2023

Volume -I

Draft Environmental Impact Assessment (EIA) Report

(Baseline period – December 2022 to February 2023)

Development of 4 lane Bakarpur-Manikpur Section, starting from design km 0.000 at Sitalpur bypass of NH-19 near village Bakarpur in district Saran and terminate at design km 38.813 near village Manikpur merge into SH-74 in district Muzaffarpur in the state of Bihar (Total length-38.813km)

Project Proponent: National Highway Authority of India
Ministry of Road, Transport & Highways, Govt. of India

Environmental Consultant: P and M Solutions

For National Highway Authority of India

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This document has been prepared by National Highways Authority of India (NHAI) and its consultants for the internal consumption and use by the NHAI for obtaining Prior Environmental clearance. This document has been prepared based on the information available from public domain sources, primary and secondary data sources, site visits and assessment of the NHAI and its consultants etc. The purpose of this report is to identify & mitigate the impacts on the environment for the "development of 4 lane Bakarpur-Manikpur Section, Starting from design km 0.000 at Sitalpur bypass of NH-19 near village Bakarpur in district Saran and terminate at design km 38.813 near village Manikpur merge into SH-74 in district Muzaffarpur in the state of Bihar (Total length-38.813km) (the "Project") based on the Terms of Conditions proposed by the MoEF&CC.

It is however, to be noted that this report has been prepared with assumptions and estimates considered to be appropriate and reasonable, which though cannot be guaranteed. There might be inadvertent omissions/errors/aberrations owing to situations and conditions that are out of the control of NHAI and its consultants. Further, the report has been prepared on a best-effort basis, based on inputs considered appropriate for the report.

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ABBREVIATIONS

°C	:	Degree Celsius	DFO	:	Divisional Forest Officer
°F	:	Degree Fahrenheit	DM	:	District Magistrate
µmhos/cm	:	micromhos per centimetre	DM	:	Disaster Management
AADT	:	Annual Average Daily Traffic	DM&R	:	Disaster Management & Relief
AAQ	:	Ambient Air Quality	DO	:	Dissolved Oxygen
	:		DOR	:	Department of Revenue
AE	:	Authority Engineer	DoT	:	Department of Telecommunications
AM	:	Anti Meridiem	E	:	East
ANL	:	Ambient Noise Level	E. coli	:	Escherichia coli
APHA	:	American Public Health Association	EAC	:	Expert Appraisal Committee
AQ	:	Air Quality	EC	:	Environmental Clearance
ATM	:	Automated Teller Machine	EIA	:	Environmental Impact Assessment
Avg.	:	Average	EMP	:	Environmental Management Plan
AWWA	:	American Water Works Association	EOC	:	Emergency Operation Centre
BC	:	Bituminous Concrete	EP	:	Environmental (Protection)
BOD	:	Biological Oxygen Demand	ETC	:	Electronic Toll Collection
CaCO3	:	Calcium Carbonate	FCI	:	Food Corporation of India
CAGR	:	Cumulative Annual Growth Rate	FY	:	Fiscal Year
CALINE	:	California Line Source Dispersion Model	GoI	:	Government of India
CBRN	:	Chemical, Biological, Radiological, and Nuclear	GSB	:	Granular Sub-Base
CD	:	Cross Drainage	DLC	:	District Level Committee
CER	:	Corporate Environmental Responsibility	GSDP	:	Gross State Domestic Product
CGWB	:	Central Ground Water Board	GSVA	:	Gross State Value Added
Cm	:	Centimetre	GW	:	Ground Water
CO	:	Carbon Monoxide	Ha.	:	Hectare
COD	:	Chemical Oxygen Demand	HDPE	:	High-density Polyethylene
CoRTN	:	Calculation of Road Traffic Noise	HMA	:	Hot Mix Asphalt
CPCB	:	Central Pollution Control Board	HMAC	:	Hot Mix Asphalt Concrete
CPR	:	Community Property Resource	HMP	:	Hot Mix Plant
Cr.	:	Crore	SPCB	:	State Pollution Control Board
CRRI	:	Central Road Research Institute	IA	:	Impact Assessment
CSIR	:	Council of Scientific and Industrial Research			
CTE	:	Consent to Establish	IMD	:	India Meteorological Department
CTO	:	Consent to Operate	INR	:	Indian Rupee
CTSB	:	Cement Treated Sub-base	IPCC	:	Inter-Governmental Panel on Climate Change
cum	:	Cubic Meter	IRC	:	Indian Roads Congress
dB	:	Decibels	IS	:	Indian Standard
DBC	:	Dense Bituminous Concrete	ITI	:	Industrial Training Institute
DBM	:	Dense Bituminous Macadam	IVI	:	Importance Value Index
Dept.	:	Department	IUCN	:	International Union for Conservation of Nature and Natural Resources
Km/hr	:	Kilometre per Hour	PH	:	Public Hearing
Km2	:	Square kilometre	PHED	:	Public Health Engineering Department

			PMC	:	Project Monitoring Consultant
LARR	:	Land Acquisition, Rehabilitation and Resettlement	PPP	:	Public Private Partnership
LCV	:	Light Commercial Vehicles	PQC	:	Pavement Quality Concrete
LED	:	Light Emitting Diode	PRI	:	Primary Rate Interface
Leq	:	Equivalent Continuous Noise Level	PROW	:	Proposed Right of Way
LHS	:	Left Hand Side	PUC	:	Pollution Under Control
LMV	:	Light Motor Vehicle	PVC	:	Poly Vinyl Chloride
LS	:	Lateral Section	PWD	:	Public Works Department
LULC	:	Land Use and Land Cover	R&R	:	Rehabilitation and Resettlement
LVUP	:	Light Vehicular Under pass	RAP	:	Resettlement Action Plan
M	:	Meter	RCC	:	Reinforced Concrete Cement
MAV	:	Multi Axle Vehicles	RDD	:	Rural Development Department
MC	:	Monitoring Consultant	RHS	:	Right Hand Side
mm	:	Millimetre	ROB	:	Road Over Bridge
MoEF&CC	:	Ministry of Environment, Forest and Climate Change	ROW	:	Right of Way
MoH&UA	:	Ministry of Housing & Urban Affairs	SBWL	:	State Board of Wildlife
MSL	:	Mean Sea Level	SC	:	Supervision Consultant
MSME	:	Micro, Small and Medium Enterprises	SDM	:	Sub Divisional Magistrate
MT	:	Metric Tonne	SDMA	:	State Disaster Management Authority
N	:	North	SDRF	:	State Disaster Response Force
NAAQS	:	National Ambient Air Quality Standards	SEIAA	:	State Environment Impact Assessment Authority
NBWL	:	National Board of Wildlife	SH	:	State Highways
NCR	:	National Capital Region	SIA	:	Social Impact Assessment
NGO	:	Non-Governmental Organisation	SL	:	Sound Level
NH	:	National Highway	SMA	:	Stone Matrix Asphalt
NHAI	:	National Highways Authority of India	SO_2	:	Sulphur Dioxide
NOC	:	No-objection Certificate	SOP	:	Standard Operating Procedures
NOX	:	Oxides of Nitrogen	SOx	:	Oxides of Sulphur Dioxide
NP	:	National Parks	SPCB	:	State Pollution Control Board
NSDP	:	Net State Domestic Product	SPL	:	Sound Pressure Level
OHT	:	Over Head Tanks	Spp.	:	Species
OPD	:	Outpatient Department	sq. km.	:	Square kilometre
PAF	:	Project Affected Family	SVUP	:	Small Vehicular Underpass
PAP	:	Project Affected Person	SW	:	Surface Water
PCU	:	Passenger Car Unit	TCS	:	Typical Cross Section
PDS	:	Public Distribution System	TDS	:	Total Dissolved Solids
PM	:	Particulate Matter	wt./ wt.	:	Weight/Weight

1 INTRODUCTION

1.1 The Project

The Govt. of India (GoI) through Ministry of Roads & Highways (MORT&H) is contemplating to enhance the traffic capacity and safety for efficient transshipment of goods as well as passenger traffic on the heavily trafficked National Highway sections. GoI has entrusted National Highways Authority India (NHAI) with the responsibility of development of Economic Corridors, Inter-Corridors, Feeder Routes and Coastal Road primarily to improve freight movement in the country. The project under consideration aims at developing Bakarpur - Manikpur section as Feeder Corridor in the state of Bihar under Bharatmala Pariyojana.

The proposed development of four lane highway starts from Sitalbari bypass (Ch: 0+000) near Bakarpur village in Saran district and terminate at (Ch 38+813) at SH-74 near Manikpur village in Muzaffarpur district of Bihar State. The proposed alignment traverses through the Tarwan Mangerpal, Manpur, Sarnarayan, Darihara nasikh, Darihara chaturbhuj, Bailka, Bhagwanpur, Keshopur, Manpura, Basarh, Harpur Basant, Birpur and Manikpur villages/towns in Sara, Vaishali and Muzaffarpur districts in the state of Bihar. Total length of the proposed alignment is 38.813km.

The existing road is generally intermidate lane with both side earthen shoulders. These roads carries roads carries substantial amount of traffic which entering or existing to/from Patna City. Available ROW varies 10-20 m on existing roads. The project road is passing through plain terrain, bypasses are provided to avoid built-up section.

The proposed project is planned as 4 lanes carriageway with paved shoulder and service roads as per requirements. The salient features of the proposed project are as follows.

Table 1-1: Project Salient Features

Sl. No.	Particular	Details
1	Project Name	Development of 4 lane Bakarpur-Manikpur Section, Starting from design km 0.000 at Sitalpur bypass of NH-19 near village Bakarpur in district Saran and terminate at design km 38.813 near village Manikpur merge into SH-74 in district Muzaffarpur in the state of Bihar (Total length-38.813km)
2	Project Length	38.813km
3	Right of Way (ROW)	45m
4	Configuration	4 lane carriageway +PS with services roads as per requirements
5	Location of project stretch	Sara, Vaishali and Muzaffarpur districts in the state of Bihar
6	Geographical Coordinates	From: 25°43'22.77"N 85° 8'16.13"E; To: 26°1'38.15"N,85°7'54.47"E.
7	Total Area requirement	203.201 ha.
8	Water demand	About 1250 KLD water during construction phase
9	Sources of water	Surface water & Tanker Supply
10	Lad Use	Agricultural, barren and vegetation
11	Nearest railway station	Railway Stations with arieal distance from the proposed alignment- Sonpur Junction Railway Station ~4.1 km (Ch: 1+400) Hajipur Juction Railway Station ~6.5 km (Ch: 2+300) Bharpura Pahleza Ghat Junction ~2.0 km (Ch: 0+000) Vaishali Railway Station ~0.9 km (Ch: 31+900) Saraiya Railway Station (Prodposed)~1.3 km (Ch: 38+300)
12	Forest area required	About 4.108 ha of Notified Forest Land shall be affected due to the

Sl. No.	Particular	Details
		proposed development
13	Eco-sensitive areas	The proposed alignment neither passing through nor falling within 10km radius of any wildlife sanctuary/National Park notified under Willdife Protection Act 1972.
14	Nearest airport	Jayprakash Narayan Airport, Patna , ~ 14.9 km (Ch: 0+000) Muzaffarpur Airstrip, ~22 km (Ch: 38+300)
15	Seismic Zone	Proposed alignment falls under Seismic Zone IV (High Risk Zone) as per IS 1893(Part-1):2002
16	Project Cost	1344.46 Cr.

1.2 Project Proponent

National Highways Authority of India (NHAI), an autonomous agency of the Government of India, is responsible for management of the network of national highways across the country. It is a nodal agency of the Ministry of Road Transport and Highways (MoRTH), Government of India. NHAI vision is to meet the nation's need for the provision and maintenance of national highways network to global standards and to meet user expectations in time-bound and cost-effective manner, within the strategic policy framework set by the Government of India and thus promoting economic well-being and quality of life of the people.

NHAI is the nodal authority / project proponent for the development of the highway project under present study.

1.3 Project Location

The proposed Bakarpur – Manikpur 4 lane highway as Feeder Corridor in the state of Bihar under Bharatmala Pariyojana highway starts from Sitalbari bypass (Ch: 0+000) near Bakarpur village in Saran district and terminate at (Ch 38+813) at SH-74 near Manikpur village in Muzaffarpur district of Bihar State. The proposed alignment traverses through the Tarwan Mangerpal, Manpur, Sarnarayan, Darihara nasikh, Darihara chaturbhuj, Bailka, Bhagwanpur, Keshopur, Manpura, Basarh, Harpur Basant, Birpur and Manikpur villages/towns in Sara, Vaishali and Muzaffarpur districts in the state of Bihar. Location of the propoed project section is shown in Figure 1.1.

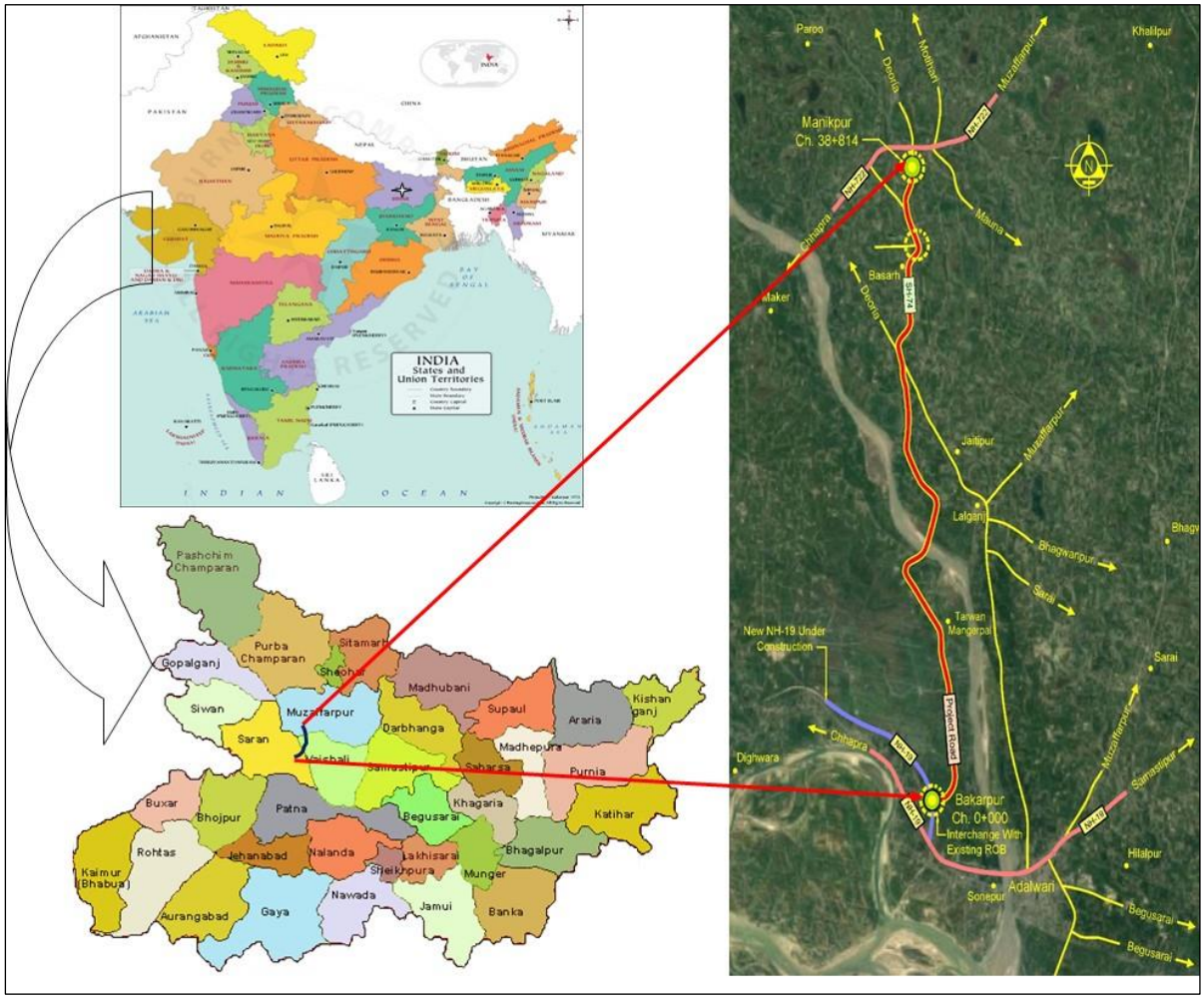


Figure 1-1: Location Map of Proposed Project

Project alignment duly imposed on Survey of India toposheet is attached as **Annexure 1.1**.

1.4 Connectivity to the site

Project road initiates from Sitalpur bypass at Bakarpur area and terminates at SH-74 near Manikpur area. In between the project road stretch three highway category road connects with the project stretch. The first one is Patna AIIMS connecting under construction road. This road starts from AIIMS, Patna and connects with NH-19 and Bakarpur-Manikpur project road through a under construction ROB. The second one is NH-19 Sitalbari bypass under construction road. This road connects with our Bakarpur-Manikpur project road through a cloverleaf grade separated interchange. The third one is SH-74. This road is the existing main connecting road between Adalwari as well as Patna city and Manikpur area. Bakarpur-Manikpur project road connects with SH-74 just before Manikpur area.

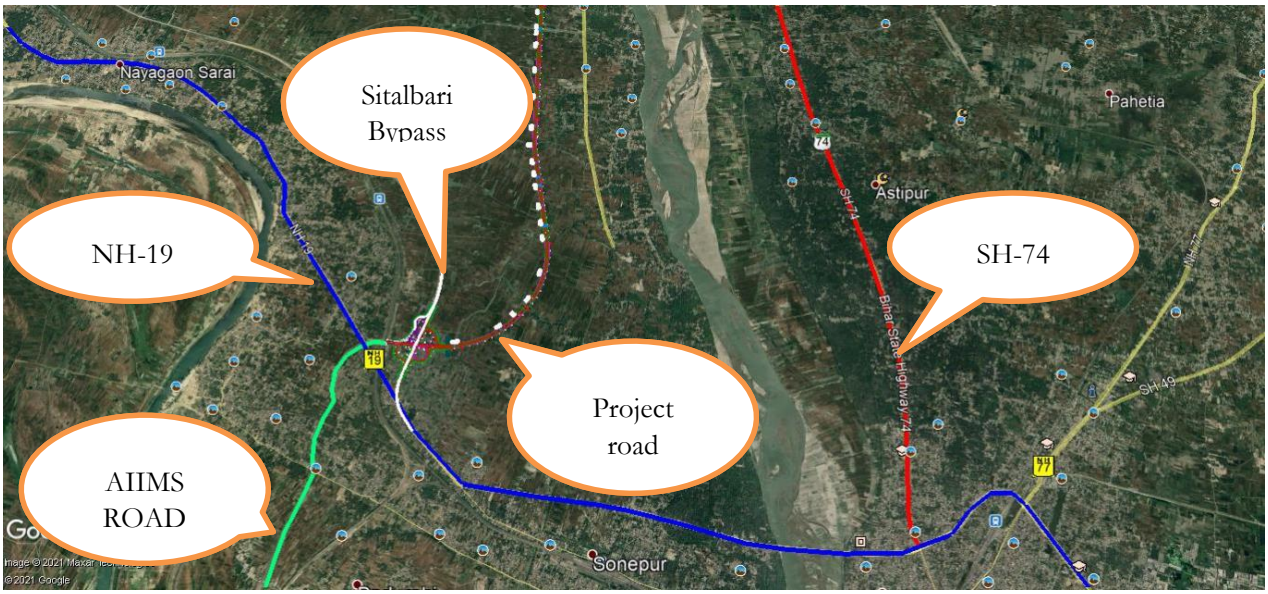


Figure 1-2: Connectivity of proposed site

The project road is part of SH-74 connecting Bakarpur and Manikpur in the state of Bihar. The proposed project road starts from design chainage Km 0+000 at the junction of NH-19 (Sitalpur Bypass) near village Bakarpur where is follows the bypass section and crossed Gandhak River at design km 16.700 km travels with bypass section till design km 35.200 near village-Hapur Basant at SH-74 and terminated at SH-74 with design km 38+813 near Manikpur where it touches NH-722.

1.5 Importance Tourist Destination nearby the Project Corridor

Bihar in eastern India is one of the oldest inhabited places in the world with a history going back 3000 years. The rich culture and heritage of Bihar is evident from the innumerable ancient monuments that are dotted all over the state. Bihar is home to many tourist attractions and is visited by large numbers of tourists from all over the world. Around total 6 million tourists visit Bihar every year.

Some of the important religious and tourist destination which can be connected by proposed Bakarpur-Manikpur alignment area Gandhak River, Hariharnath Temple, Sonpur Fair, Ashok Pillar Stupa, Budh Stupa, Jain Temple, Mahatma Gandhi Setu and National Leechi Research center .

However, potentiality of finding Buddhist and Jain pilgrimages in some places is viable. The proposed Bakarpur-Manikpur project will direct connectivity to pilgrimage of ancient importance such as Budh Stupa, Jain temple, Mahatma Gandhi Setu. Some of the importance religious places and tourist destinations are as follows:

Figure 1-3: Tourist Destination nearby the Project Corridor

Gandak River, Sonpur, Saran

Hariharnath Temple, Sonpur,

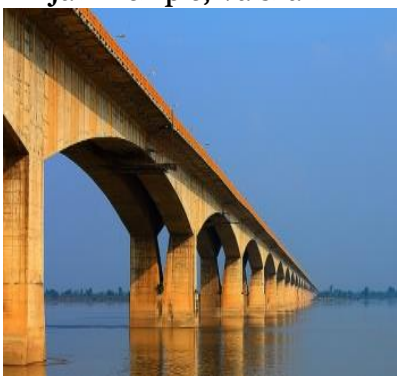
Sonpur Fair, Sonpur, Saran

Saran

Jain Temple, Vaishali

Budh Stupa, Vaishali

Ashoka Pillar, Vaishali



Mahatma Gandhi Setu, Sonpur

National Leechi Research Center, Muzaffarpur

1.6 Needs of Bakarpur- Manikpur Road Project

- The proposed project Bakarpur to Manikpur section (NH-139W) is a feeder route which is starts from NH-19 junction (Sitalpur Bypass) near village-Bakarpur and travel till Manikpur (merge into SH-74 with design km 38+813).
- Bakarpur-Manikpur section is terminal part of NH-139W, it will be terminated before NH-227. Which is connected with Nepal Border via Chakia, Motihari, Sugauli, Raxaul (SH-86, NH-27 and NH-527D) and via Muzaffarpur, and Sitamarhi (NH-227 and NH-22). Hence it has an importance for international freight movement, trade and strategic relations with Nepal.
- NH-139W provides direct connectivity to state capital Patna via Hazipur Industrial Area and other districts viz. Hajipur, Saran, Vaishali, Muzaffarpur, Sitamarhi, , leading to Nepal Border.
- It will provide connectivity with Patna City to the rural areas of project affected districts. It will be very connectivity to the religious and tourist places along the project highway.
- The regional connectivity will be enhanced and this leads to promote trade and commerce and boost up the overall economic benefits for the population of backward areas in the state.
- It aims to provide batter connectivity to the backward areas, religious and other tourist places in the project area. Hence, it will encourage the tourism industries in the project affected areas.

1.7 Environment Impact Assessment Process

Applicability of various environmental regulations and guidelines was reviewed for the project and its allied activities. As per the EIA Notification 2006 & amended thereof, the project is covered under serial no. 7(f) as Category 'A'. The proposed project has been scoped for Terms of

Reference (ToR) vide File No.10/2/2023-IA.III dated 21st February, 2023 (Annexure 1.2). ToR compliance is presented as Annexure 1.3 of this report.

1.8 Approach and Methodology

Present EIA study has been undertaken based on EIA Notification, 2006 (amended thereof), ToR accorded for the project from MoEF&CC and Environmental Impact Assessment Guidance Manual for Highways prepared by Administrative Staff College of India.The EIA study was carried out simultaneously with design of the project road and methodology is shown in Figure 1.2. The important findings of the assessment provided feedback to the design team, especially in terms of the sensitive receptor, forest and wildlife area, archaeological sites and religious properties. It helped in modification of the designs report and incorporated mitigation measures, wherever the impacts are avoidable.The sections below detail out the methodology adopted for the assessment of environment for the project.

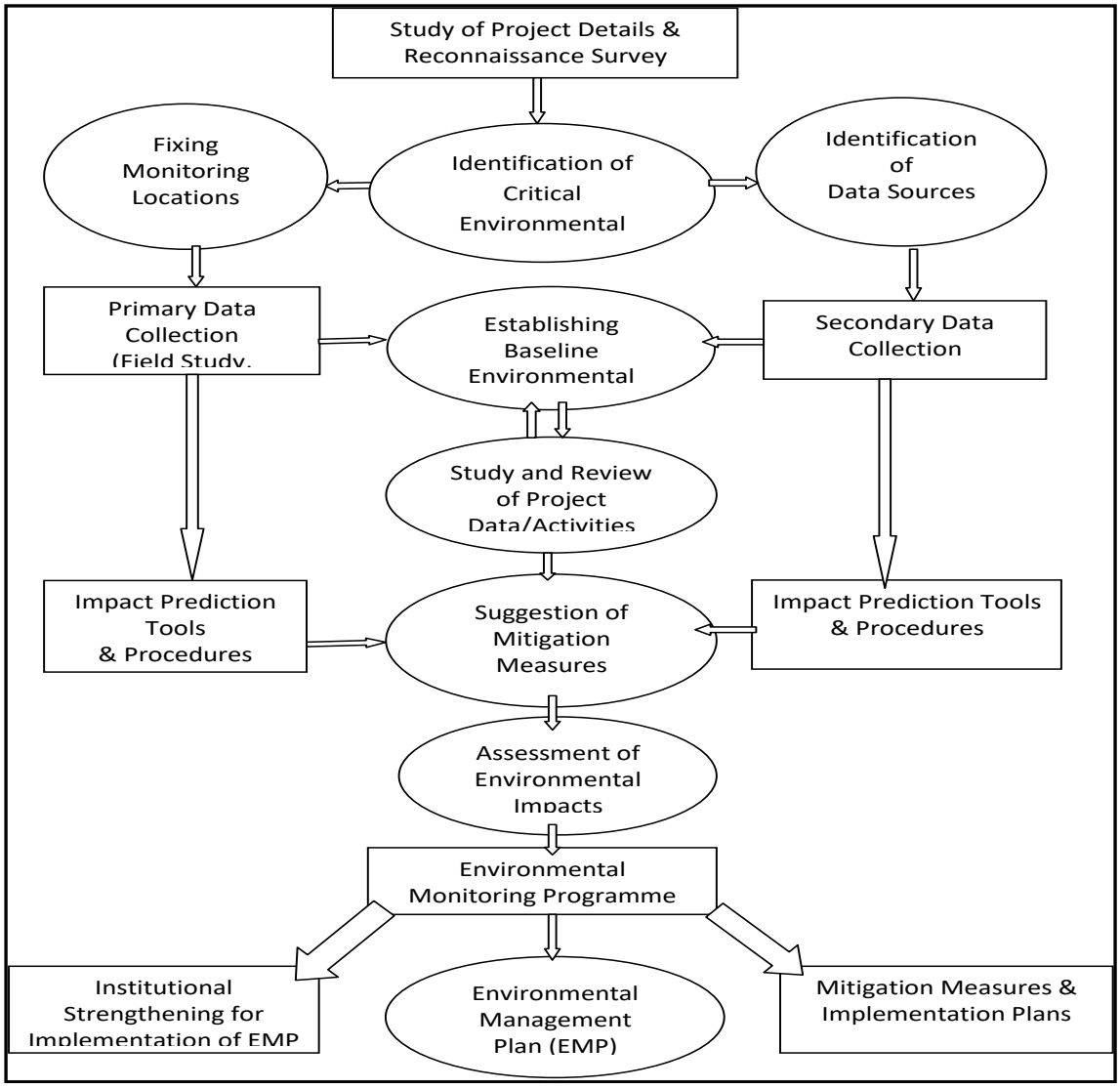


Figure 1-4: Methodology of EIA

1.8.1 Reconnaissance Survey

A reconnaissance survey has been undertaken for identification of Valued Environment Components (VECs) falling within the RoW of proposed highway. Locations of environmentally

protected areas (National Parks, Wildlife Sanctuaries, Biosphere Reserves, Reserved / Protected Forest, Important Bird Areas, World heritage Sites, Archaeological Monuments, *etc.*); surface water bodies; environmentally sensitive receptors (educational institutions, religious structures, medical facilities, etc.) along the green field alignment have been identified during the survey. The Consultant conducted preliminary analysis of the nature, scale and magnitude of the impacts that the project is likely to cause on the environment, especially on the identified VECs.

1.8.2 Review of the Project Information

Project information from Design Reports prepared by DPR Consultant and other secondary information were reviewed and assess the project status and various technical aspects. Accordingly, major impact areas were identified for detailed assessment in present EIA report.

1.8.3 Review of Applicable Environmental Regulations

Applicability of various environmental regulations and guidelines were reviewed for the project and its allied activities. Review analysis in respect to Govt. of India guidelines and regulatory environment framework is presented in the Table 1-2.

1.8.4 Assessment of Alternatives

With and without project scenarios have been assessed. The assessment of alternatives included that of Process Technology (pavement, cross-sections, etc.), sources of materials from an environmental management perspective, selection of alignment, etc.

1.8.5 Assessment of Baseline Environmental Profile

Secondary data such as Survey of India Toposheets, District Planning Maps, Forest Working Plans, booklet of Central Ground Water Board, details of Archaeological Monuments etc. have been collected from various secondary sources. Further, secondary data, which are relevant to understand the baseline as pertaining to physical and biological environments has been collected and reviewed.

Data pertaining to all facets of environment which include physical, ecological and socioeconomic environment, both through primary and secondary sources were collected. Sources of key relevant information have been summarised in Table 1-3.

Ambient Air, Noise, Soil and Water samples were collected at various locations identified along the corridor by M/s Shree Krishna Analytical Services Private Limited approved by NABL & MOEF&CC. The monitoring and analysis for each component were carried out as per MoEF&CC and CPCB guidelines during the study periodfrom January 2023 to March 2023. The results of the monitoring were compared with the relevant national standards.

In order to quantify the impacts of the project road on various receptors, a receptor identification survey was carried out. The receptors included the information for educational institutes, hospitals, cultural & religious properties, community properties, water bodies, major pollution generating sources, ecological receptors etc.

Table 1-2: Applicability Review of the Regulatory Environment Framework

Sl. No.	Regulation / Guidelines	Relevance	Applicability (Yes / No)	Reason for Application	Implementing / Responsible Agency
1	The Environmental (Protection) Act. 1986, and the Environmental (Protection) Rules, 1987-2002 (various amendments)	Umbrella Act for protection and improvement of the environment.	Yes	All environmental Notifications, Rules and Schedules are issued under the EP Act	MoEF&CC, State Dept. of Environment & Forest, CPCB and SPCB
2	The EIA Notification, 14th September 2006 & amended thereof	Identifies all new national highways, expansion of national highways projects greater than 100 km involving additional ROW or land acquisition greater than 40m on existing alignments and 60m on re-alignments or by-passes (item 7 (f) of schedule) as one of the projects requiring prior clearance.	Yes	The project is development of a new National Highway. Hence, Environment Clearance is required from MoEF&CC.	MoEF&CC & SEIAA
		Opening of new Quarry Area (including excavation of Riverbed)	Yes	Prior EC to be taken by Contractor if there is any need of mining activity	
3	Notification for use of Fly ash, 3rd November 2009 and its amendment on 25th January 2016	"No agency, person or organization shall, within a radius of 300 Kilometres of a thermal power plant undertake construction or approve design for construction of roads or flyover embankments with top soils; the guidelines or specifications issued by the Indian Road Congress (IRC) as contained in IRC specification No. SP:58 of 2001 as amended from time to time regarding use of fly ash shall be followed and any deviation from this direction can only be agreed to on technical reasons if the same is	Yes	Kanti Thermal Power Station, Barh Super Thermal Power Plant, Kahalgaon Super Thermal Power Station, Nabinagar Super Thermal Power Project and Barauni Thermal Power Stationare located within 300km from the proposed highway alignment	MoEF&CC, SPCB

Sl. No.	Regulation / Guidelines	Relevance	Applicability (Yes / No)	Reason for Application	Implementing / Responsible Agency
		approved by Chief Engineer (Design) or Engineer-in-Chief of the concerned agency or organization or on production of a certificate of "fly ash not available" from the Thermal Power Plant(s)			
4	The Water (Prevention and Control of Pollution) Act, 1974	Central and State Pollution Control Boards to establish / enforce water quality and effluent standards, monitor water quality, prosecute offenders, and issue licenses for construction / operation of certain facilities.	Yes	Consent required for not polluting ground and surface water during construction	Bihar State Pollution Control Board
5	The Air (Prevention and Control of Pollution) Act. 1981	Empowers SPCBs to set and monitor air quality standards and to prosecute offenders, excluding vehicular air and noise emission.	Yes	Consent required for establishing and operation of crushers, hot mix and batching plants etc.	Bihar State Pollution Control Board
6	Noise Pollution (Regulation And Control) Act, 1990, 2010 and its subsequent amendments	Standards for noise emission for various land uses	Yes	Construction machineries and vehicles to conform to the standards for construction	Bihar State Pollution Control Board
7	Forest (Conservation) Act, 1980 its subsequent amendments.	Conservation and definition of forest areas. Diversion of forest land follows the process as laid by the Forest conservation Act.	Yes	The proposed project is passing through the notified forest strips along the existing roads/canals crossing by the proposed alignment.	State Forest Department, MoEF&CC
9	Wildlife Protection Act, 1972 and amended thereof,	Protection of Wildlife Sanctuaries and National Park	No	The proposed alignments is passing through the Sri Venksetswara NP/WLS and Sri Penusila Narasimha Wildlife Sanctuaryasprotected under Wildlife (Protection) Act, 1972.	NBWL, SBWL & Chief Wildlife Warden
10	Ancient Monuments and Archaeological	To protect and conserve cultural and	No	The proposed project is not falling	Archaeological

Sl. No.	Regulation / Guidelines	Relevance	Applicability (Yes / No)	Reason for Application	Implementing / Responsible Agency
	sites & Remains Act 1958 and amended thereof,	historical remains found.		within 300m of any Ancient Monuments notified under Ancient Monuments and Archaeological sites & Remains Act 1958 and amended thereof,	Survey of India, State Dept. of Archaeology
11	The Motor Vehicle Act. 1988 its subsequent amendments.	Empowers State Transport Authority to enforce standards for vehicular pollution. From August 1997 the "Pollution Under Control Certificate" is issued to reduce vehicular emissions	Yes	All vehicles used for construction will need to comply with the provisions of this act.	State Motor Vehicles Department
12	The Explosives Act (& Rules) 1884 (1983) its subsequent amendments.	Sets out the regulations as to regards the use of explosives and precautionary measures while blasting & quarrying	Yes	Use of blasting materials (if required) for new quarrying operation and storing of Diesel / Petrol in the camp site	Chief Controller of Explosives
13	Public Liability and Insurance Act, 1991	Protection to the general public from accidents due to hazardous materials	Yes	Hazardous materials like Bitumen shall be used for road construction	Labour Commissioner / District Magistrate
14	Hazardous and Other Wastes (Management, & Trans-boundary Movement) Rules, 2016 and amended thereof	Protection to the general public against improper handling and disposal of hazardous wastes	Yes	Hazardous wastes shall be generated due to activities like of maintenance and repair work on vehicles	Bihar State Pollution Control Board
15	Construction and Demolition Waste Management Rules, 2016 and Solid Waste Management Rules 2016	Safe disposal of construction waste and municipal solid waste	Yes	Construction and demolition waste due to demolition of existing structures & construction activities and municipal waste shall be generated from the construction worker camp	Bihar State Pollution Control Board
16	Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996	Protection against chemical accident while handling any hazardous	Yes	Handling of hazardous (flammable, toxic and explosive) chemicals during	District & Local Crisis Group

Sl. No.	Regulation / Guidelines	Relevance	Applicability (Yes / No)	Reason for Application	Implementing / Responsible Agency
		chemicals resulting		road construction	headed by the DM and SDM
17	Mines & Minerals (Regulation & Development) Act, 1957 & amended thereof,	Permission of Mining of aggregates and sand from riverbed & aggregates	Yes	Mining of sand, soil or aggregates shall require permission from mining dept.	State Department of Mining
18	The Building & Other Construction Workers (Regulation of Employment & Conditions of Service) BOCW Act, 1996	Employing Labour / workers	Yes	Employment of labours	District labour Commissioner

Table 1-3: Primary and Secondary Information Sources

Parameters	Information Source
Technical information	Design Report
Inventory of features like water Bodies, Community structures, environmentally sensitive locations areas, congested locations *etc.*	Total station surveys, Google Earth, Bhuvan, Survey of India Maps, Primary Transect Walk
Climatic Condition & Meteorological data	India Meteorological Department, Districts Groundwater Brochure of CGWB, Primary data collection
Geology, Seismicity, Soil and Topography	Districts Groundwater Brochure of CGWB, Seismicity data available of National Disaster Management Authority Website andPrimary survey & Investigation
Land Use / Land Cover	Survey of India Toposheet, Google Earth, Bhuvan and Ground Truthing
Drainage Pattern	Survey of India Toposheet, Total Station Survey at Site, Districts Groundwater Brochure of CGWB, field observation and consultation with stakeholders
Ecology & Biodiversity and identification of Forest Area	Onsite survey, Consultations in DFOs /wildlife officersand Research journals
Air quality Noise, Soil and Water	Onsite monitoring and Analysis of Field samples, SPCB & CPCB published data
Borrow Areas, Quarries and other construction material source	Material Surveys
River geo-morphology, hydrology, drainage, flood patterns	Water resource Dept., Districts Groundwater Brochure of CGWB, outcome of the consultation and field observations
Socioeconomic Environment	Census of India and Public Consultation during the Field survey

1.8.6 Assessment of Impacts

Assessment of potential impacts has been carried out based on the project design and baseline environment data as collected from primary and secondary sources. Assessment of the environmental impacts were carried out to ascertain the direct and indirect impacts likely to be induced due to proposed development. The general impacts are land acquisition& allied impacts on society, dust & air pollution due to removal of structures, trees & vegetation and other construction activities; noise pollution due to construction activities, loss of flora and its impacts on the ecology and impacts on water resources.

For each impact predicted, feasible and cost-effective mitigation measures have been suggested to reduce potentially significant adverse environmental impacts to acceptable levels.

1.8.7 Consultations

Consultations on environmental issues with community members, institutional stakeholder and PAPs in the form of focused group discussions, stakeholder meetings etc. were carried out. Consultation process were involved both formal and non-formal discussion. The feedback generated through these meetings has been incorporated as far as possible in the design and construction of the highway. The consultation process shall continue even during the implementation stage to gauge the general opinion. The outcome of consultation activities is elaborated in Chapter 7- Additional Studies.

1.8.8 Environment Management and Monitoring Plan

All affirmative action's not only to avoid and deter but also to capitalise on the opportunities provided by the project in order to improve the environmental conditions have been deliberated. The various mitigation and enhancement measures proposed have been included in the EIA report. Based on their applicability, both general and case specific measures were incorporated.

The EMP action plan has been prepared to detail out the implementation plan of the proposed mitigation and enhancement measures. Monitoring indicators have been identified to have a continuous check on impacts associated with project activities.

1.9 Structure of the Report

The EIA report excluding the first chapter has been structured into the following chapters:

Chapter- 2 **Project Description** describes the project design features related to environment, health and safety aspects.

Chapter-3 **Analysis of Alternatives** details out the various alternatives for the project str*etc*h, construction technology alternative, etc.

Chapter- 4 **Baseline Environmental Profile** describes the existing environmental set up of the study area;

Chapter-5 **Anticipated Environmental Impact & Mitigation Measures** details out about impacts associated with the proposed developmental activities. Mitigation measures for identified impacts are also covered in this chapter.

Chapter- 6 **Environmental Monitoring programme** discuss about the monitoring indicators, reporting mechanism and responsibility distribution for successful implementation of Environment Management Plan

Chapter -7 **Additional Studies** covers details about the Public Consultation and Hearing. Chapter also contains the brief of additional studies suggested by MoEF&CC during ToR appraisal meeting.

Chapter-8 **Project benefits** to the local community and environment are discussed in this chapter;

Chapter- 9 **Environmental Management Plan** details both the generic and specific EMPs for the project Highway.Implementation arrangements give a brief about the implementation methodology. This chapter also discusses about the Environmental Budget.

Chapter- 10 **Summary and Conclusion** briefs the EIA study outcome along with recommendation for the project.

Chapter-11 **Disclosure of the Consultant** provides the details of the consultants engaged along with their capabilities and experiences.

2 PROJECT DESCRIPTION

2.1 Project Profile

The proposed project is development of 4 lane Bakarpur-Manikpur Section, Starting from design km 0.000 at Sitalpur bypass of NH-19 near village Bakarpur in district Saran and terminate at design km 38.813 near village Manikpur merge into SH-74 in district Muzaffarpur in the state of Bihar. The proposed project is falling in Saran, Vaishali and Muzaffarpur districts of Bihar State. Total length of the project is 38.813km. The staring and ending coordinates of the proposed sectionare given in Table 2-1.

Table 2-1: Project Coordinates

Description	Coordinates
Starting point	25°43'22.77"N 85° 8'16.13"E;
Terminating point	26°1'38.15"N,85°7'54.47"E.

The photogrphic and google view of the starting and ending locations of the proposed alignment is given in Figure 2.1.

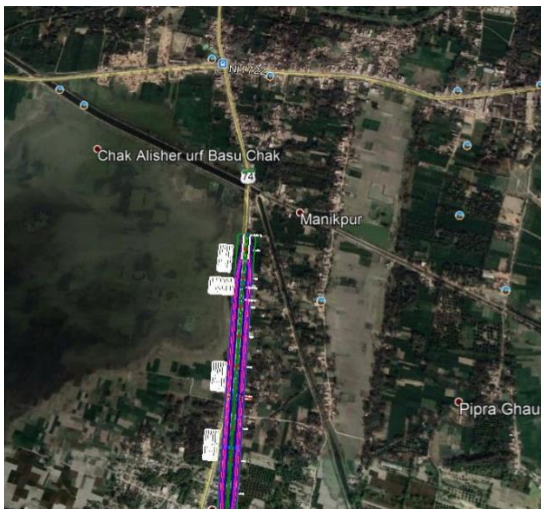


Figure 2-1: Start/End Point view of the Proposed Highway

The list of built-up areas and project affected villages along the proposed alignment are given in Table 2-2 & Table 2-3. The proposed alignment duly marked on google satellite imagery is shown as Figure 2.1.

Table 2-2: List of affected villages along the Project Highway

S. No.	District	Name of the Taluk	Name of the Village
1	Saran	Dariyapur	Barwa
2		Dariyapur	Darihar Bhualpur/538
3		Dariyapur	Darihara Nisakh
4		Dariyapur	Darihara Chaturbhuj
5		Dariyapur	Konhwa
6		Dariyapur	Belhar Janki
7		Dariyapur	Belhar Fattu
8		Dariyapur	Khushihal pur
9		Dariyapur	Mangarpal Murtuza
10		Dariyapur	Mangarpal Nuran
11		Dariyapur	Manpur
12		Dariyapur	Saraia
13		Dariyapur	Sarnarayan
14		Sonepur	Akilpur
15		Sonepur	Baqarpur
16		Sonepur	Chitarsenpur
17		Sonepur	Dariyapur
18		Sonepur	Gobind Chak
19		Sonepur	Ismail Chak
20		Sonepur	Makhdumpur
21		Sonepur	Parmanandpur
22		Sonepur	Shikarpur
1	Vaishali	Lalganj	Etwarpur Jagir
2		Lalganj	Etwarpur Nizamat
3		Lalganj	Jalalpur Gopi Mal
4		Lalganj	Jalalpur Gopi Milki/109
5		Lalganj	Jalalpur urf Bishunpur Gamhir/ 113
6		Lalganj	Jalalpur/112
7		Lalganj	Khanjahan Chak urf Saidanpur/ 102
8		Lalganj	Pirapur Urf Shahabad
9		Lalganj	Tajpur / 105
10		Lalganj	Sararia Urf Saranthi Chhapra B
11		Lalganj	Yusufpur
12		Vaishali	Bailka
13		Vaishali	Basarh urf Vaishali/43
14		Vaishali	Basra urf Chak Ramdat
15		Vaishali	Bhagwanpur
16		Vaishali	Harpur Basant
17		Vaishali	Jafraha
18		Vaishali	Keshopur
19		Vaishali	khijirpur
20		Vaishali	Manpura
21		Vaishali	Munimchak

S. No.	District	Name of the Taluk	Name of the Village
22		Vaishali	Parsurampur
23		Vaishali	Rukanpur/18
1	Muzaffarpur	Saraiya	Abu Chak
2			Anandpur Singh
3			Chak Abdul Rahim
4			Manikpur
5			Manikpur
6			Pipra Ghaus

Table 2-3: List of Built-up/Town along the Project

S. No.	Built-up section/Town Name	Design Chainages (km)	
		Start	End
1.	Tarwan Mangerpal	9+600	10+400
2.	Manpur	10+700	11+600
3.	Sarnarayan	12+700	13+200
4.	Darihara nasikh	13+500	14+300
5.	Darihara chaturbhuj	15+700	16+500
6.	Bailka	25+100	25+300
7.	Bhagwanpur	29+100	29+200
8.	Keshopur	29+700	30+300
9.	Manpura	30+800	30+900
10.	Basarh	33+900	34+600
11.	HarpurBasant	35+200	36+200
12.	Birpur	37+800	38+100
13.	Manikpur	38+100	38+814

2.2 Project Features

The proposed project highway is 4 lane carriageway with paved soulder and provision of service roads as per requirements. This project will follow the National Highway standards as per IRC guidelines. The various aspects of design that have been considered in the development of design for the proposed highway are brought out in this section. It mainly consists of geometrics of highway, interchange design, junction design, cross sections, drainage design, pavement design, structure design for culverts, bridges, flyover, ROBs, VUP's, LVUP's, SVUP's, and interchanges.

2.2.1 Design Speed

The project corridor passes through plain and rolling terrain. The adopted design speed is 100kmph throughout the stretch. Design speed is given in Table 2-4.

Table 2-4: Design Speed

Nature of Terrain	Cross slope of the ground	Design Speed (km/hr)	
		Ruling	Minimum
Plain	Up to 25 %	100	80

2.2.2 Right of Way (ROW)

The proposed Right of Way (PROW) shall be 45m in general. Additional land shall be acquired at interchanges, toll booth, highway amenities, truck lay byes. The existing ROW is varies from 10 - 20m as per available recordes.

