Ganges from one side and Karmnasa from other side divide it from Bihar State. It is bounded by Ballia and Bihar State in east, Jaunpur, Varansi and Azamgarh in west, Mau and Ballia in north and Chandauli in south. The boundaries are generally conventional though at places they are marked by natural feature. Total geographical area of the district is about 3377 Sq.Km.

The District has a sound agricultural base and reasonably good infrastructure but industrial potential is low. The lack of enterprise and technical knowledge of local people may be the major constraints in industrial growth of district. Ghazipur has long been famous for the manufacture of perfume especially Rose Water and Itr (Otto of roses). A local firm of this industry was awarded a medal for the quality of its product at British Empire exhibition in London in last century. Now this industry is facing gradual decline due to the shrinkage of cultivation of perfume-bearing plants. another is Sugar industry, but now there are no more factory in existence. The manufacturing of Saltpeter is present is Saidpur. The Weaving of clothes is mainly centered in Bahariabad. There are 47 registered factories under section 1948 and 24 are in working condition and from 19 factories their return are received, total laborers and employees were 2198 in 1991.

The manufacture of Rice, agriculture goods, furniture, leather article, utensils, Khandsari, Weaponry, Steel trunk, Almirah, candles and Handloom clothes are the main small scale industries of the district. As the colour packing, sugar processing and flour milling are also undertaken in the district.

Village & Cottage industries includes mostly the handicraft handed down from generation to generation like Gur making, Village Oil Industry, Leather Tanning & Foot Wear, Woolen Blanket Pottery etc.

Govt. Opium and Alkaloids Works- Opium and Alkaloid Works, Ghazipur a government enterprise, specialises in manufacture of excise opium, export opium and alkaloids. The raw material used is raw opium which derived from the white or opium poppy (Papaver somnigerum) through the fields organisation of the industries department of state , which comprises four division - Bareilly, Shahjahapur ,

Barabanki, and Faizabad. Every year the Government of India notifies the areas in which poppy can be cultivated and the extent to which it can be cultivated in each division and licenses are issued to cultivators, who desire to grow the plant.This unit first established in 1820 under the Benaras Opium Agency is now the biggest industrial enterprise for making opium in the country. The factory consists of several godowns, power-houses and workshops. It is provided with a railway siding and the wagons containing opium are shunted out from the station to the factory siding. Raw opium is imported from different States and all the opium that is seized throughout the country is sent to this factory. Opium is also exported to different countries.

The city has sound agriculture base and reasonably good infrastructure, yet the industrial potential is low. The lack of enterprise and technical knowledge of local people may be the major constraints in industrial growth. Ghazipur has long been famous for the manufacture of perfumes especially rose water (Ghazipuri Gulabjal)and Attar of roses (Rose oil). A local firm was awarded a medal for the quality of product in British empire exhibition in London in the last century. Now this industry is facing gradual decline due to the shrinkage of cultivation of perfume bearing plants. Sugar industry was important to this region but now there are few factories left. The manufacturing of saltpeter is done in Saidpur. Cloth weaving is centered in Bahariabad. There are 47 registered factory under section 1948. But scenario have change from last decade, a multi productive agro manufacturing unit M/s Sukhbhir Agro, an alcohol manufacturing unit M/s Lords Distillery, a Polythene Manufacturing unit M/s Bryplast Private Limited, a Homoeopathic Medicines Manufacturing unit M/s M.D.Homoeo Lab. Pvt. Ltd., Maharajganj, Ghazipur worked successfully in district. These companies provide many employment opportunities.

12. Cost Estimates

12.1 COST ESTIMATES

Based on the improvement options considered, the quantities are estimated for:

- Rehabilitation of existing carriageway
- Construction of new carriageway
- Roadside furniture including safety devices
- Passenger amenities and toll gates

The pavement quantities are worked out for the adopted flexible and rigid Pavement design made based on the traffic data and other design criteria. The analysis of rates has been carried out as per the Standard Data Book of MORT&H.