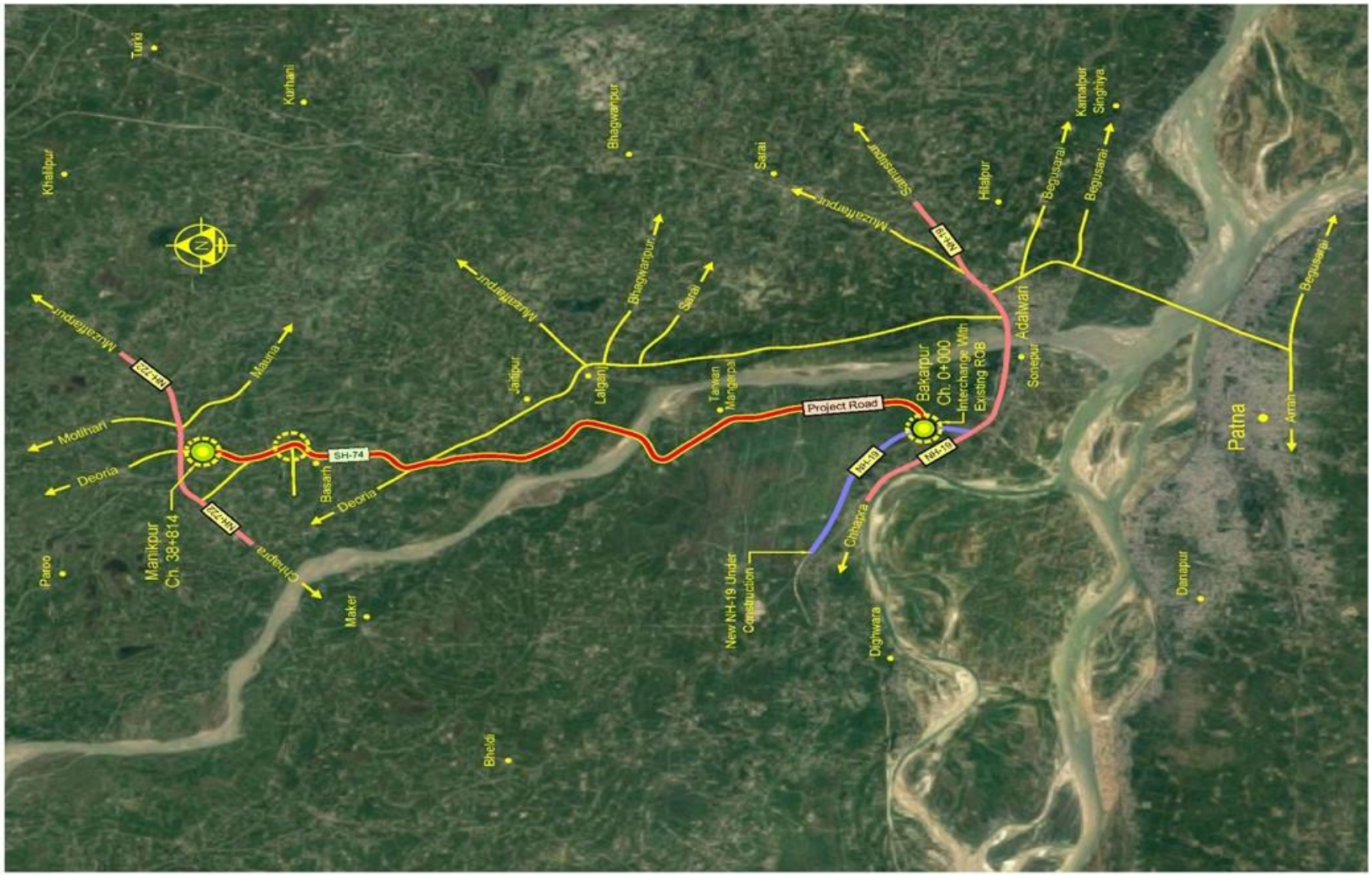
Table 2-5: Proposed Right of Way (ROW)

Sl.	Design Chainage (km)	Length	Left from	Right from	Remark

No	From	To	(m)	PCL	PCL	
1.	0	840	840	VARRIES	VARRIES	Cloverleaf Area
2.	840	8+540	7700	22.5	22.5	
3.	8+540	4+660	120	30	30	Truck Lay Bye
4.	4+660	21+195	12535	22.5	22.5	
5.	21+195	21+275	80	30	30	Toll Plaza
6.	21+275	21+725	450	37.5	37.5	
7.	21+725	21+805	80	30	30	
8.	21+805	34+700	12895	22.5	22.5	
9.	34+700	34+770	70	43.7 to 22.5	22.5	
10.	34+770	34+914	144	22.5	22.5	
11.	34+914	35+172	258	22.5	144.4	Rest Area
12.	35+172	35+220	48	22.5	22.5	
13.	35+220	35+410	190	70	22.5	
14.	35+410	35+585	175	22.5	22.5	
15.	35+585	35+680	95	63.7 to 28.3	21.5 to 16.8	
16.	35+680	36+200	520	30.2 to 20.4	14.7 to 24.5	
17.	36+200	36+300	100	22 to 45	24.7 to 26	
18.	36+300	36+440	140	19.8 to 22.5	26.2 to 22.5	
19.	36+440	37+440	1000	22.5	22.5	
20.	37+440	37+560	120	30	30	Truck Lay Bye
21.	37+560	38+814	1254	22.5	22.5	

Source: Design Report

Figure 2-2: Proposed Alignment Marked on Satellite Imagery (Google Earth)



2.2.3 Typical Cross Sections

Typical cross-sections have been proposed as per IRC of each lane having 3.5m width. Paved Shoulder width is 1.5 m on both sides along with 2m earthen shoulder and Median. Typical cross-sectional drawings are shown Annexure 2.1. The project corridor has been designed for widening in 4 lane as per the following Typical Cross-Sectional Schedule mentioned Table 2-5.

Table 2-6: Typical Cross-Sectional

S.No.	Chainage		Length	TCS Type	Description
	From	To			
1	0+000	0+122	122	-	Existing ROB
2	0+122	0+217	95	Flyover	As per GAD
3	0+217	0+352	135	TCS-8	Typical cross section of cloverleaf approach at start of bypass
4	0+352	0+418	66	Flyover	As per GAD
5	0+418	0+640	222	TCS-8	Typical cross section of cloverleaf approach at start of bypass
6	0+640	0+860	220	TCS-8A	Typical cross section of main carriageway with ramps at start of bypass
7	0+860	0+882	22	TCS-2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
8	0+882	0+887	5	SVUP (Type-II)	As per GAD
9	0+887	1+010	123	TCS 2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
10	1+010	2+048	1038	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
11	2+048	2+053	5	SVUP (Type-II)	As per GAD
12	2+053	3+020	967	TCS-1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
13	3+020	3+271	251	TCS-2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
14	3+271	3+307	36	MNB	As per GAD
15	3+307	3+470	163	TCS-2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
16	3+470	3+909	439	TCS-1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
17	3+909	3+923	14	MNB	As per GAD

S.No.	Chainage		Length	TCS Type	Description
	From	To			
18	3+923	4+040	117	TCS-1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
19	4+040	4+076	36	MNB	As per GAD
20	4+076	4+600	524	TCS-1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
21	4+600	4+614	14	TCS-2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
22	4+614	4+619	5	SVUP(Type-II)	As per GAD
23	4+619	4+660	41	TCS-2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
24	4+660	5+176	516	TCS-1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
25	5+176	5+181	5	SVUP(Type-II)	As per GAD
26	5+181	5+550	369	TCS- 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
27	5+550	5+555	5	SVUP (Type-II)	As per GAD
28	5+555	6+574	1019	TCS-1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
29	6+574	6+610	36	MNB	As per GAD
30	6+610	7+121	511	TCS-2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
31	7+121	7+145	24	MNB	As per GAD
32	7+145	7+220	75	TCS-2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
33	7+220	8+050	830	TCS-1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
34	8+050	8+206	156	TCS-2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
35	8+206	8+211	5	SVUP (Type-II)	As per GAD
36	8+211	8+370	159	TCS-2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral

S.No.	Chainage		Length	TCS Type	Description
	From	To			
					section (vup/lvup/svup)
37	8+370	9+650	1280	TCS-1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
38	9+650	9+872	222	TCS-3	Typical cross section for 4 lane carriageway at grade separated approach location with service road/slip road applicable in rural section (rob/vup/lvup/svup)
39	9+872	9+877	5	SVUP (Type-II)	As per GAD
40	9+877	10+260	383	TCS-3	Typical cross section for 4 lane carriageway at grade separated approach location with service road/slip road applicable in rural section (rob/vup/lvup/svup)
41	10+260	10+267	7	SVUP (TYPE I)	As per GAD
42	10+267	10+540	273	TCS-3	Typical cross section for 4 lane carriageway at grade separated approach location with service road/slip road applicable in rural section (rob/vup/lvup/svup)
43	10+540	10+693	153	TCS-2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
44	10+693	10+698	5	SVUP (Type-II)	As per GAD
45	10+698	11+130	432	TCS-1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
46	11+130	11+250	120	TCS-2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
47	11+250	11+255	5	SVUP (Type-II)	As per GAD
48	11+255	12+148	893	TCS-1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
49	12+148	12+153	5	SVUP (Type-II)	As per GAD
50	12+153	12+723	570	TCS-1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
51	12+723	12+728	5	SVUP (Type-II)	As per GAD
52	12+728	12+740	12	TCS-1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
53	12+740	13+019	279	TCS-3	Typical cross section for 4 lane carriageway at grade separated approach location with service road/slip road

S.No.	Chainage		Length	TCS Type	Description
	From	To			
					applicable in rural section (rob/vup/lvup/svup)
54	13+019	13+031	12	LVUP	As per GAD
55	13+031	13+340	309	TCS-3	Typical cross section for 4 lane carriageway at grade separated approach location with service road/slip road applicable in rural section (rob/vup/lvup/svup)
56	13+340	14+283	943	TCS-1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
57	14+283	14+288	5	SVUP (Type-II)	As per GAD
58	14+288	14+500	212	TCS-2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
59	14+500	14+724	224	TCS-4	Typical cross section for 4-lane carriageway at grade separated approach location with rhs slip road bypass / realignment in rural section (vup/lvup/svup)
60	14+724	14+729	5	SVUP (Type-II)	As per GAD
61	14+729	14+840	111	TCS-2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
62	14+840	15+847	1007	TCS-1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
63	15+847	15+852	5	SVUP (Type-II)	As per GAD
64	15+852	16+395	543	TCS-2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
65	16+395	16+495	100	TCS-9	TYPICAL CROSS SECTION FOR MAJOR BRIDGE APPROACHES
66	16+495	18+905	2410	MJBR	As per GAD
67	18+905	19+005	100	TCS-9	TYPICAL CROSS SECTION FOR MAJOR BRIDGE APPROACHES
68	19+005	19+373	468	TCS-2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
69	19+373	19+378	5	SVUP (Type-II)	As per GAD
70	19+378	19+898	520	TCS-1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
71	19+898	19+903	5	SVUP (Type-II)	As per GAD

S.No.	Chainage		Length	TCS Type	Description
	From	To			
72	19+903	20+423	520	TCS 2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
73	20+423	20+428	5	SVUP (Type-II)	As per GAD
74	20+428	20+520	92	TCS 2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
75	20+520	21+195	675	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
76	21+195	21+805	610	Toll Plaza	As per GAD
77	21+805	23+274	1469	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
78	23+274	23+279	5	SVUP (Type-II)	As per GAD
79	23+279	24+040	761	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
80	24+040	24+108	68	TCS 2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
81	24+108	24+113	5	SVUP (Type-II)	As per GAD
82	24+113	24+180	67	TCS 2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
83	24+180	24+308	128	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
84	24+308	24+323	15	MNB	As per GAD
85	24+323	24+685	362	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
86	24+685	24+690	5	SVUP (Type-II)	As per GAD
87	24+690	25+263	573	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
88	25+263	25+268	5	SVUP (Type-II)	As per GAD
89	25+268	26+620	1352	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
90	26+620	26+705	85	TCS 2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)

S.No.	Chainage		Length	TCS Type	Description
	From	To			
91	26+705	26+710	5	SVUP (Type-II)	As per GAD
92	26+710	26+810	100	TCS 2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
93	26+810	27+240	430	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
94	27+240	27+374	134	TCS 2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
95	27+374	27+379	5	SVUP (Type-II)	As per GAD
96	27+379	27+460	81	TCS 2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
97	27+460	27+820	360	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
98	27+820	28+054	234	TCS 3	Typical cross section for 4 lane carriageway at grade separated approach location with service road/slip road applicable in rural section (rob/vup/lvup/svup)
99	28+054	28+066	12	VUP	As per GAD
100	28+066	28+418	352	TCS 3	Typical cross section for 4 lane carriageway at grade separated approach location with service road/slip road applicable in rural section (rob/vup/lvup/svup)
101	28+418	28+423	5	SVUP (Type-II)	As per GAD
102	28+423	30+225	1802	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
103	30+225	30+230	5	SVUP (Type-II)	As per GAD
104	30+230	32+370	2140	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
105	32+370	32+602	232	TCS 2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
106	32+602	32+609	7	SVUP (TYPE I)	As per GAD
107	32+609	32+630	21	TCS 2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)

S.No.	Chainage		Length	TCS Type	Description
	From	To			
108	32+630	32+938	308	TCS 3	Typical cross section for 4 lane carriageway at grade separated approach location with service road/slip road applicable in rural section (rob/vup/lvup/svup)
109	32+938	32+962	24	VUP	As per GAD
110	32+962	33+383	421	TCS 2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
111	33+383	33+388	5	SVUP (Type-II)	As per GAD
112	33+388	33+430	42	TCS 2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
113	33+430	33+578	148	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
114	33+578	33+583	5	SVUP (Type-II)	As per GAD
115	33+583	33+660	77	TCS 2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
116	33+660	34+240	580	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
117	34+240	34+482	242	TCS 2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
118	34+482	34+489	7	SVUP (TYPE I)	As per GAD
119	34+489	35+180	691	TCS 7	Typical cross section for 4 lane carriageway at grade separated approach location and rhs slip road bypass/realignment in rural section (vup/lvup/svup)
120	35+180	35+400	220	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
121	35+400	35+820	420	TCS 5A	Typical cross section for 4-lane carriageway at grade seperated approach location with lhs service road applicable in rub section (rub)
122	35+820	35+900	80	RUB	As per GAD
123	35+900	36+200	300	TCS 5A	Typical cross section for 4-lane carriageway at grade seperated approach location with lhs service road applicable in rub section (rub)

S.No.	Chainage		Length	TCS Type	Description
	From	To			
124	36+200	36+630	430	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
125	36+630	36+773	143	TCS 2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
126	36+773	36+780	7	SVUP (TYPE I)	As per GAD
127	36+780	37+080	300	TCS 7	Typical cross section for 4 lane carriageway at grade separated approach location and rhs slip road bypass/realignment in rural section (vup/lvup/svup)
128	37+080	37+280	200	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
129	37+280	37+370	90	TCS 2	Typical cross section for 4 lane carriageway without service road at bypass / realignment location in rurral section (vup/lvup/svup)
130	37+370	38+300	930	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location
131	38+300	38+580	280	TCS 6	Typical cross section for 4 lane carriageway with service road at reconstruction location (reconstruction of existing road)
132	38+580	38+814	234	TCS 1	Typical cross section for 4 lane carriageway without service road at bypass / realignment location

2.2.4 Intersections and Grade Separators

All intersections and grade separators shall be as per Section 3 of the highway manual. Interchanges shall be constructed at locations and as per layouts given in highway drawing and structures for interchange shall be constructed as per the mentioned details in clause 2.2.9 & 2.2.10.

The crossroads underneath the Flyovers, Underpasses shall be treated as at grade intersection. These junctions of the crossroads shall be developed as at grade intersection as per manual requirement, layouts.

2.2.5 Major & Minor Bridge

One (1) major bridges, 6 minor bridge, 1 ROB, 2 VUP, 1 LVUP and 28 SVUP are proposed for the proposed project. Detailed chainage of the structures are listed from Table 2-7 to Table 2-8.

Table 2-7: Major Bridge

Sl.No.	Chainage (km)	Span	Skew angle (degree)	Structure Type	Deck Configuration (m)	Discharge (cumecs)
1	17+700	2x46+42x53+2x46	0	Simply Supported	26.60	28316.85

Source: Design Report

Table 2-8: Minor Bridge

Sl.No.	Chainage (km)	Span	Skew Angle (Degree)	Type of Structure	Deck Configuration (m)	Width of Open Median (m)
1	3+289.536	3 x 12.0	0	RCC Box	2x 11.0	3
2	3+916.470	2 x 7.0	66	RCC Box	2 x 11.0	3
3	4+058.700	3 x 12.0	35	RCC Box	2 x 11.0	3
4	6+592.300	3 x 12.0	7	RCC Box	2 x 11.0	3
5	7+132.750	2 x 12.0	12	RCC Box	2 x 11.0	3
6	24+315.000	2 x 7.50	0	RCC Box	2 x 11.0	3

Source: Design Report

Table 2-9: Flyover Details

Sl. No.	Design Chainage (m)	Span Arrangement	Skew (degree)	Structure Width (m)	Median
1	0+148.80 (LHS)	7x10 + 2x20.00	0	1x11	3.50
2	0+162.361(RHS)	20+3x15+21.50	0	1x11	3.50
3	0+373	2x32.84	12	2 x 18	3.50
4	Loop-1	1x10.0	0	48	-
5	Ramp-3	1x10.0	0	35	-

Source: Design Report

2.2.6 Slip / Service Roads

The Slip / Service roads has been provided at the following locations for the project corridor.

Table 2-10: Slip/Service Roads Locations

S. No.	Location (Design Ch.)		Sides	Width of Slip/Service Road (m)	Type	Length of Service road (km)	Total length of Service road (km)
	From	To					
1	9.650	10.540	BHS	7	Service Road	0.890	1.780
2	12.740	13.340	BHS	7	Slip Road	0.600	1.200
3	14.500	14.725	RHS	5.5	Service Road	0.225	0.225
5	27.820	28.420	BHS	7	Slip Road	0.600	1.200
7	32.630	32.938	BHS	7	Slip Road	0.308	0.616
8	34.485	35.180	RHS	7	Service Road	0.695	0.695
9	35.400	35.820	LHS	7	Service Road	0.420	0.420
10	35.900	36.200	LHS	7	Service Road	0.300	0.300
11	36.782	37.080	RHS	7	Slip Road	0.298	0.298
12	38.300	38.580	BHS	7	Service Road	0.280	0.560
Total length (km)						4.616	**7.294**

Source: Design Report

2.2.7 Road Under Bridge (RUB)

At present only single twin cell RUB is at site on the existing State Highway. Another RUB shall be designed and constructed by the Railway Department near the existing RUB. Contractor shall merge the project road smoothly with the constructed RUB. The details are provided as under.

Table 2-11: Details of RUB

Sl.No.	Location of ROB/RUB (km)	Nature and extent of repairs/strengthening to be carried out
1	RUB at proposed chainage 35+854	-

Source: Design Report

2.2.8 Proposed Junction/Interchange

The intersecting roads have been developed into vehicle under passes and categorised as per their priority which is detailed as below.

Table 2-12: Details of Major Junction

Sl. No.	Location(km)	Connecting Road	Type of Intersection	Type Design	Destination
1	0+385	NH-19	Interchange	Full Clover leaf	Hajipur/Sonepur on RHS and Chapra/Siwan on LHS

Source: Design Report

Table 2-13: Details of Minor Junction

Sl.No.	Design Chainage (km)	Type of Junction		Name of Crossing Road/Features	Remarks
		LHS	RHS		
1.	9+875	T		Village Road	On Service Road
2.	13+025	T		Bela Darihara Road	On Service Road
3.	28+060	T		Sonhani Bhagwanpur Road	On Service Road
4.	32+950	T		SH 74	On Service Road
5.	35+380	Y	_	SH 74	At Grade On Service Road
6.	35+600	Y	_	SH 74	At Grade On Service Road
7.	36+200	Y	_	SH 74	At Grade On Service Road
8.	38+300	T	X	SH 74	At Grade On Service Road

Source: Design Report

2.2.9 Vehicular Under Pass (VUP)

VUPs are provided at crossing between the project highway and MDRs. The lane width of the crossroads varies from 7.0m to 10.0m. The provision of future widening from 4 lanes is already taken into consideration for these roads. These are provided perpendicular to the project road.

Table 2-14: Vehicle Under Passes (VUP)

Sl. No.	Chainage (km)	Clear Span (m)	Skew Angle	Deck Configuration	Width of Open Median (m)	Vertical Clearance
1	28+060	1x12.0	36	2x11.0	3	5.6
2	32+950	2x12.0	30	2x11.0	3	5.6

Source*: Design Report*

2.2.10 Light Vehicular Under pass (LVUP)

LVUP shall be provided for ODRs and low configuration road compared to VUPs. The LVUPs are provided perpendicular to the proposed alignment.

Table 2-15: Light Vehicle Under Passes (LVUP)

S. No.	Design Chainage	Type of Crossing	Clear Span (m)	Skew angle (degre)	Deck Configuratin (m)	Width of Open Median (m)	Vertical Clearane
1	13+025	Village road	1X12.0	0	11.0x2	3	4.0

Source: Design Report

Table 2-16: Small Vehicular Underpass (Type-I)

S.No.	Design Chainage	Type of Crossing	Clear Span in square direction (m)	Skew angle (degre)	Deck Configuratin (m)	Width of Open Median (m)	Minimm Vertical Clearane

S.No.	Design Chainage	Type of Crossing	Clear Span in square direction (m)	Skew angle (degre)	Deck Configuratin (m)	Width of Open Median (m)	Minimm Vertical Clearane
1	10+262	Village road	1x7.0	0	11.0x2	3	4.0
2	32+605	Village road	1x7.0	48.5	11.0x2	3	4.0
3	34+485	Village road	1x7.0	30	11.0x2	3	4.0
4	36+776	Village road	1x7.0	38.33	11.0x2	3	4.0

Table 2-17: Small Vehicular Underpass (Type-II)

S.No.	Design Chainage	Clear Span in square direction (m)	Skew angle (degre)	Deck Configuratin (m)	Width of Open Median (m)	Minimm Vertical Clearane
1	0+882	1x5.0	20	11.0x2	3	3.0
2	2+050	1x5.0	0	11.0x2	3	3.0
3	4+616	1x5.0	11	11.0x2	3	3.0
4	5+178	1x5.0	13	11.0x2	3	3.0
5	5+552	1x5.0	14	11.0x2	3	3.0
6	8+208	1x5.0	42	11.0x2	3	3.0
7	9+874	1x5.0	26	11.0x2	3	3.0
8	10+695	1x5.0	38.6	11.0x2	3	3.0
9	11+252	1x5.0	36.28	11.0x2	3	3.0
10	12+150	1x5.0	54	11.0x2	3	3.0
11	12+725	1x5.0	7	11.0x2	3	3.0
12	14+285	1x5.0	15	11.0x2	3	3.0
13	14+726	1x5.0	24.8	11.0x2	3	3.0
14	15+849	1x5.0	32	11.0x2	3	3.0
15	19+375	1x5.0	21	11.0x2	3	3.0
16	19+900	1x5.0	24	11.0x2	3	3.0
17	20+420	1x5.0	21	11.0x2	3	3.0
18	23+276	1x5.0	0	11.0x2	3	3.0
19	24+110	1x5.0	0	11.0x2	3	3.0
20	24+687	1x5.0	14	11.0x2	3	3.0
21	25+265	1x5.0	8	11.0x2	3	3.0
22	26+707	1x5.0	14.9	11.0x2	3	3.0
23	27+376	1x5.0	0	11.0x2	3	3.0
24	28+420	1x5.0	24	11.0x2	3	3.0

2.2.11 Pavement Design

Pavement for proposed carriageway is designed based on subgrade strength, material characteristics/strength, and design traffic as discussed in previous sections.

As per IRC:37-2018 the design is governed by the fatigue tensile cracking at the bottom of the bituminous layer and rutting compressive strain on the top of subgrade which are considered as failures.. The crust detail is in Table 2-18 & Table 2-19.

Table 2-18: Crust details for Flexible Pavement (Option-1)

S. No.	Pavement layer	For Main Carriageway along with Loops & Ramps for the Interchanges	For service road
1	Bituminous Concrete	50 (Grade I, PMB)	30 (Grade-II, VG30)
2	Dense Bituminous Macadam (DBM)	100 (Grade II, VG-40)	50 (Grade-II)
3	Unbounded Granular Base Layer (WMM)	150	150

S. No.	Pavement layer	For Main Carriageway along with Loops & Ramps for the Interchanges	For service road
4	Cement Treated Granular Sub-Base (CTSB)	200	200
5	Subgrade	500	500
Note: *The adopted mix design parameters Va=3.50%&Vbe=10.40% for Main carriageway and Va=3.50% & Vbe=10.00% for Service Road is to be achieved for Bituminous Layer while designing in accordance to MS-II & MORTH Specification.*			

Source: Design Report

For rigid pavement design, the granular sub base (GSB) is considered 150mm thick and dry lean concrete (DLC) base layer is taken as 150 mm.

Table 2-19: Crust details for Rigid Pavement (Option-2)

Layer Type	Layer Thickness
Pavement Quality Concrete, PQC (With 28 days flexural strength of 4.5 MPa)	290 mm
Separation Membrane	150 Micron
Dry Lean Concrete, DLC (With characteristic 7 day compressive strength of 7 MPa)	150 mm
Granular Sub-base Drainage Layer	150 mm
Select Sub-grade (With minimum 4days soaked CBR@97%MDD, 8%)	500 mm
Embankment just below Select Subgrade (With minimum 4days soaked CBR@95%MDD, 6%)	500 mm

Source: Design Report

2.2.12 Drainage

Earthen drains are provided through-out the project corridor to ensure efficient drainage from carriageway to drain. All drains are connected to cross drainage structure. Median drains are provided with rain water harvesting structure. Proper drainage arrangements are provided for grade separated structures. If required, CD work is also provided for loops and ramps.

In addition to the provisions given in TCS, adequate Drainage system including surface and subsurface drains and median drainage system in super elevation section for the Project Highway shall be provided as per Schedule D.

Unlined / lined drains shall be provided in the entire project length as per the Drainage Plan. The brief of the same as mentioned below-

Table 2-20: Drainage details

Type of Drain	Position			Total Length
	LHS (in m)	Median (in m)	RHS (in m)	(in m)
RCC Rectangular Drain	1080	800	1080	2360
Semilined Drain	35748		35748	71496

The above mentioned lengths are indicative and may very due to condition of outlet near the strutures, changes in disposal points and any other site specific requirements. The drain at the median location shall be provided as per the provision of section 6.3 of the highway Manual.

2.2.13 Highway Amenities

The facilities provided for the project stretch include busbays, truck laybyes and road signages which facilitate the users as well as reducing the disruption of traffic flow.

Table 2-21: Details of the Bus Shelters

Sl. No	Design Chainage (km)	
	LHS	RHS
1	9+875	9+875
2	13+025	13+025
3	28+060	28+060
4	32+950	32+950
5	35+380	35+380
6	35+600	35+600
7	36+200	36+200
8	38+300	38+300

Table 2-22: Details of the Truck Lay Byes

Sl. No	Design Chainage (Km)	Location
1	8+600	Mangarpal
2	37+500	Birpur

Table 2-23: Details of the Rest Areas

Sl. No.	Chainage (km)	Location	Remarks
1	35+000	Harpurbasant	Rest Area

The rest area have been planned with the following features:

- Fuel zone – with fuelling station, charging station, CNG point, toilets, kiosks, ATM etc.
- Truckers zone- with parking, dhaba, dormitory, workshop, toilets, etc.
- Passenger's zone – with parking, children's play area, medical facilities, toilets, meeting rooms, guest rooms, food court, kiosks, restaurant
- Gram bazars

2.2.14 Toll Plaza

Toll plazas at Ch. 21+500 having 16 toll lanes of 3.5m each, 3.2m for manual/smart card lanes & will be and one lane of 4.5m at the extreme outer side for over dimensional vehicles are proposed along the project stretch for collection of toll fee.

2.2.15 Lighting

Lighting shall be provided at all interchanges, toll booths, bridges, overpasses/ underpasses etc. as specified in IRC:SP:99-2013

2.2.16 Crash Barriers

The metal beam crash barriers are required in the sections where the height of embankment is more then 3.0 m.

2.2.17 Traffic Control Devices, Road Safety Devices and Road Side Furniture

Traffic control devices, road safety devices and road side furniture shall comprise of road signs, road markings, object markers, hazard markers, studs, delineators, attenuators, safety barriers, boundary fences, boundary stones, kilometre stones, etc. as per Relevant IRC Guidelines (IRC 2,

IRC:8, IRC:35, IRC:67, IRC SP 99 etc.), MoRT&H Guidelines for highway manual and Section 800 of MoRT&H Specifications shall be followed.

2.3 Project Cost

The estimated cost of the project is INR 1344.46 Cr. excluding the cost towards LA, EMP and Utility Shifting Cost.

2.4 Traffic Studies & Forecast

This section presents the traffic studies and analysis carried out for addressing various objectives and issues pertaining to development of project highway. The forecast of traffic helps in planning and designing of the pavement, developing capacity augmentation proposals, designing the toll plaza and design of intersections / interchanges along the project road.

Since it is a existing/greenfield highway, a thorough knowledge of the travel characteristics of the traffic on the existing alternate routes is essential for future diverted traffic estimation on the project road. Hence, detailed traffic surveys were carried out to assess the baseline traffic characteristics on various alternative routes along the proposed alignment. The project highway has been consider one homogeneous section, the details are provided in Table 2-24.

Table 2-24: Homogeneous Sections

Section No.	Section Name	Section Details		Section Length (km)
		Section Start Point	Section End Point	
Section 1	Bakarpur-Manikpur	Bakarpur (km 0+000)	Manikpur Junction (km 38+813)	38.813

Source: Design Report

2.4.1 Traffic Survey Locations

With the aim of comprehensively appreciating the traffic and travel characteristics on the project corridor, the type of surveys along with their locations and duration identified during the reconnaissance survey have been followed during data collection exercise keeping in mind the site conditions. The data for traffic survey types and locations are represented in table 2-25.

Table 2-25: Types of Traffic Surveys, Locations and Duration on Project Road

Section No.	Type of Survey	Locations of Survey	Duration
Traffic surveys on Project Corridor			
Bakarpur-Manikpur	Classified Traffic Volume Survey (CTVC)	1. Basant-Jahanabad 2. Amritpur	7 days, 17/06/19 to 23/06/19
	Axle Load Survey (ALS)	1. Basant-Jahanabad 2. Amritpur	24 hours, 19/06/19 to 20/06/19
	Origin-Destination Survey (ODS)	1. Basant-Jahanabad	24 hours, 20/06/19
	Turning Movement Survey (TMS)	1. Adalwari Chowk, 2. Lalganj Chowk, 3. Manikpur Junction	24 hours, 18/06/19

Source: Design Report

2.4.2 Average Daily Traffic

The traffic data (in vehicles) collected during field surveys has been compiled and converted into Equivalent Passenger Car Units (EPCU) to determine the Average Daily Traffic (ADT) in terms of vehicles and PCUs. The section wise traffic has been provided from Table 2-26.

Table 2-26: Average Daily Traffic (ADT) for the base year on the Project Road

Location/Modes			Bakarpur-Manikpur	
			SH-74, Basant Jahanabad	SH-74, Amritpur
Motorized Vehicles	Passenger Vehicles	2-wheeler	7671	4406
		3-wheeler	1632	720
		Car/Jeep	2158	1402
		Standard Bus	119	102
		Mini Bus	21	10
		LCV-Passenger	11	3
	Goods Vehicle	LCV	1389	1043
		2-Axle Trucks	608	411
		3-Axle Trucks	142	114
		Multi-Axle Trucks	181	156
		Tractors	11	7
		Tractors with Trailer	68	39
Non-Motorized Vehicles		Cycle	1636	970
		Cycle Rickshaw	67	26
		Animal Drawn Vehicles	1	0
		Hand Cart	4	1
Total Number (Both Direction)		**Vehicles**	**15719**	**9413**
		PCUs	**14499**	**9244**
PCU/Vehicle Ratio			**0.922**	**0.982**

Source: Design Report

2.4.3 Seasonal Correction Factor (SCF) and Average Annual Daily Traffic (AADT)

Traffic varies by the hour, by the day and by the month. Hence, it is essential to estimate a factor which provides a relationship between Annual Average Daily Traffic (AADT) and Average Daily Traffic (ADT) of the month corresponding to the traffic surveys. While hourly and week day variations have been captured for by conducting surveys continuously for one week (7 days) round the clock, the Seasonal Correction Factor (SCF) is required to estimate AADT from this ADT data. The project corridor is being used by considerable non-urban traffic, which is expected to be affected by various seasons. For instance, from January to May 2018 traffic is slightly more than the other months.

Table 2-27: SCF Factor Adopted

S.No.	Mode	SCF
1	Car	1.05
2	Taxi	1.32
3	Commercial	1.32
4	NMV	1.00

Source: Design Report

Table 2-28: Estimated AADT for base year on the Project Highway

Location/Modes			Bakarpur-Manikpur Section	
			SH-74, Basant Jahanabad	SH-74, Amritpur
Motorized Vehicles	Passenger Vehicles	2-wheeler	8055	4626
		3-wheeler	1714	756
		Car/Jeep	2849	1851
		Standard Bus	157	135
		Mini Bus	28	13
		LCV-Passenger	15	4

Location/Modes			Bakarpur-Manikpur Section	
			SH-74, Basant Jahanabad	SH-74, Amritpur
	Goods Vehicle	LCV	1833	1377
		2-Axle Trucks	803	543
		3-Axle Trucks	187	150
		Multi-Axle Trucks	239	206
		Tractors	15	9
		Tractors with Trailer	90	51
Non-Motorized Vehicles		Cycle	1636	970
		Cycle Rickshaw	67	26
		Animal Drawn Vehicles	1	0
		Hand Cart	4	1
Total Number (Both Direction)		**Vehicles**	**17693**	**10718**
		PCUs	**17360**	**11232**
PCU/Vehicle Ratio			**0.981**	**1.048**

Source: Design Report

2.4.4 Projected Traffic Growth

Long term forecasting of traffic on project road for next 20 years is required for pavement design. The traffic forecast has been carried for each Basant-Jahanabad and Amritpur locations using the corridor growth rates. The mode-wise forecasted traffic per day for the concession period on each section is presented in Table 2-29.

Table 2-29: Projected Traffic at Survey Locations for NH-19 (Bakarpur-Manikpur Section)

Year	2 Wheelers	3 Wheelers	Car+Jeep	Mini Bus	Std. Bus	Lcv- Passenger	Lcv-Goods	2- Axle Trucks	3- Axle Trucks	Multi Axle Trucks
Basant-Jahanabad Location										
2019	8055	1714	2849	28	157	15	1833	803	187	239
2020	8970	1800	3043	29	165	16	1925	860	199	267
2021	9989	1890	3250	31	173	17	2021	922	213	298
2022	11124	1984	3472	32	182	17	2122	988	227	332
2023	12387	2083	3708	34	191	18	2228	1058	242	371
2024	13512	2188	3906	36	200	19	2339	1114	255	402
2025	**14739**	**2297**	**4114**	**38**	**210**	**20**	**2456**	**1172**	**269**	**435**
2026	16077	2412	4333	39	221	21	2579	1234	284	472
2027	17537	2532	4564	41	232	22	2708	1298	299	511
2028	19130	2659	4807	43	244	23	2844	1366	316	554
2029	20563	2792	5048	46	256	24	2986	1435	331	590
2030	22103	2932	5300	48	269	26	3135	1506	348	629
2031	23758	3078	5565	50	282	27	3292	1582	365	670
2032	25538	3232	5843	53	296	28	3456	1661	384	715
2033	27450	3394	6135	55	311	30	3629	1744	403	762
2034	29183	3563	6442	58	326	31	3811	1831	423	804
2035	31024	3741	6764	61	343	33	4001	1923	444	848
2036	32982	3929	7103	64	360	34	4201	2019	466	895
2037	35063	4125	7458	67	378	36	4411	2120	490	945
2038	37275	4331	7831	71	397	38	4632	2226	514	997
2039	39288	4548	8222	74	417	40	4863	2337	540	1047
2040	41410	4775	8633	78	437	42	5107	2454	567	1100
2041	43646	5014	9065	82	459	44	5362	2577	595	1154
2042	46002	5265	9518	86	482	46	5630	2705	625	1212
2043	48487	5528	9994	90	506	48	5912	2841	656	1273
2044	50911	5804	10494	95	532	51	6207	2983	689	1336
2045	53457	6094	11018	100	558	53	6518	3132	723	1403
2046	56129	6399	11569	105	586	56	6843	3288	760	1473
2047	58936	6719	12148	110	615	59	7186	3453	798	1547
2048	61883	7055	12755	115	646	62	7545	3626	838	1624

Year	2 Wheelers	3 Wheelers	Car+Jeep	Mini Bus	Std. Bus	Lcv- Passenger	Lcv-Goods	2- Axle Trucks	3- Axle Trucks	Multi Axle Trucks
2049	64977	7408	13393	121	679	65	7922	3807	879	1706
2050	68226	7778	14063	127	712	68	8318	3997	923	1791
2051	71637	8167	14766	133	748	71	8734	4197	970	1881
2052	75219	8575	15504	140	786	75	9171	4407	1018	1975
2053	78980	9004	16279	147	825	79	9629	4627	1069	2073
2054	82929	9454	17093	154	866	83	10111	4859	1122	2177
2055	**87075**	**9927**	**17948**	**162**	**909**	**87**	**10616**	**5102**	**1178**	**2286**
Amritpur Location										
2019	4626	756	1851	13	135	4	1377	543	150	206
2020	5152	794	1977	14	142	4	1446	582	160	230
2021	5737	833	2112	14	149	4	1518	623	171	257
2022	6388	875	2255	15	156	5	1594	668	182	286
2023	7114	919	2409	16	164	5	1674	716	194	320
2024	7760	965	2538	17	172	5	1757	753	205	346
2025	8465	1013	2673	17	181	5	1845	793	216	375
2026	9233	1064	2815	18	190	6	1938	834	228	407
2027	10072	1117	2965	19	199	6	2034	878	240	441
2028	10986	1173	3123	20	209	6	2136	924	253	477
2029	11809	1231	3279	21	220	7	2243	970	266	509
2030	12694	1293	3443	22	231	7	2355	1019	279	542
2031	13644	1358	3616	23	242	7	2473	1070	293	578
2032	14666	1426	3796	25	255	8	2597	1123	308	616
2033	15765	1497	3986	26	267	8	2726	1179	323	656
2034	16760	1572	4186	27	281	8	2863	1238	339	693
2035	17817	1650	4395	28	295	9	3006	1300	356	731
2036	18941	1733	4615	30	309	9	3156	1365	374	772
2037	20137	1819	4845	31	325	10	3314	1433	393	814
2038	21407	1910	5088	33	341	10	3480	1505	412	860
2039	22563	2006	5342	34	358	11	3654	1580	433	903
2040	23782	2106	5609	36	376	11	3836	1659	455	948
2041	25066	2211	5889	38	395	12	4028	1742	477	995
2042	26419	2322	6184	40	415	12	4229	1829	501	1045
2043	27846	2438	6493	42	435	13	4441	1921	526	1097

Year	2 Wheelers	3 Wheelers	Car+Jeep	Mini Bus	Std. Bus	Lcv- Passenger	Lcv-Goods	2- Axle Trucks	3- Axle Trucks	Multi Axle Trucks
2044	29238	2560	6818	44	457	14	4663	2017	553	1152
2045	30700	2688	7159	46	480	14	4896	2118	580	1210
2046	32235	2822	7517	49	504	15	5141	2224	609	1270
2047	33847	2964	7892	51	529	16	5398	2335	640	1333
2048	35539	3112	8287	54	556	16	5668	2452	672	1400
2049	37316	3267	8701	56	583	17	5951	2574	705	1470
2050	39182	3431	9136	59	613	18	6249	2703	741	1544
2051	41141	3602	9593	62	643	19	6561	2838	778	1621
2052	43198	3782	10073	65	675	20	6889	2980	817	1702
2053	45358	3972	10577	68	709	21	7234	3129	857	1787
2054	47626	4170	11105	72	745	22	7596	3285	900	1876
2055	50007	4379	11661	75	782	23	7975	3450	945	1970

Source: Design Report

3 ANALYSIS OF ALTERNATIVES

This chapter is an attempt to compare feasible alternatives to the proposed development in respect to site, technology, design, etc. The criteria adopted for the evaluation of the alternate route for construction of proposed highway comprise of engineering, economic, environmental and social considerations. The chapter discusses how environmental and social parameters were assigned due importance and were carefully considered in the analysis of alternatives.

3.1 With & Without Project Alternatives

3.1.1 Without Project Scenario

The existing connectivity with the proposed section is mostly intermediate lane roads with poor geometric design and varying pavement width. The existing scenario of the traffic volumes along with higher estimated future traffic volumes coupled with the aim of improving the efficiency of freight movement, the capacity of the existing highways is insufficient for handling the high volume of traffic and freight movement. This is further compounded by the various land use conflicts, in terms of uncontrolled development along the highway. There are settlements / habitations along the existing highway which causes disruptions to the traffic flow and further vehicular-pedestrian conflicts creates higher probability for accident occurrence. These conflicts lead to reduced efficiency and mobility of the existing infrastructure. The population growth increase in traffic volumes and the economic development along the corridor would continue to occur and will worsen the already critical situation. In the absence of proposed development, the existing unsafe conditions and the adverse environmental consequences in terms of the environmental quality along the existing roads would continue to worsen. Moreover, if it is decided not to proceed with the project, then the regional beneficiaries (sub-urban and rural population) of the proposed project will be deprived of the socio-economic development of project region. Therefore, the no-action alternative is neither a reasonable nor a prudent course of action for the proposed project, as it would amount to failure to initiate any further improvements and impede economic development. The inability of the existing infrastructure to meet future demands calls for development of a partiallygreenfield highway.

3.1.2 With Project Scenario

The 'with project scenario' is found to have a positive impact in the long run on social, environmental, economic and financial issues. This scenario includes the development of partially greenfield highway with controlled widening of the existing highway in forest area. The scenario is economically viable and will improve the existing socio-economic conditions of the project area. It would thereby, contribute to the developmental goals envisaged by NHAI, MoRTH, GoI and enhance the growth potential of the area.

In-spite of the various development benefits likely to accrue due to the project, as is the case of every road development project, the project would be accompanied by certain impacts on the natural, social and environmental components. The potential impacts on the various environmental components can be avoided through good environmental practices. Wherever avoidance of negative impact has not been possible, appropriate mitigation and enhancement actions are worked out to effectively offset the environmental damages inflicted due to the project. Comparative assessments of the "with and without" project scenarios are presented in the Table 3-1.

Table 3-1: Comparative Assessment of "With and Without" Project Scenarios

Component	"With" Project Scenario	'Without" Project Scenario

Component	"With" Project Scenario	'Without" Project Scenario
Highway Geometrics	4 lane carriageway with PS and good geometrics	Existing roads of 2 lanes carriageway with poor geometrics
Design Speed	100 kmph	50-60 kmph with traffic jam incidences
Congestion in Settlements	Free flow of traffic due to high speed traffic movement	Congestion in urban areas as well as rural areas
Felling of trees	Felling of both old and young trees at only cross roads in rural areas. 3 times of the number of trees felled to be planted as compensatory plantation.	No felling of trees. The old trees may become a safety hazard to the existing roads with passage of time
Road Safety Measures	Highway with provision of proper road markings and design geometry to reduce accidents	Accident incidents shall rise with an increased traffic volume
Environmental Quality	Provision of drain on both side of the highway. To improves environmental quality an aggressive tree plantation as per IRC SP-21:2009 and compensatory plantation shall not only improve aesthetics but also improve the quality of air. Lesser distance and free flow traffic condition will reduce carbon emission as expected from similar traffic volumes on existing highway	Poor due to congestion and high emission levels of pollutants because of slow movement of traffic. A further deterioration is expected due to Increase in traffic volumes and further congestion
Drainage	Drainage along side the proposed highway shall be imporved due to both side drainage facility	These issues shall remain unaddressed on existing highways
Road Side Amenities	Appropriate road side amenities to be provided at various locations along the corridor.	Not adequate
Development	Higher potential for development due to improvement in access and connectivity	Development activities will be greatly hampered by the gross inadequacy of infrastructure
Improvement in tourism and pilgrimage	Fast and safe connectivity resulting in saving fuel, travel time and cost to reach the different tourist places	Slow movement of traffic on existing highways. Situation will further be worsened as the traffic nos. shall be increased with time

3.2 Criteria for Fixing Alignment for National Highway

Obligatory points considered while fixing the project alignment are listed below.

Habitations: Proposed alignment is fixed in such a way that it traverses away from built up areas avoiding community buildings & structures. However, few isolated buildings falling along the alignment cannot be avoided due to geometric requirements.

Wildlife Sanctuaries, National Parks, Reserve Forest and other Eco Sensitive zones: Utmost care is taken while fixing the alignment near Reserve Forest, wildlife sanctuaries and National Parks (NP). The MoEF&CC guidelines have been adhered to and the alignment has been fixed keeping it away from eco-sensetive areas. The proposed alignments neither passing through nor falling within any Wildlife Sanctuary/National Park under Wildlife (Protection) Act, 1972. About 4.108 ha of Notified Protected Forest along the crossing of existing roads/canals shall be affected by the crossing of the proposed alignments.

Water Bodies: The greenfield alignment has been fixed taking due consideration & importance of retaining the existing water bodies, ponds, tanks etc. as far as feasible.

Crossings and Important Structures: The components which increases the project cost are the presence of the Major bridges, ROBs and other structures. In order to reduce the project cost, number of structures and their respective lengths were given due consideration while finalising the proposed option.

Moreover, the alternative options have been worked out keeping the following in mind:

- The Greenfield alignment between two terminal stations to be short and straight as far as possible, but due to engineering, social and environmental considerations some deviations may be required
- The project should be constructible and easy to maintain; the greenfield project should reduce the vehicle operation cost with respect to the existing option already available *i.e.* using the NH/SHs in combination to reach from point A to point B
- The project contains the major bridge over the Gandak river and a high embankment with adequate cross drainage structures to avoide water logging along the project road.
- The project has been fixed with a major interchange (Cloverleaf) at the initial point of the project to provide the better and smooth connectivity to different routes of major cities/towns.
- It should be safe at all stages *i.e.* during design, construction and operation stages. Safety audits at each stage should confirm the same.
- The initial cost of project (capital expenditure), maintenance cost, and operating cost should be optimum, to enable comparison of economics pertaining to life cycle cost versus other alignment options.
- The Greenfield alignment should be finalised giving due consideration to siting/location of major structures including Major/Minor Bridges, Interchanges and RUB/ROB. The space requirement of interchanges to be kept into consideration to avoid major resettlement

The proposed options in the present case connects the 3 districts of Bihar State, which would lead to the development of new growth centres along the proposed highway *i.e.* paving the way for economic development of the region.

3.3 Alignment Options

The National Highways are the highest category of roads in the Indian road network. Most of the major NHs has the following issues:

- As Highways require larger corridor to fit the cross-sectional elements befitting the futuristic traffic flow pattern, desired width cannot be accommodated within the existing road network/corridor.
- Existing Alignment has either reached their Level of Service or would be reaching in near future

In order to provide better connectivity between towns, to strengthen overall growth in the region and providing connectivity with urban & sub-urban areas through improvement of existing roads and new/virgin alignment (Greenfield), which would reduce the distance and travel time between Bakarpur –Manikpur Section significantly. The proposed alternative option would thus be designed

for a speed of 100-80 kmph taking all design, traffic and safety considerations so as to have a world class highway catering to the future traffic demands.

3.3.1 Option analysis for Bakarpur-Manikpur National Highway

Three alignment options (Figure 3.1) were studied and compared in order to finalize the proposed alignment. The comparative statement for proposed alignment of the proposed Bakarpur-Manikpur highway is given in Table 3-2.

Table 3-2: Comparative Analysis for Proposed Alignment

Sl. No	Description	Option	Option 2	Option 3
A	**General Alignment Perspective**			
1	Route Alignment	Green Field Alignment	Green Field Alignment	Green Field Alignment
2	Start Point	Ch:0+000, Alignment starts from Sitalpur bypass of NH 19 (near Bakarpur village)	Ch:0+000, Alignment starts from from Sitalpur bypass NH 19 (near Bakarpur village)	Ch:0+000, Alignment starts from from Sitalpur bypass NH 19 (near bakarpur village)
3	End Point	Ch: 38+813 Alignment merge into SH-74 near Manikpur village	Ch: 39+203 Alignment merge into SH-74 near Manikpur village	Ch: 38+581 Alignment merge into SH-74 near Manikpur village
4	Total Length (km)	38.813	39.203	38.902
a	Total Greenfield Length (km)	37.400	35.55	37.100
b	Total Brownfield Length	1.413	1.653	1.802
5	Proposed ROW	45 meter	45 meter	45 meter
B	**Environmental Perspective**			
1	Total Forest Land (Cross Road side Protected Forest Land)	4.108 Ha.	9.383 Ha.	7.432 Ha.
2	Area under wildlife protected area / or eco sensitive zone.	The alignment does not pass through any wildlife protected area and its eco sensitive zone	The alignment does not pass through any wildlife protected area and its eco sensitive zone.	The alignment does not pass through any wildlife protected area and its eco sensitive zone.
3	Trees to be affected	1678	2328	1875
C	**Socio-economic Perspective**			
1	Social Impact	Moderate - As the alignment passes through Agricultural and no. of structures affected are very less.	High - As the alignment passes through Agricultural land and no. of structures affected are more.	Very High - As the Alignment is passing through more built-up sections, therefore demolition of large no. of residential and commercial buildings are involved in this option.
2	Predominant land use pattern	Agriculture land	Agriculture land	Agriculture land

3	Land Acquisition (in Hectare)	199.093	222.637	208.42
4	Tentative LA Cost (Cr.)	162.26	193.96	184
D	**Design and Engineering Perspective**			
1	Geometrics	Smooth curves with standard geometrics	Relatively Sharp curves with geometrics standards.	Smooth but frequent curves with standard geometrics
2	No of structures	MJB-01, MNB-07, ROBs-01 Trumpet-0 and Cloverleaf: 01	MJB- 01, MNB-08, ROBs: 01, Cloverleaf-01, Trumpet: 0	MJB-01, MNB -08, ROBs- 01, Cloverleaf-1 and Trumpet: 0
3	Material requirement	Cement: 2,11,927.05 Ton Sand: 2,13,963.29 cum. Bitumen: 381.04 Ton Aggregates: 7,25,630.16 cum. Steel: 30,726.10 tonnes Stone Boulder: 34,953.94 Cum. Soil: 70,82,918.35 Cum.	Cement: 245825.07 Ton Sand: 263465.62 cum. Bitumen: 468.32 Ton Aggregates: 769428.41 cum. Steel: 52483.91 tonnes Stone Boulder: 52461.23 Cum. Soil: 9167421.35 MT	Cement: 236245.51 Ton Sand: 243142.53 cum Bitumen: 448.63 Ton Aggregates: 748213.25 cum. Steel: 48157.61 tonnes Stone Boulder: 47935.42 Cum. Soil: 8753162.84 MT
4	Terrain	Plain terrain	Plain terrain	Plain terrain
5	Land Use	Agriculture area	Partially Built-up & Agricultural area	Major Built-up & Agricultural area
6	Estimated Cost (Cr.)	1344.46 Cr.	1589.12 Cr.	1514.52 Cr.
E	**Marites and Demerits**			
1	Merits	**1.** Project length involved in this option is less compared to option-2 & 3. **2**. Less no. of trees will be affected in this option compared to option 2 & 3. **3.** Forest area involved in this option is less compared to option 2 & 3. **4**. Less Social Impact Compared to Option -2 & 3 as very less amount of structure for demolition is required in this option. **5.** Less LA Cost compared to Option 2 & 3.		

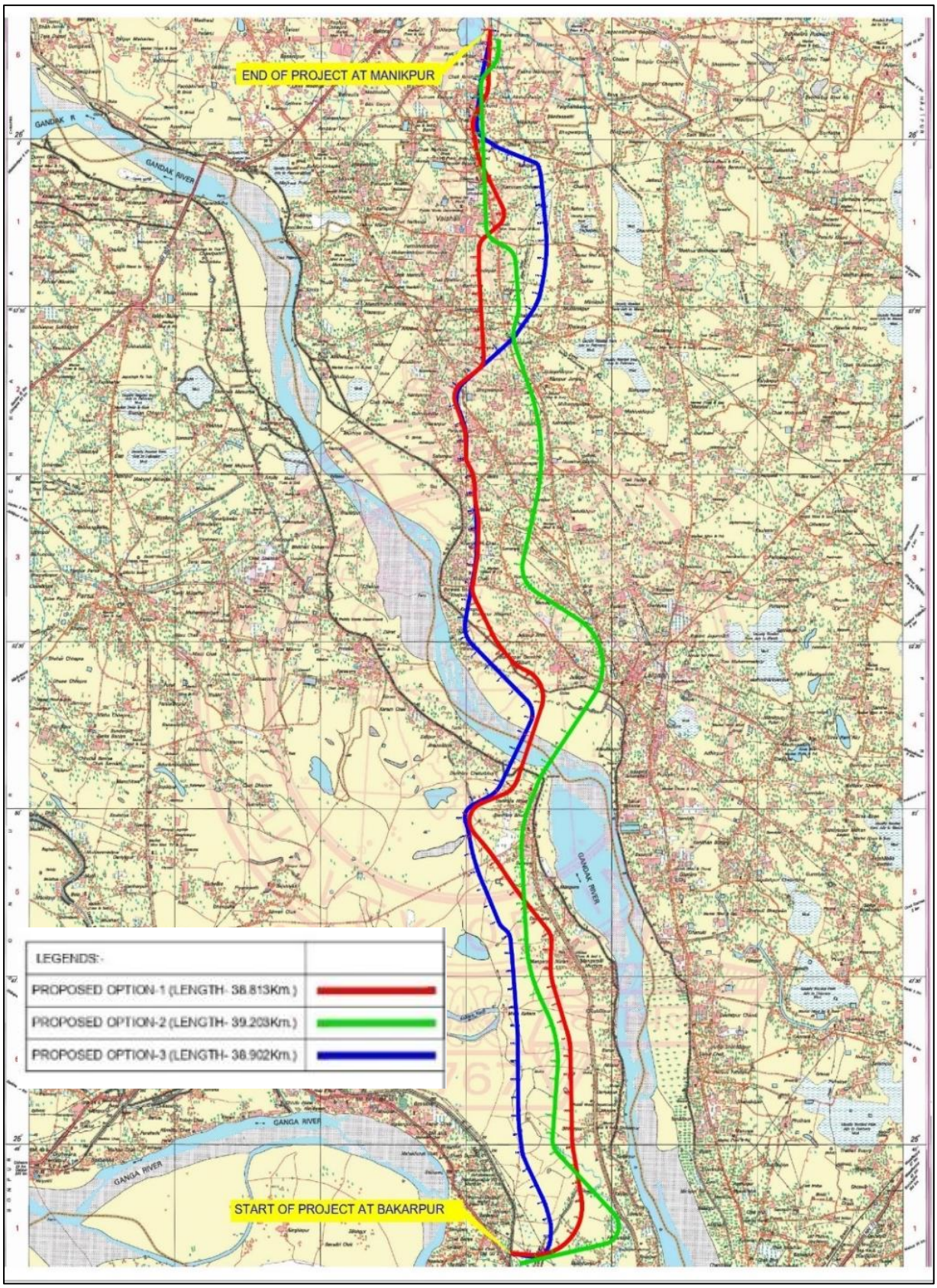
		6. Less Construction Cost compared to Option 2 & 3.		
2	Demerits		**1.** Project Length involved in this option is more compared to option-1 & 3. **2.** Forest Area involved in the project is more compared to option-1 & 3. **3.** No. of trees involved in the project is more than option-1 & 3. **4.** Moderate number of structures will be affected. **5.** LA cost involve in this option will be high compared to option-1. **6.** Total project cost will be high compared to option-1. **7.** 3 water pond will be impacted at km 8.600, 15.800, 36.800 due to this project option.	**1.** Project Length involved in the project is more compared to option-1. **2.** Forest Area involved in the project is more compared to option-1. **3.** No. of trees involved in the project is more than option-1. **4.** Large number of structures will be affected in this option compared to option 1 & 2. **5.** Total Project cost will be very high as demolition of structures involved in this project option is more. **6.** LA cost involved in this option is high compared to Option-1. **7.** 3 water pond will be impacted at km 7.200, 10.200 &13.600 due to project.
F	**Recommendations**	**Recommended**	**Not Recommended**	**Not Recommended**

From the above table it is evident that Option 1 is the preferred option due to following reasons and hence the same was selected by the NHAI:

- Less forest area diversion required
- Least settlement affected
- Less number of water bodies/channel affected
- LA cost is less
- Project cost is less

The above-mentioned comparisons and alignments were discussed with MoRTH and NHAI in several meetings. After various rounds of discussion in NHAI office, Option 1 was accepted considering lesser length and higher degree of freedom to maintain national highway standards.

Figure 3-1: Alignment Options Map



3.4 Cold Mix & Hot Mix Technology Analysis

Cold Mix Technology involves cold asphalt, which is a high-quality, polymer-modified cold mix asphalt available in batch orders. Hot Mix Technology involves Hot Mix Asphalt (HMA) which is a combination of approximately 95% stone, sand, or gravel bound together by asphalt cement, a product of crude oil. Asphalt cement is heated aggregate, combined, and mixed with the aggregate at an HMA facility. The comparison between the two construction technologies are given in Table 3-3.

Table 3-3: Analysis of Cold & Hot Mix Technology

Sl. No.	Parameter	Cold Mix	Hot Mix
1	Description	Street Cold Asphalt is a relatively new product developed in 1995 through the introduction of new polymer technology and research into the manipulation of viscosity and material design, of the various components of an asphalt mix - Street Cold Asphalt is soft and sticky out of the bag, but it quickly hardens after application and the end result is a pavement patch with better strength but similar properties to hot asphalt.	Hot mix asphalt is used primarily as paving material and consists of a mixture of aggregate and liquid asphalt cement, which are heated and mixed in measured quantities. Hot mix asphalt facilities can be broadly classified as either drum mix plants or batch mix plants, according to the process by which the raw materials are mixed. In a batch mix plant, the aggregate is dried first, then transferred to a mixer where it is mixed with the liquid asphalt. In a drum mix plant, a rotary dryer serves to dry the aggregate and mix it with the liquid asphalt cement.
2	Requirements	Cold patch, also known as cold mix or cold asphalt, was first recognized as a way to make road repairs quickly because it can be applied right from the container without heating. Cold asphalt also doesn't require any special heavy rolling machines or special applicators as it can be shovelled or poured into a pothole or utility cut and tamped down with a hand tool.	Hot mix asphalt concrete (commonly abbreviated as HMAC or HMA) is produced by heating the asphalt binder to decrease its viscosity, and drying the aggregate to remove moisture from it prior to mixing. Mixing is generally performed with the aggregate at about 300°F (roughly 150°C) for virgin asphalt and 330°F (166°C) for polymer modified asphalt, and the asphalt cement at 302°F (150°C). Paving and compaction must be performed while the asphalt is sufficiently hot
3	Use	Cold mix asphalt concrete is produced by emulsifying the asphalt in water with (essentially) soap prior to mixing with the aggregate. While in its emulsified state the asphalt is less viscous and the mixture is easy to work and compact The emulsion will break after enough water evaporates and the cold mix will, ideally, take on the properties of cold HMAC Cold mix is commonly used as a patching material and on lesser trafficked service roads	HMAC is the form of asphalt concrete most commonly used on high traffic pavements such as those on major highways, racetracks and airfields Asphalt concrete has different performance characteristics in terms of surface durability, tire wear, braking efficiency and roadway noise.

Sl. No.	Parameter	Cold Mix	Hot Mix
4	Merits	Actually less expensive to use over the life of a road repair Completely seals and patches potholes, utility cuts, edge repairs, and even overlays.	Less expensive for new road construction
5	Demerits	Less resilient and more vulnerable to cracking	Expensive

Cold Mix technology is more suitable for repair of potholes and cracks on roads, bridges, overlays, parking lots, other asphalt and concrete surfaces. However, for constructing new roads hot mix technology is better suited. Contractor / Concessionaire shall utilise the same wherever suitable.

3.5 Environmental Considerations

The various mitigation measures for minimising the extent of environmental impacts and avoiding of sensitive environmental features have been worked out. Table 3-4 provides the measures that have been adopted for offsetting the impacts. A description of the measures has been presented in the following sections.

Table 3-4: Minimization of Environmental Impacts

Criteria	Means
Maintenance of Design Speed through traffic	Geometrics as per standard IRC codes
Improvement of Road Safety	Intersection as per IRC safety codes;
Adequate drainage	Provision of drains
Reduction of Air and Noise Pollution	Aggressive tree plantations; good EMP implementation practices
Displacement of Local Population	Limiting of development within PRoW, SIA & RAP
Minimisation of Direct Impact on Sensitive Receptors, cultural and religious properties	Alignment option analysis, Public consultations, Good EMP measures
Minimisation of Property acquisition	Alignment selection, SIA & RAP
Loss of Water body	Wise design
Avoidance of contamination due to Siltation / spillage	Silt Fencing, Oil Interceptor
Displacement of Commercial Properties	Alignment Selection, SIA & RAP
Minimisation of Loss of Utility Lines	Utility shifting after concurrence of regulatory authority and stakeholders
Minimisation of Tree Loss	Maximum effort shall be given to avoid avoidable tree felling
Stabilisation of Slope	Turfing / Pitching
Accidental Road Kill of Fauna	Proper Signage, Speed Control

3.5.1 Improvement of air and noise quality

- Siting of greenfield alignment beyond the settlement reach;
- Lesser the distance (in comparison to existing route options) will result in lesser carbon footprint;
- Free flow traffic conditions will reduce the jam related air and noise pollutions;
- Provision of Noise barrier

3.5.2 Avoidance of Impact of Sensitive, Cultural and Community Properties

- Siting of greenfield highway beyond the reach of such areas;
- By providing underpass for smooth and safe travel of local population;
- Providing greenbelt within the avialabe ROW as noise attenuation measures;
- Avoiding direct impact on sensitive receptors

4 DESCRIPTION OF ENVIRONMENT

4.1 General

As a precursor for the prediction of various types of environmental impacts likely to arise due to implementation of the project, it is essential to establish the baseline environmental status in project study area. Details of baseline environment parameters are required for decision making for the project.

4.2 Study Area & Period

As per the EIA Guidance Manual for Highways (MoEF&CC, 2010), a study area of 15 Km radius from the project road was considered for secondary data collection. Primary data has been collected within 500 meters on either side of the proposed alignment. Secondary data were collected from published reports, research papers, working plans, consultations and discussions with govt. officials. Primary baseline environment monitoring along the projectwas carried out for the period from January 2023 to March 2023.

The proposed alignmentare passing are Saran, Vaishali and Muzaffarpur districts in the state of Bihar.

4.3 Physical Environment

Physical environmental components along the project road are described below.

4.3.1 Physiography and Terrain

The Saran district occupies an area of 2,641 square kilometers.The district is shaped like a triangle with its apex at the confluence of the boundary of Gopalganj district and the Gandak river. The Gandak river along with Muzaffarpur and Vaishali districts forms the eastern side, the Ganges and the Ghaghra along with Bhojpur and Patna districts forms the southern side, whereas the boundaries of Balia district of U.P. and Siwan and Gopalganj districts of Bihar and north western form the western side of the triangular Saran district. The land slopes towards the south east which is also the direction followed by the rivers.The district is entirely constituted of plains but there are quite a few depressions andmarshes.

The Muzaffarpur district occupies an area of 3,172 square kilometers. It covers 3.4 % of the total areas of the state of Bihar. The district has an average elevation of 170 meter from mean sea level. The district is surrounded by Sitamarhi, Sheohar and PurbaChamparan district in the north, Vaishali and Saran district in the south, Darbhanga and Samastipur district in the east and Saran and Gopalganj district in the west.It comprises an extensive plain formed by the alluvium brought by the Gandak, the Bagmati and other rivers which flow through it. The ground is not marked by any high contour and at many places there are chains of shallow marshes which serve the purpose of drainage for excessive water due to rainfall and overflow of the stream.

The Vaishali district occupies an area of 2,036 square kilometers. The district is surrounded by Muzaffarpur district in the north, Ganga River and Patna District in the south, Samastipur district in the east, Gandak River and Saran district in the west. The district comprises an extensive plain formed by the alluvium brought by the Ganga, the Gandak and other rivers which flow through it. It lies on the south of the BurhiGandak and is bounded by the Ganges on the South and the Gandak on the sout-west. It is a plain with very few waterlogged or low-lying tracts, highly fertile and well-suited for both food and cash crops. The morphology of the area has been shaped mainly by Gandak River which originates in the Himalayas in Nepal.

The proposed alignment mostly follows 'plain' terrain. The elevation varies from~58 m to ~47 m above MSL at different locations. Average elevation of the project stretch is ~52 m above MSL.

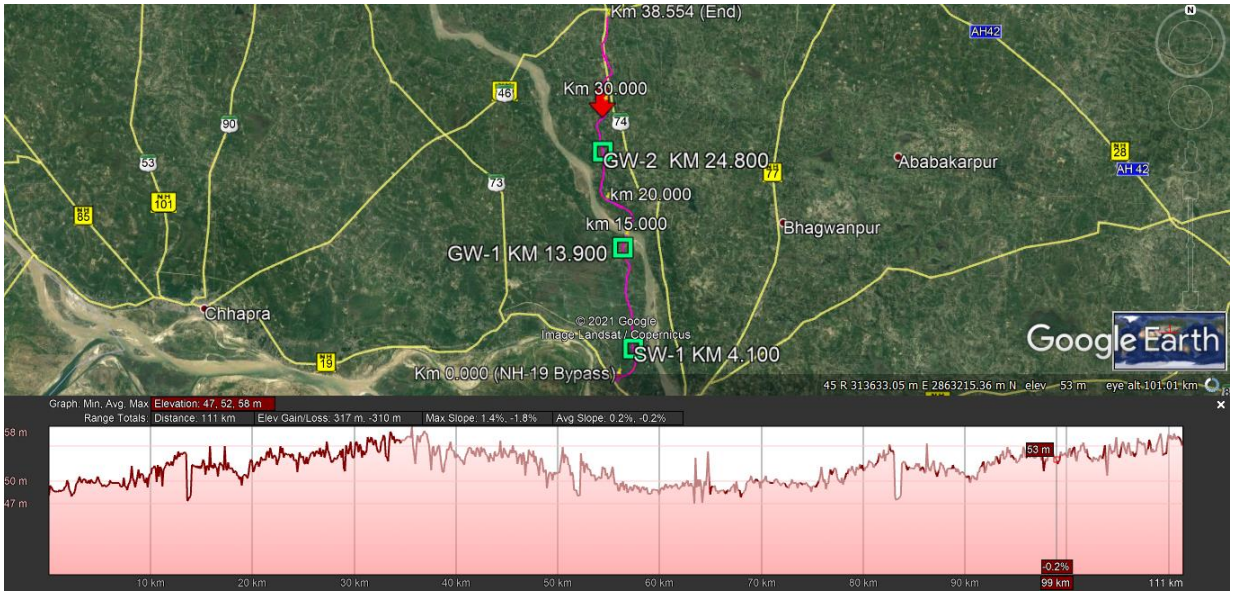


Figure 4-1: Elevation Profile of Proposed Project

4.3.2 Digital Elevation Model (DEM)

The DEM map is prepared with the help of Alaska High Resolution terrain 3d model data and is shown in Figure 4-22.The DEM also indicates the elevation is gradually decreasing towards South direction.

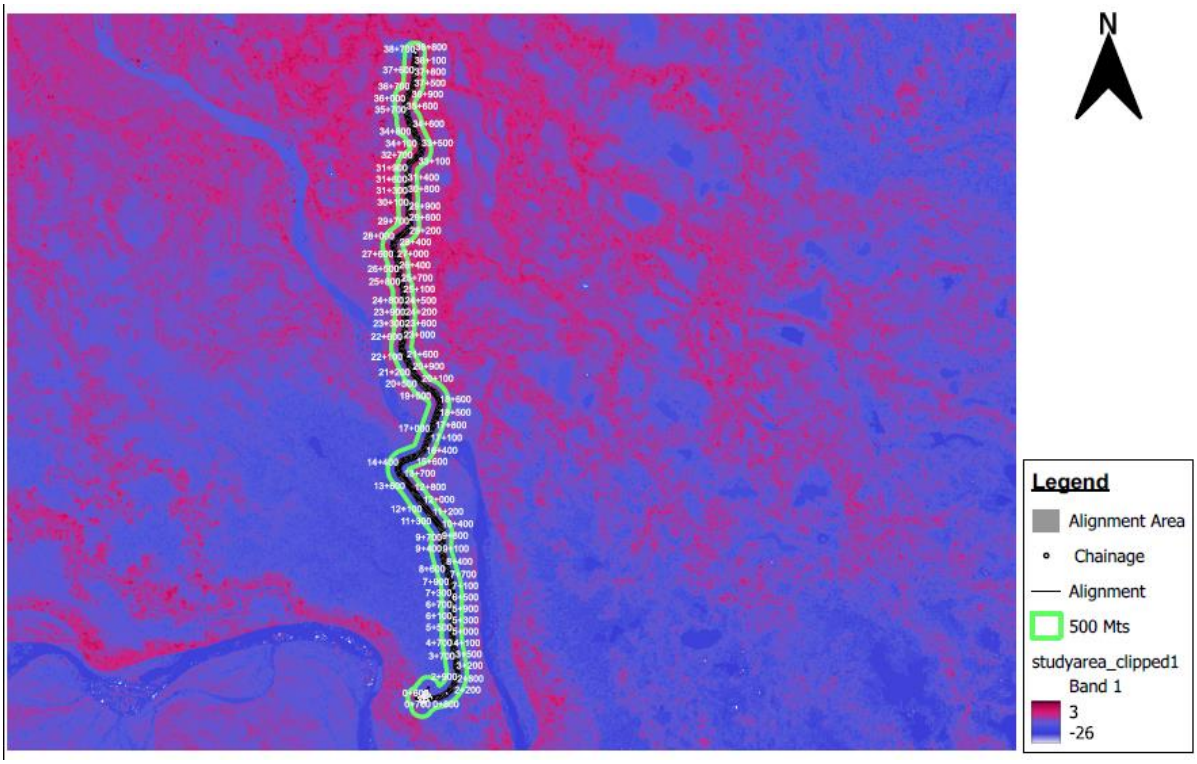


Figure 4-2: Digital Elevation Model (DEM) of project area

4.3.3 Drainage Pattern

General Drainage pattern of the project road is delineated using ArcGIS software using DEM model for Bakarpur-Manikpur sections is given below figure 4-3.

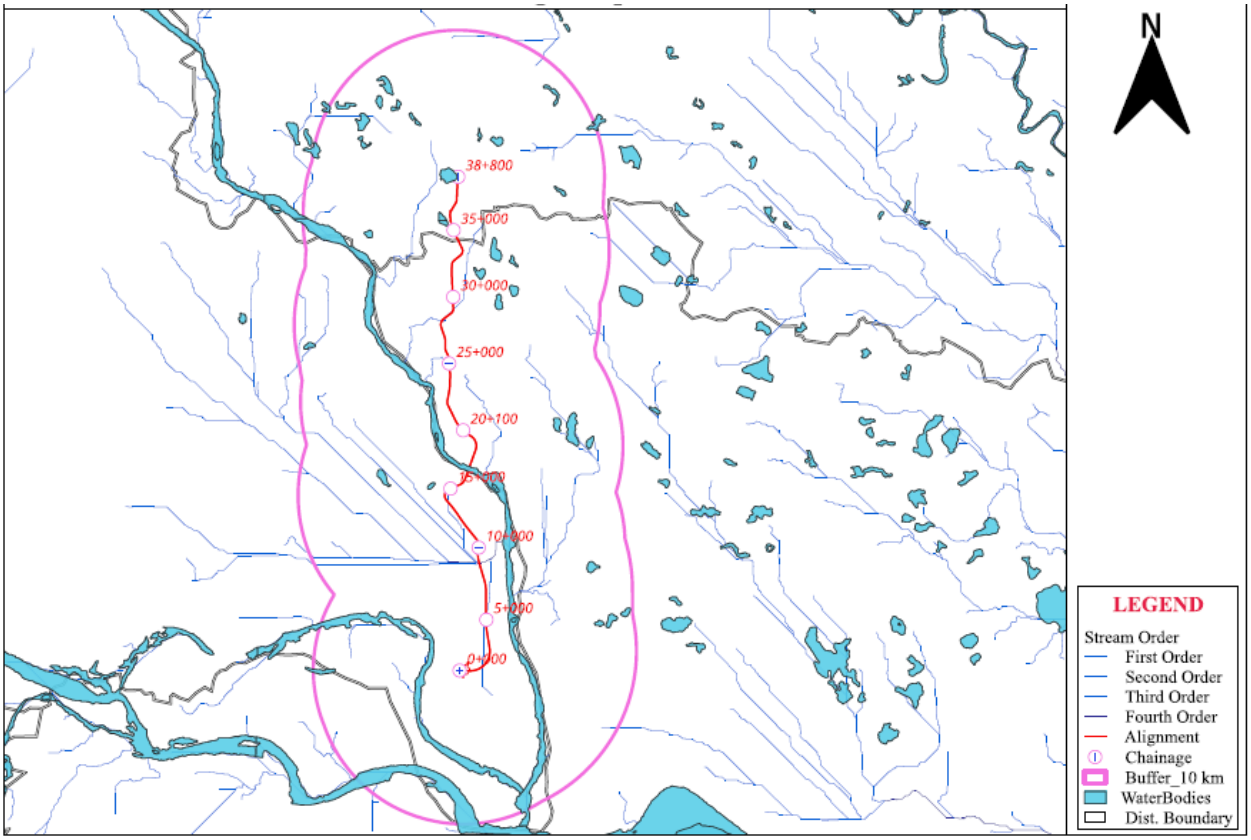


Figure 4-3: Drainage Map of project road

4.3.4 Hydrological Study for CD structures

The details hydrological and hydraulics along the project areas were studied with the watershed areas impacting the proposed project road, delineated using ArcGIS software using DEM model for Bakarpur-Manikppur sections is provided in Annexure 4.2.

4.4 Climatology

In summer the climate of the project area is hot and dry but winter months are quite cool andpleasant. Winter comes towards the middle of October after the rains are over. The temperaturebegins falling and January is the coldest month of the year with mercury falling to about 5ºC. Theblowing of westerly wind accompanied by dust storms about the middle of March marks thebeginning of hot weather. The mercury starts shooting upward and May is the hottest month of the year when the maximum temperature goes up to 45ºC. The summer continues till the end of June when the onset of rains brings the much awaited relief and the temperature falls, though thehumidity is still high the rise in humidity often makes the heat only more oppressive during the rainy season which lasts till the end of September. From November to February the district has a pleasant climate.

The Indian Meteorological Department's (IMD) observatories in vicinity of proposed highway

alignment is located at Muzafarpur. Long-Term climatological data (Years 1981 – 2010) has been analyzed for assessment of prevailing meteorological scenario in the project region and is shown in the Table 4.1

Table 4-1: Long-Term Climatologically Conditions at Muzafarpur IMD Observatories

Month	Temp Monthly (°C)		Humidity (%)		Avg. Rainfall (mm)	Avg. Wind Speed (kmph)
	Max	Min	Mor.	Eve.		
January	21.9	10.2	83	77	10.4	1.8
February	25.7	13.1	72	66	11.5	2.3
March	31	17.2	58	54	8.4	2.6
April	35.3	22	56	49	20.2	3.2
May	35.2	24.7	67	60	71.5	4
June	34.9	26.5	75	72	160.1	3
July	32.6	26.6	84	82	294.5	2.8
August	33	26.8	82	82	287.6	2.6
September	32.3	25.8	81	82	208.5	2.3
October	31.6	22.4	72	77	65.4	1.4
November	28.7	16.3	71	74	4.3	1.2
December	24.3	11.8	79	78	4.6	1.2
Total / Avg.	**30.5**	**20.3**	**73**	**71**	**1147.1**	**2.4**

Source: Climatological Normals, 1981-2010, India Meteorological Dept., Govt. of India

4.5 Micro-Meteorology

To assess the primary meteorological scenario of the area, primary meteorological data for one season (December 2022 to February 2023) were collected near Saran in Bihar by Shri Krishna Analytical Laboratory, New Delhi, a NABL accredited & MoEF&CC recognised laboratory. The data as collected are presented in table below:

Table 4-2Onsite Micro-meteorological Conditions

Month	Temp Monthly (°C)			Relative Humidity (%)			Avg. Rainfall (mm)	Avg. Wind Speed (kmph)
	Max	Min	Avg	Max	Min	Avg		
December 2022	26	9	17.22	100	38	69	0	2.69
January 2023	28	7	17.5	100	30	65	0	4.69
February 2023	33	12	22.5	100	32	66	0	5.33
Total / Avg.	**29**	**9.33**	**19.16**	**100**	**33.33**	**66.66**	**0**	**4.23**

Source: Shri Krishna Analytical Laboratory, New Delhi

4.6 Geology

The geological formation of the Saran district is Indo Gangetic alluvium. The silt brought down by the river Ganges and its tributaries since time immemorial has created the plains of the district. In the older alluvium, nodular segregations of the carbonate of line, known as knakar, are found. In many places the soil is Saliferous from which saltpeter is extracted.

The Vashali and Muzafarpur districts are formed of alluvial soil but the Vashali district soil is dark in colour, with greater content of sand and mineral salts whereas Kankar is found in some parts of the Muzafarpur district. It is actually limestone of inferior quality which finds use as road-metal.

4.7 Soil

The soil quality was monitored at Three (3) locations to assess the soil quality in and around the project alignment, which were truly representing the soil conditions of project area. Soil of the

project districts Saran, Vaishali and Muzaffarpur is light, sandy loam to loam and its pH varies from 5.8 to 8.0 (mostly natural soil but some are slightly acidic and some saline). The nutrient status in soil is low to medium with deficiency of zinc and phosphorous pent oxide Sand and silt are deposited in the middle of the river whereas fine sand and soil are deposited at the fringe of the riverbanks. Soil/ alluvium varying in thickness from 0.20 m to 0.60 m constitute the top horizons in the area suitable for agriculture. River Gandak meanders through the area exposing the alluvium and soil at the banks. Sand is found in the river bed up to a depth of more than 4.0 m. The soil of the Vashali district is capable of retaining moisture. It is considered to be one of the fertile districts in Bihar.Soil sampling locations are given in Table 4-3.

Table 4-3: Soil Sampling Locations

Sl. No.	Location Code	Village Name	Tentative Chainage (km)	Geo-Coordinates	Distance from the road centreline (m)
1	S1	Chappra	5+600	25.759422° 85.160204°	501
2	S2	Jafarbad	24+100	25.903576° 85.126811°	192
3	S3	Chakbrahim	37+600	26.015952° 85.129549°	181

Figure 4-4: Soil Sampling Photographs

pH of soil along project section were found in the range of 7.52 to 7.82, therefore the soil is slightlybasic. The texture of soil is found to be Clayey Sandin nature. Conductivity of soil in the proposed study area is found to be in the range of 298 µm/cm to 362 µmhos/cm. Available phosphorous in soil samples along the study area ranges from 45.5mg/kg to 65.5 mg/kg. Potassium content as K in soil samples in the study area is found in the range of 152.5mg/kg. to174.5mg/kg. Soil Quality results along the proposed alignment is provided in Table 4-4.

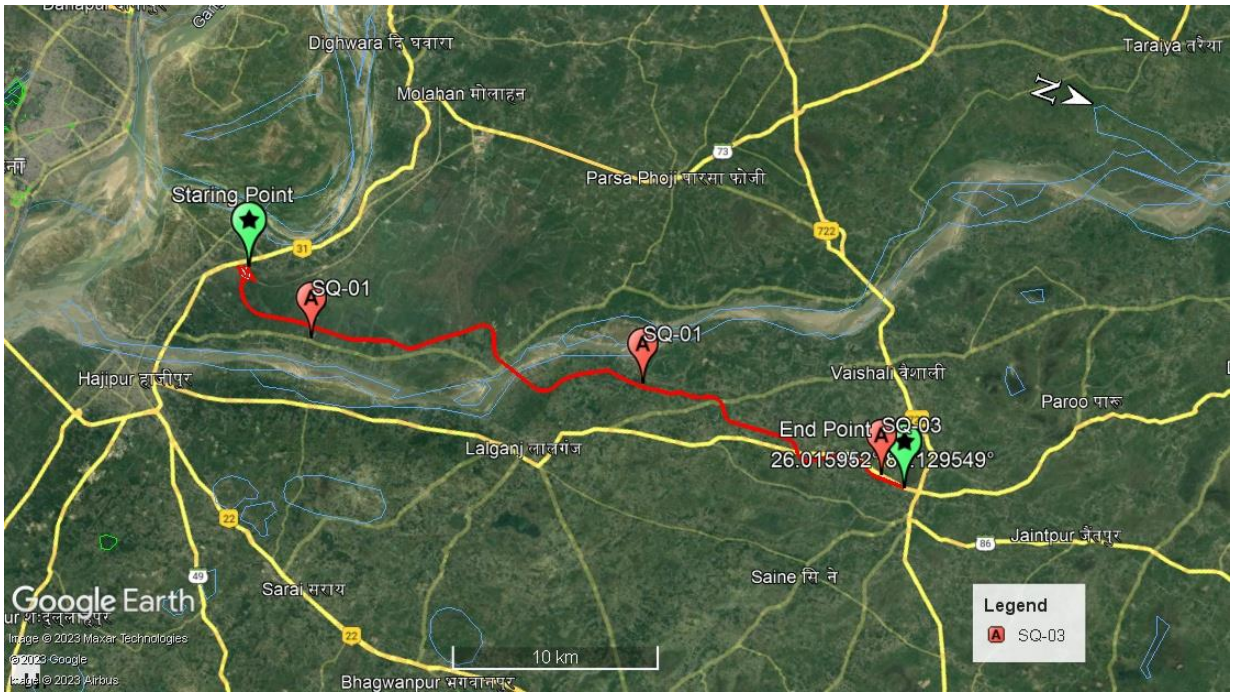
Table 4-4: Soil Test Result along the Proposed Alignment

S. No.	Parameter	Unit	SA-1	SA-2	SA-3
1.	Colour	-	Light Black		
2.	Particle Size Distribution				
3.	Sand	%(w/w)	37.6	36.9	35.3
4.	Clay	%(w/w)	51.2	50.6	52.2
5.	Silt	%(w/w)	11.2	12.5	12.5
6.	pH (2:5 Suspension)	-	7.82	7.52	7.62
7.	Electrical Conductivity (2:5)	µmhos/cm	322	362	298
8.	Bulk Density	gm/cc	1.12	1.25	1.26
9.	Texture	-	Clay	Clay	Clay
10.	Total Nitrogen as N	mg/kg	655	585	648

S. No.	Parameter	Unit	SA-1	SA-2	SA-3
11.	Total Phosphorus as P	mg/kg	45.5	65.5	62.1
12.	Exchangeable Potassium as K	mg/kg	152.5	164.5	174.5
13.	Exchangeable Sodium as Na	mg/kg	94.5	84.5	98.5
14.	Exchangeable Calcium as Ca	mg/kg	4586.5	5652.5	5845.5
15.	Exchangeable Magnesium as Mg	mg/kg	994.5	845.5	785.5
16.	Cation exchange capacity	meq/100 gm	32.0	36.1	36.6
17.	Total Iron (as Fe)	mg/kg	978.5	874.5	944.5
18.	Total Zinc (as Zn)	mg/kg	154.5	165.5	142.5
19.	Total Copper	mg/kg	26.5	22.5	19.5
20.	Total Boron	mg/kg	45.5	44.1	49.8
21.	Sulphate as SO4	mg/kg	84.5	251.5	214.1
22.	Chloride as Cl	mg/kg	245.5	284.5	312.2
23.	Moisture	%	11.5	15.2	14.2
24.	Alkalinity	mg/kg	277.6	288.5	345.2
25.	Acidity	mg/kg	42.5	46.5	48.5
26.	Specific Gravity	gm/cc	1.24	1.32	1.25
27.	Porosity	%(w/w)	52.5	57.5	59.5
28.	Infiltration capacity	inch/hr	0.06	0.07	0.05
29.	Carbonate	mg/kg	19.5	24.5	28.5
30.	Sodium Absorption Ratio	(meq/100gm)1/2	0.07	0.07	0.08
31.	Permeability	cm^2	0.05	0.04	0.02
32.	Water Holding Capacity	%(w/w)	66.5	62.5	61.5

Source: Primary Survey by Shri Krishna Analytical Laboratory, New Delhi

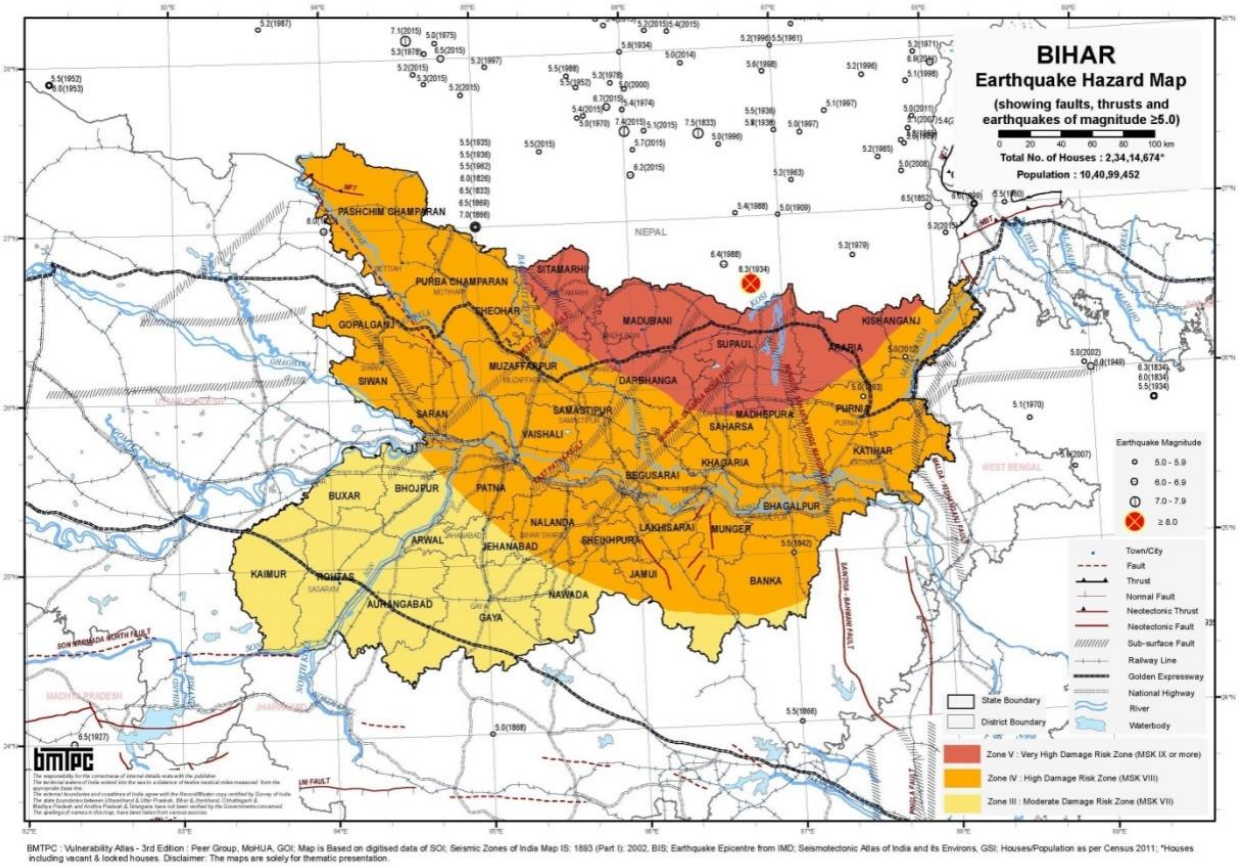
Figure 4-5: Soil Sampling Location Map



4.8 Seismicity

Bureau of Indian Standards [IS-1893 Part 1:2002] categorises the country into four seismic zones viz. Zone-II, Zone-III, Zone-IV and Zone-V. Seismicity increases from Zone-II (Least active) to Zone-V (Highest Active). Alignment of proposed highway is found in Seismic Zone IV (High Risk Zone).

Figure 4-6: Seismic Zones Map of Bihar



BMTPC : Vulnerability Atlas - 3rd Edition : Peer Group, MoHUA, GOI; Map is Based on digitised data of SOI; Seismic Zones of India Map IS: 1893 (Part I): 2002, BIS; Earthquake Epicentre from IMD; Seismotectonic Atlas of India and its Environs, GSI; Houses/Population as per Census 2011; *Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

Source: Building Materials and Technology Promotion Council, MoH&UA, GOI

4.9 Land Use and Land Cover

The land use along the project highway and in study area were found to be agricultural land, waste land, Built-up area, plantation/protected forests, etc. The Land Use & Land Cover along the project alignment are presented in Table 4-5. The LULC maps is given in Annexure 4.1.

Table 4-5: Land Use Land Cover of the 500 m Buffer of Proposed Alignment

Sl. No.	Category	Area (ha)	Percentage
1	Builtup Land	6125.997	20.04
2	Permanent Wetlands	2071.193	6.78
3	Shrubland	663.029	2.17
4	Cropland	17098	55.94
5	Fallow Land	480.518	1.57
6	Plantations	1114.815	3.65
7	Water Bodies	3010.4	9.85
	Total	**30564.482**	**100.00**

Source: Google Earth and SoI toposheet

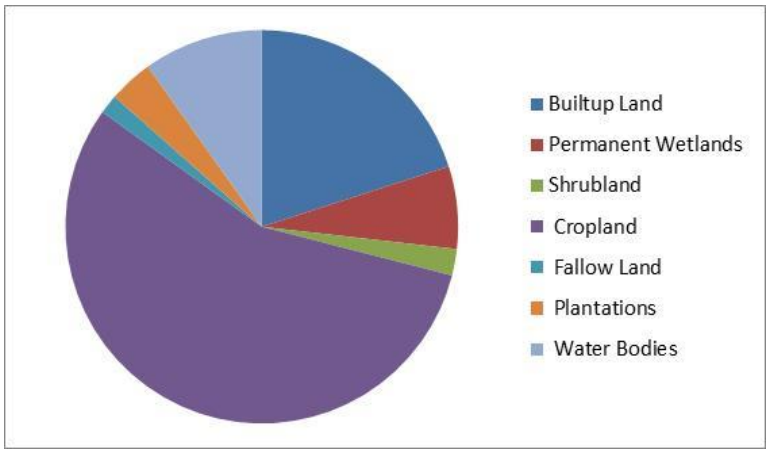


Figure 4-7: Pie chart of LULC for 500 m Buffer

Agricultural area is the predominant land use in the Study area.

4.10 Ambient Air Environment &Quality

A network of three ambient air quality sampling locations has been selected along proposed alignmentfor assessment of the existing status of air environment within the study zone. The selection of monitoring locations has been distributed throughout the study area to get representative baseline of any variation in land use as well as road geometrics and traffic conditions across the proposed alignment including the baseline at sensitive receptors along the project. The selected locations of ambient air monitoring stations are presented in Table 4-6 and Figure 4-8.

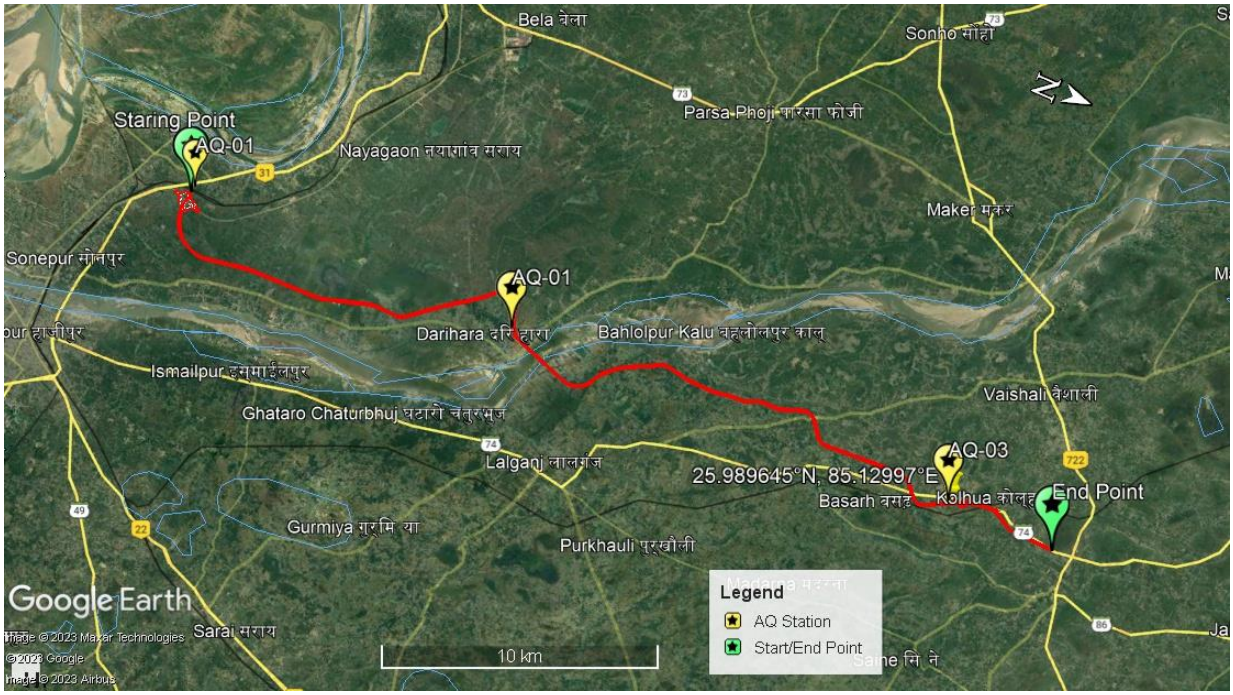
Table 4-6: Ambient Air Quality (AAQ) Monitoring Stations/Location

Sl. No.	Station Code	Design Chainage (km)	Location	Distance from PROW (m)	GPS Coordinates
1	AQ1	0+000	GovindChak School	251	25.723479°N,85.135377°E
2	AQ2	16+600	High school Darihar	85	25.836623°N, 85.1361°E
3	AQ3	34+500	Govt High School-Vaishali	163	25.989645°N, 85.12997°E

Source: Primary Survey by Shri Krishna Analytical Laboratory, New Delhi

Figure 4-8: Ambient Air Quality Sampling Photographs

Figure 4-9: Ambient Air Quality Monitoring Location Map



The summary of ambient air quality results for the project stretch is presented in Table 4-7. The results indicate that all air quality parameters are within the standards specified in the NAAQS.