12.2 UNIT RATES

The Unit rates of all items of construction work have been analyzed as per the guidelines given in Standard Data Book of MORT&H. The rates of materials are obtained from the SOR of UP/Bihar. Market rates are adopted for items for which the rates are not available in the SOR. The location of material quarries like gravel, sand, crushed aggregate is obtained from the material investigations. The leads of different materials are obtained by drawing the lead chart. In respect of hourly hire and operating cost of various road construction machinery and equipment, rates given in MORT&H Standard Data Book and SOR are considered. For machinery and equipment not covered by these two, the prevailing market rates are considered. The labour rates are taken from SOR. Unit rates so arrived have been compared with reference to the rates of similar items in the ongoing projects and are found comparable.

12.3 CONSTRUCTION QUANTITIES

The quantities of earthwork in cut and fill are calculated based on the highway design. Provision is made for hard rock excavation. The pavement quantities like Sub grade, GSB, WMM, DBM and BC are computed using the Pavement design and the typical cross section adopted. Adequate provision is made for roadside furniture including safety devices and miscellaneous items.

The abstract of cost estimate for entire project stretch from Ghazipur to UP/Bihar border is given below.

Table-12.2: Abstract of Cost Estimate

ITEM DESCRIPTION	TOTAL AMOUNT
BILL NO: 1 - SITE CLEARANCE	49,876,234
BILL NO: 2 - EARTHWORKS	4,173,791,135
BILL NO: 3 - SUB-BASE AND BASE COURSES	5,651,239,496
BILL NO: 4 - BITUMINOUS WORKS	3,323,924,345
BILL NO: 5 - CULVERTS	314,232,130
BILL NO: 6A - BRIDGES	1,902,112,050
BILL NO: 6B - ROBs, UNDERPASSES, OVERPASSES & INTERCHANGES	1,419,609,279
BILL NO: 7 - DRAINAGE AND PROTECTION WORKS	3,929,698,706
BILL NO: 8 - ROAD JUNCTIONS	3,782,604
BILL NO: 9 - TRAFFIC SIGNS, MARKINGS AND APPURTENANCES	2,972,324,839
BILL NO: 10 - MISCELLANEOUS	1,006,362,664
TOTAL CONSTRUCTION COST	24,746,953,481
GST@12%	2,969,634,418
TOTAL COST	**27,716,587,899**
LENGTH OF PROPOSED ROAD (KMS)	**132.735**
CONSTRUCTION COST IN CRORES PER KM	**18.64**

13. Conclusions and Recommendations

Some of the important aspects which require the attention of the authority have been presented below for consideration, along with the recommendations of the consultants.

1. Right of Way

The Proposed Right of Way is 60m along Greenfield Alignment and 45m where Existing Alignment is retained.

2. Traffic

Based on the traffic survey carried out, the traffic on Project Highway as shown in below table.

Existing Chainage	Survey location	AADT	
		Vehicles	PCUs
419+000	Near Sultanpur	14951	13303
526+000	Near Bariya	4395	5677

3. Pavement Type

Flexible pavement is recommended for main carriageway for the entire Project Highway. Rigid pavement is recommended for Toll Plaza locations.

4.Proposed Structures

The Summary of proposed structures are tabulated below for:

a) Greenfield Alignment:

S. No	Type	Total
1	Flyover	2
2	VUP	12
3	LVUP	17
4	SVUP	0
5	ROB	1
6	Box Culverts	56
7	Pipe Culvert	34

S. No	Type	Total
8	Minor Bridge	16
9	Major Bridge	3
Total		**141**

a) Buxar Spur:

S. No	Type	Total
1	ROB	1
2	Minor Bridge	2
3	Box Culverts	8
4	Pipe Culverts	1
Total		**12**

5. Project Facilities

Roadside furniture like Traffic signs/overhead signs, pavement markings, crash barriers, road studs is proposed as per Four laning manual.

6. Mode of Execution

The mode of execution is Hybrid Annuity Model (HAM).