Table 4-7: Results of Ambient Air Quality Monitoring along Proposed Alignment

Sl. No	*Sample Code*	PM10 (µg/m³)				PM 2.5 (µg/m³)				SO2 (µg/m³)				NOx (µg/m³)				CO (mg/m³)			
		Min	Max	98%	Avg.	Min	Max	98%	Avg.	Min	Max	98%	Avg.	Min	Max	98%	Avg.	Min	Max	98%	Avg.
1	AQ1	79.5	91.1	91.1	86.05	50.1	58.1	58.1	53.76	5.9	8.7	8.7	6.8	10.2	16.9	16.9	12.35	1.01	1.16	1.2	1.1
2	AQ2	79.8	89.5	88.53	84.00	48.5	57.5	57.5	53.22	5.2	7.5	7.5	6.6	10.4	16.4	16.4	12.55	1.02	1.2	1.2	1.1
3	AQ3	79.8	95.4	94.94	89.34	45.5	58.8	58.8	52.69	5.2	8.7	8.7	7.29	10.4	19.9	19.9	14.86	1.02	1.21	1.21	1.1
NAAQS Limit		**100**				**60**				**80**				**80**				**02**			

Source: Primary Survey by Shri Krishna Analytical Laboratory, New Delhi

PM10: Average Concentration of PM10 was found within the CPCB limits at all monitoring locations. Concentration for PM10 ranged between 79.5 µg/m^{3}to 95.4 µg/m^3.

PM2.5: Average Concentration of PM2.5 was found below the limits prescribed by CPCB. Concentration for PM2.5 ranged between 45.5µg/m^{3}to 58.8µg/m^3.

SO_2: The Concentration ranged between 5.2µg/m^{3}to 8.7µg/m^3 and is well below the CPCB prescribed limits**.**

NO_x: The Concentration ranged between 10.2µg/m^{3}to 19.9µg/m^3 and is well below the CPCB prescribed limits.

CO: The concentration of CO was found within the permissible limit.

4.11 Ambient Noise Quality

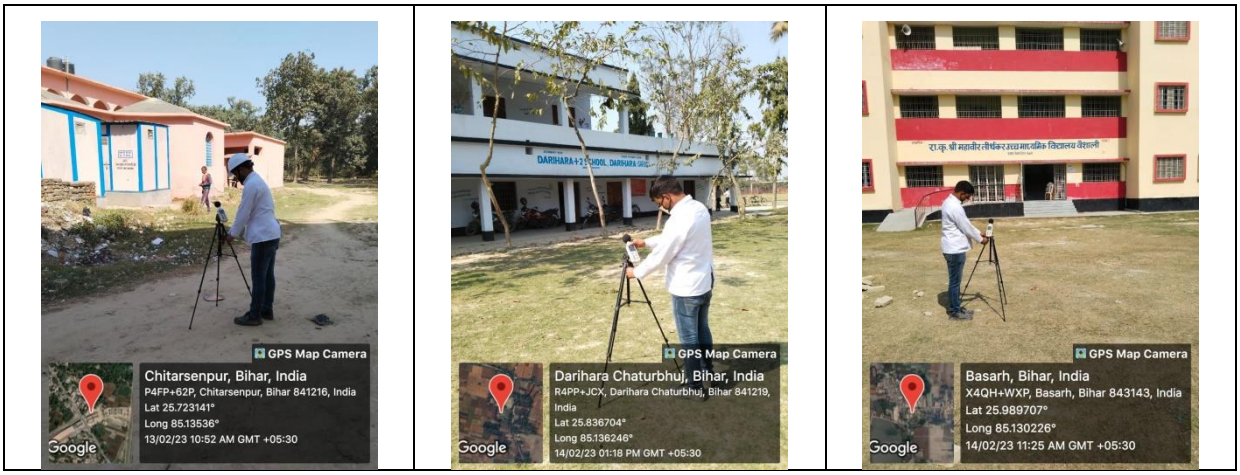
Noise is an important environmental attribute in all road projects because vehicular traffic is a major source of noise pollution. 3ambient noise-sampling locations along project section of and were identified to characterize the baseline noise levels in the project area. Locations for noise monitoring along the corridor are identified to cover the various land use present along the corridor. Noise monitoring stations are detailed in Table 4-8 and Figure 4-11.

Table 4-8: Noise Monitoring Locations

Sl. No.	Station Code	Tentative Chainage (km)	Location	GPS Coordinates
1	ANQ-1	0+000	GovindChak School	25.723141°N, 85.13536°E
2	ANQ-2	16+600	High school Darihar	25.836623°N, 85.1361°E
3	ANQ-3	34+500	Govt High School-Vaishali	25.989707°N, 85.130226°E

Source: Primary Survey by Shri Krishna Analytical Laboratory, New Delhi

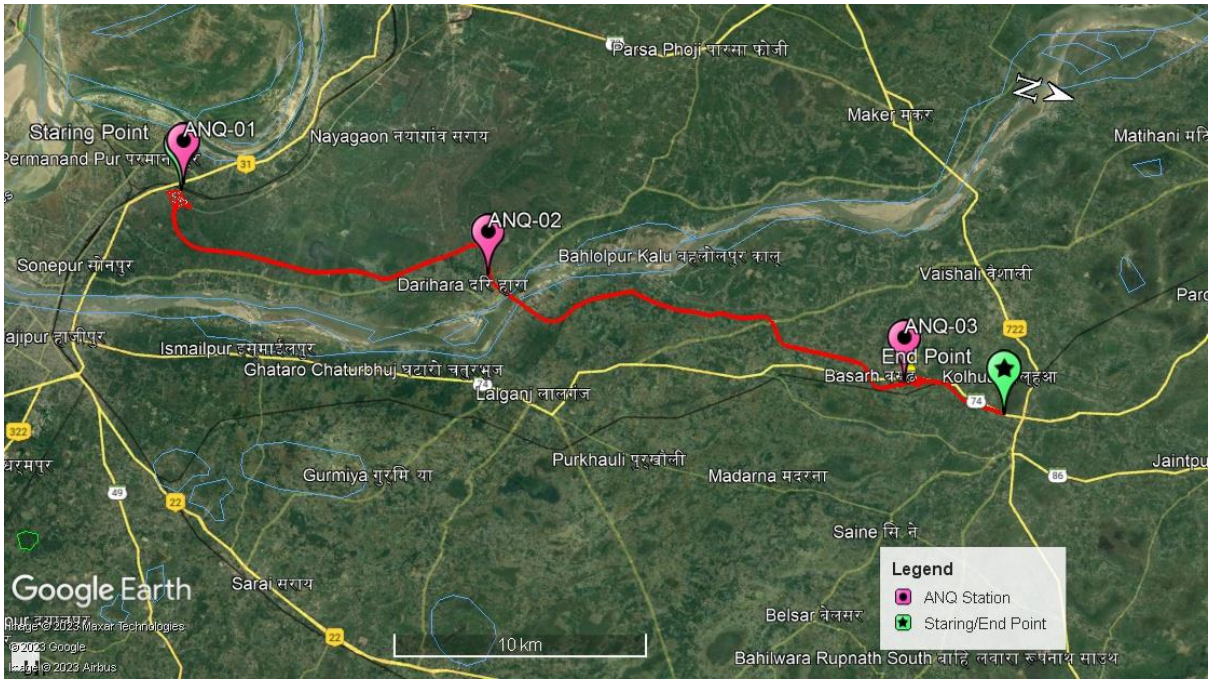
Figure 4-10: Noise level Monitoring Sampling Photographs



Noise Monitoring has been conducted to assess the background noise levels in different zones viz., residential, industrial, commercial and silence zones. The main objective of noise monitoring was to establish the baseline noise levels and assess the impact of the total noise that is expected to be generated in the surrounding areas by implementing the proposed project.

The day noise levels were recorded between 6 am to 10 pm and night noise levels were recorded between 10 pm and 6 am at all locations.Leq day and Leq night calculated for various locations in the area are presented below which has been compared with the standards prescribed by CPCB for various zones.

Figure 4-11: Noise Level Monitoring Location Map



The Noise quality result presented in below table for Bakaerpur-Manikpur section shows that Leq Day time varies from 46.2 to 47.1 dB(A) and LeqNighttime varies from 37.7 to 38.1 dB(A).

Table 4-9: Results of Primary Noise Monitoring

Sl. No.	Location Code	Leq Day	Leq Night	Noise Quality Standards in dB (A)	
				Daytime	Night time
1	ANQ1	46.2	37.7	55	45
2	ANQ2	46.7	38.0	55	45
3	ANQ3	47.1	38.1	55	45

Source: Primary Survey by Shri Krishna Analytical Laboratory, New Delhi

4.12 Water Resources

Saran district is a part of the Lower Ganga Basin. It falls in the Gandak sub-basin. Perennial rivers viz., the Ganga, the Ghagra and the Gandak, govern the drainage system in the district. The river Ganga meets the district at Kotwapatti Rampur and flow from west to east along the southern boundary of the district. The Gandak flows from northwest to southeast forming the northeastern boundary of the district. The river Gandak meets the river Ganga at Sonepur. The tributaries of the Gandak River viz., Mahi, Ghoghari and Gandaki flow roughly in the southeast direction. The Ghagra River also known as Suryu, in the adjacent state Uttar Pradesh, flows in the southeast direction. It forms the southwestern boundary of the district. The river Ghagra meets the river Ganga near Chapra.

The Vaishali district constitutes a part of Ganga river basin. It has two sub-basins, namely Gandak sub-basin and Burhi Gandak sub-basin. The major part of the district falls under Burhi Gandak sub-basin. The Gandak is the main river flowing in the southeasterly direction and forming western boundary of the district. It disgorges in the river Ganga near Hajipur. The river Gandak does not receive any important tributary in its course. There are two important distributary channels namely the Gandaki and the Baya rivers flowing parallel to the river Gandak and discharge into the river Ganga. The Baya runs through the central part of the district in north–south direction.

The drainage system of the Muzaffarpur district originates from Himalayas and converges into the major rivers. The district is mainly drained by river Burhi Gandak, Baghmati, Baya which generally flow in south

easterly direction. Though all three rivers and their tributaries are perennial but these rivers are very in predictable during rainy season during monsoon, these rivers become very devastating in nature causing flood in this area. Due to this peculiar character, the sedimentation rate during monsoon is very high near the river banks which have resulted in formation of the elevated up land and gradually decreases away from the river channels.

Project section is crossing 1 River (Gandak River). Elevated structures are proposed along the water bodies being crossed. Silt fencing is proposed near major canals and pond.

4.12.1 Groundwater Status &Quality

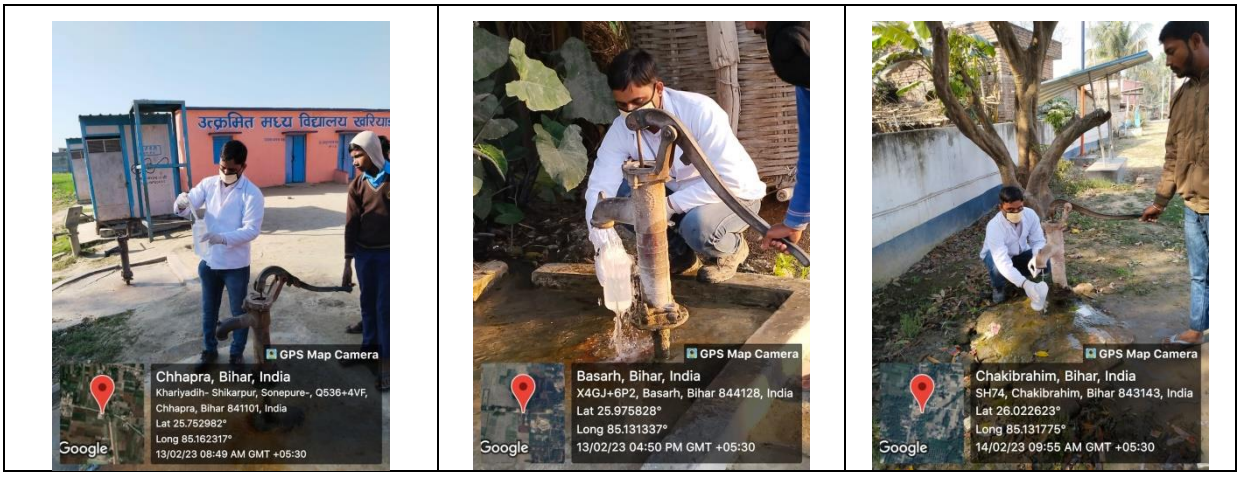
Samples for ground water quality assessment were collected from three (3) locations for proposed alignment and analysed for assessment of water quality. Locations of ground water sampling are provided in Table 4-10 and Figure 4.12.

Table 4-10: Ground Water Sampling Locations

Sl. No.	Location Code	Chainage (km)	Location Name	Distance from Centre line (m)	Geo-Coordinates
1	GW-01	4+900	Sonepur	707	25.752983° 85.162315°
2	GW-02	32+700	Basarth	54.50	25.975812° 85.131344°
3	GW-03	38+300	Chakibrahim	15.70	26.022623° 85.131775°

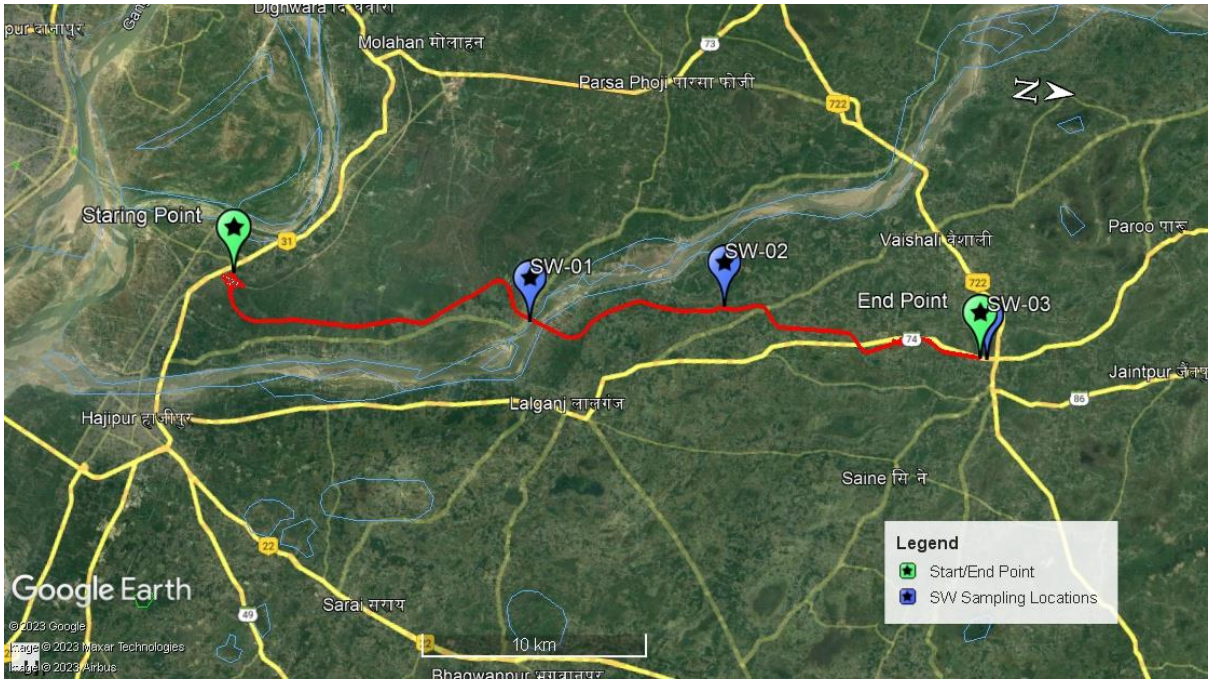
Source: Primary Survey by Shri Krishna Analytical Laboratory, New Delhi

Figure 4-12: Ground Water Sampling Photographs



The water samples as collected were analysed in laboratory and the result was compared against IS 10500: 2012 for drinking water standards.

Figure 4-13: Ground Water Sampling Location Map



The results for project section shows that pH was found ranging from 6.93 to 8.04 in ground water samples taken along the proposed alignment. The chloride content varied between 28.49 to 52.49 mg/l. The Fluoride content was found within the maximum permissible limit (1.0 mg/l) in drinking water as prescribed by BIS. The concentration of Nitrate ranges between 2.0 to 4.3 mg/l. The concentration of iron in ground water has been found within the permissible limits at all locations.

Figure 4-14: Surface Water Sampling Locations Map

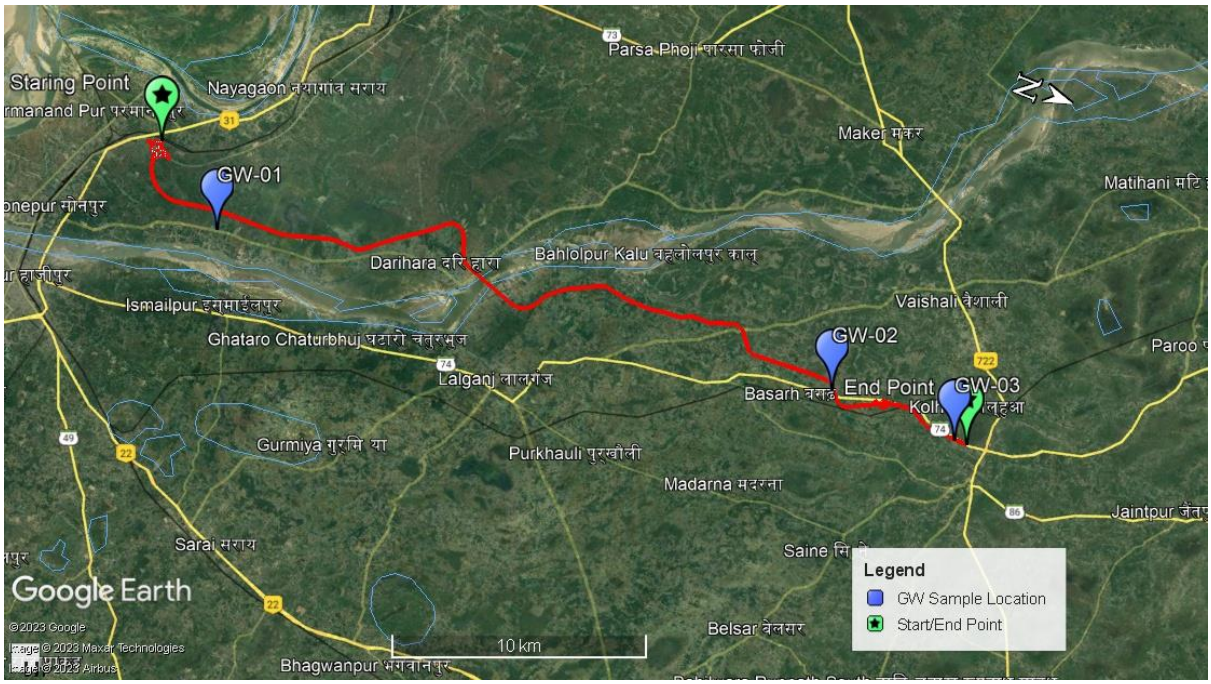


Table 4-11: Ground Water Monitoring Results

Sl. No.	Parameter	Unit	Limit (IS -10500:2012)		Ground Water Result		
			Desirable	Permissible	GW1	GW2	GW3
1	Colour	Hazen	5	15	BDL	BDL	BDL
2	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Turbidity	NTU	1	5	BDL	BDL	BDL
4	pH	-	6.5-8.5	No Relaxation	7.39	7.06	7.22
5	Total Hardness (as CaCO3)	mg/l	200	600	138	216	228
6	Iron (as Fe)	mg/l	1	No Relaxation	0.07	0.08	0.1
7	Chlorides (as Cl)	mg/l	250	1000	18.9	42.2	46.6
8	Fluoride (as F)	mg/l	1	1.5	0.18	0.21	0.24
9	TDS	mg/l	500	2000	248	408	433
10	Calcium(as Ca2+)	mg/l	75	200	32.6	40.2	44.6
11	Magnesium (as Mg2+)	mg/l	30	100	13.73	28.07	28.3095
12	Sulphate (as SO4)	mg/l	200	400	9.2	24.2	26.5
13	Nitrate(as NO3)	mg/l	45	No Relaxation	2.1	4.2	4.9
14	Chromium (as Cr+6)	mg/l	0.05	No Relaxation	BDL	BDL	BDL
15	Alkalinity as CaCO3	mg/l	200	600	116	252	245
16	Aluminium (as Al)	mg/l	0.03	0.2	BDL	BDL	BDL
17	Copper (as Cu)	mg/l	0.05	1.5	BDL	BDL	BDL
18	Zinc (as Zn)	mg/l	5	15	BDL	0.11	0.16
19	Ammonia (as NH3-N)	mg/l	0.5	No relaxation	BDL	BDL	BDL
20	Anionic detergents (as MBAS)	mg/l	0.2	1	BDL	BDL	BDL
21	Boron (as B)	mg/l	0.5	1	BDL	BDL	BDL
22	Mineral oil	mg/l	0.5	No relaxation	BDL	BDL	BDL
23	Phenolic compounds (as C6H5OH)	mg/l	0.001	0.002	BDL	BDL	BDL
24	Cadmium (as Cd)	mg/l	0.003	No relaxation	BDL	BDL	BDL
25	Cyanide (as CN)	mg/l	0.05	No relaxation	BDL	BDL	BDL
26	Lead (as Pb)	mg/l	0.01	No relaxation	BDL	BDL	BDL
27	Mercury (as Hg)	mg/l	0.001	No relaxation	BDL	BDL	BDL
28	Nickel (as Ni)	mg/l	0.02	No relaxation	BDL	BDL	BDL
29	Sulphide(H2S)	mg/l	0.05	No relaxation	BDL	BDL	BDL
30	Residual Free Chlorine(RFC)	mg/l	Min-0.2	1	BDL	BDL	BDL
31	Total arsenic (as As),	mg/l	0.01	No relaxation	BDL	BDL	BDL
32	Barium	mg/l	0.7	No relaxation	BDL	BDL	BDL
33	Silver(as Ag)	mg/l	0.1	No Relaxation	BDL	BDL	BDL
34	Molybdenum (as Mo)	mg/l	0.07	No Relaxation	BDL	BDL	BDL
1	Total coliform	MPN/100ml	Absent	-	Absent	Absent	Absent
2	E.coli	e.coli/100ml	Absent	-	Absent	Absent	Absent

Source: Primary Survey by Shri Krishna Analytical Laboratory, New Delhi

4.12.2 Surface Water Quality

Surface water quality of the entire project stretch has been monitored as per the parameters laid down by Central Pollution Control Board for surface water quality criteria at 3 locations along the project section. Surface water sampling lication area given in Table 4-12 and Figure 4.15.

Table 4-12: Surface Water Sampling Locations

Sl. No.	Location Code	Tentative Chainage (km)	Location Name	Geo-Coordinates
1	SW1	16+700	Gandak River	25.844625° 85.141932°
2	SW2	26+200	nalla	25.921912° 85.123606°
3	SW3	38+800	canal	26.029959° 85.131725°

The analysis of surface water quality is given in the Table 4-13.

Figure 4-15: Surface Water Sampling Photographs

Table 4-13: Surface Water Test Resultalong Proposed Alignment

Sl. No .	Parameter	Unit	Tolerance Limit as per IS:2296 Class-C	Surface Water Result		
				SW1	SW2	SW3
1	Temperature	°C		28	27	27
2	Nitrite(as NO2)	mg/l		<0.02	<0.02	<0.02
3	Boron (as B)	mg/l		0.07	0.08	0.06
4	Free Ammonia	mg/l		<0.1	<0.1	<0.1
5	Mercury (as Hg)	mg/l		<0.001	<0.001	<0.001
6	Selenium (as Se)	mg/l		<0.005	<0.005	<0.005
7	Cyanide (as CN)	mg/l		<0.05	<0.05	<0.05
8	Silver (as Ag)	mg/l		<0.1	<0.1	<0.1
9	Barium (As Ba)	mg/l		<0.1	<0.1	<0.1
10	Colour	Hazen	300	<0.5	<0.5	<0.5
11	Turbidity	NTU		<1.0	<1.0	<1.0
12	pH	-	6.5-8.5	8.29	7.29	7.64
13	DO	mg/l	Minimum-4	8.1	8	7.9
14	BOD	mg/l	3	1.4	1.6	1.8
15	COD	mg/l		6	8	10
16	Total Hardness (as CaCO3)	mg/l		90	124	80
17	Iron (as Fe)	mg/l	50	0.12	0.14	0.13
18	Chlorides (as Cl)	mg/l	600	28.5	37.5	24.5
19	Fluoride (as F)	mg/l	1.5	0.11	0.13	0.09
20	Conductivity	umho/cm		268	389	239

Sl. No .	Parameter	Unit	Tolerance Limit as per IS:2296 Class-C	Surface Water Result		
				SW1	SW2	SW3
21	TDS	mg/l	1500	160	233	143
22	Calcium(as Ca2+)	mg/l		18	32	16
23	Magnesium (as Mg2+)	mg/l		10.94	10.69	9.72
24	Cadmium	mg/l	0.01	<0.002	<0.002	<0.002
25	Copper (as Cu)	mg/l	1.5	<0.05	<0.05	<0.05
26	Sulphate (as SO4)	mg/l	400	9.5	16.5	7.9
27	Nitrate(as NO3)	mg/l	50	1.1	2.1	1.2
28	Zinc (as Zn)	mg/l	15	<0.01	<0.01	<0.01
29	Oil & Grease	mg/l	0.1	<0.1	<0.1	<0.1
30	Alkalinity (as CaCO3)	mg/l		84	112	80
31	Lead (as Pb)	mg/l	0.1	<0.01	<0.01	<0.01
32	Total Arsenic (as As)	mg/l	0.2	<0.005	<0.005	<0.005
33	Phenolic Compound	mg/l	0.005	<0.001	<0.001	<0.001
34	Anionic Surface Active Detergent as MBAS	mg/l		<0.05	<0.05	<0.05
35	Sodium	mg/l		16.2	24.5	16.5
36	Potassium	mg/l		6.6	6.2	5.2
37	Total Kjeldahl Nitrogen (as N)	mg/l		2.4	3.2	2.5
38	Odour	°C		Odourless	Odourless	Odourless
Biological Parameter						
1	Total coliform	MPN/100 ml	5000	16	28	
2	Fecal Coliform	MPN/100 ml	-	8	12	

Source: Primary Survey by Shri Krishna Analytical Laboratory, New Delhi

The surface water results for project section showed that the pH of the collected Surface water in the study area was found to be in the range of 7.29 to 8.29. The value of TDS found to be in the range from 143 to 233 mg/l. The chloride and Sulphate values of the samples were observed from 24.5 to 37.5 mg/l and from 7.9 to 16.5 mg/l respectively. Dissolved oxygen found from 7.9 to 8.9 mg/l. Most of the trace metal concentration is observed below limit of quantification.

4.13 Use of Natural Resources

The objective was to locate suitable materials for the construction of embankment, sub-grade and top layers of pavement and bridge structures. The study was carried out to determine the engineering properties of the following materials, which are to be used in construction. The details of construction material source as identified for the project are described under Section 5.2.2.2 and 5.2.2.3 of this EIA Report.

- Borrow areas for locating suitable soils for use in embankment and sub-grade.
- Quarries for locating hard stone / granular materials for use in subbases, bases, bituminous mixes and concrete works
- Source of fine aggregate for use in DBM/BC layers and cement concrete works.

4.14 Biological Environment

Biological environment is the study of the biotic factors prevailed in the study area. Biotic factors are the community of different organisms under two broad categories i.e. flora and fauna. Biological assessment of an study area is an essential part of EIA studies to understand the status of the living communities in the area as well as to determine the probable impacts of the proposed projects on the same.

4.14.1 Forest

The state of Bihar has only 6.9% of forest cover to its total geographic area. Legally this area has been classified into "Reserved Forest, Protected Forests, and Unclassified Forest" and their areas are 693 sq. km (0.75%), 5779 sq. km (6.14%) and 1 sq. km (0%) respectively. Per capita forest area in the state is 0.01 ha against the national average of 0.07 ha.

The Forest cover of the state and the project districts are given in the Table 4-14. Forest Cover Map of Bihar is given in Figure 4-16.

Figure 4-16: Forest Cover Map of Bihar

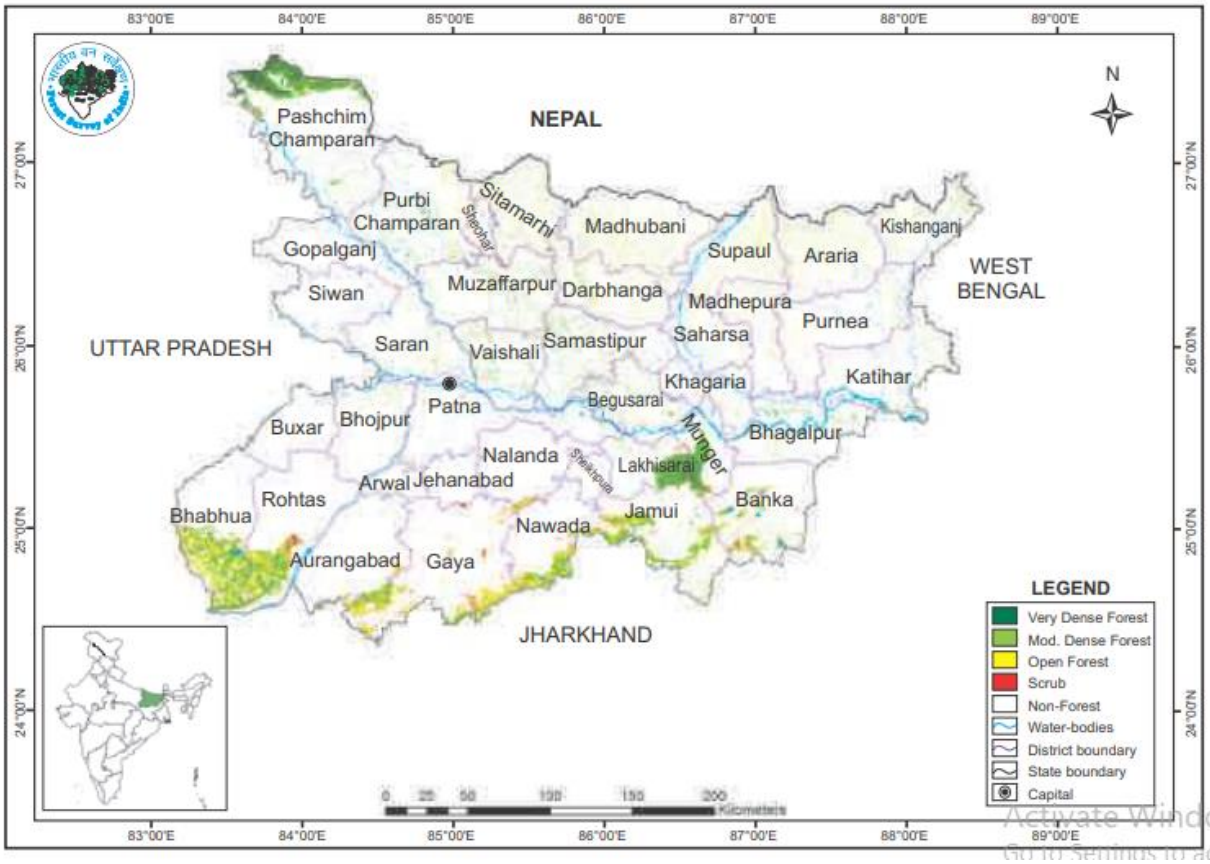


Table 4-14 : Forest cover of State and Districts under Proposed Project (km²)

District	Geographical Area (km²)	Very Dense Forest (km²)	Mod. Dense Forest (km²)	Open Forest(km²)	Total (km²)	% of GA
Saran	2641	0.00	26.30	32.83	59.13	2.24
Vaishali	2036	0.00	82.49	29.33	111.82	5.49
Muzaffarpur	3712	0.00	52.17	109.65	161.82	5.10
Bihar	**94163**	**333.13**	**3280.32**	**3692.54**	**7305.99**	**7.76**

Source: *India State of Forest Report, 2019*

Around 0.56% of the total geographical area of Saran, Vaishali & Muzaffarpur district under forest. Although no protected/ reserved forest area is in the vicinity of the project road.

As per Van Vibhag state of Bihar Gazette notification-no. 50/97-921-E dated Aug. 28/1997, the vacant space on both sides of existing National Highways project road has been declared as protected forest and therefore, widening of existing road requires diversion of forest land.

The project road is notified under the road side protected forest area of existing state highway-SH-74 road section.

No National Park, Wildlife Sanctuary, Biosphere Reserve, Tiger / Elephant Reserve, Wildlife Corridor, Reserved/ Protected Forest etc. are crossing by the project road.

4.14.2 Bio-diversity Study

Flora Diversity

Flora of an area depends on climatic conditions, topography, rainfall, soil type, land use and demography of an area. These factors highly affect the floral cover and quality of an area. A floral survey was carried out in the core as well as buffer zone of the project site. The plant species found in the area are given in Table 4-15.

Table 4-15: Type of Flora in Project Area

S. No.	BotanicalName	Common name	Family
1.	Azadirachta indica	Neem	Meliaceae
2.	Averrhoa carambola	Amrakh	Oxalidaceae
3.	Albizzia lebbeck	Sirish	Fabaceae
4.	Aegle marmelous	Bael	Rutaceae
5.	Achyranthes aspera	-	Amaranthaceae
6.	Argemone Mexicana	Pivladhotra	Papaveraceae
7.	Acacia catechu	Khair	Fabaceae
8.	Acacia nilotica	Babul	Fabaceae
9.	Annona squamosa	Sarifa	Annonaceae
10.	Adina cordifolia	Haldu	Rubiaceae
11.	Bombax ceiba	Samal	Malvaceae
12.	Bauhinia variegate	Kachanar	Fabaceae
13.	Borassus flabellife	Sugar palm	Arecaceae
14.	Citrus medica	Nimbu	Rutaceae
15.	Cassia fistula	Amaltash	Fabaceae
16.	Carica papaya	Papaya	Caricaceae
17.	Cassia siamea	Kashid	Fabaceae
18.	Cassia tora	Tarota	Fabaceae
19.	Caesalpinia pulcherrima	Krishnachaura	Fabaceae
20.	Colocasia esculenta	Elephant ear	Araceae
21.	Dalbergia sisso	Sisam	Fabaceae
22.	Eucalyptus globolus	Safeda	Myrtaceae
23.	Ficus benghalensis	Wad	Moraceae
24.	Ficus racemosa	Umber	Moraceae
25.	Erythrina variegate	Sunshine Tree	Fabaceae
26.	Ficus religiosa	Pimpal	Moraceae
27.	Gardenia turgid	Khahar	Rubiaceae
28.	Leucaena leucocephala	Subabul	Fabaceae
29.	Lantana camara	Raimuniya	Verbenaceae
30.	Mitragyna parvifolia	Karam	Rubiaceae
31.	Mangifera indica	Aam	Anacardiaceae
32.	Mimusops elengi	Molshri	Sapotaceae
33.	Nerium indium	Kaner (Red)	Apocynaceae
34.	Nephelium litchi	Litchi	Sapindaceae
35.	Pithecellobium dulce	Jungle jalebi	Fabaceae
36.	Phoenix sylvestris	Khajoor	Arecaceae
37.	Pongamia pinnata	Karanj	Fabaceae
38.	Prosopis juliflora	BilayatiBabool	Fabaceae
39.	Psidium guajava	Amrud	Myrtaceae

S. No.	BotanicalName	Common name	Family
40.	Ricinus communis	Arandi	Euphorbiaceae
41.	Syzygium cumini	Jamun	Myrtaceae
42.	Solanum nigrum	Regani	Solanaceae
43.	Tamarindus indica	Imli	Fabaceae
44.	Thevetianerii folia	Kaner (Yellow)	Apocynaceae
45.	Terminalia arjuna	Arjun	Combretaceae
46.	Zizphus glaberrima	Ber	Rhamnaceae
47.	Parthenium hysterophorus	Gajar Grass/Congress grass	Asteraceae
48.	Dendrocalamus strictus	Baas	Poaceae
49.	Bambusa arundinacea	Kat bass	Poaceae
50.	Saccharum spontaneum	Kans	Poaceae
51.	Cynodon dactylon	Dube	Poaceae
Aquatic Vegetation			
52.	Typha elephantine	Era	Typhaceae
53.	Hydrilla verticillata	Hydrilla	Hydrocharitaceae
54.	Nymphaea lotus	White lotus	Nymphaeaceae
55.	Nelumbo nucifera	Indian lotus	Nelumbonaceae
56.	Cyperus rotundus	Nutgrass, Coco	Cyperaceae
57.	Lemna perpusila	Small Duckweed	Lemnaceae
58.	Spirodela polyrrhiza	Giant Duckweed	Araceae

Fauna Diversity

A faunal survey was carried out in the core as well as buffer zone of the project site. Details of faunal species found in the area are given in Table 4-16.

Table 4-16: list of Fauna in the Study Area

Sl.No.	ScientificName	English/Popular Name	Status according to IWPA 1972
Mammals			
1.	*Canis aureus*	Jackal	Sch. II
2.	*Herpestes edwardsii*	Common Mongoose	Sch. II
3.	*Presbytis entellus*	Common Langur	Sch. II
4.	*Macaca mulatta*	Rhesus monkey	Sch. II
5.	*Rattus rattus*	House Rat	Sch. V
6.	*Funambulus palmarum*	Four Striped Palm Squirrel	Sch. IV
7.	*Suncus murinus*	Musk Shrew	Sch. V
8.	*Pteropus giganteus*	Indian fly fox	Sch. V
9.	*Lepus nigricollis*	Indian hare	Sch. IV
Amphibians and Reptiles			
1.	*Calotes versicolor*	Common Garden Lizard/Girgit	-
2.	*Naja naja*	Cobra	Sch. II
3.	*Ptyas mucosa*	Dhaman/Ret Snake	Sch. II
4.	*Eryx johnii*	Do-muha	Sch. IV
5.	*Bungarus caeruleus*	Common Krait	Sch. IV
6.	*Rana hexadactyla*	Indian Pond Frog	Sch. IV
7.	*Rana tigerinus*	Indian Bull Frog	Sch. IV
8.	*Mabuya carinata*	Brahminy Skink/ Bahmani	-
9.	*Hemidactylus flaviviridis*	House Gecko/Chhipkali	-
Butterflies			
10.	*Papilio polytes*	Common Mormon	-

11.	*Papiliopolym nesfor*	Blue Mormon	-
12.	*JunoniaIe monias*	Lemon Pansy	-
13.	*Euploea core*	Common Crow	-
14.	*Danaus chrysippus*	Plain Tiger	-

Figure 4-17: Photographs of Fauna Distrubition along the Project Road

Birds: Birds recorded in the project area are given in Table 4-17:

Table 4-17: List of Avifauna in the Study Area

Sl.No.	ScientificName	English / popular Name	IUCN Red List Categorisation
1	*Upupa epops*	Common Hoopoe	-
2	*Cuculus canorus*	Common Cuckoo	Sch. IV
3	*Corvus macrorhynchos*	Jungle crow	Sch. IV
4	*Streptopelia chinensis*	Spotted dove	Sch. IV
5	*Streptopelia decaocto*	Indian ring dove	Sch. IV
6	*Streptopelia tranquebarica*	Red turtle dove	Sch. IV
7	*Sterna aurantia*	River Tern	Sch. IV
8	*Nectarinia asiatica*	Purple Sunbird	Sch. IV
9	*Turoides striatus*	Jungle Babbler	Sch. IV
10	*Ardea cinerea*	Grey Heron	Sch. IV
11	*Vanellus cinereus*	Red-wattled lapwing	Sch. IV
12	*Ardeola grayii*	Indian Pond Heron	Sch. IV
13	*Francolinus pondicerianus*	Grey francolin	Sch. IV
14	*Psittacula krameri*	Rose-ringed parakeet	Sch. IV
15	*Centropus bengalensis*	Lesser coucal	Sch. IV
16	*Merops orientalis*	Green bee-eater	-
17	*Orthotomus sutorius*	Tailor birds	-
18	*Apus affinis*	House swift	-
19	*Columba livia*	Rock pigeon	-
20	*Halcyon smyrnensis*	White-throated kingfisher	Sch. IV
21	*Psittacula krameri*	Rose-ringed parakeet	Sch. IV
22	*Egretta garzetta*	Little egret	Sch. IV
23	*Bubulcus ibis*	Cattle egret	Sch. IV
24	*Corvus splendens*	House crow	Sch. V
25	*Dicrurus macrocercus*	Black drongo	Sch. IV
26	*Acridotheres tristis*	Common myna	Sch. IV
27	*Acridotheres ginginianus*	Bank myna	Sch. IV
28	*Saxicoloides fulicata*	Indian robin	Sch. IV
29	*Sturnus pagodarum*	Brahminy starling	Sch. IV
30	*Pycnonotus cafer*	Red-vented bulbul	Sch. IV
31	*Nectarinia asiatica*	Purple sunbird	Sch. IV
32	*Passer domesticus*	House sparrow	Sch. IV
33	*Motacilla maderaspatensis*	White-browed wagtail	-
34	*Microcarbo niger*	Little cormorant	Sch. IV
35	*Himantopus himantopus*	Black wing Still	Sch.IV
36	*Saxicola caprata*	Pied Bush chat	Sch. IV
37	*Anas poecilorhyncha*	Spot bill duck	Sch. IV
38	*Elanus caeruleus*	Black kite	Sch.IV
39	*Accipiter bediua*	Shikra	Sch.IV
40	*Milvus migrana*	Pariha kite	Sch.IV
41	*Micropternus brachyurus*	Rufous wood packer	Sch.IV

Fishes

Apart from above wild animals few important fishes also recorded in the project area are given in Table 4-18:

Table 4-18: Fishes in the Study Area

Sl. No.	Scientific Name	Common Name	Local name
1.	*Channa gachua*	Snake head	Girai
2.	*Catla catla*	Indian carp	Katla
3.	*Labeo rohita*	Rohu	Rohu

The biological study conducted for the core as well as buffer zone of the project site reveals that the fauna found in the study area majorly belongs to Schedule III, IV & V.

Also, no species recorded during the study period falls under any category of threatened species according to IUCN Red Data List of India.

Figure 4-18: Photographs of Flora distrubition along the project road

4.15 Socio-Economic Profile

Socio-economic analysis has been conducted for the state and project influence districts along the proposed project road. The primary purpose of socio-economic analysis is to provide an overview of the socio-economic setup of the affected districts. The population forms the basic planning parameter for the preparation of any transport related plan/study and indicates the scale of required development. Bihar is situated in the Eastern region of India. It is an entirely land-locked state. Bihar lies mid-way between the humid West Bengal in the east and the sub humid Uttar Pradesh in the west which provides it with a transitional position in respect of climate, economy

and culture. It is bounded by Nepal in the north and by Jharkhand in the south. The Bihar plain is divided into two unequal halves by the river Ganga which flows through the middle from west to east. The proposed alignment is passing through the Saran, Vaishali and Muzafarpur districts in the state of Bihar.

4.15.1 Demographic Profile

As per Census 2011, the total population of Bihar is 104,099,452 with the density as 94163 per sq.km. The demogroahic profile of the project influence area are given in Table 4-19.

Table 4-19: Demographic profile of the Project districts

Sl. No.	State	District	Population	Population Density (per sq.m.)
1.	Bihar	Saran	3951862	2641
2.		Vaishali	3,495,021	1717
3.		Muzafarpur	4,801,062	1514

Source: Census 2011

4.15.2 Rural and Urban Population

The rural and urban population of the project influenced State/Districts is indicated in the Table 4-.20

Table 4-20: Rural and Urban Population

Sl. No.	State	District	Urban	Rural	Total
1.	Bihar	Saran	3,598,660	353,202	3,951,862
2.		Vaishali	3,261,942	233,079	3,495,021
3.		Muzafarpur	4,327,625	473,437	4,801,062

4.15.3 Sex Ratio

Sex ratio of Bihar is (918 females per 1000 males) is lower than that of many district falling along the proposed project road. Among the project influenced districts, a comparative analysis to other concerned State/Districts figures is presented in Table 4-21.

Table 4-21: Sex ratio

Sl. No.	State	District	Sex ratio
1.	Bihar	Saran	954
2.		Vaishali	895
3.		Muzafarpur	900

4.15.4 Religion

The project highway traverses through a number of settlements and is often dotted with religious and cultural properties, which though not of archaeological significance are nevertheless, very significant to the community. A total of 19 religious structures are likely to be affected in this section. 9 temples are found along the project road. No mosque or church is found along the project road. A detailed break up is presented in the following Table 4-22.

Table 4-22: Impact on Religious Properties

Type of Religious & Community Properties	Number of Structures
From Bakarpur at Ch.00+000 km toManikpur at Ch. 38+813 km	
Big Temple	05
Small temple	0
Mosque	00
Total	**05**

Source: LASA Census Survey 2019-20.

4.15.5 Impact on Structures

It has emerged from the census survey that out of total 172 structures that are likely to be affected, (164) belong to the category of private ownership followed by government properties (4) and religious and community properties (4). The census survey results package-wise are summarized in table 4-23.

Table 4-23: Impact on Structures

Types of Properties	Number	Percentage
Adalbari to Manikpur		
Private Properties	164	94.80
Religious Properties	4	2.49
Government Properties	4	2.49
Total	**172**	**100.00**

Source: LASA Census Survey 2019-20.

4.15.6 Impact on Private Structures

Out of 164 private structures which are likely to be affected, 110 are residential structures, 13 are commercial and 41 Petty Shops, as shown in table 4-24

Table 4-24: Impact on Private Properties

Adalbari to Manikpur		Number	Percentage
1	Residential Structure	ss110	67.07
2	Commercial Structure	13	7.93
3	Petty Shops/Kiosk	41	25.00
	Total	**164**	**100**

Source: LASA Census Survey 2019-20.

5 ENVIRONMENTAL IMPACT & MITIGATION PLAN

5.1 Introduction

This chapter assesses the nature, type and magnitude of the potential impacts likely on physical, biological and cultural environmental components along the project corridor. Chapter also discusses about suitable mitigation. For superimposition of the impacts, the baseline information was collected through primary and secondary data.

The impacts on the various environmental components were assessed considering following stages of the project:

- Planning and design stage;
- Construction stage; and
- Operation stage

The description and magnitude of likely impacts on various environmental components along with mitigation measures are presented in the following sections.

5.2 Physical Environment

5.2.1 Meteorological Parameters

Impact

In summer the climate of the project area is hot and dry but winter months are quite cool andpleasant. Winter comes towards the middle of October after the rains are over. The temperaturebegins falling and January is the coldest month of the year with mercury falling to about 5ºC. Theblowing of westerly wind accompanied by dust storms about the middle of March marks thebeginning of hot weather. The mercury starts shooting upward and May is the hottest month of the year when the maximum temperature goes up to 45ºC. The summer continues till the end of June when the onset of rains brings the much awaited relief and the temperature falls, though thehumidity is still high the rise in humidity often makes the heat only more oppressive during the rainy season which lasts till the end of September. From November to February the district has a pleasant climate.

Mitigation

Although the impact is significant but reversible in nature and shall be compensate by avenue tree plantation alongside the proposed highway as per IRC SP-21:2009 to compensate the micro-climatic impacts. It must be noted that the impact is unavoidable. However, it may be pointed out that the project has taken care to minimise tree felling as no tree felling shall be done beyond corridor of impact. Considering the highway, no slow moving traffic or pedestrians are likely on proposed highway.

5.2.2 Land

5.2.2.1 Physiography

Project highway mostly follows the plain and rolling terrain. Highway construction activities involve alterations in the local topography and drainage patterns.The impacts on physiography may include de-stabilization of slopes due to cut and fill operations. Total 1 major bridges, 6 minor bridges, 67 RCC Box type culverts and 50 RCC encased cross road pipe culverts are proposed for the proposed project section to avoid any impact on local hydrology.

5.2.2.2 Geology and Seismology

The entire stretch of the project traverses through Seismic Zone IV (High Risk) as defined by the Indian Standard (IS) seismic zoning classification system. The project does not have any direct impact on the geological or seismic stability of the area. However, associated mining activities for construction material may alter the local geology to some extent. The structure as proposed for the project are being designed considering the seismic magnitude of the region.

5.2.2.3 Quarries

Impact

Existing quarries that are already in operation with the required clearances have been recommended for this project. No new quarries are proposed and hence no major impacts, which arise in making new quarries operational, are likely. In case Contractor / Concessionaire decides in opening new stone quarries stipulated GoI norms should be followed as mining in non-scientific manner may unstable the soil condition and affect the terrain of the area.

Dust, in addition to associated health impacts also reduces visibility thereby increasing safety concerns. As no new quarry is proposed to be opened for this project, therefore, no new impacts are likely to arise due to quarrying operations. It will be ensured that quarry contractor is following environment management system to take care of the working conditions of workers in the existing quarry areas selected for the project. Raw material requirements for the construction activities are detailed in Table 5-1.

Table 5-1: Tentative Raw Material Requirement

Sl. No.	Item	Unit	Total Qty
1.	Earthwork	Cum	4,690,830.12
2.	Agreegate	Cum	781,627.12
3.	Bitumen	MT	11,433.56
4.	Emulsion	MT	5,952.11
5.	Cement	MT	95,737.34
6.	Sand	Cum	113,316.08
7.	Steel	MT	22,033.26
8.	Stone Boulder	Cum	30,714.17

Source: Design report

Mitigation

Existing approved quarries which are already in operation with the required environmental clearances have been recommended for this project, hence no new quarries have been proposed. It needs however, to be noted that recommendation on use of quarries is a guideline only and has been done to establish the feasibility of construction. The issue of dust generation etc. along the haul roads needs to be addressed through proper enforcement of dust suppression measures.

Sand required for the construction will mostly be procured from the approved operating river quarries. As an alternative to borrowing of sand from river-bed the possibility of using stone crusher dust and fly ash shall be explored. Stone dust from crusher can be used for the construction works provided the quantity and the quality produced is certified by Monitoring Consultant to be satisfactory for all construction works, else river sand shall be used from the identified quarry. The long leads mean that care would have to be taken to prevent spillage of material and damage to the haul roads during transportation. No additional adverse environmental impact except those resulting from spillage during transportation is expected to occur. Hence proper care for transportation should be taken into account.

Guidelines for Existing Quarry Management & Guidelines for New Quarry Management have been presented in Annexure 5.1 & Annexure 5.2 respectively.

5.2.2.4 Borrow Area

Impact

Borrow areas may become potential breeding ground for mosquitoes and other bacterial infection disease if not reclaimed properly in a scientific manner. The transportation of borrow materials may also cause dust nuisance. Top-soil as removed from the borrow area may lose its fertility if not handled properly.

Mitigation

The borrow areas are selected in a scientific manner with due care of local environment and social sensitivity. The excavation of soil shall be conducted as per the EMP and will be fully rehabilitated with proper NOC from the respective land owner / authority. The top soil from the borrow area shall be preserved separately and will be re-used for rehabilitation. MoEF&CC norms & guidelines shall be followed for borrow area opening and management. The detailed plan for borrow area management has been attached as Annexure 5.3.

Total of 8 nos. borrow area were identified and soil samples were collected to identify the physical properties to define its usefulness for the project. The details of lead chart for borrow samples are presented in figure 5-1.

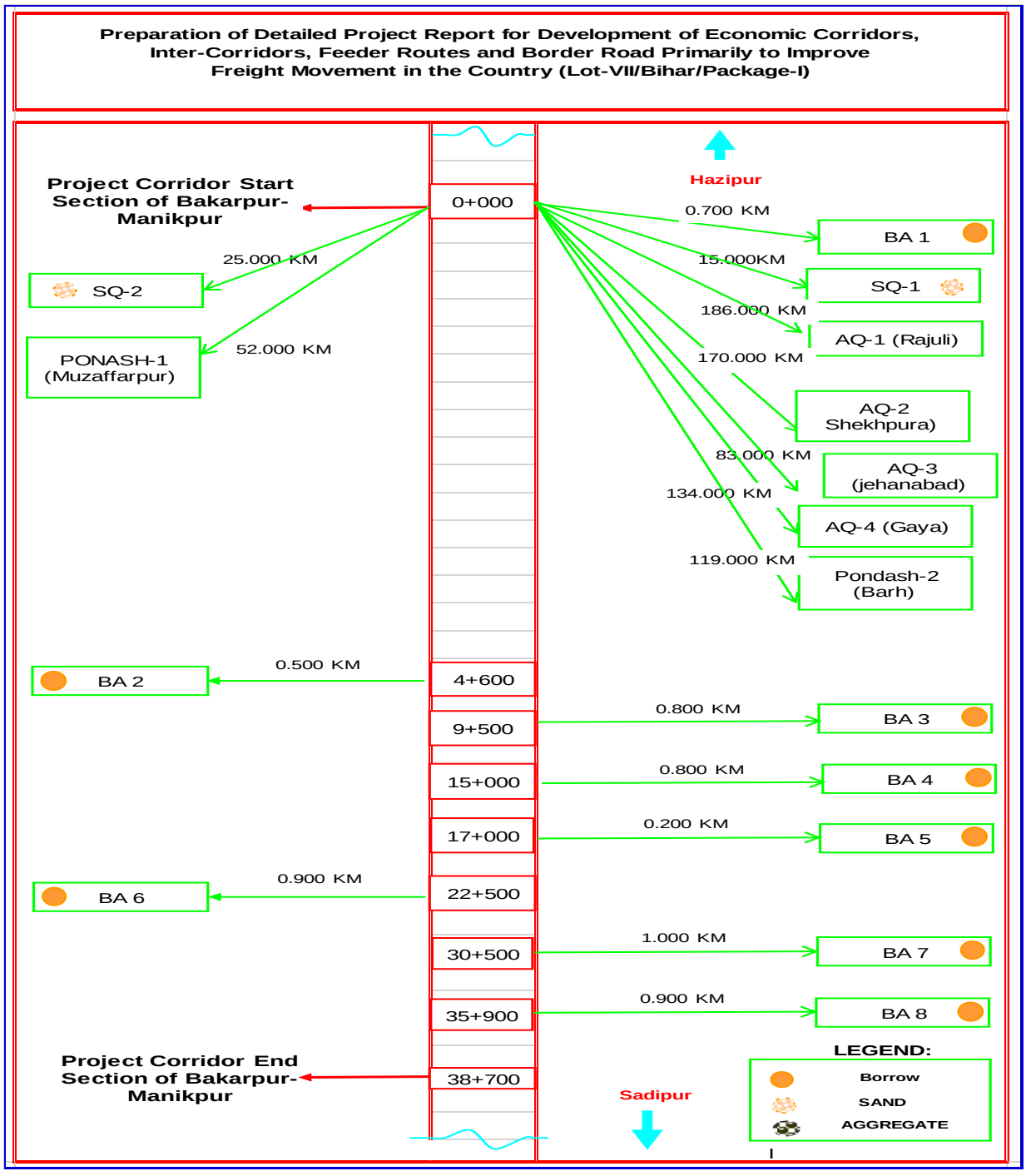


Figure 5-1: Lead Chart of Borrow Samples

5.2.2.5 Soil Erosion

Pre-Construction Stage

Impact

The removal of vegetation will cause erosion and increased run-off due to paved surface would in turn lead to erosion of productive soil from nearby areas. The direct impact of erosion is the loss of embankment soil and danger of stability loss for the road itself. This impact is generally restricted to the RoW. No vegetation clearance or tree felling is proposed beyond the construction zone.

Mitigation

The project has taken care of this issue at the engineering design stage itself, as at design gradients of 1:2, the slopes of the embankments are perceived to be stable. Tree felling shall be limited for the corridor of impact only. High embankment section of the road shall be suitably turfed by stone pitching or any other suitable turfing materials.

Construction Stage

Impact

Elevated sections of the highway, high embankments along the bridges and the bridge approaches would be vulnerable to erosion and need to be provided proper slope protection measures to prevent erosion. Construction of new bridges involves excavation of riverbed and banks for the construction of the foundations and piers. If the residual spoil is not properly disposed off, increased sedimentation downstream of the bridge is likely.

Mitigation

Adequate slope protection measures are proposed as part of engineering design. Silt fencing shall be provided to prevent eroded material from entering watercourses. Though during construction period, drainage alteration and downstream erosion / siltation is anticipated, however, cross drainage structure based on hydrology study shall compensate the drainage alteration in the surrounding area.

Operation Stage

No soil erosion is envisaged when the road is in operation as all the slopes and embankments of the project road shall be stabilised through sound engineering techniques. The regular cleaning of the drains by the Contractor will ensure that these structures are not overloaded or rendered ineffective due to overload.

5.2.2.6 Compaction of Soil

Impact

Compaction of soil may take place due to movement of heavy machinery and vehicles on nearby agricultural land. Similarly, compaction will take place during setting up of construction camps and stockyards.

Mitigation

The movement of construction vehicles shall be limited to designated road. So that compaction of nearby productive land can be saved. Provision of reclaiming of nearby land has also been suggested to cure the soil compaction in nearby productive lands.

5.2.2.7 Contamination of Soil

Impact

Soil contamination may take place due to waste disposal from the labour camp set up during pre-construction stage. The sites where construction vehicles shall be parked and serviced are likely to be contaminated because of leakage or spillage of fuel and lubricants. Fuel storage areas are also susceptible to the soil contamination by accidental spillage and run-off. Unwarranted disposal of construction spoil and debris will add to soil contamination. During the operation stage, soil pollution due to accidental vehicle spills or leaks is also having a low probability.

Mitigation

Following mitigation strategies are proposed to control soil contamination.

- Fuel oil shall be stored in separately designated covered area with RCC surface to prevent any soil contamination due to spillage
- Overflow of service and washing areas shall be passed through the oil interceptors
- Septic tank with soak pit facility will be provide in labour camps to prevent any soil contamination due to sewage discharge
- Waste management system was per Solid Waste Management Rules, 2016 will be adopted in construction camps
- Scarified bitumen (if any) waste shall be disposed-off at designated landfill site only

The quality of the soil shall be monitored on regular basis to find out the effectiveness of the mitigation measures and further improvement in measures (if required). The monitoring plan shall be functional in construction as well as in operation stages. The frequency, duration and responsibility will be as per the Environmental Management Plan.

Guidelines for Identification of Debris Disposal Sites & Precautions and Guidelines for Rehabilitation of Dumpsites & Quarries have been attached as Annexure-5.4 & Annexure-5.5 respectively.

5.2.3 Air Quality

Air quality along the project road will be impacted both during the construction and operation stages of the project. Construction stage impacts will be of short term and have adverse impacts on the construction workers as well as the habitation located near to the proposed highway, especially those in the down wind direction. Operation stage impacts will not be as severe as the construction stage impacts and will generally be confined to a strip of upto 100m from the edge of the lane on either side of the corridor.

5.2.3.1 Generation of Dust

Pre-Construction Stage

Impact

Generation of dust is the most likely impact during this stage due to:

- Site clearance and use of heavy vehicles and machinery etc.
- Transport of raw materials from quarries to construction sites

Mitigation

Adequate measures such as regular sprinkling of water, covering of dumpers carrying construction & excavated materials, use of PUC certified vehicles, etc. are proposed for abatement of dust emission.

Construction Stage

Impact

Construction activities to be carried out during the dry season when the moisture content would be less, dust generation, particularly due to earthworks will be significant. Dust is likely to be generated due to the various construction activities including:

- Movement of construction vehicles and machineries on unpaved surface;
- Transportation of construction materials;
- Mixing of construction materials;
- Construction and allied activities.

Mitigation

Generation of dust is a critical issue and is likely to have adverse impact on health of workers working in dust prone areas. The Environmental Action Plan to be prepared by Contractor / Concessionaire must lay emphasis on enforcement of measures such as provision of pollution masks, regular sprinkling of water to suppress dust, transportation of construction material in covered trucks, etc. to mitigate the impact.

Operation Stage

No dust generation is envisaged during the operation stage as shoulders shall be compacted & paved and all slopes & embankments shall be turfed as per best engineering practices. The air quality shall further also be improved due to the plantation activity to be carried out in the available RoW at the end of construction phase.

5.2.3.2 Generation of Exhaust Gases

Impact

Generation of exhaust gases is likely during the pre-construction stage due to movement of heavy vehicles & machinery, oil tankers, etc. SO2, NO2 and HC are likely to be emitted from hot mix plant operations. Volatile toxic gases may also be released due to heating process during bitumen production. Although the impact is much localized however, it can spread downwind depending on the wind speeds. Construction vehicles shall also be releasing exhaust gases.

The major impact on air quality during operation stage will be due to plying of vehicles. The impacts on air quality will at any given time depend upon traffic volume / rate of vehicular emission within a given stretch and prevailing meteorological conditions. Air pollution impacts arise from two sources: (i) inadequate vehicle maintenance; and (ii) use of adulterated fuel in vehicles.

Mitigation

- Regular maintenance and pollution check is proposed for construction vehicles and machineries
- No bad quality fuel shall be used in construction vehicles and machinery
- Hot mix Plant to be installed in downwind direction from nearby settlement at minimum 1000m distance.
- Broad-leaved pollution resistant species, which can grow in high pollutant concentrations or even absorb pollutants, shall be planted as they help settle particulates with their higher surface areas along with thick foliage.
- *Cassia fistula* (Amaltas), *Ficus religiosa* (Peepal), *Ficus bengalensis* (Banyan), *Tamarindus indica* (Imli) and *Azadirachta indica* (Neem). However, plantation shall be carried out in close communication with the forest dept. with the help of native species.

Other measures such as the reduction of vehicular emissions, ensuring vehicular maintenance and upkeep, educating drivers about driving behaviour. However, these methods are beyond the scope of the project but will be far more effective in reducing the pollutant levels. NHAI together with the Motor vehicles Department and SPCB can arrange for provision for inspection for PUC certificates at the toll plazas.

5.2.3.3 AAQ Impact Prediction Modelling of CO Using CALINE 4 Dispersion Model

CALINE 4 (Caltrans, 1989) is a simple line source Gaussian plume dispersion model that predicts air impacts near roadways. The model is broadly divided into five screens such as Job Parameters, Run Conditions, Link Geometry, Link Activity and Receptor Positions.

Job Parameters

- **Run Type:** determine averaging times and how the hourly average wind angle(s) will be determined. In the present case modelling exercise were made to predict the impact on worst case scenario. Multi-Run / Worst Case Hybrid type was used for CO impact modelling.
- **Aerodynamic Roughness Coefficient:** determine the amount of local air turbulence that affects plume spreading. CALINE 4 offers the 4 choices for aerodynamic roughness coefficient namely; Rural, Suburban, Central Business District and Other. For the present modelling rural roughness options have been considered.
- **Altitude above Sea Level:** Define the altitude above mean sea level. This input is used to determine the rate of plume spreading.

Run conditions

- **Wind Speed:** Expressed in meters per second. USEPA recommends a value of 1 m/s as the worst-case wind speed.
- **Wind Direction:** The direction the wind is blowing from, measured clockwise in degrees from the north. As the model study is on "Worst Case scenario", therefore CALINE 4 will consider this input by default.

Link Geometry

- **Link Type:** 5 choices available such as At Grade, Fill, Depressed, Bridge and Parking lot. In this particular model study At Grade link type is used.
- **Link Height:** For the project link height is being considered as zero.
- **Mixing Zone Width:** Mixing zone is defined as the width of the roadway, plus 3m on either side.

Link Activity

- **Traffic Volume:** The hourly traffic volume anticipated to travel on each link, in units of vehicles per hour.
- **Emission Factor:** The weighted average emission rate of the local vehicle fleet, expressed in terms of grams / mile per vehicle.

Receptor Positions

Receptors positions expressed in Cartesian (x, y) coordinate system. Z value can also be provided to assess the proposed impacts at various heights. For the present case incremental GLCs were assessed at every 10m interval from the edge of the project highway.

Approach and Methodology

Emission Factors were arrived using standard values prescribed by The Automotive Research Association of India, Pune under Air Quality Monitoring Project-Indian Clean Air Programme (ICAP). Project stretch is the part of one traffic sections. Traffic load and emission factors were estimated for all the traffic sections for the projection year 2055 to assess the worst case scenario analysis.

Results

For One-hour simulations, the concentrations were estimated around 4 receptors to obtain an optimum description of variations in concentrations over the distance of 30m, 50m, 80m and

100m from the centerline for the worst angles as identified by the model. Based on the observed traffic flows and reconnaissance surveys, the proposed project National Highway has been considered one homogenous traffic section. The nearest receptor was considered to be at 30m from the centerline of homogenous section. The Air modeling results of the proposed project highway have been presented in Table 5-3.

Table 5-2: Air Modelling Results for Project Highway

Predicted Maximum 1-hour Concentration of CO (ppm)				
Receptor Distance from Center Line	**2023**	**2033**	**2043**	**2055**
30m	1.1	1.1	1.2	1.4
50m	1	1.1	1.1	1.3
80m	1	1	1.1	1.2
100m	1	1	1.1	1.2
Predicted Maximum 1-hour Concentration of CO (µg/m³)				
Receptor Distance from Center Line	**2023**	**2033**	**2043**	**2055**
30m	1195	1260	1260	1489
50m	1195	1195	1260	1374
80m	1195	1195	1260	1374
100m	1260	1260	1374	1603

Conclusion

The predicted 1hr maximum concentration of CO after construction of the proposed project is found to be within 4000 µg/m3 prescribed in National Ambient Air Quality Standards, 2009 for residential, rural and other areas. The predicted concentration is based on Emission Level of the vehicle as present scenario. However, there is enough possibility of the advancement towards cleaner fuel and technology.

5.2.4 Water Resources

5.2.4.1 Physical Loss of Surface Water Bodies

Impact

- Alteration of the surface water regime is expected due to proposed highway construction
- Surface water bodies along the project road might be subject to adverse impacts due to the various construction activities
- Project section is crossing 1 River.

Mitigation

- 1 major bridges, 6 minor bridges, 67 RCC Box type culverts and 50 RCC encased cross road pipe culverts culverts are proposed to avoid any impact on local hydrology.
- Cross drainage structures are designed to avoid any compromise on the flow part.
- Cross-drainage structure is proposed at pond locations to limit the affected area and to maintain the catchment unaffected. Compensatory digging is proposed to maintain the storing capacity of the ponds.
- Continuous both side drain has been proposed along the proposed highway. Surface runoff shall be drained to the nearest cross drainage structure. The engineering design includes design of cross drainage structures, which should take care of the extra flow.

- Structure on the Irrigation Canals and Minors shall be designed in concurrence of Irrigation dept.
- Silt fencing during construction period will be provided between road and water bodies to avoid any siltation due to run-off from construction area

5.2.4.2 Water Required for the Project

Impact

The construction works requires a considerable quantity of potable water for the various activities including construction of the pavement, dust suppression, curing etc. The total demand of water to be used during the construction phase will be around 1250 KLD. The demand though is only indicative in nature and shall differ during the period of construction. The demand shall be met through availability of supply both from surface and ground sources. However, mostly surface water shall be used for the construction work.

Mitigation

Prior approval for taking adequate quantities of water from surface and ground water sources shall be taken from respective authority before start of construction. The road operation does not make a demand on the available water resources apart from time to time requirement during works such as maintenance of roadside tree plantations. Rainwater harvesting structures all along the proposed alignment as per as per MoEF&CC guidelines and are a cost effective method for recharging of ground water level in the project area. The rainwater-harvesting chamber shall be placed at every 1000m interval c/c (500m interval in a staggered way)with dimensions of 2 x 2 x 0.75m^3 all throughout the project corridor. A perforated RCC Slab covers the chamber. There is a 20cm filling, which also acts as sediment trap. There is another sediment trap in the bottom from where debris can be removed manually after certain period. A vertical drain (PVC pipe) is then sunk from the bottom of the chamber to a depth which varies as per the water table. Drains interconnect these chambers.

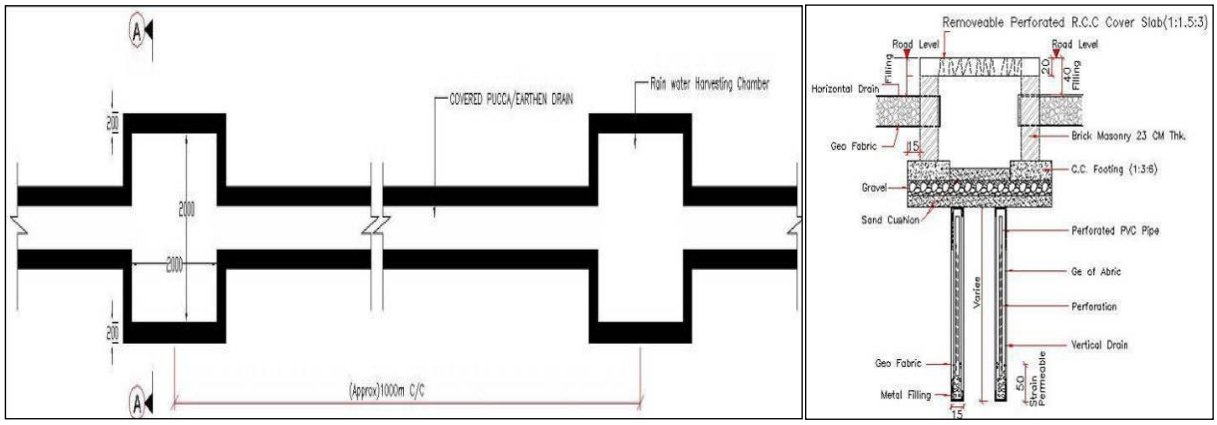


Figure 5-2: Rainwater Harvesting Structure

5.2.4.3 Loss of Drinking/Household Water Resources

Impact

The impact on the local water supply sources like hand pumps, wells and tanks is likely due to proposed development. Relocations of all existing water supply sources have been recommended and the cost of the relocation shall be paid as per LARR, 2013 provisions.

Mitigation

The losses have been covered under the utility relocation process. Compensatory water supply sources will be set up before the start of construction and shall be as close as possible to the original location.

5.2.4.4 Water Quality

Impact

Due to site clearing activities, soils around the surface water regime will be exposed, due to which, the suspended sediments and the associated pollutants can be transported into these water sources. The impacts due to the increased sediment load will be significant to some extent. Contamination of groundwater is another likely impact of road construction and allied activities. The contamination of the water resources due to the project is likely from following reasons:

- Concentration of suspended solids in receiving water bodies due to soil erosion from site clearing area
- Run-off from the construction site near the water bodies and sources of water supply
- Disposal of solid and liquid wastes by labour, spills or leaks can affect the water quality
- Run-off from fuel storage and work-shop area as Oil and grease form a film on the water surface and hinder the transfer of oxygen into water
- Contamination by fuel and oil containing discharge or accidental spillage from construction vehicles or bitumen from hot-mix plants
- Sewage discharge from the labour camp

Increased sediment load, lesser sunlight, difficulty to settle, etc. will make the surface water more turbid. If the concentrations are higher, smaller fish may be harmed. Large, heavy sediment, particularly with slow moving water may smother algae and eventually alter the nature of the sub-stratum. Excessive sediment loads may also mean disruption to areas where fish lay their eggs. The water quality of surface drainage channels is likely to be impaired as long as the construction period continues.

Mitigation

The engineering design shall ensure protection of embankment slopes. Loose soil and construction material heaps around the construction sites are prone to erosion and contribute to the increased sediment load in the near-by water bodies. The major parameter of concern would be the sediment load from the spoils. The major pollutants of concern are suspended solids, oil and grease, lead and other heavy metals.

Surface Water Bodies:

In order to restore the storage capacity of the water bodies if located within 500mts, surface dredging will be carried out; ponds bunds will be improved and silt trap chambers will be created if the natural slope is towards ponds. In case of rivers and natural drains the total cross section and flow level will be maintained. The surface near the cut and fill area will be leveled, side wall the cut section of the banks will be established by creation of retaining wall, stone pitching, etc. this will prevent cutting and erosion of the river banks. No natural drains and rivers will be diverted or obstructed by the proposed road construction. As mitigation measures, culverts and bridges has been proposed to maintain the natural flow of the area and also to prevent inundation. The proposed project road map is given in figure 5.3. The details design dimension and location of

culverts proposed is discussed in **Error! Reference source not found.** and **Error! Reference source not found.**

Table 5-3:List of RCC Box Type Culverts for Cross Drainage on Project Road

S. No.	Design (km)	Span (m)	Clear Height	Skew Angle
1	0+260	3	3	0
2	0+470	3	3	0
3	0+877	2	2	20
4	0+887	2	2	20
5	1+446	3	3	0
6	2+025	2	2	0
7	2+215	3	3	31
8	2+862	3	3	28
9	4+400	2	2	0
10	4+611	2	2	11
11	4+621	2	2	11
12	4+900	2	2	0
13	5+346	2	2	0
14	6+040	2	2	0
15	7+700	2	2	0
16	8+202	2	2	42
17	8+214	2	2	42
18	9+350	2	2	0
19	9+500	2	2	0
20	9+950	2	2	0
21	10+689	2	2	38.6
22	10+701	2	2	38.6
23	11+000	2	2	0
24	11+690	2	2	0
25	12+400	2	2	0
26	13+520	2	2	0
27	14+100	2	2	0
28	14+721	2	2	24.8
29	14+732	2	2	24.8
30	15+500	2	2	0
31	16+200	3	3	0
32	19+200	2	2	0
33	19+700	2	2	0
34	21+250	2	2	0
35	21+800	2	2	0
36	22+805	2	2	0
37	23+900	2	2	0
38	24+390	2	2	0
39	24+900	2	2	0
40	25+352	2.9	2.5	60
41	26+000	2	2	0
42	26+300	2	2	0
43	26+800	2	2	0
44	27+200	2	2	0
45	27+625	2	2	0
46	28+050	2	2	36
47	28+070	2	2	36

S. No.	Design (km)	Span (m)	Clear Height	Skew Angle
48	28+300	2	2	0
49	28+545	2	2	0
50	29+050	2	2	0
51	29+800	2	2	0
52	30+400	2	2	0
53	30+950	2	2	0
54	31+400	2	2	0
55	32+200	2	2	0
56	32+800	2	2	0
57	33+200	2	2	0
58	33+350	2	2	0
59	33+800	2	2	0
60	34+350	2	2	0
61	34+800	2	2	0
62	35+345	2	2	0
63	35+700	2	1.5	0
64	36+150	2	1.5	0
65	36+600	2	1.5	0
66	37+300	3	3	0
67	37+600	3	3	0

The minimum width of the above culverts shall be kept equal to roadway width (including median). In cases of the culverts with fill culvert to be provided though out roadway width and median width.

Vent way/Span arrangements are minimum specified. The actual vent way/span arrangements of culverts shall be determined on the basis of detailed investigations by the Concessionaire in accordance with the Specifications and Standards.The floor protection of the culverts shall be as per the provision of IRC:SP:13 (latest edition)

Additional 4 number of box culverts of size 1x3x3 shall be provided on the loops and ramps at the interchange location based on ground condition.

Table 5-4: List of RCC encased cross road pipe culverts on cross road

S.No.	Design (Km)	Crossing Type	Inner Diameter	Skew angle
1.	0+882	x	0.9	20
2.	2+050	+	0.9	0
3.	4+616	+	0.9	11
4.	5+178	+	0.9	13
5.	5+552	+	0.9	14
6.	7+578	+	0.9	0
7.	8+208	x	0.9	42
8.	9+430	+	0.9	35
9.	9+874.700	+	0.9	26
10.	10+262.880	+	0.9	0
11.	10+695.000	x	0.9	38.6
12.	11+252.000	x	0.9	36.28
13.	12+150.649	x	0.9	54

S.No.	Design (Km)	Crossing Type	Inner Diameter	Skew angle
14.	12+725.000	+	0.9	7
15.	13+025.000	+	0.9	0
16.	13+412.000	x	0.9	54
17.	14+285.000	+	0.9	15
18.	14+726.600	x	0.9	24.8
19.	15+849.000	x	0.9	32
20.	19+375.000	+	0.9	21
21.	19+900.000	+	0.9	24
22.	20+425.000	+	0.9	21
23.	21+090.000	+	0.9	26
24.	21+764.000	x	0.9	60
25.	22+626.000	x	0.9	14
26.	23+276.000	+	0.9	0
27.	23+630.000	x	0.9	54
28.	24+110.000	+	0.9	0
29.	24+687.000	x	0.9	14
30.	25+265.000	+	0.9	8
31.	26+085.000	+	0.9	43
32.	26+707.000	+	0.9	14.9
33.	27+376.500	x	0.9	0
34.	28+060.000	+	0.9	36
35.	28+420.000	x	0.9	24
36.	29+245.000	x	0.9	22.5
37.	29+875.310	+	0.9	20
38.	30+227.300	+	0.9	11
39.	30+670.000	+	0.9	16
40.	32+605.700	x	0.9	48.5
41.	32+950.000	x	0.9	30
42.	33+385.000	+	0.9	9
43.	33+580.500	+	0.9	0
44.	34+485.600	+	0.9	30
45.	34+740.000	T	0.9	0
46.	35+240.000	Y	0.9	0
47.	35+350.000	T	0.9	0
48.	35+600.000	Y	0.9	0
49.	36+776.500	x	0.9	38.33
50.	38+331.000	T	0.9	0

The cross road culverts shall connect the drains on either side of the cross road. Any culvert on main carriageway required at the cross road location for smooth flow of water, the same is dealt separately.The floor protection shall be as per the provision of IRC:SP:13 (latest edition).

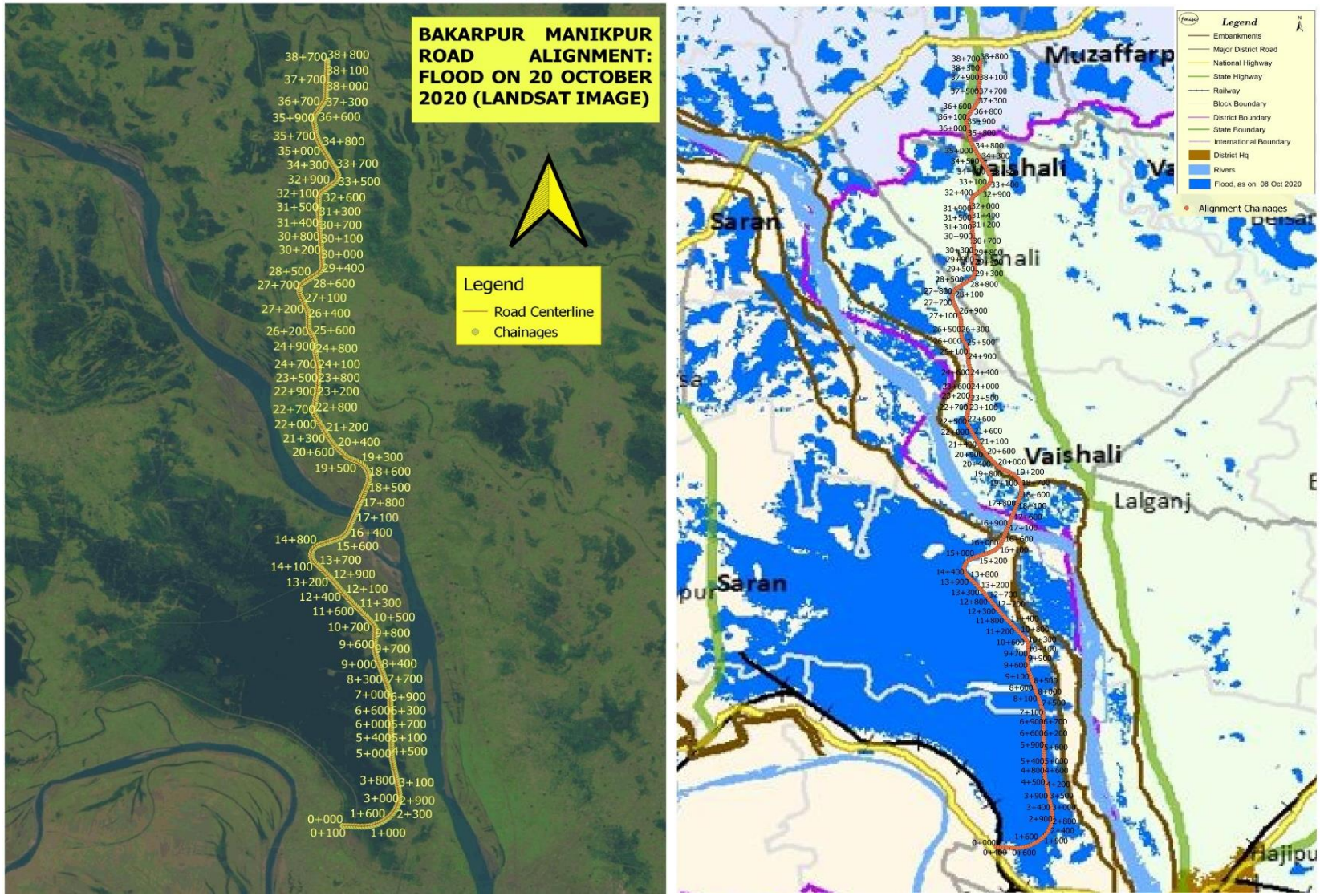


Figure 5-3: Flood Projection Maps for the Project Area

Slope Protection Measures:

After complete filling, stone pitching on embankment slope surface of the streams is to be provided. About 25,809 cum of stone pitching has been proposed for slope and cutting stabilization during monsoon season.For all the embankments having height more than 3.00 m along the project road, 300 mm thick stone pitching with concrete over the minimum 300 mm thick cover of low to moderately plastic granular soil mixed with little clay/silt is recommended as an erosion control measure. It is recommended that the stone pitching be provided for the entire face of the embankment slope along with slope. Chute drain should be provided at an interval of 20 m c/c. At these locations complete removal of slush/ unsuitable materials shall be ensured up to the competent founding stratum and backfilled with compacted approved granular material.

- While working around or near the water body following measures should be undertaken:
- Silt/sediment should be collected and stockpiled for possible reuse as surfacing of slopes for revegetation
- Silt fencing shall be provided along the river and ponds. Silt fencing shall be provided on either side of the crossing water body to the affected length plus 5 m on either side to control the sediment load.

Detailed Specifications For Silt Fencing

Description:

Silt fencing is a temporary sediment barrier made of woven, synthetic filtration fabric supported by steel or wood post. The purpose of the silt fence is to prevent sediment carried by sheet flow from leaving the site and entering to natural drainage or any other water body located near the construction site. Silt fencing encourages the sheet flow and reduces the potential for development of rills and gullies. Care should be taken that silt fences are not installed across streams, ditches, waterways or other concentrated flow areas.

Construction Specification:

- Silt fencing (Refer figure5-4 for Cross-section) consists of 1.0 m wide filter fabric and should be placed on the contour. Incase runoff flow or velocities are very high or where slope exceed vertical height of 3.0 m, silt fencing should be wire reinforced. The Contractor should purchase silt fencing in a continuous role to the length of the barrier to avoid the use of joint. Incase of joints, filter cloth should be spliced together only at supporting post, with minimum 15 cm overlap and securely sealed. The pile is drive to the depth of 300 mm into the ground by pressing from the top. The frame will be installed at the edge of stockpiles and at the water bodies along which construction is in progress.

Inspection:

- The PIU will inspect location as well as efficiency of silt fencing. The inspection should be done after every 15 days and incase of storm water, within 24 hours after the end of rain.

Maintenance:

- The contractor should remove sediments, once it has accumulated to one-half the original height of the fence. Filter fabric should be replaced whenever it has deteriorated to such an extent that the effective of the fabric is reduced. Silt fence should remain in place until disturb areas have been permanently stabilized. All the sediments accumulated and properly disposed of before the fence is removed. The operation of removing and disposing have to be monitored by the PIU or Engineer In-charge.

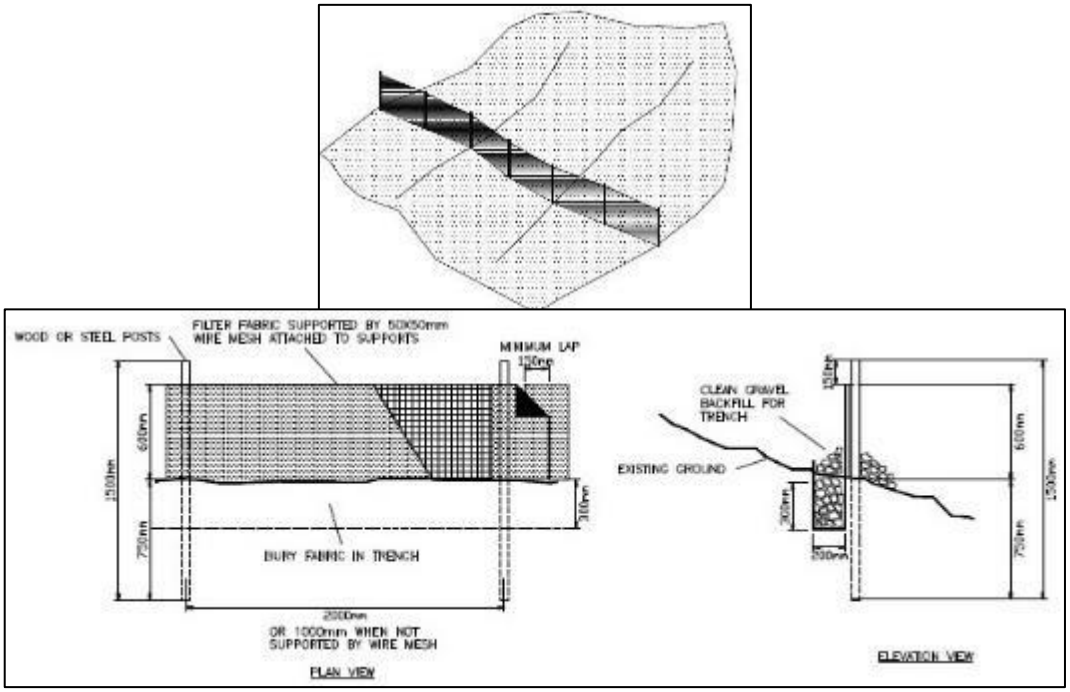


Figure 5-4: Schematic diagram of Silt Fencing

Oil interceptor: Oil and grease from road run-off is another major concern during construction as well as operation. During construction, discharge of oil and grease is most likely from workshops, oil and waste oil storage locations, and vehicle parking areas of construction camps. Waste having hazardous properties will be stored in designated area only. 2 nos. of oil interceptors shall be provided at camp sites to arrest oil and grease, as per Figure 5-5. The arrested products shall be disposed as per MoEF&CC and SPCB guidelines. The location of fuel storage and vehicle cleaning area will be at least 500 m from the nearest drain / water body.

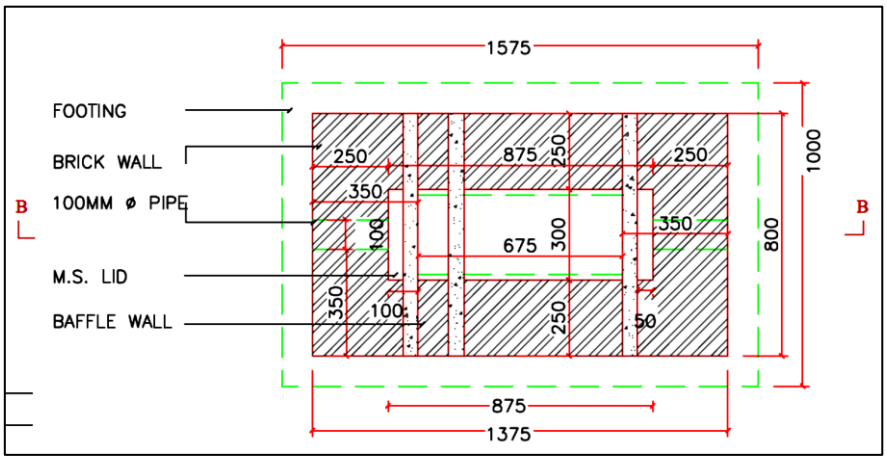


Figure 5-5: Schematic diagram of Oil Interceptor

No contamination of any water source is envisaged during the operation period. However, water quality may be impacted due to washing of the vehicles near the water bodies, run-off from the oil spillage area due to wear and tear of vehicles, etc. Road run-off can contain oil, which may end up reaching into local water bodies.

5.2.5 Noise levels

5.2.5.1 Pre-construction and Construction Stage

Impact

Site clearing activities, movement of HEMMs, operation of machineries, crusher & mixing plants, vehicular movement, etc. are likely to increase the noise level of project region. Noise pollution is matter of concern, where alignment passes nearby to sensitive receptors like habitation, forest area, etc.

About 90 dB (A) of noise shall be generated from construction activity which shall attenuate to less than 55 dB (A) i.e. day time prescribed noise level at about 100m and less than 45 dB (A) i.e. night time prescribed noise level at about 300m. Comparison of distance vs Noise level (considering two Noise source of Intensity 90 dB(A) are working in parallel) for day and night time are shown in figures below.

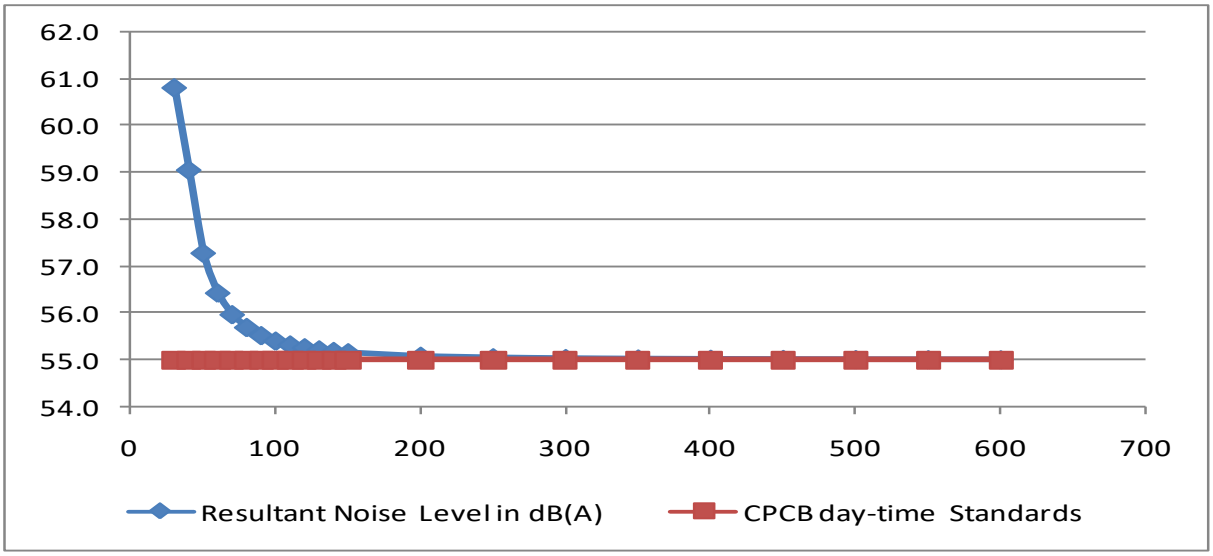


Figure 5-6: Day-time Construction Noise Intensity vs Distance from the Source

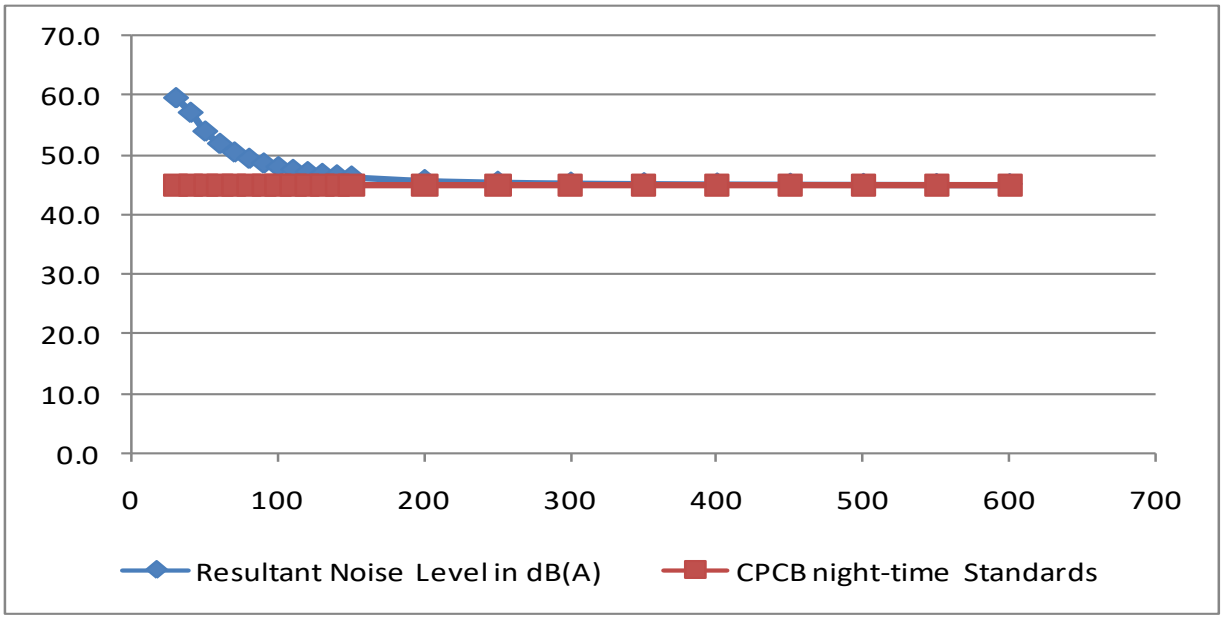


Figure 5-7: Night-time Construction Noise Intensity vs Distance from the Source

Part of the project stretch is proposed adjacent to settlement areas. Therefore, the impact due to the noise shall be significant at these locations. Prior mitigation measures shall be required for neutralizing the effects.

Mitigation Measures

Construction camp shall be established at least 500m away from the nearest habitation and forest area. Temporary noise barriers should be provided surrounding the high noise-generating construction equipment during work near habitation and forest area. Stationary noise sources like generator sets shall be provided with an acoustic shield around them. The plants, equipment, and vehicle used for construction will strictly conform to CPCB standards. Vehicles and equipments used will be fitted with silencers and maintained accordingly.

Noise generating activities should be scheduled based on community welfare. The noise level will regularly be monitored as per the monitoring plan and if the noise level at any time is found to be higher, then immediate measures to reduce noise in that area will be ensured.

Noise standards of industrial area/zone will be strictly enforced to protect construction workers. All the workers working very close to the noise-generating machinery shall be provided earmuffs to avoid any ill impacts on their health and condition will be made a part of conditions of contract.

Operation Stage

Impact

Road noise depends on factors such as traffic intensity, the type, and condition of the vehicles plying on the road, acceleration / deceleration / gear changes by the vehicles depending on the level of congestion and smoothness of the road surface. Noise is a major area of concern, especially since sensitive receptors (forest, habitation, etc.) have been identified in close proximity of the road.

CoRTN (Calculation of Road Traffic Noise) model developed by up UK Department of Transport is used for assessment of Noise Impact Intensity at various distances from the proposed highway. Traffic Noise has been estimated for uninterrupted traffic flow conditions.

Limitations

Metrological conditions are not taken into account and Model does not take background noise into account such as trains, aero plane, industry, daily activities, market activities, etc.

Classification of Vehicles

In CoRTN model vehicles are classified onto two categories:

- Light vehicles
- Heavy vehicles

Approach, Methodology & Validation

The model has been validated for Indian Conditions by CSIR Central Road Research Institute and published the validation in 2008 vide paper titled "Validation of Noise Prediction Model for an Urban Area". The present model used for the project is derived from the CSIR CRRI validated and modified model.

Input Traffic

CoRTN model software was run by using traffic forecast data of year 2055.

Result Discussion

Considering individual sections have different traffic intensities, therefore, variation in the noise level increments is observed along the proposed corridor. However, to attain the worst case scenario, the traffic project of the section having the highest intensity used as the input for the noise prediction model.

The increment noise level will attain the standards of residential i.e. 55 dB(A) at a distance of 58m from the carriageway edge. Space of carriageway and median is limited for 19m out of 45m RoW. Therefore, the effective distance for attenuation of noise level to ambient standard level shall be 13m from the RoW edge.

Table and figures below shown the Noise level due to traffic activities at various distances from carriageway edge against the Noise standards for Rural and residential areas.

Table 5-5: Noise Level due to Vehicular Traffic at Amritpur (Year 2055)

Dist. from CW edge (m)	Noise Level in dB(A)	Noise Standards for day time in dB(A)
13	67.52	55
18	63.58	
23	61.88	
28	60.47	
33	59.27	
38	58.23	
43	57.3	
48	56.46	
53	55.71	
58	55.23	
63	55.23	

Source: Outcome of Mathematical Modeling

Figure 5-8: Noise Intensity due to Vehicular Operation vs Noise Standards (Year 2055)

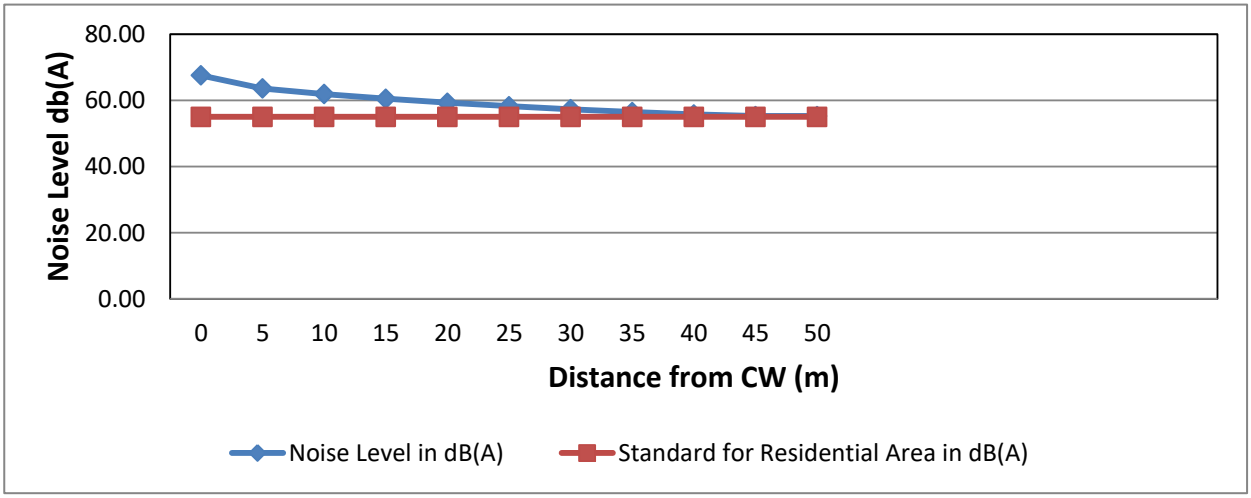


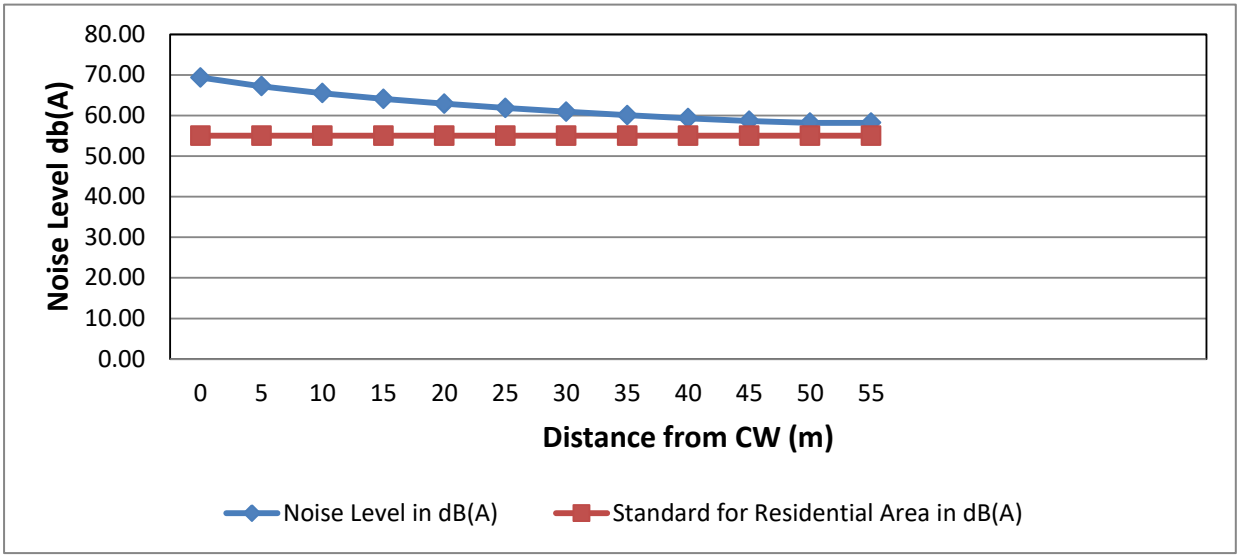
Table 5-6: Noise Level due to Vehicular Traffic at Basant Jahanbad (Year 2055)

Dist. from CW edge (m)	Noise Level in dB(A)	Noise Standards for day time in dB(A)
13	69.34	55
18	67.2	
23	65.5	

Dist. from CW edge (m)	Noise Level in dB(A)	Noise Standards for day time in dB(A)
28	64.09	
33	62.89	
38	61.84	
43	60.92	
48	60.08	
53	59.33	
58	58.64	
63	58.2	
68	58.2	

Source: Outcome of Mathematical Modeling

Figure 5-9: Noise Intensity due to Vehicular Operation vs Noise Standards (Year 2055)



Mitigation Measures

Though the level of discomfort caused by noise is subjective, there is a definite increase in discomfort with an increase in noise levels. Road noise depends on factors such as traffic intensity, the type and condition of the vehicles plying on the road, acceleration / deceleration / gear changes by the vehicles depending on the level of congestion and smoothness of road surface. Noise is a major area of concern, especially since a number habitation and forest area have been identified in close vicinity of proposed alignment. The mitigation measures for noise are essentially aimed at protecting the receptor.

Noise barrier shall be provided in forest area and other sensitive receptors (Education and Medical facilities). No horn zone sign shall be displayed 100m before on either side of these receptors. Plantation as planned on both side of the proposed highway will help in attenuation on noise disseminated from vehicular operation. Regular monitoring is proposed in operation stage to monitor the efficiency of mitigation measures.

To reduce noise and vibrations, compound wall as noise barriers (wall of 2m height) is proposed in front of religious, education and medical facilities located along the proposed corridor. As per the research carried out in the developed countries, a masonry wall has Noise Reduction Coefficient (NRC) value between 0.2 to 0.5.

The issue for provision of Noise barrier needs to be discussed during construction phase. The contractor will hold a discussion with stakeholders related to sensitive receptor during pre-construction and construction stage of the road.

Noise generating activities should be scheduled based on community welfare. Noise level should regularly be monitored as per monitoring plan and if the noise level at any time found to be higher, then immediate measure to reduce noise in that area should be ensured. The following mitigation measures as given in Table 5-10 need to be worked out for the noise impacts associated with the various construction activities.

Table 5-7: Summary of Mitigation Measures for Construction Stage

Source of Noise Pollution	Impacts	Generic Mitigation Measures
• Utilization of heavy construction machinery; • Construction of structures and facilities; • Crushing plants, asphalt production plants; and • Loading, transportation and unloading of construction materials	Increased Noise Levels causing discomfort to local residents and workers	• All construction equipment, plants, machinery and vehicles will follow prescribed noise standards. • All construction equipment used for an 8 hour shift shall conform to a standard of less than 90 dB (A). If required, machinery producing high noise as concrete mixers, generators etc. must be provided with noise shields; • At construction sites within 500 m of human settlements, noisy construction activities shall be stopped between 9.00 PM and 6.00 AM; • Vehicles and construction machinery shall be monitored regularly with particular attention to silencers and mufflers to maintain noise levels to minimum; • Workers in the vicinity of high noise levels must wear ear plugs, helmets and should be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90 dB (A) per 8 hour shift; • Hot mix plant, batching or aggregate plants shall not be located within 1000 m of sensitive land use and settlements; • Project is an highway project and shall facilitate free flow of the traffic. Therefore, proposed development is likely to reduce the noise associated with Traffic Jam on existing roads.

5.2.5.2 Operation Stage

Impact

Road noise depends on factors such as traffic intensity, the type and condition of the vehicles plying on the road, acceleration / deceleration / gear changes by the vehicles depending on the level of congestion and smoothness of road surface. Noise is a major area of concern, especially since sensitive receptors (school, hospital, etc.) have been identified in proximity of the road.

Mitigation Measures

Though the level of discomfort caused by noise is subjective, however, there is a definite increase in discomfort with an increase in noise levels.

The noise impact of the proposed highway shall be limited for 15m from the RoW edge. Therefore, no noise barrier is proposed at this location. No horn zone sign and speed barrier shall be place where the alignment is passing in vicinity of the settlement areas.

5.3 Biological Environment

5.3.1 Protected Areas

The proposed alignment is neither passing through nor falling within 10.0km radius of any wildlife Sanctuary/protected area notified under Wildlife (Protection) Act, 1972. Therefore, NBWL recommendations shall not be required for the proposed project.

Forest Areas

About 4.108 ha of notified forest land shall be diverted for the proposed alignment. Hence, Forest Clearance under the purview of Forest (Conservation) Act, 1980 is applicable.

5.3.2 Impacts on Biological Environment

Development activities of a road project implies direct impacts on the biological environment in its vicinity. Road projects are linear in nature and it traverses several types of landscapes depending on the length of the project stretch. The degree of impact on biological environment thus depends on the type of the landscapes i.e. forest/wooded area, agricultural, urbanised, rural, wastelands & barren areas. The proposed road project is a partially greenfield project that will pass mainly through the agriculture fields. In this scenario and based on the observations following impacts on the terrestrial flora, fauna and aquatic life have been envisaged in the construction and operation phases of the project.

5.3.2.1 Construction Phase

In construction phases various impacts take place on flora and fauna due to the anthropological activities like movement of machines, storing of material, living camp formation, movement of staff/workers and other group of people during project construction phase.

Felling of Trees and Habitat Destruction

At the first place, trees and vegetations area on the RoW shall be cleared for the road. About 1678 nos. of trees are likely to be felled in the Non Forest area. Joint Inspection with forest dept. is under process for enumeration of trees. The details of the total trees to be felled shall be given in the final EIA report.

The felling of trees shall have manifold impact. Most visible impact is the loss of shade. Also, there is a possibility of the local people being deprived of tree products, such as wood, fruits, leaves, etc. The removal of trees also increases the degree of soil erosion. Trees act as micro-ecosystems and habitat/shelter for birds, small mammals and insects which depend on these trees, removal of which will also affect these faunal species.

Habitat destruction and loss of trees also takes place under the demand of firewood and timber for cooking by workers. Moreover, there are chances for bush fire-accidents that may spread due to uneducated/unaware workers.

Impact on Fauna

The removal of trees will result in loss of micro-ecosystems i.e. habitat/shelter for birds, small mammals and insects which depend on these trees. Therefore, removal of vegetation, ultimately affects the terrestrial fauna, avifauna and insects etc. which are dependent on these habitats. The movements of the worker and sounds of the machines also scares the fauna that interfere with their routine habits.

Impact on Aquatic Life

Road development activity is likely to disturb the aquatic habitat depending on the extant and design of the project. A large quantity of construction material like stones, pebbles, gravel and sand are stored & used in construction phase. There are possibilities of contamination of the waterbodies like ponds, canals etc. due to spillage of the construction material. This sediment loading & increased turbidity shall result in decline in the number and diversity of aquatic flora and fauna.

5.3.2.2 Operation Phase

Roads are considered as the major cause of the pollution due to the vehicular movement. This affects the biotic components in the surrounding. The noise caused by the vehicular movements shall disturb and frighten the fauna & their habitats.

Moreover, road kills & accidents are also a common phenomenon where the domesticated and wild fauna get injured or killed while crossing the roads. Roads also isolate the habitats, and act as barrier in the corridors/migratory routes.

5.3.3 Mitigation Measures

5.3.3.1 Construction Phase

- Clearing of the RoW and propagation of the road structure will be carried carefully to cause least possible disturbance to the soil, water and air environment. Disposal of construction wastes shall be done in approved wastelands besides recycling & reuse of certain materials as per the approval obtained from SPCB.
- Labour camps shall be setup only after obtaining proper permissions from the Engineer and alternate fuel shall be provided to the labourers in the labour camps to ensure that no firewood will be used for cooking etc. The camps shall have proper toilets with sanitary disposal of wastes. Smoking, hunting & fishing in the wild are prohibited and the contractor shall conduct regular awareness trainings related to non-use of firewood, prohibition on smoking in natural areas, bush fires accidents, safe handling of animals (if encountered), prohibition of fishing etc.
- No labour camps shall be permitted in the vicinity of any water body in order to avoid the deterioration of water quality and any human induced impact on aquatic life nor shall workers be permitted to use waterbodies for bathing and washing. Silt fencing has also been proposed to ensure that siltation and hence turbidity doesn't increases.
- The contractor shall regularly service the construction vehicles & machinery and maintain these in good condition to avoid high level noise. The construction activities shall not be permitted after 8:00 PM in normal circumstances. In case of exigencies permissions for the same shall be accorded by the PD & the TL of the Engineer. Moreover, all EMP provisions made for the air, water, noise pollution control will be implemented, and thus will be also helpful to control the negative impacts on the flora and fauna.
- The loss of trees and ecosystem shall have to be compensated through compensatory plantations in accordance with the principles of the Forest (Conservation) Act, 1980 and Indian Forest Policy. Compensatory plantation/afforestation shall be undertaken for each tree to be felled as per forest department's directive. Such compensation shall be done with native species and proper care of the saplings will be taken to ensure survival. Plantation along the proposed highway shall act as a new habitat for avifauna, lesser mammals & insects.
- The avenue and median plantation shall also be undertaken as per SP-21:2009. Adequate provisions for the maintenance & monitoring of the same must be worked out. Co-operation

of locals to ensure that local cattle does not damage the saplings during the early stages of growth will be required. Tree Plantation strategy has been attached as Annexure 5.7. List of local native floral species are recommended for taking up afforestation has been presented in table below. Local forest authority and populace may also be consulted by the Contractor for selection of species types.

Table 5-8: Species Recommended

Scientific name	Common Name	Reason
Azadirachta indica	Neem	Noise barrier, Pollution sink, Economic & Medicinal Value
Butea monosperma	Dhak	Aesthetic value, Pollution sink
Cassia fistula	Indian laburnum	Landscaping, Flowering plant, Pollution sink
Dalbergia sissoo	Sheesham	Economic Value, Pollution Sink
Ficus bengalensis	Banyan	Noise barrier, Pollution sink, Shade, Supports other species, Religious values
Ficus religiosa	Peepal	Noise barrier, Pollution sink, Shade, Supports other species, Religious values
Magnifera indica	Mango	Noise barrier, Pollution sink, Economic Value (fruit bearing), Shade

5.3.3.2 Operational phase

The provisions for the mitigation measures as described in the EMP shall be complied. The compensatory plantation work will replenish the loss of greenery. This will also recreate the habitat for the small animals and avifauna. Therefore, the plantation/compensatory afforestation along the proposed highway and other areas shall act as new habitat for these faunal species and after a period of time the negative impact due to the road construction shall be mitigated with more aesthetic advantages.

There will be proper embankment with crash barriers & other barricades to stop the wild & domesticated animals to enter or cross the road. The proposed project is a national highway. Entry and exit at the highway shall be allowed through interchanges. LVUP / SVUP shall be provided to maintain the crossings of wild and domesticated animals. Therefore, no roadkill is likely due to the proposed improvement. Roadkill data of the proposed highway shall be recorded during operation stage of the project. Format for reporting of Roadkill is provided in Annexure 5.10.

Tree Transplantation

As part of the green corridor initiative, transplantation of smaller girth trees has been proposed. With this regard, the tree transplantation technique that has been successful during the previous attempts was discussed with the forest department and their knowledge has been utilized. Based on the discussions and available literature the methodology for tree transplantation has been propossed. The factors that need to be considered while implementing the tree transplantation scheme are detailed below:

Girth size of the trees should be from 30 cm to 90cm determined by the capacity of the transplanting machine,

- Trees having tap root system should be avoided unless they are very young thereby having smaller tap roots,
- There should be sufficient vertical clearance with respect to overhead utilities for the entire transplanting operation,s

- The donor and the recipient sites should be free of underground utilities. The cone of soil dug out by the machine is approximately 2m in depth and has 2m diameter at the ground level,
- Accessibility of the multi- axle truck carrying the transplanting equipment to the donor and recipient sites needs to be ensured.

Transplanting operations

Tools and equipment -All tools and equipment shall be appropriate to the operations and prepared in advance. Digging and root pruning tools shall be sharp and clean in order to cut without breaking, crushing or tearing roots. Mechanical digging and root pruning equipment shall be operated according to manufacturers' recommendations to minimize root damage.

Lifting cables, chains, straps, and/or slings shall be inspected and used according to manufacturers' instructions and specifications.

Tree Transplanter machine performs various jobs like as: -

- Uprooting Tree Keeping Root Stock & Earth Ball Intact
- Transporting the Uprooted Tree
- Transplanting At New Place
- Filling the Pit with Dugout Soil

Importance of tree transplant machine: -

- Useful and valuable in saving the trees by way of transplanting to other location.
- Useful in developing public awareness for conservation of trees.
- With the blend of this technology, tree conservation can be coupled with the development process.
- How trees can be saved is the main lesson of the use of this technology

Preparation of root ball- Root pruning is sometimes required before transplanting a tree. Sufficient time shall be allowed between preparation and final lifting for development of new roots capable of sustaining and continuing the growth of the transplanted tree.

The root system of a woodland or open-grown tree will normally be widespread. Lifting such trees without initial preparation of a root ball will result in much of the root system being left in the soil. After transplanting, the tree crown may then die back, or the tree may not be able to recover and will die eventually.

The root ball size shall varies depending on species, habit, location and specific attributes which shall be as large as practicable to maximize the potential of survival during and after transplanting while balancing other logistical and cost concerns.

The root ball sizes would be of a diameter and depth to encompass enough of the root system as necessary for establishment. Normally the diameter of a root ball is larger than its depth which seldom exceeds 1 meter. There may be practical difficulties in forming a root ball of regular shape or recommended size due to intrinsic conditions of the site or tree, e.g., conflict with adjacent structures or utilities. In such cases the advice of a tree specialist has to be sought on the optimal dimensions of the root ball to be achieved specific to the situation.

Stage for digging: - Root pruning to form a reasonable size of root ball is required and may be adjusted to suit specific tree species and/or imposed project constraints. For mature trees, root pruning is usually required to be carried out at different stages with a minimum of 1 month allowed for root regeneration between cuts. Stage digging can be carried out in the following stages in situations if the locations and work programmed are considered suitable. The four stages are:

Stage-1: - Dig a trench on the outside of the marked circumference in only two opposing segments;

Stage-2: - After a period of no less than 1 month since the 1st root pruning, dig a trench on the outside of the marked circumference in the adjacent two opposing segments;

Stage-3: - After another period of no less than 1 month since the 2nd root pruning, dig a trench on the outside of the marked circumference, in the remaining two opposing segments; and

Stage-4: - After a further period of not less than 1 month since the 3rd root pruning, prepare the root ball and cut the underside of the root ball, followed by uplifting and transplanting.

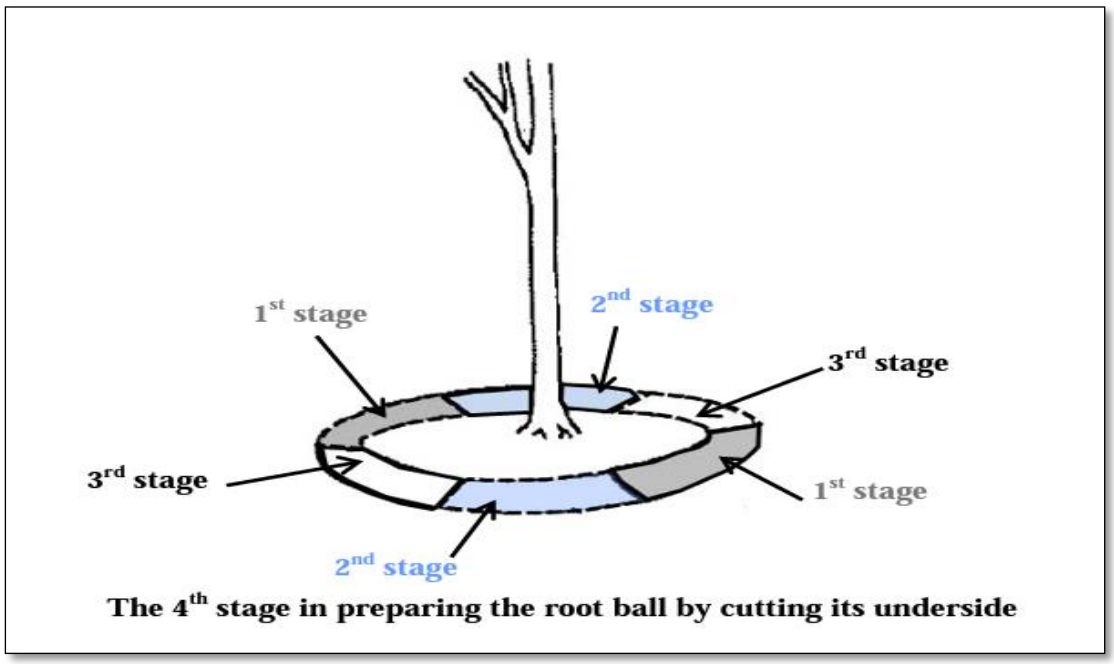


Figure 5-10: 4th Stage in Preparing the Root Ball

- The width and depth of trench will vary for different trees and the excavated trench shall be backfilled with amended soil mix with growth hormones to encourage the growth of the fibrous absorption roots at the region of the cut zone.

Figure 5-11: Sign of Fibrous Roots Found in the Peripheral of the Root Ball of a Tree

- Cuts must be clean to avoid tearing or breaking the roots. All cut roots shall be trimmed cleanly back to the healthy tissues to reduce the split and torn roots. Sharp cut ends can promote a flush of new fibrous roots, helping the trees recover faster from injuries.

Figure 5-12: Photogrphs showing the Root Cutting

Pre-lifting operations -Tree lifting operations shall be carefully timed so as to enable direct delivery to the receptor site. No transplanting operations would commence until either the receptor site or the holding nursery is fully prepared. Tree uplifted must be transplanted and watered the same day. Watering before lifting is recommended.

- Before uplifting, the outer edge of the previously dug trenches shall be loosened from the surrounding soil, and the root ball can be shaped with taper on the sides, slanting inward toward the base. The first cut around the perimeter of the root ball should be made with a sharp tool. Cuts

should be clean to avoid tearing or breaking the roots. The shaping and final cuts should be done by hand.

Figure 5-13: Photogrphs showing base of the Root Ball to be slanted inward for lifting operation

- Damp hessian/sacking is placed on the sides and across the tip of the ball and pinned. The hessian should cover the full circumference of the root ball with bottom skirt hanging out. This skirt is pinned to the root ball later after the tree is taken out of the hole. The base of the root ball should also be properly wrapped. This hessian shall be kept moist throughout the time of uplifting until the uplifted tree is transplanted in its new location.

Figure 5-14: Photogrphs showing Hessian/sacking cover to protect circumference of the root ball & root wall

Temporary support of trees before lifting- A tree after root pruning shall not be having extensive root support during the interim of the transplanting process. It may be vulnerable to inclement weather, such as typhoon or heavy rainfall.

Removal of the root system may sometimes aggravate the natural form and balance of a tree and is prone to tree failure. When the stability of a tree is likely to be jeopardized, a temporary support, such as guying or simple prop is essential.

Lifting and handling of root-balled trees - The root ball would be properly wrapped before lifting. Lifting shall be done by direct lift, with padded protection for the tree, using a machine of appropriate capacity connected to the support around the root ball, not to any other part of the trees. Trees shall not be lifted by the trunk as this can cause serious trunk injury but by its root ball which shall be properly prepared and wrapped. Root balls that are not properly protected would easily collapse during transplanting due to its own weight.

Figure 5-15: Proper lifting up by the root ball, not by the trunk

Containerized root ball- Trees in containers are more resistant to root damage during transportation. This is a recommendable method of transplanting as the root ball is well protected and lifting of the boxed root ball during transplanting will give better protection during the transplanting operation and enhance better establishment of the tree afterwards.

Figure 5-16: Tree should be well protected during transplanting

Planting

- All root ball supporting materials should be removed from the planting hole prior to final back filling. Crown wrappings and fastenings used to tie in the branches for transport should be removed. Any branches damaged in transit should be properly pruned back to the nearest branch bark ridge.

- When finally set, the top surface of the root ball should not be below the surrounding soil. The bottom of the trunk flare should be at or above the finished grade. The back-fill soil shall be reinstated and settled in layered sections to limit future settling and prevent air pockets. It shall not be compacted to a density that inhibits root growth.
- The backfill soil should be tamped firmly around the base to stabilize a tree, but the rest of the soil should be tamped only lightly, or left to settle on its own. Water should be added to the root ball and the backfill to bring the root ball to field capacity. Soaking will assist in settling the soil naturally.
- Immediately following planting and where appropriate, a soil saucer can be formed on the soil surface around the edge of the root ball circumference to permit rain or irrigation water to be retained and slowly infiltrate into the root ball perimeter.

Post-Transplanting Care- In case of translocation of trees within the project site amidst the construction activities, they will be well protected with robust fencing.

All newly transplanted trees shall receive proper maintenance care in order to facilitate recovery of tree from the transplanting shock. It would be ensuring the tree shall be stable before its root system is fully recovered to give support.

The stress of a tree shall be observed immediately after transplanting or gradually after a period of time. Proper care after transplanting will help to assure survival and minimize stress and ensure a higher successful rate. Maintenance of transplanted trees will be in continuation till one year.

Mulching and watering: - Mulch can be used to conserve soil moisture, to buffer soil temperature extremes, to control weeds and other competing vegetation, and to replenish organic matters and nutrients in the soil. A well-established layer of mulch can hold more water than the soil itself, without decreasing soil aeration. Mulch should not be placed too close to the tree trunk or root collar.

The size of the mulched area depends on the size of the tree. Mulch layer around 5cm thick usually covers the area where roots will grow during the first two years after planting. However, mulch used should be free from pests and diseases. The root zone and base of trees should be free from shrubs or other planting to facilitate the proper establishment of trees.

Sufficient and appropriate watering is important for the proper root growth. Provision should be made for watering, allowing for total wetting of the rooting volume to minimize susceptibility to stress and assure survival.

Greenbelt Development

Greenbelt is an important sink of air pollutants including noise. Green cover in Highway Projects not only helps in reducing pollution level, but also improves the ecological conditions and prevents soil erosion to great extent. It further improves the aesthetics and beneficially influences the microclimate of the surrounding. Many a times, it attracts the avifauna and other wildlife to re-colonize the area. The establishment of plant species also sequesters the soil "carbon, which is the leading gas responsible for the "Global Warming" in Planet Earth.

Greenbelt plantation would be developed on Both Side of the Highways

Median Plantation

The species of plantation would be selected considering the soil quality, place of plantation, chances of survival, commercial value etc. Only indigenous species should be planted. Mixed plantation should be done keeping optimum spacing between the saplings. The species for greenbelt development would be selected on the basis of their availability in the area and suitability for the particular location. Further, guideline for greenbelt development given in Central Pollution Control Board's publication "Guidelines for Development of Greenbelt CPROBES/75/1999-2000" would also be followed, while selecting the plant species for greenbelt development. In order to supply of seedlings for the continuing greenbelt development plan, a nursery may be developed in the nearby area. Sapling may be done from seeds or seedling collected from nearby forest areas.

The plant species for Green belt Development will be selected on the basis of following characteristics:

- The species should be native and locally available.
- The species should be fast growing, deep rooted with colonizing behavior.
- The species should be fruit bearing/flowering with dense foliage cover and small/pendulous leave with smooth surface.
- The species should have good root-shoot ratio and soil-binding capacity.
- The species should have aesthetic beauty and should also be low water demanding.
- The species with ability to fix atmospheric Nitrogen (Preferably Leguminous species of family Fabaceae) may be preferred.

5.4 Social Environment

5.4.1 Land Acquisition & Extent of Loss to Properties

About 203.2 ha total land shall be required for the development of the proposed highway.

5.4.2 Project Affected Families

Total 463 PAP are likely to be affected due to proposed development. Compensation shall be provided as per LARR Act, 2013. Details of mitigation measures are provided in SIA & RAP report being submitted separately.

5.4.3 Cultural and Community Properties

Few structures having religious / cultural importance (cerimetry, graveyard, samadhi, dev-sthan and temple) are likely to be affected. Detailed impacts on Cultural & Religious properties are elaborated in SIA & RAP.

5.4.4 Land use Change

Considering the national highway status, ribbon development near the proposed highway is having very less possibility. However, interchanges locations are likely to induce ribbon development. The availability of labour and easy access to markets in the city will make roadside areas quite an incentive for the industrialist and investors of their sectoral development. Reduced transportation costs and availability of high-class transportation facilities for raw materials and products will be the most important advantage of the proposed highway.

5.4.5 Exploitation of Resources

Improvement in the connectivity will have an impact on the natural resources. Easy accessibility of the area will increase the migration and population of the region. This means more and more use of the natural resources like ground water and energy needs like fuel, etc. While the medium-term impacts may not be large enough to be noticed, the long-term implications are potentially noticeable. Separate labour camp away from habitation shall be constructed. All day to day need shall be procured from nearby city markets. No fuelwood shall be permitted for the cooking and other purpose.

5.4.6 Traffic congestion during construction

Traffic congestion due to construction activities is common phenomena for any developmental activities. Safe and convenient passage for public vehicles, pedestrians and livestock to and from crossing roads and property access connecting the project highway is the mostly required. The construction activities that shall affect the use of crossing roads and existing access to individual properties shall not be undertaken without providing adequate provisions.

Detailed Traffic Control Plans will be prepared prior to commencement of works on any section of the project highway. These plans shall be approved by the consultant and employer prior to execution. The traffic control plans will contain details of temporary diversions details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day.

Temporary diversion at the junction locations will be constructed with the approval of the monitoring consultant before undertaking the construction activities at any existing roads. Special consideration will be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night. The road safety measured to be adopted during construction for traffic control and safety during construction are provided under Annexure 5.8.

5.4.7 Working conditions

Contractor is required to comply with all the precautions as required for the safety of the workmen as per the International Labour Organization (ILO) Convention No.62 as far as those are applicable to this contract. Contractor supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workers and staff. Contractor shall to comply with all regulation regarding sage scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.

5.4.8 Risk from Electrical Equipment

Adequate precautions will be taken to prevent danger from electrical equipment. No material or

any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public.

5.4.9 Risk at Hazardous Activity

All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc, will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. The use of any toxic chemical, if any will be strictly in accordance with the manufacturer's instructions. The Monitoring consultant will be given at least 6 working days' notice of the proposed use of any toxic chemical.

5.4.10 Malarial Risk

Gravid, blood-laden mosquitoes cannot fly very far, so they generally bite within a kilometer or so of their breeding place. Pits dug up nearby settlement will be adequately drained to prevent water logging. Proper preventive measures are to be taken as per the malaria prevention guidelines adopted in the State Govt. Suitable direction of the medical authorities will also be taken. The people in the camps should also be informed and educated on the prevention of malaria.

5.4.11 First Aid

At every workplace, a readily available first aid and unit including an adequate supply of sterilized dressing material and appliances will be provided as per the Factory and Safety Rules.

5.4.12 Potable Water

In every workplace, at suitable and easily accessible places, potable water (as per IS) supply will be provided. If the drinking water is obtained from an intermittent public water supply then, storage tanks will be provided.

5.4.13 Construction Camp

Contractor during the progress of work will provide, erect and maintain necessary living accommodation and ancillary facilities for labour to standards and scales approved by monitoring consultant. All temporary accommodation shall be constructed and maintained in such a fashion that quality water is available for drinking and other domestic purpose. The sewage system for the camp shall be properly designed, built and operated so that no water related health hazard occurs and no pollution to the air, ground or adjacent watercourses take place. Compliance with the relevant legislation must be strictly adhered to. Garbage bins shall be provided in the camp and regularly emptied and the garbage disposed-off in hygienic manner. Guidelines for Sitting and Layout of Construction Camp have been presented in Annexure 5.9.

5.4.14 Safety

Project would be developed as per National Highway standards and no entry shall be provided to the highway at interchange locations. Further, smooth geometry of the project highway will be helpful in reduction of accident probability.

5.5 Conclusion

Based on the analysis of environmental impacts in the above sections, it can be concluded that the project is anticipated to cause the following environmental impacts:

- About 199.093 ha land is required for proposed highway is distributed across 463 Titleholders.
- About 1678 nos. of trees are likely to be felled for non forest area. Compensatory plantation shall be undertaken in 1:3 ratio for each tree to be felled. Tree enumeration for forest area shall be conducted with forest dept.
- Avenue plantation on both side of the highway is proposed as per IRC SP-21:2009.

- About 4.108 ha of notified forest along the exiting roads and canals shall be diverted for the project. Compensatory afforestation according to Forest Conservation Act, 1980 shall be undertaken to mitigate the loss of plantation cum forest area.

6 ENVIRONMENTAL MONITORING PROGRAMME

6.1 General

The environmental monitoring programme is devised to ensure that the envisaged purpose of the environment management plan is achieved and results in the desired benefit to the target population. To ensure the effective implementation of the EMP, it is essential that an effective monitoring programme be designed and carried out. Broad objectives of the monitoring programme are:

- To evaluate the performance of mitigation measures proposed in the EMP;
- To suggest improvements in the management plans, if required;
- To satisfy the statutory and community obligations; and,
- To provide feedback on adequacy of Environmental Impact Assessment

6.2 Monitoring Indicators

The monitoring programme contains monitoring plan for all performance indicators, reporting formats and necessary budgetary provisions. Physical, biological and environmental management components, identified as of significance in affecting the environment at critical locations have been suggested as Performance Indicators. The Performance Indicators shall be evaluated under three heads as:

- Environmental condition indicators to determine efficacy of environmental management measures to control air, noise, water and soil pollution
- Environmental management indicators to determine compliance with the suggested environmental management measures
- Operational performance indicators have also been devised to determine efficacy and utility of the mitigation/enhancement designs proposed

For each of the environmental condition indicator, the monitoring plan specifies the parameters to be monitored, location of the monitoring sites, frequency and duration of monitoring. The monitoring plan also specifies the applicable standards, implementation and supervising responsibilities.

The Environmental Monitoring Programme has been detailed out in Annexure 9.2 along with stipulated standards for Air, Water and Noise, etc. level. Successful implementation of the Environmental Monitoring Programme is contingent on the following:

- The Independent Engineer / Authority Engineer or equivalent consultant to request the Concessionaire / Contractor to commence all the initial tests for monitoring of air, water quality, soil and noise levels within 3 months of receiving Appointed date (unless the period within 3 months is monsoon season, in which case, it shall be after monsoon season) to establish the 'baseline' *i.e.* to assess the existing conditions prior to effects from the construction activities being felt
- The Independent Engineer / Authority Engineer or equivalent consultant to request the Concessionaire / Contractor to submit for approval a proposed schedule of subsequent periodic tests to be carried out
- Monitoring by the Independent Engineer / Authority Engineer or equivalent consultant of all the environmental monitoring tests, and subsequent analysis of results

- Where indicated by testing results, and any other relevant on-site conditions, Independent Engineer / Authority Engineer or equivalent consultant to instruct the Concessionaire / Contractor to:
    - Modify the testing schedule (dates, frequency)
    - Modify (add to or delete) testing locations
    - Verify testing results with additional testing as/if required
    - Require recalibration of equipment, etc., as necessary
    - Request the Concessionaire / Contractor to stop, modify or defer specific construction equipment, processes, etc., as necessary, that are deemed to have contributed significantly to monitoring readings in excess of permissible environmentally "safe" levels.

6.3 Monitoring of Earthworks Activities

Earthworks activities like quarries and borrow areas may cause some environment issues. Details regarding the guidelines and procedures adopted to minimize the environmental impacts of opening, operating and closing of Quarries and Borrow Areas are presented in Annexure 5.1, 5.2, 5.3, 5.4, 5.5 & 5.6. Contractor / concessionaire shall ensure that measures proposed in these procedures are being followed in addition to law of lands. Other environmental effects associated with the earthworks include the development of adequate temporary drainage to minimize detrimental effects (e.g. erosion) due to run-off, and safety aspects related to Works implementation.

6.4 Monitoring of Concessionaire / Contractor's Facilities, Plant and Equipment

All issues related to negative environmental impacts of the Concessionaire / Contractor's facilities;

- Plant and equipment are to be controlled through the Concessionaire / Contractor's self-imposed quality assurance plan
- Regular / periodic inspection of the Concessionaire / Contractor’s plant and equipment
- Monthly appraisal of the Concessionaire / Contractor

Other environmental impacts are to be regularly identified and noted on the monthly appraisal inspection made to review all aspects of the Concessionaire / Contractor's operation. The Independent Engineer / Authority Engineer or equivalent consultant is to review all monthly appraisal reports and instruct to the Concessionaire / Contractor to rectify all significant negative environmental impacts.

7 ADDITIONAL STUDIES

7.1 Public Consultation

7.1.1 General

As a part of the project preparation and to ensure that the community support is obtained, and the project supports the felt needs of the people; public consultations were undertaken as an integral component for input to the project development. The information gathered in the consultation process has led to substantial inputs for the project preparation including, influencing designs. Consultations involve soliciting people's views on proposed actions and engaging them in a dialogue. It is a two-way information flow, from project authorities to people and, from people to project authorities. While decision making authority would be retained by the project authority, interaction with people and eliciting feedback allows affected populations to influence the decision-making process by raising issues that should be considered in designing, mitigation, monitoring and management plans and the analysis of alternatives.

Major purpose of the public consultation on environmental issues in the EIA study is to appraise the stakeholders on potential environmental impacts and collect their feedback so that adequate safeguards can be considered during the planning phases. The objectives of consultation sessions, the procedure adopted, and the outputs of the consultation conducted have been described in the following sub-sections.

7.1.2 Objectives

The main objective of the consultation process is to minimize negative impacts of the project and to maximize the benefits from the project to the local populace. The objectives of public consultation as part of this project are:

- To obtain the information on baseline scenario;
- Promote public awareness and improve understanding of the potential impacts of proposed projects;
- Solicit the views of affected communities / individuals on environmental and social aspects;
- Improve environmental and social soundness;
- Identify contentious local issues which might jeopardize the implementation of the project;
- Establish transparent procedures for carrying out proposed works;
- Inform the affected populace about the entitlement framework and to settle problems with mutual consent; and
- Create accountability and sense of local ownership during project implementation.

7.1.3 Type of Stakeholders

For the project, following major groups of stakeholders were identified for consultations at screening stage:

- **Primary Stakeholders** are local people including project affected people, local residents, shopkeepers, farmers, etc.; and
- **Institutional Stakeholders** such as concerned Govt. departments etc. and local authorities

The stakeholder consultation adopted was rapid appraisal methodology which included community meetings and in-depth interviews institutional stakeholders.

Consultations was undertaken using various tools including, interviews with government officials, dialogues were set-up with the community through structured questionnaireon general environment & social aspects related questions. The public consultation carried out at the various stages of the study has been summarized in this section.

7.1.4 Methodology

Project affected villages were selected for conducting public consultation. Affected communities and potential stakeholders such as local residents, panchayat members, etc. were invited to attend the meeting. Effort was made to make the gathering representative of the local population directly or indirectly affected by the potential impacts. During the meetings, no person was prevented from entering and /or leaving the meeting as he / she desired.

Discussions, Questions and Answers: During consultation meeting, the participants were explained the proposed project and potential environmental impacts due to the proposed highway. Thereafter, a session for question and answer was kept facilitating interaction with the stakeholders, exchange of information & direct communication and collect their opinion on the environmental issues. The issues broadly covered in questionnaire included the following topics

- Disturbance due to present traffic scenario with respect to environmental pollution and road safety
- Anticipation of disturbance due to the proposed green field highway with respect to environmental pollution and road safety
- Expectation on road safety measures in the improvement proposal
- Accidents and conflicts involving wildlife, if any
- Preference of avenue trees, if any
- Forest, Wildlife and environmental sensitive area.
- Historical and Archaeological sites
- Flora& fauna of the area

7.1.5 Consultations with Institutional Stakeholders

Institutional level consultations were held with officials of State Forest Dept, Revenue Dept., PWD, Irregation etc and their inputs have been incorporated in the report.

7.1.6 Consultations with Community / Primary Stakeholders

Consultations were held with the affected population and community residing in near the vicinity of the proposed project. Probable Management plan to avoid or minimize the negative impacts were also discussed during consultation.

Figure 7-1: Risk Assessment Process

7.1.7 Outcome of the Consultation

Major findings related to key issues such as general perception about the project; suggestions to mitigate hardships resulting from dislocation and loss of livelihood are presented below:

- It was observed that people were not only aware of the project but also welcomed the project in general.
- Adequate support should be provided to the affected households for the restoration of their livelihood;
- Affected people demanded for vehicular underpass for day to day activities
- Loss of agriculture land and commercial structures are major concern of the local people. Adequate mitigative measures should be taken to avoid/minimize land acquisition.
- Adequate support should be provided to the affected households for the restoration of their livelihood;
- People requested for provision for quality drinking and irrigation facilities
- The potential PAPs in general were very much concerned about the mode and amount of compensation
- People suggested that adequate safety measures should be provided. In brief, it was felt during consultation that regular meeting with the local population / community could easily resolve any dispute between the community people and implementing agency settlements.

- Green Belt development along the highway
- Site specific EMP has been designed to address environmental and social related issues

7.2 Public Hearing

7.2.1 Purpose of Public Hearing

Public consultation is an integral part of the project and required to conduct prior to Environmental Clearance. Public consultation is the process by which the concerns of local affected persons and others who have reasonable stake in the environmental impacts of the project or activity are ascertained. The proposed project falls under Category 'A' and Public Hearing was organised as per the provisions of EIA Notification 14th September, 2006 & its subsequent amendments. The project proponent submitted the draft EIA report along with executive summary in Hindi and English to State Pollution Control Board for its wide circulation. Public hearing will be conducted in each of the project districts as per provisions of EIA Notification, 2006 (amended thereof). Outcome of Public Hearings will be given in this Report after completion of the district wise public hearing.

7.2.2 Social Impact Assessment

The proposed project is likely to have positive as well as negative impacts on the local people and community. To identify these impacts, a Socio-economic Impact survey was conducted for each affected household/structure. The purpose of this exercise was to assess the losses and social impacts due to the proposed project and to gather information on the affected persons. During the SIA, the profiling of the project area has been done for better planning and implementation of the proposed project. Based on the findings of SIA, a Resettlement Action Plan (RAP) will also be prepared to deal and mitigate the negative impacts on the people due to project implementation.

The proposed project involves acquisition of private (agricultural andnon-agricultural) as well as the government land. The acquisition of land may lead to socio-economic changes in the project area. The development of proposed section can be viewed as boosting economic growth and poverty reduction which will bring substantial social and economic development in the region. The social benefits arising due to the project will be triggered off by the improved accessibility to various services such as easy access to markets, health facilities, schools, workplace etc. It will in turn increase the income of the local people and elevate their standard of living. The possible direct and indirect positive impacts are listed below:

7.2.3 Generation of Employment Opportunity

The construction phase of the project will generate both skilled and unskilled employment. The opportunity will be given to the project affected persons as well as other people of the affected villages especially to those who work as daily wage laborers etc.

7.2.4 Economic Growth

The employment generation due to the propsoed project within the project area will generate income as well as the expenditure capacity of the people which will enhance the economic growth of the region.

7.2.5 Improvement of Road Network

The improved road network will provide better links between villages/towns and communities. It shall provide wider access to market facilities, health centres, education etc. Improved roads not only help people building strong institutional network with outside agencies but also allow people to link with better markets and new work opportunities at distant places. People can shuttle to

distant places for work such as engage in construction, factories, business as well as domestic works.

7.2.6 Impact on Land and Structures

The land required for the proposed project is about 201.13ha. Which includes Government, and private land. Land majorly belongs to the private ownership. Total 172 structures are likely to be affected, out of total 164 are under private ownership, followed by 4 government and 4 religious properties.

7.2.7 Impact on Landowners

In total, 463 private landholders will be impacted due to land acquisition.

7.3 Comprehensive Social Economic Assessment

EAC has recommended the project for grant of ToRVide File No.10/2/2023-IA.III dated 21st Februray,2023 with condition estipulated that "*the proponent shall carry out a comprehensive socio-economic assessment with emphasis on impact of ongoing land acquisition on the local people living around the proposed alignment. The Social Impact Assessment shall take into consideration of key parameters like people's dependency in the study area, socio-economic spectrum, impact of the project at local and regional levels*". Socio-Economic Assessment has been conducted to compliance the estipulated of the conditions. The report of the Social Impact Assessment (SIA) shall be submitted seperatly.

7.4 Disaster Management, Risk Assessment & Mitigation Procedures

Risk assessment is a process that seeks to estimate the likelihood of occurrence of adverse effects as a result of major road mishaps, gas tanker explosions, fire hazards, floods, cyclones, earthquakes etc. at Highway projects. Fatality rate on Indian highways is very high mainly due to road accidents. The other adverse impacts due to gas tanker explosions, fire hazards, floods, cyclones, earthquakes etc. are nominal. Elimination of the risk (avoidance of accidents) is given prime importance and NHAI has introduced road safety provisions during the design of highway with the help of Road Safety Manual. 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 junctions
- Removal of junctions and direct access points on main roads
- Improved median openings with stacking lanes
- Separate provisions and direct access point
- Service/silip roads in towns and villages for segregating local and highways traffic.

The Contractors shall conduct Risk Assessment for all works to decide on priorities and to set objectives for eliminating hazards and reducing risks.

7.4.1 The Risk Assessment Process and Hazard Identification

A critical observation/study of the structure/process/site under consideration by the risk assessment team is an essential part of hazard identification as is consultation with the relevant section of the workforce. It is important that unsafe conditions are not confused with hazards, during hazard identification.

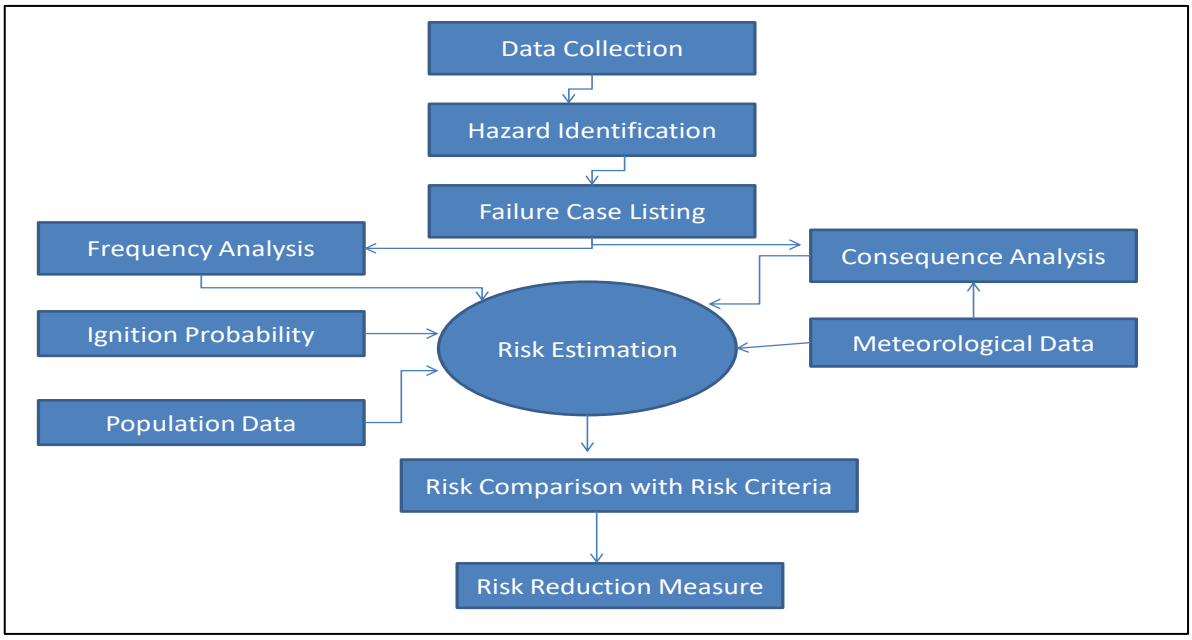


Figure 7-2: Risk Assessment Process

7.4.2 Person(s) at Risk

On a construction area, the persons at risk would be site operatives, supervisors, transport drivers, other visitors and the general public. The risk assessment includes any additional controls required due to mitigate vulnerability of any of these groups, perhaps caused by inexperience or disability.

7.4.3 Emergency Response Plan

Concessionaire/Contractor shall prepare Emergency Response Plans for all work sites as a part of the Safety procedures. The plan shall integrate the emergency response plans of the Contractor and all other sub-contractors. Each Emergency Response Plan shall detail the procedures, including detailed communications arrangements, for dealing with all emergencies that could affect the site. This include where applicable, injury, sickness, evacuation, fire, chemical spillage, severe weather and rescue. Emergency plans and Fire Evacuation plans shall be prepared and issued. Mock drills shall be held on a regular basis to ensure the effectiveness of the arrangements and as a part of the programme, the telephone number of the local fire brigade should be prominently displayed near each telephone on site. The Emergency Response Plan is prepared to deal with emergencies arising out of:

Fire and Explosion

Fire Safety Procedures will be developed and shall be integrated into Emergency Response Plan.

Road Accident

In case of road accidents, the following contact no should be contacted.

Table 7-1: Emergency Contact Number

Help Line no	Description
100	Police
101	Fire
102/1911	Ambulance
103	Traffic Police
1033	Emergency Relief Centre on National Highways
104	State level helpline for Health
104	Hospital On Wheels
1066	Anti-poison
1070	Central Relief Commissioner for Natural Calamities
1070	Relief Commissioners of Central/State/Union territory
1073	Road Accident
1073	Traffic Help Line
1077	Control room of District Collector/Magistrate
108	Disaster management
1090	Anti-terror Helpline/Alert All India
1091	Women in Distress
1092	Earth-quake Help line service
1096	Natural disaster control room
1098	Child Helpline
1099	Central Accident and Trauma Services
1099	Catastrophe & Trauma service
112	General emergency Department of Telecommunications (DoT)
112	All in one Emergency Number
1910	Blood bank Information
1911	Dial a doctor
1913	Tourist Office (Govt.of India)

Source:http://www.newincept.com/helpline-numbers-all-over-in-india.html

7.4.4 Traffic Management

Hazards due to external traffic are as follows:

- Construction workers hit by external vehicles while working
- Injury to Pedestrians
- Due to fall in excavated trenches
- Hit by construction equipment / vehicle
- As they use carriageway due to blockage / absence of footpath
- Collision due to improper traffic management
- Between external vehicle and construction equipment / vehicle
- Between external vehicles
- External vehicle with other stationery objects in the side of the road

Traffic Control Plan

This plan gives the detailed guideline for traffic management in most of the common situations at our project. Traffic Control Plan for a specific road sections should be prepared based on this general guideline and applying the following variables, which may vary from project to project. The

variables are:

- Average Vehicular Traffic Density at junctions in peak and non-peak hours.
- Maximum width of lane required for construction during various activities.
- Number and types of junctions in the road.
- Availability of standard footpath and its location and dimensions.
- Change in the lane width if any and its location.
- Regulatory and advisory speed limits etc.

Traffic Control Devices

Traffic control devices used to regulate the traffic in Road Construction Zones includes:

- Road Signs
- Delineators
- Barricades
- Cones
- Pylons
- Pavement markings
- Flashing lights

Table 7-2: Minimum Sightline Distance and the Minimum Size of the Signs

Average Speed (Km/h)	Distance of first sign in advance of the first channelizing device (m)	Size of Warning Sign (mm)	Minimum no of signs in advance of the hazard
Under 50	100	600	3
51 – 60	100 – 300	750	3
61 – 80	120 – 300	900	3 or 4
81 – 100	300 – 500	1200	4
Over 100	1000	1200 to 1500	4

Cautionary / Warning Signs

In case of divided carriageways, the signs should be provided both adjacent to the shoulder and on the central median so as to be visible from all lanes.

Delineators

Delineators are devices or treatment which outlines the roadway or portion thereof. They include Safety Cones, Traffic Cylinders, Tapes, Drums, Painted lines, Raised Pavement Markers, Guide Posts, and Post-mounted Reflectors etc. They are used in or adjacent to the roadway to control the flow of traffic. Delineators are basically driving aids and should not be regarded as a substitute for warning signs or barriers for out-of-control vehicles.

Drums

Drums of height 800 mm to 1000 mm high and 300 mm in diameter can be used as either channelizing on warning devices. Both plastic and metallic drums (e.g. Bitumen drums) can be used for this purpose. Drums need to be filled up with earth or sand to increase its stability. Drums should be reflective and painted as shown in the Figure 7-3.

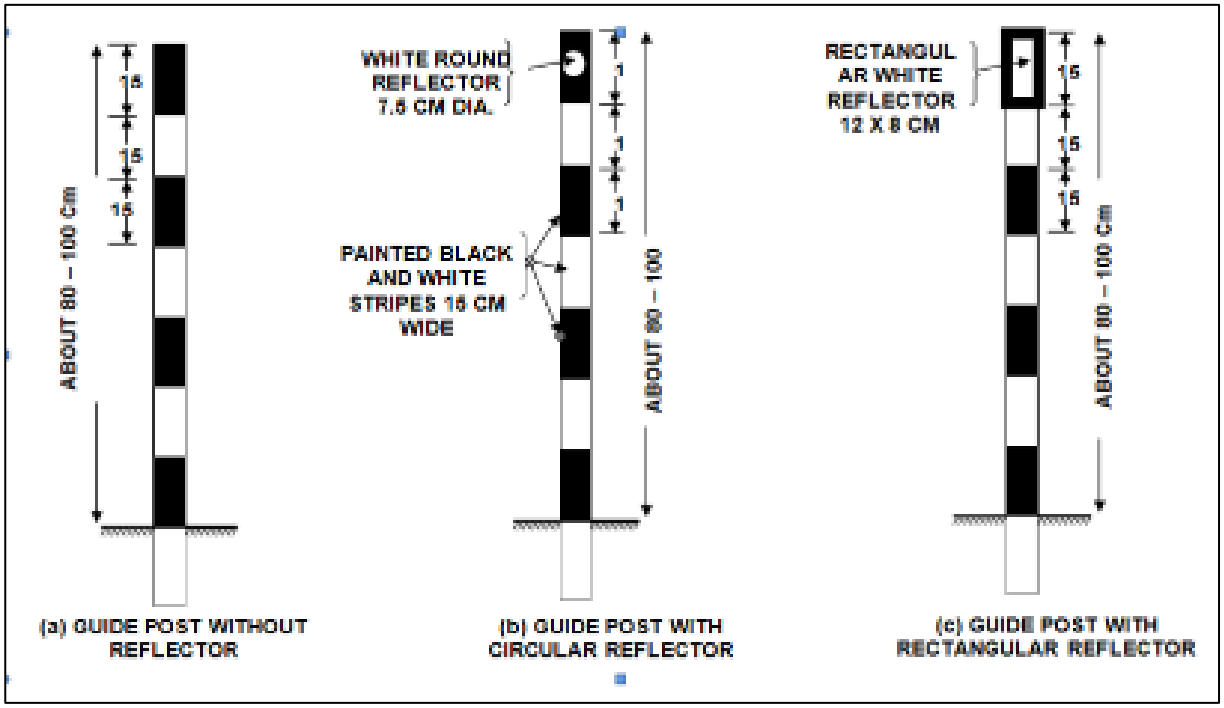


Figure 7-3: Drum Reflections

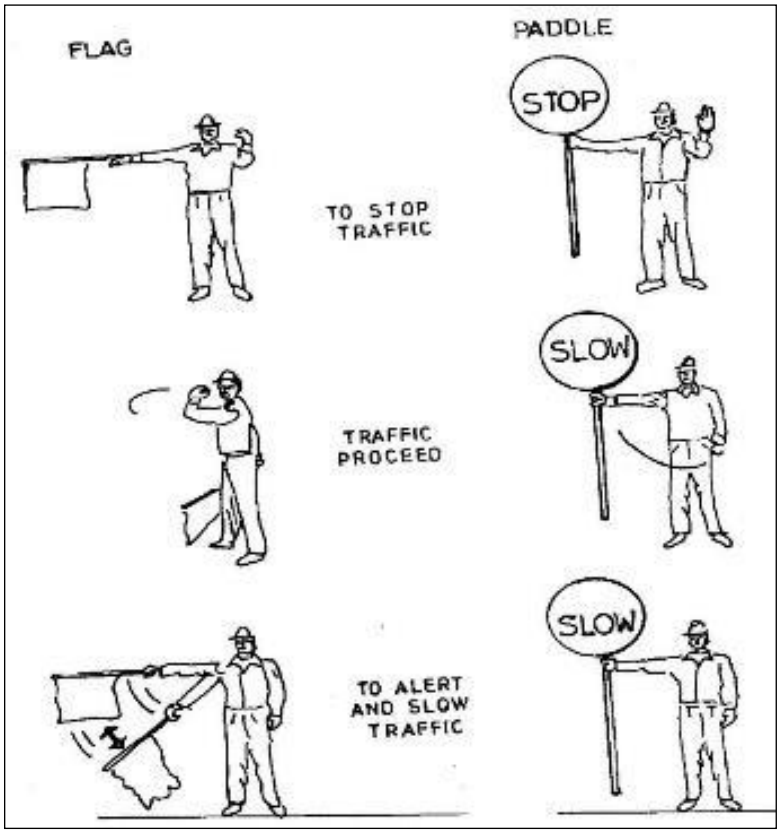


Figure 7-4: Road Traffic Signals

Flagmen

- An authorised personnel at least average intelligence, be mentally alert and good in physical condition be selected, since flagmen are responsible for public and workmen safety
- Flagmen should be equipped with yellow helmet with green reflective sticker fixed around and reflective jacket along with hand signalling devices such as flags and sign paddles
- Flagmen need to maintain the flow of traffic continuous past a work zone at relatively reduced speeds by suitably regulating the traffic. He shall stop the traffic for a short while whenever required (e.g. for entry and exit of construction equipment in to work zone)
- Flagman should be positioned in a place where he is clearly visible to approaching traffic and at a sufficient distance to enable the drivers to respond for his flagging instructions. A flagman never leaves his post until properly relieved
- The standard distance shall be maintained at 60 – 100 m but can be altered depending upon the approach speed and site conditions. In urban areas this distance shall be taken as 20 m to 50 m

Guide Post

They are intended to delineate the edges of the midway so as to guide driven about the alignment ahead, particularly where it might be confusing. Guideposts can be of metal, concrete, cut stone, amber or plastic. The posts can be made of Circular, Rectangular or Triangular Cross-section but the side facing traffic should be at least 10 cm wide.

Barricades

Standard barricades shall be used.

Safety Cones

Safety cones are 500 mm, 750 mm and 1000 mm high and 300 mm to 500 mm in diameter. They are usually made of plastic, rubber, HDPE, PVC and have retro refectories red and white bands. Safety cones would be displaced or blown unless their bases are anchored or loaded with ballast. This can be avoided by, using sandbag rings to provide increased stability, heavier weighted cones, cones with special weighted bases & or doubling the cones to provide added weight.

7.4.5 Traffic Management Practices

Definitions

Road traffic control involves directing vehicular and pedestrian traffic around a construction zone, accident or other road disruption, thus ensuring the safety of emergency response teams, construction workers and the general public.

Working zone

The plant/camp site, construction zone of road etc. at which workmen will be working.

Working space

The space around the works area that will requirestoring tools, excavated material and other equipment. It is also the space to allow workmen, movement and operation of plant, (e.g. swing of jibs, excavator arms) to move around to do the job. Materials and equipment must not be placed in the zone either. Workmen will only need to enter the zone to maintain cones and other road sign.

Safety zone

The zone that is provided to protect workmen from the traffic and to protect from them.

Approach Transition Zone

This will vary with the speed limit and the width of the works.

Longitudinal buffer zone

This is the length between the end of the lead-in taper of cones (T) and the working space. It will vary with the speed limit.

Lateral buffer zone

This is the width between the working space and moving traffic. It will vary with the speed as given in table (Traffic Control zone). The lateral buffer zone safety clearance is measured from the outside edge of the working space to the bottom of conical sections of the cones on the side nearest to the traffic.

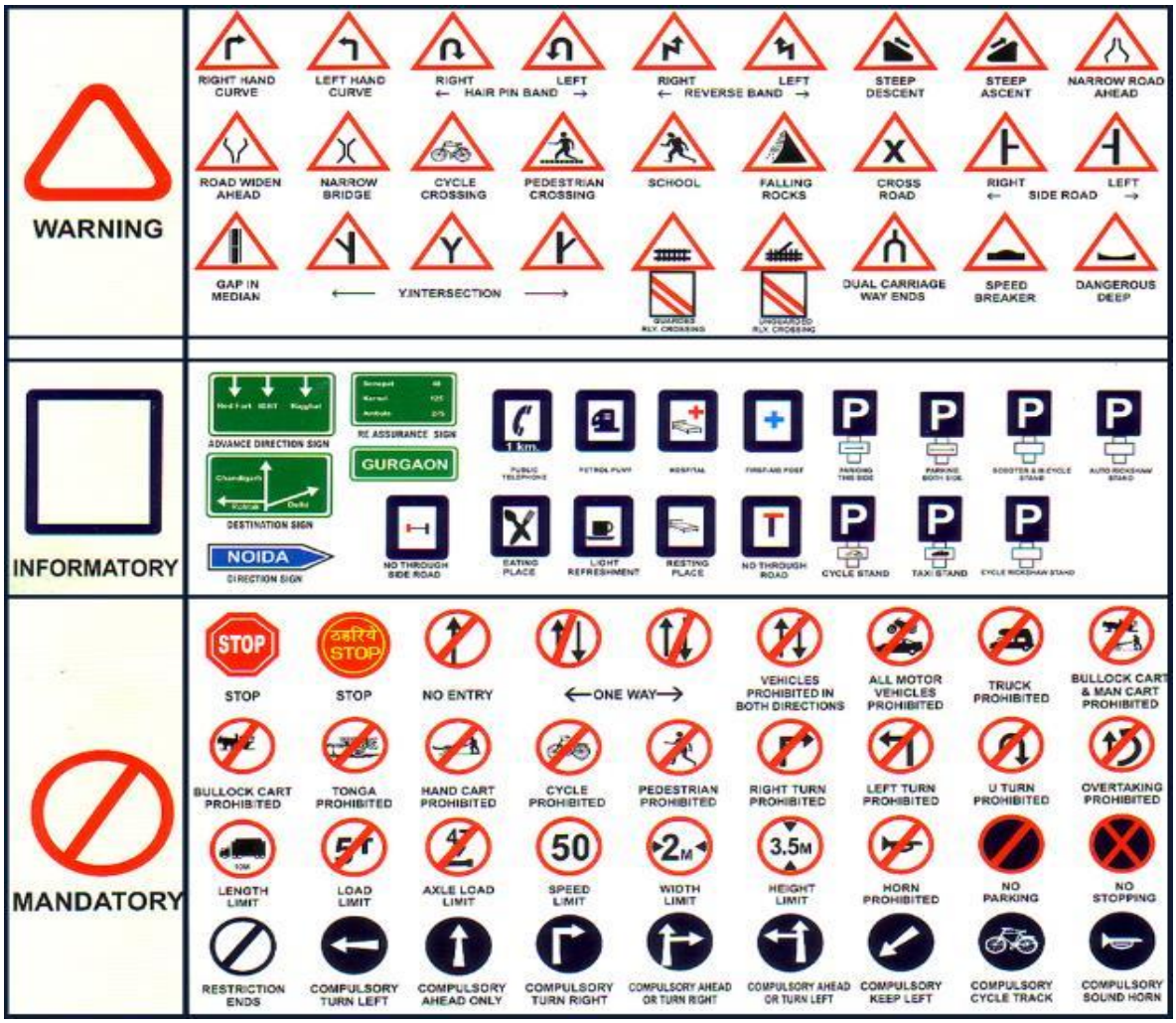


Figure 7-5: Traffic Signages

7.4.6 Traffic Management on Road Junction

Construction Traffic meets Live Traffic from Quarry/Plant/Borrow Pit

- Where vehicles are more to the approach junction from the side road, permission shall be seek for providing speed breaker at junction from local traffic police and road-authority
- Flag man shall be kept in the peak time provided with the traffic circle painted with red and white at the corner at a height of 500 mm, clearly visible to approaching traffic for a distance provided with while gloves and STOP, GO Paddle and night time flagman should use LED Batons
- Spillage of earth / Gravel / Aggregates / Bituminous mix from the tipper shall be cleaned on regular basis, if required 2 labourers to be permanently posted for booming
- All Construction vehicles must follow lane discipline and road signs

Activities inside Median / Island

- The traffic would discontinue from plying temporarily on the carriageway; for two min for reversing & dumping earth / stones / etc. under the direction of helper and the flagman
- The construction zone shall be barricaded
- One Flagman shall be appointed at traffic coming side of the transition zone.
- No personnel shall be allowed to come out of the safety zone, unless under flagman guidance.

7.5 Disaster Management Manual

Primarily disasters are triggered by natural hazards or human-induced or result from a combination of both. In particular, human-induced factors can greatly aggravate the adverse impacts of a natural disaster. Even at a larger scale, globally, the UN Inter-Governmental Panel on Climate Change (IPCC) has shown that human-induced climate change has significantly increased both the frequency and intensity of extreme weather events. While heavy rains, cyclones, or earthquakes are all natural, the impacts may, and are usually, worsened by many factors related to human activity. The extensive industrialization and urbanization increase both the probability of human-induced disasters, and the extent of potential damage to life and property from both natural and human-induced disasters. The human society is also vulnerable to Chemical, Biological, Radiological, and Nuclear (CBRN) disasters.

7.5.1 Natural Hazards

The widely accepted classification system used by the Disaster Information Management System of DesInventar classified disasters arising from natural hazards into five major categories (DesInventar, 2016).

- **Geophysical:** Geological process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Hydro-meteorological factors are important contributors to some of these processes. Tsunamis are difficult to categorize; although they are triggered by undersea earthquakes, and other geological events, they are essentially an oceanic process that is manifested as a coastal water-related hazard.
- **Hydrological:** Events caused by deviations in the normal water cycle and/or overflow of bodies of water caused by wind set-up
- **Meteorological:** Events caused by short-lived/small to meso-scale atmospheric processes (in the spectrum from minutes to days)

- **Climatological:** Events caused by long-lived meso- to macro-scale processes (in the spectrum from intra-seasonal to multi-decadal climate variability)
- **Biological:** Process or phenomenon of organic origin or conveyed by biological vectors, including exposure to pathogenic micro-organisms, toxins and bioactive other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

A brief description of these five major categories of the disasters arising from natural factors with the sub-categories is given in Table 7-3. The below classification is not a water tight one. In real life situations, many disasters are a combination of different types of disasters. In addition, secondary disasters may occur after a disaster has occurred.

Table 7-3: Categories of Natural Hazards

Sl. No.	Family	Main Event	Short Description/ Secondary Disaster
1	Geophysical	Earthquake/Mass movement of earth materials	• Landslide following earthquake; • Urban fires triggered by earthquakes; • Liquefaction - the transformation of (partially) water-saturated soil from a solid state to a liquid state caused by an earthquake; • Mass movement of earth materials, usually down slopes; • Surface displacement of earthen materials due to ground shaking triggered by earthquakes.
2	Hydrological	Flood, Landslides and Wave Action	• **Flood Hydrological-** A general term for the overflow of water from a stream channel onto normally dry land in the floodplain (riverine flooding), higher-than normal levels along thecoast and in lakes or reservoirs (coastal flooding) as well as ponding of water at or near the point where the rain fell (flash floods) • **Wave Action-** Wind-generated surface waves that can occur on the surface of any open body of water such as oceans, rivers and lakes, etc. The size of the wave depends on the strength of the wind and the travelled distance (fetch).
3	Meteorological	Hazard caused by short-lived, micro- to meso-scale extreme weather and atmospheric conditions that may last for minutes to days	• Cyclone, Storm Surge, Tornado, Convective Storm, Extratropical Storm, Wind Lightning, Heavy Rain
4	Climatological	Unusual, extreme weather conditions related to long-lived, meso- to macro-scale atmospheric processes ranging from intra-seasonal to multi-decadal (long-term) climate variability	• Extreme hot/cold conditions • Subsidence

Sl. No.	Family	Main Event	Short Description/ Secondary Disaster
5	Biological	Exposure to germs and toxic substances	• Epidemics: viral, bacterial, parasitic, fungal, or prion infections • Insect infestations

7.5.2 Human-Induced Disasters

The NPDM (2009) notes that rise in population, rapid urbanization and industrialization, development within high-risk zones, environmental degradation, and climate change aggravates the vulnerabilities to various kinds of disasters. Due to inadequate disaster preparedness, communities, and animals are at increased risk from many kinds of human-induced hazards arising from accidents (industrial, road, air, rail, on river or sea, building collapse, fires, mine flooding, oil spills, etc.). Chemical, Biological, Radiological, and Nuclear (CBRN) hazards rank very high in among the human-induced risks. Terrorist activities and secondary incidents add to these risks and call for adequate preparedness and planning.

7.5.3 Levels of Disasters

The disaster management and its planning at various tiers must take into account the vulnerability of disaster-affected area, and the capacity of the authorities to deal with the situation. Using this approach, the High-Power Committee on Disaster Management, in its report of 2001, categorized disaster situations into three 'levels': L1, L2, and L3. The period of normalcy, L0, should be utilized for disaster risk reduction.

- **Level-L1:** The level of disaster that can be managed within the capabilities and resources at the District level. However, the state authorities will remain in readiness to provide assistance if needed.
- **Level-L2:** This signifies the disaster situations that require assistance and active mobilization of resources at the state level and deployment of state level agencies for disaster management. The central agencies must remain vigilant for immediate deployment if required by the state.
- **Level-L3:** This corresponds to a nearly catastrophic situation or a very large-scale disaster that overwhelms the State and District authorities.

The categorization of disaster situations into levels L0 to L3 finds no mention in DM Act 2005. Further, the DM Act does not have any provision for notifying any disaster as a national calamity or a national disaster.

7.5.4 Project Specific Provisions for Disaster Management Plan/provisions

Nodal Operation Control Rooms

Nodal Control Canters should be equipped with the latest Communication facilities and will be manned 24 x 7 during the Construction and Operations Phase. During the Construction Phase, these rooms will be manned by the Contractor's personnel along with the Supervisory staff of the Disaster Management Cell.These Nodal Operation Control Rooms will maintain effective communication at all times with the various agencies listed in Disaster Management Plan viz.

- Police Commissionerate
- Traffic Police
- Municipal Corporation
- Home Guards and Civil Defence

- District Collectorates (City & Suburban)
- Indian Meteorological Department (Regional Office)
- Railways (Central & Western)
- Fire Brigade
- Telecom Service Providers
- Hospitals
- Radio & TV Centre

Standard Operating Procedures during Road Construction

Standard Operating Procedures (SOPs) as stipulated in MORT&H Specifications – Revision 5, a document which is largely used in India for construction of Highways, shall be used during the Construction Phase. These also include precautions to be taken for safeguarding the environment. A summary of provisions is given in Table 7-4.

Table 7-4: SOP Requirement

Sl. No.	Description	Reference Clause No. of MORT&H Specification
1	Borrow Pits for Embankment Construction	111.2
2	Quarry Operations	111.3
3	Control of Soil Erosion, Sedimentation & Water Pollution	111.4
4	Pollution from Plants and Batching Plants	111.5
5	Substances hazardous to health	111.6
6	Use of Nuclear Gauges	111.7
7	Environment Protection	111.8
8	Occupational Health and Safety of the Workforce	111.9
9	Control & Disposal of Waste	111.10
10	Transport of hazardous materials	111.11
11	Emergency Response	111.12

It is expected that the Contractor will prepare an exhaustive project specific Health & Safety Management Plan before commencement of Construction activities and implement the same rigorously.

7.5.5 Mitigation Measures Undertaken

Relief measures shall be taken with co-ordination of all Departments.

Table 7-5: Role and Action Plan of Various Departments

Sl. No.	Department	Disaster Specific Action Plan
1.	Disaster Management & Relief (DM&R)	• Ensure coordinated movement of all departments, officials and agencies for combating the disaster • Issue necessary directions and ensure effective and coordinated response of all departments. • Arrange regular meetings for updating the apex body on a daily basis. • Provide inputs to concerned departments for effective implementation of the rehabilitation plans.

Sl. No.	Department	Disaster Specific Action Plan
		• Document the experiences and best practices.
2.	Animal Husbandry	• Prepare contingency plan • Constitute veterinary mobile teams with required resources like medicines, doctors, subordinate staff, laboratories, protective gears, antibiotics, vaccines and antitoxins, etc. in abundance. • Constitute technical groups at state, zone and district levels. • Identification of affected areas. • Safe disposal of dead carcasses. • Focused attention to veterinary health. • Mass vaccination programme of animals in affected areas Make arrangements for rescue and evacuation of stranded livestock. • Pool in sufficient doctors for treatment of sick animals/ poultry. • Control spread of animal disease. • Carry out epidemiological surveillance to evade biological disasters. • Promote awareness through IEC activities.
3.	Public Health Engineering Department (PHED)	• Prepare Contingency plan • Enforce ground water legislation • Strict monitoring and vigilance on water for drinking purpose only. • Identify additional sources of water for maintenance of regular supply. • Ensure supply of sufficient water through tankers for habitats and cattle camps. • Provide household water purification tablets. • Augmentation of existing Resources • Hiring of Private Wells • Hand Pump repair programme • Installation of New Hand Pumps and Tube wells • Transportation of water through road tankers and by Rail • Earmark water for drinking purpose available in the tanks and ensure no illegal pumping takes place. • Provide adequate quantity of bleaching powder to PRI, especially Gram Panchayats to protect spread of water and vector borne diseases. • Promote awareness on safe hygienic practices and sanitation.
4.	Department of Health and Family Welfare	• Health and epidemiology surveillance • Constitute mobile teams with required resources like medicines, doctors, paramedics, subordinate staff, laboratories, protective gears, antibiotics, vaccines, etc. in abundance. • Mobile clinics for health check-ups • Organise regular rural health camps and keep public informed of such camps. • Check & monitor the nutritional status of affected people especially for women and children and give treatment. • Check samples of food grains, cooked food in community kitchens, etc. • Promote general awareness of health and hygiene • Manning of control room 24x7.

Sl. No.	Department	Disaster Specific Action Plan
		• Maintain regular contact with EOC. • Keep all ambulances, mobile teams, specialists, blood, medicines, paramedics, etc. in a state of readiness. • Carry out triage. • Provide first aid to minor injuries. • Evacuate injured to hospitals. • Constitute and effectively deploy mobile teams having Doctors paramedical, • Set up health centres in relief camps and assure hygiene and sanitation. • Prevention/ control of epidemics and vaccination, availability of adequate x-ray machines and orthopaedic, neurology equipment. • Availability of stretchers, blood, medicines, ambulances. • Arrange additional beds and medical treatment in local and nearby hospitals as required. • Psychosocial counselling to distressed people. • Maintain continuous supply of medicines and emergency services till normalcy is restored.
5.	Disaster Management & Relief (DM& R)	• Ensure coordinated movement of all concerned departments, officials and agencies for combating Drought. • Make sufficient funds available for Drought response • Arrange regular meetings for updating the apex body and issue directions to all concerned departments regularly. • Document experiences and best practices
6.	Public Works Department (PWD)	• Listing of works that could be done as under relief programmes as per the priority • Carry out sudden checks and supervise the relief works. • Provide temporary employment opportunity to employable people from affected families • Manning of control room 24x7 • Maintain regular contact with EOCs at district/ state levels • Keep all resources in the state of readiness • Assessment of damage to infrastructure, roads, bridges and buildings and commencement of restoration work. • Carry out search, rescue, evacuation, relief operation. • Clearance of roads and debris of collapsed infrastructures. • Identification and demolition of unsafe buildings/ infrastructures. • Barricade the disaster site and unsafe areas. • Identification and demarcation of safe areas and preparation of temporary shelters for relief camps. • Prepare temporary roads and bridges, helipads and air strips on the need basis for effective relief operations. • Deployment of heavy equipment like dozers, excavators, cranes, pulleys, power saws, gas cutters, L&Ts, JCBs and other specialist equipment and vehicles. • Restoration of buildings, roads, bridges and other Government buildings.

Sl. No.	Department	Disaster Specific Action Plan
		• Ensure close monitoring of response and rehabilitation operations and relief camps.
7.	Civil Supplies and Public Distribution System (PDS)	• Distribution of food packets, dry rations, fuel, oil and other essential items • Take precautionary steps against hoarding and profit mongering and ensure normal prices of commodities in the market. • Adequate supply and reserves of FOL and coordinate with all the national agencies for smooth transportation of food and civil supplies. • Supply daily necessities of food items, stock position and ensure continuous supply, in relief camp too. • Coordination with FCI/ warehouses. • Make public aware through media about food distribution and about the availability of items at subsidized rates.
8.	Municipal Corporation	• Coordination and supply of safe drinking water using tankers, etc. • Manning of control room 24x7. • Issue warnings to all Fire Service stations. • Keep all resources in a State of readiness • Assist in evacuation, search and rescue operations. • Ensure availability of all types of extinguishers for fire following earthquakes. • Appoint labourers for excavation works; dismantle unsafe buildings, disposal of solid garbage and liquid waste, disposal of dead persons and carcasses. • Control other potential hazardous situations that might arise from oil, gas and hazardous material spills. • Organise relief camps wherever required; ensure pure drinking water, Sanitation, food, temporary shelters, basic relief materials as per requirements and needs. • Assist in post disaster response and rehabilitation work
9.	District Administration	• Prepare Drought Contingency Plan. • Issue necessary directions/ instructions to all concerned departments to be proactive to combat the upcoming situation in an effective and coordinated manner. Ensure effective coordination with all departments, agencies, NGOs and stakeholders. • Arrange/mobilize equipment and resources like water tankers, trucks/ vehicles to transport food supply, fodder, mobile medical vehicles, ambulances, etc. • Arrange for disposal of dead carcasses. • Generate daily reports of relief activities and disseminate. • Organise relief camps wherever required; ensure pure drinking water, Sanitation, food, temporary shelters, basic relief materials as per requirements and need. • Media Management • Procure tents, sanitation block, essential materials, etc. for relief camps.
10.	Department of Information and Public	• Information dissemination, issue periodic bulletins to media. • Ensure information given to media are facts and true to avoid rumours.

Sl. No.	Department	Disaster Specific Action Plan
	Relation	Arrange visit for media personnel in affected areas. • Information dissemination, update public on various relief interventions. • Operate the Control Room round the clock. • Nodal person to be designated as spokesperson for the Government. • Information dissemination, issue periodic bulletins to media.
11.	Emergency Operation Centre (EOC)	• Coordinate and issue direction to all concerned stake holders/ departments regularly • Brief the Disaster Management & Relief Commissioner regularly. • Coordinate the relief and rescue operation. • EOC to function as control room where all SDMA members and experts from various departments are available and take charge for effective coordination monitoring and implementation of rescue operations. • Prepare, forward and compile reports and returns from time to time. • Brief media regularly about the situation' • Brief/ Update the Govt.
12.	Police	• Manning of control room 24x7. • Maintain regular state of readiness • Communication to EOC and stakeholders instantly. • As first responder assume command for security and law and order • Demarcate entries and exits for rescue and relief operation and proper traffic management. • Support SDRF, Civil Defence, Home Guard, Army, Sainik Kalyan and other first responders for search and rescue. • Take necessary actions to avoid rumours. • Ensure prevention of theft and loot. Deployment of lady police personnel in relief camps for Gender concerns.
13.	Electricity Board	• Issue direction to all officials/ staff. • Manning of control room 24x7. • Keep all resources in a state of readiness • Immediately shut down the supply of electricity in the area • Start restoration work of the damaged lines • Simultaneously, make electricity arrangements at the rehabilitation, relief camp areas.
14.	Rural Development Department (RDD)	• Issue warnings to all officials/ staff. • Manning of control room 24x7. • Keep all resources in a state of readiness. • Distribution of relief materials • Relief equipment, tractors, labour, digging/ excavation tools, etc. to be arranged to mobilise and Support in organizing relief camps wherever required • Ensure pure drinking water, Sanitation, food, temporary shelters, basic relief materials as per requirements and needs. • Arrangement of Rural relief camps

Sl. No.	Department	Disaster Specific Action Plan
		• Arrangement of community kitchens. • Assist in post disaster response and rehabilitation work
15.	India Meteorological Department	• Transmit updated information to EOC • Mass media publicity/ issue bulletins at regular intervals.
16.	Railways & Transport Department	• Manning of control room 24x7. • Alert officials/ staff and keep all resources in a state of readiness. • Search, rescue and evacuate injured persons to safer places. • Assess the situation for appropriate actions. • Regulate the movement of all trains and passenger buses • Carry out inspection of railway bridges and lines. • Deployment of equipment like generators sets, pump sets, cranes pulleys, dozers, gas cutters, earthmovers, labourers for clearance of fallen bogies, electricity Poles, damaged tracks, etc. • Transport and provide emergency tents, water, medicines, food, etc. to the accident site. • Adequate arrangement of specialized trains, truck and buses for transportation of rescue and relief material. • Restoration of damaged railway lines, electricity poles to restart services as soon as possible.
17.	NGOs	• Provide first aid, health services, arrangement and distribution of food and relief materials, assistance to authorities, financial assistance, etc.

8 PROJECT BENEFITS

8.1 Introduction

Community will accrue the benefit from proposed development project by way of improvement in the physical infrastructure; social infrastructure; development of economy; reduced pollution, vehicle maintenance, fuel saving, lesser carbon footprint, employment potential and other tangible benefits. In general Project will have following benefits at national and regional level:

- **High-speed connectivity and access:** The proposed project is a partialy greenfield national highway. This will avoid traffic congestion and speed-up the freight movement. It is expected that overall, the proposed highway will reduce the travel time between these places by half.
- **Aiding economic growth:** The seamless connectivity will provide better access to vehicles. The Project will reduce travel time and provide boost to trade, tourism and commerce linked to the regions.
- **Decongestion of existing National and State Highways:** The proposed corridor will take away traffic pressures from existing SH and NH passing through various cities. Also, long-distance traffic will shift to the proposed highway, thereby reducing traffic and congestion on the existing NH and SH for regional and local usage.
- **Usage shift:** Long-distance traffic will shift from existing National Highways to the proposed highway, resulting in lesser congestion leading to higher fuel savings and reduced travel time.
- **Improved safety:** Due to national highway standards, the road & travel safety of the traffic connecting the region will be enhanced as there will be minimum distractions & conflict zones.
- **Support to industry:** Different types of industries like Tourism, Pharmaceutical, warehouse facilities, etc. along the proposed corridor will be facilitated in their business operation and reachability.

Detailed environmental and social benefits associated with the proposed highway development are described in sections below.

8.2 Efficient and Safe Connectivity Option

The project will improve connectivity from Patna, Saran, Vaishali and Muzaffarpur in the state of Bihar. The proposed project section is development (greenfield) highway in the state of Bihar. The project is planned as high-speed highway which provides high speed connectivity between Saran & Muzaffarpur districts of Bihar State, more importantly giving a reliable access to the economic and tourism destination located alongside the project highway. The proposed section of economic corridor will ensure high speed traffic movement between three project affecting districts.

8.3 Traffic Decongestion

A traffic study was conducted across various locations of the existing NHs and SHs. It was found that the traffic movement capacity of existing roads has exhausted in most of sections. Hence, requirement of widening of existing road / new highway arises. The existing alignments are congested requiring more travel time. Average travel time presently is 40-50 km/hr for this section. Hence, as an alternate, the alignment is proposed to provide direct access from Patna to Saran, Vaishali and Muzaffarpur. This proposed corridor will act as feeder to other districts also.

Following major types of traffic load are expected to accrue the maximum benefit from the project:

- **Commercial and Industrial:** Traffic on the existing roads is driven by local, tourism, commercial and industrial traffic. The ecomonic corridor will support the local businesses and economy along the proposed corridor. The proposed corridore will act as a significant for Saran, Vaishali and Muzaddarpur from major industrial hubs Patna etc. It will facilitate rapid growth of the small, medium and large-scale industries mentioned above, by streamlining transport of raw materials and finished goods. Apart from this, the project corridor would help in quicker movement of agricultural commodities to the consumption centres and provide enhanced accessibility to tourists, helping in the overall development of the region.
- **Tourist:** Passenger traffic will be generated due to the pilgrimage centres connected by the project corridor.
- **Health and Education:** Faster connectivity and accessibility to Patna will help in higher flow of traffic from Bihar especially for higher education, tertiary healthcare and specialized treatments. Reduction in travel time will allow patients to avail OPD / other medical services from the national or state capital region.

8.4 Savings in Travel Time and Cost

The proposed section is expected to reduce the travel time between Saran to Muzaffarpur by at least 50-min w.r.t. existing roads. This further leads to the following cost savings for users:

- Vehicle Operation Cost;
- Travel Time and
- Toll costs

8.5 Benefit to Local Trade and Economy

The proposed project plans to link three districts of Bihar States. The strong regional connectivity proposed through the project will further increase regional tourism, trade and economic growth. The regions to be connected through the project have their distinct economic profiles.

8.6 Employment Generation (Direct and Indirect)

Proposed development is expected to generate employment during construction phase. It is estimated that ~530 direct employees will be required per day during construction of the highway. Further, due to ecosystem which will be created during construction and operations phase of the project, the highway will also create considerable indirect employment opportunities in form of transportation of construction materials, greenbelt development, ancillary facilities like canteens, dhabas, etc.

During operations phase, the project will largely have indirect employment benefits in form of highway amenities and through economic & social hubs developed around the highway. Efficient reach and connectivity to distant markets will further enhance economy of the districts and create employment opportunities.

9 ENVIRONMENTAL MANAGEMENT PLAN

9.1 General

The Environmental Management Plan (EMP) is required to ensure managing environment impacts within acceptable limits in addition to environmental enhancement during construction and operational phases. EMP is location and time specific. In general, NHAI (with assistance from Contractor/Concessionaire and Project Monitoring Consultant (PMC) / Supervision Consultant (SC) / Authority Engineer (AE) is the responsible entity for ensuring that the mitigation measures are carried out. Impact mitigation measures are provided in Annexure 9.1. The list provides reference (MoRT&H specification), implementing organization and responsible entity.

9.2 Specific Activities by Authority and Monitoring Consultant

The role of Project Implementing Authority in the implementation of EMP involves the following activities:

- Compliance to the Environment and Forest Clearances obtained from Ministry of Environment, Forest and Climate Change
- Insure all required NOC for Batching, HMP & WMM plants to be obtained from SPCB.
- Permission from Forest / District Administrative Department for felling of trees by Contractor / Concessionaire
- Supervision of implementations of EMP with the help of PMC /SC /AE

9.3 Specific Activities by Concessionaire/Contractor

The activities to be performed by the Concessionaire / Contractor to implement the EMP shall comprise the following:

- Selection, design and layout of construction areas, hot mix and batching plants, labour camps etc.
- Obtain approval from PMC / SC / AE for setting up of Plant and camp area
- Obtain permission of change of land use of the camp & plant areas from the Revenue authorities
- Confirm the Tree Cutting Schedule based on the final design and provide the same to NHAI
- Felling of trees after NHAI secures Forest Department's / District Administrative Department's permissions
- Selection of material sources (quarry, water, sand, etc.) and obtain approval of the same by PMC / SC / AE
- Obtain Prior EC for new quarries areas from MoEF&CC / SEIAA as applicable
- Obtain CTE/CTO from SPCB under Air & Water Act
- Apply for and obtain all the necessary clearances from the agencies concerned including but not limited to handling of hazardous waste from SPCB, permission for use of water, labour permits, permission for disposal of construction wastes & blasting permits
- Planning traffic diversions and detours including arrangements for temporary land utilization on lease basis

- Plant and maintain flowering, shade, medicinal, ornamental & fruit bearing trees in suitable areas as per contractual requirement

9.4 Site Specific Management Plan

9.4.1 Cultural Properties

The relocation & mitigation issue of the cultural properties directly or partially impacted shall be taken up in RAP. Wherever possible the Concessionaire / Contractor shall try to enhance the aesthetic of the cultural properties.

9.4.2 Sensitive Features

Project section is crossing 1 River. Elevated structures are proposed along the water bodies being crossed. Silt fencing is proposed near major canals and pond.

9.4.3 Water Quality

Oil Interceptor at Camp site have been proposed to control the entry of oily waste in nearby water bodies and soil. Rainwater harvesting structure is proposed at every 500m interval of the project corridor.

9.4.4 Community properties

The relocation / rehabilitation of affected community resources shall be undertaken as per the Rehabilitation Action Plan.

9.5 Implementation of EMP

The key issues that require special attention along with the mitigations and enhancement measures to be implemented have been detailed inAnnexure 9.1. It is presumed that for effective implementation for the project, the proponent shall be dividing the section into number of construction packages. A construction package shall have a single contractor or a JV of Contractors. A single or multiple IE / SC / AE shall be appointed either package wise or for the entire section who shall supervise and monitor the works of the contractor. The IE / SC / AE shall be headed by a Team Leader who shall ideally be assisted by a Resident Engineer along with other key & sub key professionals including an Environmental expert. In turn the IE / SC / AE shall be reporting to the NHAI's Project Implementation Unit, headed by a Project Director. Depending on the work's status & exigencies, the project proponent may decide to entrust the monitoring works to one or multiple Project Implementation Units. The physical, financial & the environmental compliance status of the works of the Project Implementation Units shall be monitored at the Head office of the NHAI at New Delhi.

For effective implementation and management of the EMP, the individual contractor / lead contractor (for JV)for each package shall establish an Environment, Health and Safety cell headed by an Environment Officer to deal with the environmental issues of the project and implement the various environmental mitigation and enhancement measures. The Environmental Officer of the Contractors shall be primarily responsible for compliance of EMP and should be available for the entire duration of the project. The environmental officer of the Contractor shall be assisted in his daily endeavour by safety & health officers besides other environmental assistants.The Environmental officer shall interact with NHAI, AE / SC / IE and other line departments to ensure that the mitigation and enhancement measures mentioned in the EMP are adhered.

The designated environmental expert of the IE/ SC / AE based on the periodic reports received from the contractor & site visits shall apprise the Project Director on the status of the compliance of the EMP. In the absence of the Environmental Expert of the IE / SC / AE, the responsibility

shall be entrusted with the Resident Engineer & the Team Leader of the IE / SC / AE. The Project Director of NHAI or his legal representatives shall be the official responsible for the compliance of the EMP from the project proponent's side at the site level.

9.6 Environmental Monitoring Programme

The Environmental Monitoring Programme has been detailed out in Chapter 6.

9.7 EMP Budget

The EMP cost has been presented in Table 9-2. The estimated budgetof EMP is Rs. 12.181 Cr.

Table 9-1: Project Environmental Budget

Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Cr.
1	**MITIGATION / ENHANCEMENT COST**						
1.1	**Pre-construction Stage**						
1.1.1	Land acquisition		Covered in LA Budget			0.00	0.000
1.1.2	Water	Relocation and construction of affected hand pumps, water storage tanks, open wells, water taps, OHT etc. as per directions of the Engineer.	Covered in Utility Shifting Budget			0.00	0.000
1.2	**Construction Stage**						
1.2.1		Avenue plantation with flowering, shade, medicinal, ornamental & fruit bearing trees @988 numbers per km as per IRC SP21:2009 and Green Highways (Plantation & Maintenance) Policy-2015 including compensatory plantation to offset the loss of trees due to clearing of proposed RoW at locations & as per directions of the forest department	No.	29640	1,500.00	4,44,60,000.00	4.446
1.2.2		Planting of flowering, medicinal, ornamental shrubs in the median @ 666 numbers per Km as per IRC SP21:2009 and Green Highways (Plantation & Maintenance) Policy-2015	No.	19980	1,500.00	2,99,70,000.00	2.997
1.2.3		Circular tree guard for protection of plantation	No.	29640	1,000.00	2,96,40,000.00	2.964
1.2.4		Landscaping and aesthetics of junctions and at other locations as per design, drawings and direction of the Environmental Specialist of the PPMC / SC / AE	LS	-	5,00,000.00	5,00,000.00	0.050
1.2.5	Slope /	Turfing of embankment with grasses and	Covered in Engineering Cost			0.00	0.000

Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Cr.
	Embankment protection	herbs / other engineering measures					
1.2.6	Soil & Ground Water	Providing Oil Interceptors as per design and drawing at vehicle parking areas	Nos.	2	30,000.00	60,000.00	0.006
1.2.7	Surface Water	Silt Fencing for Water Bodies adjacent to the road	running m	2000	1,100.00	22,00,000.00	0.220
1.2.8	Flora	Cost of transport & distribution of cooking fuel to construction workers	Months	24	20,000.00	4,80,000.00	0.048
1.2.9	Air	Dust Management with sprinkling of water, covers for vehicles transporting construction material	Km	121.000	30,000.00	36,30,000.00	0.363
1.2.10	Solid Waste Disposal	Disposal of Sewage and other wastes in the construction yard and labour camps as per directions of the Environmental Specialist of the PMC/ SC/AE	Month	24	15,000.00	360000.00	0.036
TOTAL MITIGATION COST						**10,85,70,000.00**	**10.857**
2	**MONITORING COST**						
2.1	**Construction Stage**						
2.1.1	Air	Sampling and monitoring ambient Air Quality and gaseous pollutants as per CPCB Standard Procedures at 4 locations including sensitive area and chainages as per direction by Environmental Specialist of the IE / SC / AE for three seasons in a year for 2 years of construction period	No. of Samples	48	2,000.00	96,000.00	0.010
2.1.2		Analysis charges of Ambient air from samples collected for parameters as per AAQ Standards Notification, 2009 in consultations and directions of the Consultant and NHAI as per MoEF&CC charges.	No. of Samples	48	4,000.00	1,92,000.00	0.019

Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Cr.
2.1.3	Water Quality	Collection of grab samples of water quality at 4 locations at chainages for twice a year in pre & post monsoon seasons for 2 years as per direction of Environmental Specialist of the PMC / SC / AE	No. of Samples	16	400.00	6,400.00	0.001
2.1.4		Analysis of water quality at locations in the monitoring plan for pH, Turbidity, total solids, COD, BOD, DO, Chlorides, Hardness, Oil & Grease, TSS, TDS, Total Coliform, Iron, Fluorides, Nitrates, E. coli, Total coliform and faecal coliform etc. as specified in "Standard Methods for Examination of Water and Wastewater" published by WEF, AWWA and APHA as per direction of Environmental Specialist of IE / SC / AE and as per MoEF&CC rate list.	No. of Samples	16	6,000.00	96,000.00	0.010
2.1.5	Noise	Monitoring Noise level at Sensitive area and Settlements using hand-held noise meters at 4 locations for once in a year for 2 years as per directions of Environmental Specialist of the IE / SC / AE	Nos.	24	1,500.00	36,000.00	0.004
2.1.6	Soil	Soil sampling at 3 locations at chainages identified by Environmental Specialist of the IE/ SC / AE for once a year for 2 year as per the Monitoring Plan given in EMP	Nos.	12	2,000.00	24,000.00	0.002
2.1.7	Transportation Cost	Transportation cost for monitoring of noise, air and water during construction period for 2 years.	L.S.	-	1,50,000.00	1,50,000.00	0.015
2.2	**Operation Stage**						
2.2.1	Air	Sampling and monitoring ambient Air	No. of	90	2,000.00	1,80,000.00	0.018

Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Cr.
		Quality and gaseous pollutants as per CPCB Standard Procedures at 3 locations including sensitive area and chainages as per direction by Environmental Specialist of Consultant for once in a season for 3 season in every year for 10 years	Samples				
2.2.2		Analysis charges of Ambient air from samples collected for parameters as per AAQ Standards Notification, 2009 in consultations and directions of the Consultant and PWD as per MoEF charges.	No. of Samples	90	4,000.00	3,60,000.00	0.036
2.2.3	Water Quality	Collection of grab samples of water quality at 2 locations at chainages for twice a year in pre & post monsoon seasons in every year for 10 years as per direction of Environmental Specialist / Environmental Engineer of the Consultant	No. of Samples	20	400.00	8,000.00	0.001
2.2.4		Analysis of water quality at locations in the monitoring plan for pH, Turbidity, total solids, COD, BOD, DO, Chlorides, Hardness, Oil & Grease, TSS, TDS, Total Coliform, Iron, Fluorides, Nitrates, E. coli, Total coliform and faecal coliform etc. as specified in "Standard Methods for Examination of Water and Wastewater" published by WEF, AWWA and APHA as per direction of Environmental Specialist / Environmental Engineer of the Consultant and as per MoEF rate list.	No. of Samples	20	6,000.00	1,20,000.00	0.012

Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Cr.
2.2.5	Noise	Monitoring Noise level at Sensitive area and Settlements using hand held noise meters at 3 locations for once in a season for three season in a year for 10 years as per directions of Environmental Specialist/ Environmental Engineer of the Monitoring Consultant	Nos.	90	1,500.00	2,25,000.00	0.023
2.2.6	Soil	Monitoring Soil at 2 locations at chainages identified by the Engineer as per directions of Environmental Specialist/ Environmental Engineer of the Engineer for once a year for 10 year as per the Monitoring Plan given in EMP	Nos.	20	2,000.00	40,000.00	0.004
2.2.7	Transportation Cost	Transportation cost for monitoring of noise, air and water during operation period for 10 years considering every year.	L.S.	10	5,00,000.00	50,00,000.00	0.500
TOTAL MONITORING COST						**65,33,400.00**	**0.653**
3	**MISCELLANEOUS COST**						
3.1	Training	Training	L.S.	-	2,50,000.00	2,50,000.00	0.025
3.2	Advocacy and Policy Making	Holding meetings for policy planning and subsequent review meetings with Revenue Department, Forest Department, local representatives, NGOs, etc. regarding development controls.	Year	13	15,000.00	1,95,000.00	0.020
3.3	Administrative Charges including logistics	Maintenance of vehicle with the Environment Cell, Data processing, administrative support, stationery etc.	Months	13	35,000.00	4,55,000.00	0.046
3.4	Miscellaneous	Digital Camera for the Environment Cell	No.	1	5,000.00	5,000.00	0.001

Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Cr.
	Items						
TOTAL MISCELLANEOUS COST						**9,05,000.00**	**0.091**
TOTAL COST						**11,60,08,400.00**	**11.601**
Contingency @ 5% on Total Environmental Cost						**58,00,420.00**	**0.580**
GRAND TOTAL						**12,18,08,820.00**	**12.181**

10 SUMMARY & CONCLUSION

10.1 Introduction

The proposed Bakarpur – Manikpur 4 lane highway as Feeder Corridor in the state of Bihar under Bharatmala Pariyojana highway starts from Sitalbari bypass (Ch: 0+000) near Bakarpur village in Saran district and terminate at (Ch 38+813) at SH-74 near Manikpur village in Muzaffarpur district of Bihar State. The proposed alignment traverses through the Tarwan Mangerpal, Manpur, Sarnarayan, Darihara nasikh, Darihara chaturbhuj, Bailka, Bhagwanpur, Keshopur, Manpura, Basarh, Harpur Basant, Birpur and Manikpur villages/towns in Sara, Vaishali and Muzaffarpur districts in the state of Bihar.

10.2 Need of the Project

The proposed project will improve connectivity from Patna, Saran, Vaishali and Muzaffarpur in the state of Bihar. The development of proposed highway will improve the connectivity between disricts of Bihar. The proposed highway will act as a significant axis of entry to / from different part of Bihar.

Moreover, the proposed highway facility will provide good riding quality, better safety and a reliable infrastructure. All these elements will result in cost savings and efficiency improvement.

10.3 Project Proponent

National Highways Authority of India (NHAI), an autonomous agency of the Government of India, is responsible for management of the network of national highways across the country. It is a nodal agency of the Ministry of Road Transport and Highways (MoRTH), Government of India. NHAI vision is to meet the nation's need for the provision and maintenance of national highways network to global standards and to meet user expectations in time-bound and cost-effective manner, within the strategic policy framework set by the Government of India and thus promoting economic well-being and quality of life of the people.

NHAI is the nodal authority / project proponent for the development of the highway project under present study.

10.4 Environmental Impact Assessment (EIA) Study

The study methodology for the EIA employs a simplistic approach in which the important environmental issues have been identified before initiation of the baseline study. Based on the identification baseline data along the proposed projectwas collected during the study period from December 2022 to February 2023 by Shree Krishna Analystical Services Pvt. Ltd., which is approved by MOEF&CC. This data has analysed to predict and quantify the impacts and suggest best suited mitigation measure to mitigate the identified impacts.

10.5 Policy, Legal and Administrative Framework

As part of the project execution, the following clearances and NOCs has to be obtained by NHAI & the Contractors:

- Prior Environmental Clearance from MoEF&CC under the purview of EIA Notification 2006 & its subsequent amendments, as the proposed project is a development of new national highway
- Forest clearance as the proposed alignment is passing through strip plantation along the existing roads/canals
- Prior permission for felling of trees from Forest dept. / District Authorities

- Compensate the affected households as per entitlement matrix based on Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation & Resettlement Act 2013. Following due procedure in th NH act 1956.
- Prior Environmental Clearance from MoEF&CC / SEIAA by the Contractors for sand and aggregate quarries, wherever and if required
- NOC and Consents under Air & Water Acts for establishing and operating the construction plants including but not limited to hot mix plants, WMM, crushers etc. from StatePollution Control Board
- NOC under the Hazardous and Other Wastes (Management and Trans-boundary Movement) Rules, 2016 & amended thereof from SPCB
- PUC certificate for use of vehicles for construction from Transport department
- NOC for water extraction for construction and allied works from Irrigation department
- Conversion of land use from the revenue department for setting camps and plants
- Approval of Independent Engineer / Supervision Consultant / Authority Engineer for location and layout of Camps & plants before start of Construction
- Approval of Independent Engineer / Supervision Consultant / Authority Engineer for Traffic Management Plan before start of Construction
- Approval of Independent Engineer / Supervision Consultant / Authority Engineer for the Emergency Action Plan for accidents responding to involving fuel & lubricants before the construction starts

10.6 Baseline Environmental Profile

10.6.1 Physical Environment

Climatology

In summer the climate of the project area is hot and dry but winter months are quite cool andpleasant. Winter comes towards the middle of October after the rains are over. The temperaturebegins falling and January is the coldest month of the year with mercury falling to about 5ºC. Theblowing of westerly wind accompanied by dust storms about the middle of March marks thebeginning of hot weather. The mercury starts shooting upward and May is the hottest month of the year when the maximum temperature goes up to 45ºC.

Topography

The proposed alignment mostly follows „plain" terrain. The elevation varies from~58 m to ~47 m above MSL at different locations. Average elevation of the project stretch is ~52 m above MSL.

Geology

Project region geological formation is Indo Gangetic alluvium. The silt brought down by the river Ganges and its tributaries since time immemorial has created the plains in project area. In the older alluvium, nodular segregations of the carbonate of line, known as knakar, are found. In many places the soil is Saliferous from which saltpeter is extracted.

Soil

The soil of the project affected area is found to be Clayey in nature.Soil samples were collected from 3 representative locations for assessment of soil characteristics for proposed project. pH of soil along project section were found in the range of 7.52 to 7.82, therefore the soil is slightly basic. Conductivity of soil in the proposed study area is found to be in the range of 298 µm/cm to 362

µmhos/cm. Available phosphorous in soil samples along the study area ranges from 45.5 mg/kg to 65.5 mg/kg. Potassium content as K in soil samples in the study area is found in the range of 152.5 mg/kg. to 174.5 mg/kg.

Ambient Air Quality (AAQ)

Ambient air quality monitoring has been done at evenly distributed 3 locationsalong the proposed alignment. The results indicate that all air quality parameters are within the standards specified in the NAAQS in absence of any major pollution generation activities near study area.

Ambient Noise Level (ANL)

Noise monitoring has been carried out once during the entire study period at 3 locations along the proposed alignment for a period of 24 hours. Day & Night-time Leq has been computed from the hourly Leq values as per standards. The Noise quality result shows that Leq Day time varies from from 46.2 to 47.1 dB(A) and LeqNighttime varies from 37.7 to 38.1 dB(A) and it is found well within the Standards.

Surface Water

Surface water quality along the project stretch was monitored at 3 representative locations along the proposed alignment as per the parameters laid down by Central Pollution Control Board for surface water quality criteria. The surface water results for project section showed that the pH of the collected Surface water in the study area was found to be in the range of 7.29 to 8.29. The value of TDS found to be in the range from 143 to 233 mg/L. The chloride and Sulphate values of the samples were observed from 24.5 to 37.5 mg/L and from 7.9 to 16.5 mg/L respectively. Dissolved oxygen found from 7.9 to 8.1 mg/L. Most of the trace metal concentration is observed below limit of quantification.

Ground Water

Keeping in view the importance of ground water to the local population, 3representative ground water sampling locations along the proposed alignment were identified and samples were analysed for assessment of ground water quality.

The results for project section shows that pH was found ranging from 6.93 to 8.04 in ground water samples taken along the proposed alignment. The chloride content varied between 28.49 to 52.49 mg/l. The Fluoride content was found within the maximum permissible limit (1.0 mg/l) in drinking water as prescribed by BIS. The concentration of Nitrate ranges between 2.0 to 4.3 mg/l. The concentration of iron in ground water has been found within the permissible limits at all locations.

10.6.2 Biological Environment

Protected Areas

The proposed alignment is neither passing through nor falling within 10.0km radius of the propsoed alignment. Therefore, Wildlife clearance is not required under Wildlife (Protection) Act, 1972.

Forest

As per the India State of Forest Report, 2019, the state of Bihar has only 6.9% of forest cover to its total geographic area. Legally this area has been classified into "Reserved Forest, Protected Forests, and Unclassified Forest" and their areas are 693 sq. km (0.75%), 5779 sq. km (6.14%) and 1 sq. km (0%) respectively. Per capita forest area in the state is 0.01 ha against the national average of 0.07 ha.

The proposed alignment is passing through strip plantation along the exiting roads/canals, which is declared as protected forests. The total protected forest area is approx. ~4.1 ha, hence, there will be diversion of forest land and necessary clearances shall be obtained as per requirements under Forest (Conservation) Act, 1980.

10.6.3 Social Environment

Census Profile

As per Census 2011, As per Census 2011, the total population of Bihar is 104,099,452 with the density as 94163 per sq.km. Sex ratio of Bihar is (918 females per 1000 males) is lower than that of many district falling along the proposed project road.

Workforce in Project area

The people in the villages are mostly engaged in the agricultural work and economy is largely based on agricultural activities. Some people are also working in nearby industries and brick kilns.

10.7 Public Interactions & Consultation

Public Interactions & consultations were conducted during the project preparations. The main purpose of these consultations was to know the community's reaction to the perceived impact of proposed project on the people at individual and settlement level.

10.8 Potential Environmental Impacts

The environmental components are mainly impacted during the construction and operational stages of the project and must be mitigated for and incorporated in the engineering design. Environmental mitigation measures represent the project's endeavour to reduce its environmental footprint to the minimum possible. These are conscious efforts from the project to reduce undesirable environmental impacts of the proposed activities and offset these to the degree practicable. Enhancement measures are project's efforts to gain acceptability in its area of influence. They reflect the pro-active approach of the project towards environmental management.Slight change in the micro-climate of the area is expected due to heat island effect as unpaved area will be converted into the paved road. However, Impact on the climate conditions from the proposed road project will not be significant in long run as removal of vegetation will be compensated by compensatory plantation.

10.8.1 Impact on Air Quality

There will be rise in PM levels during the construction activities, which shall again be within prescribed limit after the construction activities are over. The level of CO is likely to be increased, however, level shall remain within prescribed standards.

10.8.2 Impact on Noise Levels

The area is likely to experience an increment in noise level due to increase in vehicle density after road strengthening. Construction camp shall be established at least 1000m away from nearest habitation and forest area. Temporary noise barriers should be provided surrounding the high noise generating construction equipment during work near to settlement area. Avenue plantation have been proposed on either side of the highway to control the associated air and noise pollution.

10.8.3 Impact on Water Resources and Quality

The construction and operation of the proposed project roads will not have any major impacts on the surface water and the ground water quality in the area. Design made to avoid physical loss to the water bodies to the extent possible. Contamination to water bodies may result due to spilling of construction materials, oil, grease, fuel and paint in the construction camp. This will be more

prominent in case of locations where the project road crosses drains, ponds, etc. Silt fencing shall be provided along the major canals and pond. Oil interceptors are proposed near fuel handling areas.

10.8.4 Impact on Ecological Resources

Trees within ROW are likely to be affected due to the proposed development leading temporally loss of micro ecosystem. However, on the long run the impacts will be compensated in terms of compensatory and avenue plantation. The proposed alignment is passing through strip forests declared as protected forests alongside roads, canals and railway lines and approx. 4.1 ha. diversion of forest land is required.

10.8.5 Impact on Land

During the construction of the proposed project, the topography will change due to cuts & fills for project road and construction of project related structures etc. Provision of construction yard for material handling will also alter the existing topography. The change in topography will also be due to the probable induced developments of the project.

10.8.6 Social Impacts

About 203.2 ha total land is required for proposed project. Total 463 PAP has been identified during the social survey.

10.9 Analysis of Alternatives

Detailed analyses of the alternatives have been conducted taking into account both with and without project. The proposed development of partially greenfield highway is likely to have a positive impact on the economic value of the region. However, there are certain environment and social issue, these needs to be mitigated for sustainable development.

10.10 Mitigation Avoidance & Enhancement Measures

Mitigation and enhancement measures have been planned for identified adverse environmental impacts. The construction workers camp will be located at least 1000 m away from nearby habitations. Hot mix plants, batching plants, etc. will also be located more than 1000 m away from habitations and in downwind directions. Existing cross drainage structures have been planned to maintain for proper cross drainage. In order to compensate negative impacts on flora due to cutting of trees the project plans compensatory plantation in the ratio of 1:3 i.e. for every tree to be cut, ten trees will be planted. The project shall also witness the plantation of trees for providing aesthetic beauty and shade. As the space for compensatory plantation might not be adequate along the project road, this plantation shall be taken up by the forest department, after payment of the cost for raising and maintaining the saplings for five years. The project will take an opportunity to provide environmental enhancement measures to improve aesthetics in the project area. The planned environmental enhancement measures include plantation in available clear space in ROW, enhancement of water bodies etc. In order to avoid contamination of water bodies during construction Silt fencing, oil interceptors at storage areas and at construction yard have been proposed. The affected households shall be compensated as per the entitlement matrix based on Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation & Resettlement Act 201, following due procedure in NH Act 1956.

10.11 Institutional Requirements & Environmental Monitoring Plan

The responsibility of implementing the mitigation measures lies with environment team duly appointed by the Contractor/Concessionaire. The overall supervision of Environmental monitoring works during construction and operation stage shall be carried out by NHAI with the

help of the Monitoring Consultant / Supervision Consultant / Authority Engineer.To mitigate the potential negative impacts of proposed development and measurement the performance of mitigation measures, an Environmental Monitoring and Management Plan is developed. The formulation of an appropriate environmental monitoring plan and its diligent implementation are keys to overall success for the project.

10.12 Environmental Management Plan

Project specific environmental management plan have been prepared for ensuring the implementation of the proposed measures during construction phase of the project, implementation and supervision responsibilities. The cost forenvironmental management during construction has been indicated in EMP. The project impacts and management plan suggested thereof are summarized in next section.

10.13 Environment Impact & Management Matrix

Table 10-1: Environment Impact & Management Matrix

Particulars	Stages	Potential Impacts	Mitigation Measures
Physiographic Environment			
Topography	Preconstruction & Construction	• Slight changes are expected due to development of the road • Impacts are marginal, but permanent.	• Proper planning to keep the land reformation upto bare minimum • No new quarry for the project
Geology	Preconstruction & Construction	• Impacts are moderate because of extraction of sand	-
Climate			
Temperature / Rain fall / Humidity	Preconstruction & Construction	• Tree felling will have an impact of micro-climate of the area • Heat island effect due to increase in paved roads • Low spatially restricted short-term impact	• Compensatory plantation in 1:3 ratio of the trees to be cut • With the proposed avenue plantation scheme, the micro climate of the project corridor will be smoothened
Land			
Loss of Other Land	Design, Preconstruction & Construction	• Loss of Property & Livelihood	• Compensation applicable as per section RFCTLARR act
Induced Development	Preconstruction & Construction	• Insignificant change in the land use pattern	• Civil authorities to plan and guide any induced development under regulatory framework
Soil			
Soil Erosion	Preconstruction, Construction & Operation	• In Road slopes and spoils • Erosion in excavated areas	• Embankment protection through pitching & turfing • Regular water sprinkling in excavated areas
Contamination of Soil	Preconstruction, Construction & Operation	• Scarified bitumen wastes	• Hazardous and Other Wastes (Management and Trans-boundary Movement) Rules,

Particulars	Stages	Potential Impacts	Mitigation Measures
		• Oil and diesel spills • Emulsion sprayer and laying of hot mix • Production of hot mix and rejected materials • Residential facilities for the labour and officers	2016 • Oil Interceptor will be provided in storage areas for accidental spill of oil and diesel • Rejected material to be laid as directed by monitoring consultant. • Septic tank to be constructed for waste disposal.
Water			
Impact on Water Resource	Design, Preconstruction, Construction & Operation	• Depletion of ground water recharge • Contamination from fuel and lubricants & waste disposal in camp area • Contamination of surface water system due to run-off from road construction area	• Provision of Storage/harvesting structure of water, wherever feasible • Oil Interceptor and Septic tank in construction camp • Enforcement of Hazardous and Other Wastes (Management and Trans-boundary Movement) Rules, 2016 • Both side drain facility to suitably divert the run-off from roads
Air			
Dust generation	Preconstruction& Construction	• Shifting of utilities, removal of trees & vegetation, transportation of material	• Regular Sprinkling of Water • Fine materials to be completely covered, during transport and stocking. • Hot mix plant to be installed in down wind direction with at least 1000m distance from nearby settlement. • Regular monitoring of particulate matter in Ambient Air
Gaseous pollutants	Preconstruction, Construction & Operation	• Operation of Hot mix plant and vehicle operation for material transportation	• Air pollution Norms will be enforced. • Only PUC certified vehicle shall be deployed • Labourers will be provided with mask. • Regular gaseous pollution monitoring in ambient air
Ambient air quality	Operation	• Air pollution from traffic • CO level is likely to increase	• Compliance with statuary regulatory requirements
Noise			
Pre-Construction Activity	Pre-Construction	• Man, material and machinery movements	• No Horn Zone sign, Speed Barriers near sensitive receptors

Particulars	Stages	Potential Impacts	Mitigation Measures
		• Establishment of labour camps, onsite offices, stock yards and construction plants	• Camps will be setup more than 1000m away from settlements.
Construction Activity	Construction	• Operation of high noise equipment like hot mix plant, diesel generators etc. • Community residing near to the work zones.	• Camp will be setup more than 1000m away from the settlements, in down wind direction. • Noise pollution regulation to be monitored and enforced.
Operation Stage	Operation	• Indiscriminate blowing of horn near sensitive area	• Restriction on use of horns • No Horn Zone sign.
Ecology			
Flora	Preconstruction, Construction	• Loss of vegetation cover • Felling of ~1678 of trees in non forest area	• Felling of only unavoidable trees • Compensatory Plantation in the ratio of 1:3
Fauna	Preconstruction, Construction & Operation	• Loss of insect, avian and small mammalian species due to felling of trees • Impact on protected areas Conservation Reserve (if any) • Impact on migratory birds in wildlife Sanctuaries (if any) • Accidental run over	• Compensatory Plantation • Speed breaker, Signage and limit in sensitive areas • Construction of bridge over water channels
Social			
Socio Environment	Design, Preconstruction & Construction	• Loss of Property & Livelihood • Loss of CPRs, Religious Structures	• Compensation applicable as per section of RFCTLARR act following due procedure in NH act 1956 • Relocation of CPRs, Religious Structures to suitable place
Public Health and Road Safety			
Health and safety	• Preconstruction, Construction &Operation	• Psychological impacts on project affected people • Migration of worker may lead to sanitation problem creating congenial condition for disease vectors • Discomfort arising of air and noise pollution • Hazards of accident	• Continued consultation with PAPs and the competent authority for speedier settlements of appropriate compensation package and resettlement. • Ensuring sanitary measures at construction camp to prevent water borne disease and vector borne disease. • Provision for appropriate personal protective equipment like earplugs, gloves gumboot, and mask to the work force.

Particulars	Stages	Potential Impacts	Mitigation Measures
			• Safe traffic management at construction area. • Drive slow sign and speed barriers near community facilities like school, hospital, etc.

10.14 Conclusions

Based on the draft EIA study and surveys conducted for the proposed project, it can be safely concluded that associated potential adverse environmental impacts can be mitigated to an acceptable level by adequate implementation of the measures as stated in the draft EIA Report. Adequate provisions shall be made in the Project to cover the environmental mitigation and monitoring requirements, and their associated costs as suggested in environmental budget. The proposed project shall improve trade efficiency and bring economic growth. In terms of air and noise quality, the project shall bring considerable improvement to possible exposure levels to population.

11 DISCLOSURE OF CONSULTANT

Declaration by experts contributing to the draft EIA for Development of 4 lane Bakarpur-Manikpur section, starting from design km 0+000 at Sitalpur bypass of NH-19 near village Bakarpur in district Saran and terminate at design km 38+813 near village Manikpur merge into SH-74 in district Mujaffarpur in the state of Bihar (total length-38.813 km) under Bharatmala-Prayojana by M/s National Highway Authority of India.

I, hereby, certify that I was a part of the EIA team in the following capacity that developed the above draft EIA.

EIA Coordinator**:**

Name : Mr. Mayank Kumar

Signature & Date :

Period of Involvement : December 2022 to till Date

Contact information : **P and M Solution**
C-88, Sector 65 Noida, Uttar Pradesh

Functional Area Experts:

S.No	Name	EC/FAE	DETAILS	Signature
1.	Tapan Majumdar	FAE	HG, GEO	
2.	Jatin Kumar Srivastava	FAE	EB, SC,NV	
3.	Vikas Chand Tripathi	FAE	RH	
4.	Neha Singh	FAE	AP, AQ	
5.	Abhay Nath Mishra	FAE	SE	
6.	Hussain Ziauddin	FAE	SHW, WP	
7.	Poonam Kumari Mangalam	FAE	LU	

हिन्दी सारांश

4 लेन बकरपुर - मानिकपुर सेक्शन के निर्माण, बिहार राज्य में सारन जिले के बकरपुर गांव के पास NH-19 के सीतलपुर बाईपास *चेनेज* 0+000 *से* शुरू होकर मुजफ्फरपुर जिले में *चेनेज* 38+813 मानिकपुर गांव के पास SH-74 तक (कुल लम्बाई 38.813 किमी)

परियोजना प्रस्तावक: भारतीय राष्ट्रीय राजमार्ग प्राधिकरण
सड़क, परिवहन और राजमार्ग मंत्रालय, भारत सरका

पर्यावरण सलाहकार: पी एंड एम सोलूशन्स

मार्च 2023

भारतीय राष्ट्रीय राजमार्ग प्राधिकरण
पी एंड एम सोलूशन्स

विषयसूची

तालिकाओं की सूची

1.1 परिचय

भारतीय राष्ट्रीय राजमार्ग प्राधिकरण (NHAI) राष्ट्रीय राजमार्गों के प्रबंधन के लिए जिम्मेदार है और भारत सरकार के सड़क परिवहन और राजमार्ग मंत्रालय (MoRTH) की नोडल एजेंसी है। NHAI का उद्देश्य रणनीतिक नीति ढांचे के भीतर सबसे अधिक समयबद्ध और कम लागत से उपयोगकर्ता की अपेक्षाओं को पूरा करने के लिए राष्ट्रीय राजमार्ग नेटवर्क का प्रावधान और रखरखाव करना है। भारतमाला परियोजना के तहत भारत में माल ढुलाई की दक्षता में सुधार के लिए आर्थिक गलियारों, अंतर गलियारों और फीडर मार्गों के विकास के लिए एन.एच.ए.आई. नोडल प्राधिकरण/प्रस्तावक है। नए संरेखण के साथ प्रस्तावित राजमार्ग की परिकल्पना एक ऐसे क्षेत्र के माध्यम से की गई है जिसमें एक साथ विकास का लाभ होगा और साथ ही यात्रा के लिए कम दूरी तय करनी पड़ेगी।

प्रस्तावित राजमार्ग बकरपुर - मानिकपुर सेक्शन भारतमाला परियोजना के तहत बिहार राज्ये में 4 लेन संरेखण (ग्रीनफील्ड) का होगा, जोकि सीतलपुर बाईपास (Ch: 0+000) बकरपुर गांव के पास जिला सारन से शुरू-होकर SH-74 पर (Ch: 38+813) मानिकपुर गांव के पास जिला मुजफ्फरपुर, बिहार में समाप्त हो जाती है। प्रस्तावित प्रोजेक्ट की कुल लंबाई लगभग 38.813 किमी है परियोजना के लिए ROW 45 मीटर है। यह परियोजना बिहार राज्य के सारन, वैशाली और मुजफ्फरपुर जिलों में पड़ेगी।

1.2 परियोजना आवश्यकता

प्रस्तावित राजमार्ग आवश्यक है क्योंकि यह पटना, सारन, वैशाली और मुजफ्फरपुर के मध्य बेहतर यातायात को सुनिश्चित करेगी। इसके अतिरिक्त, प्रस्तावित हाईवे अच्छी गति, सेफ्टी और विश्वसनीय सुविधाएं प्रदान करेगा । ये सभी सुविधाएं धन बचत और उपयुक्त उपयोग को बढ़ावा देंगे

योजना की मुख्य विशेषताएं हैं:

- मौजूदा सड़कों की गुणवत्ता में सुधार।
- यातायात और माल ढुलाई के बेहतर प्रबंधन के लिए ग्रीनफील्ड हाईवे के निर्माण और विकास पर मुख्य जोर दिया जाएगा।

इसके अलावा, प्रस्तावित परियोजना से स्थानीय और क्षेत्रीय अर्थव्यवस्थाओं को कई गुना लाभ होंगे जोकि निम्नानुसार हैं:

- मोटरचालित और गैर-मोटर चालित वाहनों के माल ढुलाई और यात्रियों के लिए कम परिवहन लागत।
- सड़क के आसपास के गांवों के लिए बेहतर सड़क नेटवर्क कनेक्टिविटी।
- परियोजना सड़क में यातायात सुविधाओं और मात्रा में वृद्धि।
- स्थानीय लोगों के आर्थिक अवसरों/गतिविधियों में वृद्धि।
- प्रस्तावित सड़क के किनारे के गांवों के लिए बुनियादी सुविधाओं में वृद्धि।
- परियोजना प्रभाव क्षेत्र की ग्रामीण समृद्धि।
- पर्यटन को बढ़ावा देंना।
- कृषि, वाणिज्य, शिक्षा, स्वास्थ्य, सामाजिक कल्याण और सार्वजनिक सुरक्षा जैसे क्षेत्र की अर्थव्यवस्था में सुधार करना।

1.3 परियोजना क्षेत्र

प्रस्तावित 4 लेन संरेखण (ग्रीनफील्ड) राजमार्ग सेक्शन सीतलपुर बाईपास (Ch: 0+000) बकरपुर गांव के पास जिला सारन से शुरू-होकर SH-74 पर (Ch: 38+813) मानिकपुर गांव के पास जिला मुजफ्फरपुर, बिहार में समाप्त हो जाती है।

तालिका 1 : प्रस्तावित परियोजना का स्थान

क्रमिक संख्या	जिले का नाम	तालुक का नाम	गांव का नाम
1	सारन	दरियापुर	बरवा
2			दरिहर भुआलपुर/538
3			दरिहर निसाख
4			दरिहर चतुर्भुज
5			कोन्हवा
6			बेलहर जानकी
7			बेलहर फत्तू
8			खुशहालपुर
9			मनगरपाल मुर्तुज़ा
10			मनगरपाल नुरान
11			मानपुर
12			सराया
13			सरनारायण
14		सोनेपुर	अकिलपुर
15			बाकरपुर
16			चित्तरसेनपुर
17			दरियापुर
18			गोबिंद चक
19			इस्माइल चक
20			मखदुमपुर
21			परमानंदपुर
22			शिकारपुर
1	वैशाली	लालगंज	एतवारपुर जागीर
2			एतवारपुर निज़ामत
3			जलालपुर गोपी मल
4			जलालपुर गोपी मिल्की /109
5			जलालपुर उर्फ़ बिशुनपुर गंभीर / 113
6			जलालपुर /112
7			खानजहान चक उर्फ़ सैदनपुर / 102
8			पीरापुर उर्फ़ शाहाबाद
9			ताजपुर / 105
10			सरारिया उर्फ़ सारथी छपरा B
11			युसुफपुर
12		वैशाली	बैल्का
13			बसरह उर्फ़ वैशाली /43
14			बसरा उर्फ़ चक रामदत्त
15			भगवानपुर

क्रमिक संख्या	जिले का नाम	तालुक का नाम	गांव का नाम
16			हरपुर बसंत
17			जाफरहा
18			केशोपुर
19			खिजरपुर
20			मानपुरा
21			मुनीमचक
22			परशुरामपुर
23			रूकनपुर /18
1	मुजफ्फरपुर	सरैया	अबू चक
2			आनंदपुर सिंह
3			चक अब्दुल रहीम
4			मानिकपुर
5			मानिकपुर
6			पिपरा घुस

1.4 परियोजना प्रस्तावक

भारतीय राष्ट्रीय राजमार्ग प्राधिकरण (NHAI), भारत सरकार की एक स्वायत्त एजेंसी, देश भर में राष्ट्रीय राजमार्गों के नेटवर्क के प्रबंधन के लिए जिम्मेदार है। यह सड़क परिवहन और राजमार्ग मंत्रालय (MoRTH), भारत सरकार की एक नोडल एजेंसी है। NHAI की दृष्टि वैश्विक मानकों के लिए राष्ट्रीय राजमार्ग नेटवर्क के प्रावधान और रखरखाव के लिए देश की आवश्यकता को पूरा करना है और रणनीतिक नीति के भीतर समयबद्ध और कम लागत में उपयोगकर्ता की अपेक्षाओं को पूरा करना है। वर्तमान अध्ययन के तहत राजमार्ग परियोजना के विकास के लिए एन.एच.ए.आई नोडल प्राधिकरण परियोजना प्रस्तावक है।

1.5 परियोजना में पर्यावरणीय प्रभाव आकलन (ई.आई.ए.) अध्ययन

ई.आई.ए. अध्ययन के लिए एक सरल दृष्टिकोण पद्धति की पहचान की गई है जिसमें आधारभूत अध्ययन शुरू करने से पहले महत्वपूर्ण पर्यावरणीय मुद्दों की पहचान की गई है। पहचान के आधार पर प्रस्तावित परियोजना के लिए आधारभूत पर्यावरणीय आकड़े दिसंबर 2022 से फरवरी 2023 की अवधि के दौरान एकत्र किये गए। इन आकड़ो का प्रभावों की भविष्यवाणी और परिमाणित करने के लिए विश्लेषण किया है। और पहचाने गए प्रभावों को कम करने के लिए सबसे उपयुक्त शमन उपाय सुझाया है।

1.6 नीति, कानूनी और प्रशासनिक ढांचे

परियोजना निष्पादन के हिस्से के रूप में, एन.एच.ए.आई और डेवलपर को निम्नलिखित मंजूरी और एन.ओ.सी.लेना होगा:

- ई.आई.ए. अधिसूचना 2006 और उसके बाद के संशोधनों के दायरे में एम.ओ.ई.एफ और सी.सी से पूर्व पर्यावरण मंजूरी, क्योंकि प्रस्तावित परियोजना नए राष्ट्रीय राजमार्ग का विकास है।
- वन विभाग जिला प्राधिकारियों से पेड़ों की कटाई की पूर्व अनुमति।
- प्रभावित परिवारों को उचित मुआवजे और पारदर्शिता का अधिकार भूमि अधिग्रहण, पुनर्वास और पुनर्स्थापन अधिनियम 2013 मेंपात्रता मैट्रिक्स के अनुसार मुआवजा दिया जाएगा।
- रेत और कुलखदानों के लिए, जहां भी और यदि आवश्यक हो, ठेकेदारों द्वारा पर्यावरण एवं एम.ओ.ई.एफ और सी.सी/ एस.ई.आ.ई.ए.ए से पूर्व पर्यावरणीय मंजूरी।
- राज्य प्रदूषण नियंत्रण बोर्ड से हॉट मिक्स प्लांट, डब्ल्यू.एम.एम, क्रशर आदि सहित निर्माण संयंत्रों की स्थापना और संचालन के लिए वायु और जल अधिनियमों के तहत एन.ओ.सी और सहमति प्राप्त करनी होगी।
- एस. पी.सी.बी से खतरनाक और अन्य अपशिष्ट (प्रबंधन और सीमा पार आंदोलन) नियम, 2016 के तहत एन.ओ.सी।
- परिवहन विभाग से निर्माण के लिए वाहनों के उपयोग के लिए पीयूसी प्रमा णपत्र।
- निर्माण एवं सम्बद्ध कार्यों के लिए सिंचाई विभाग से जल निकासी हेतु अनापत्ति प्रमाण पत्र।
- राजस्व विभाग से कैंप वप्लांट लगाने के लिए भूमि उपयोग में परिवर्तन।
- निर्माण शुरू होने से पहले शिविरों और पौधों के स्थान और लेआउट के लिए निगरानी सलाहकार / पर्यवेक्षण सलाहकार / प्राधिकरण अभियंता की स्वीकृति।
- निर्माण शुरू होने से पहले यातायात प्रबंधन योजना के लिए निगरानी सलाहकार / पर्यवेक्षण सलाहकार / प्राधिकरण अभियंता की स्वीकृति।
- ईंधन शामिल होने पर होने वाली दुर्घटनाओं के लिए आपातकालीन कार्य योजना के लिए निगरानी सलाहकार/पर्यवेक्षण सलाहकार/प्राधिकरण अभियंता का अनुमोदन।

1.7 आधारभूत पर्यावरण प्रोफाइल

1.7.1 भौतिक वातावरण

जलवायु विज्ञानशास्त्र

परियोजना क्षेत्र की जलवायु गर्मियों में सामान्यतः गर्म और शुष्क होती है परन्तु सर्दिया काफी ठंडी और सुखद होती हे। वर्षा खतम हो जाने की बाद अक्टूबर महा में सर्दिया शुरू हो जाती हे, जनवरी महा सबसे ठंडा होता हे जिसमे तापमान 5°C तक निचे चला जाता हे । पश्चिमी हवा धूल और स्ट्रोम की साथ मार्च के मध्ये में गर्मियों की शुरुवात करती हे । मई सबसे गर्म महा हे जब अधिकतम तापमान 45°C तक चला जाता हे ।

तलरूप

प्रस्तावित संरेखण 'मैदान' इलाके का अनुसरण करता है। विभिन्न स्थानों पर ऊंचाई एम.एस.एल ~58 मीटर से ~47 मीटर तक है। परियोजना खंड की औसत ऊंचाई एम.एस.एल से ~52 मीटर ऊपर है।

मिट्टी

प्रोजेक्ट क्षेत्र में मिट्टी क्लाये प्रकृति की पायी गयी । प्रस्तावित राजमार्ग के लिए मिट्टी की विशेषताओं के आकलन के लिए 3 प्रतिनिधि स्थानों से मिट्टी के नमूने एकत्र किए गए थे। मिट्टी में pH की मात्रा 7.52 से 7.82 के बीच, मिट्टी में प्रवाहकत्त्व की मात्रा 298 µmhos/cm से 362 µmhos/cm के बीच, उपलब्ध फास्फोरस की मात्रा 45.5 mg/kg से 65.5 mg/kg के बीच, पोटैशियम तत्व की मात्रा 152.5 mg/kg से 174.5 mg/kg के बीच पायी गयी ।

परिवेश वायु गुणवत्ता (ए.ए.क्यू.)

प्रस्तावित संरेखण के साथ समान रूप से वितरित 3 स्थानों पर परिवेशी वायु गुणवत्ता निगरानी की गई है। परिणाम दर्शाते हैं कि अध्ययन क्षेत्र के निकट किसी भी प्रमुख प्रदूषण उत्पादन गतिविधियों के अभाव में सभी वायु गुणवत्ता मानदंड NAAQS में निर्दिष्ट मानकों के अनरूप पायी गयी है।

परिवेश शोर स्तर (ए.एन.एल)

प्रस्तावित संरेखण के साथ 3 स्थानों पर पूरे अध्ययन अवधि के दौरान एक बार शोर निरीक्षण किया जाता है (24 घण्टा की अवधि मै हर घंटे के समय अंतराल पर) प्रत्येक स्थान पर, प्रति घंटे की leq दर से दिन और रात के समय की Leq दर का निर्धारण किया गया है ताकि राष्ट्रीयपरिवेश शोर स्तर से तुलना कीजा सके। शोर की गुणवत्ता के परिणाम से पता चलता है कि Leq दिन के समय 46.2 से 47.1 dB (A) और Leq रात के समय 37.7 से 38.1 dB (A) तक होता है। शोर का स्तर मानकों के भीतर पाया गया।

सतही जल

सतही जल गुणवत्ता मानदंड के लिए केंद्रीय प्रदूषण नियंत्रण बोर्ड द्वारा निर्धारित मापदंडों के अनुसार प्रस्तावित संरेखण के साथ 3 स्थानों पर परियोजना खंड के साथ सतही जल की गुणवत्ता परीक्षण किया गया। परियोजना में सतही जल क्षारीय पाया गया जिसका pH 7.25 से 7.54 के बीच था। TDS की मात्रा 143 mg/l से 233 mg/l के बीच, क्लोराइड की मात्रा 24.5 mg/l से 37.5 mg/l के

बिच, सलफेट की मात्रा 7.9 mg/l से 16.5 mg/l के बिच, घुली हुए ऑक्सीजन 7.9 mg/l से 8.1 mg/l के बीच, अधिकतम ट्रेस मटेल की मात्रा गणनात्मक मात्रा से निचे पायी गई ।

भूजल

स्थानीय आबादी के लिये भूजल के महत्व को ध्यान में रखते हुए, भूजल नमूनो के लिये 3 स्थानों की पहचान की गई और भूजल की गुणवत्ता के आकलन के लिए विश्लेषण किया गया। पानी का विश्लेषण प्रयोगशाला में किया।

प्रोजेक्ट सेक्शन की परिणाम ये दर्शाते हे कि प्रस्तावित परियोजना की साथ लिए गए भूजल नमूनों में pH कि मात्रा 6.93 से 8.04 के बिच पायी गई| क्लोराइड की मात्रा 28.49 mg/l से 52.49 mg/l के बिच, फ्लोरिड की मात्रा भी अधिकतम अनुमेय मात्रा की भीतर ही पायी गयी जैसा की BIS ने पीने की पानी की लिए कहा हे, नाइट्रेट की मात्रा 2.0 से 4.3 mg/l के बिच पायी गई, सभी अस्थानो पर आयरन की मात्रा भी अधिकतम अनुमेय मात्रा की भीतर ही पायी गयी।

1.7.2 जैविक पर्यावरण

संरक्षित क्षेत्र

कोई वन्य जीव अभयारण्य या राष्ट्रीय उद्यान प्रस्तावित संरेखण के 10.0 किमी त्रिज्या के भीतर स्थित नहीं है। इसलिए, वन्यजीव (संरक्षण) अधिनियम, 1972 के तहत वन्यजीव मंजूरी की आवश्यकता नहीं है।

जंगल

प्रस्तावित परियोजना के विकास के लिए लगभग **4.108** हेक्टेयर संरक्षित वन भूमि को परिवर्तित किया जाएगा। प्रस्तावित संरेखण सड़कों और नहर के किनारे संरक्षित वन के रूप में अधिसूचित पट्टी वृक्षारोपण से गुजर रहा है। अतः वन भूमि का परिवर्तन के लिए वन संरक्षण अधिनियम 1980 लागू होगा।

1.7.3 सामाजिक वातावरण

जनसांख्यिकी रूपरेखा

2011 की जनगणना के अनुसार, बिहार राज्ये की कुल जनसंख्या 104,099,452 है जिसका घनत्व 1106 लोग /किमी है।

तालिका 2: परियोजना जिले की जनसांख्यिकी

क्रमांक	राज्य	ज़िला	जनसँख्या	जनसँख्या घनत्व पर किमी
1.	बिहार	सारन	3951862	2641
		वैशाली	3,495,021	1717
		मुजफ्फरपुर	4,801,062	1514

1.8 सार्वजनिक इंटरैक्शन और परामर्श

परियोजना की तैयारी के दौरान सार्वजनिक इंटरैक्शन और परामर्श आयोजित किए गए। इन परामर्शों का मुख्य उद्देश्य प्रस्तावित परियोजना के अनुमानित प्रभावों पर समुदाय की प्रतिक्रिया को जानना और गाव के स्तर पर निपटारा करना था।

1.9 संभावित पर्यावरण प्रभाव

पर्यावरण के घटक मुख्य रूप से परियोजना के निर्माण और परिचालन चरणों के दौरान प्रभावित होगे। इन प्रभावों को कम करने का प्रावधान अभियांत्रि की योजना मे सम्मिलित होगा। पर्यावरणीय समन उपाय परियोजना से होने वाले पर्यावरणीय प्रभाव को कम करने की कोशिश को प्रस्तुत करते है। पर्यावरणीय समन उपाय परियोजना के आवंधित पर्यावरणीय प्रभाव को कम करने की कोशिश है। पर्यावरणीय समन उपाय परियोजना प्रभावित क्षेत्रमें परियोजनाके लिए सकारात्मकता की कोशिश को उजागर करते है। वे पर्यावरण प्रबंधन के लिए परियोजना के समर्थक सक्रिय दृष्टिकोण को प्रतिबिंबित करतेहैं।गर्मी द्वीप प्रभाव के कारण क्षेत्र के सूक्ष्म जलवायु में मामूली बदलाव की उम्मीद है क्योंकि कच्चा क्षेत्र पक्की सड़क में परिवर्तित हो जाएगा। हालांकि, प्रस्तावित सड़क परियोजना से जलवायु की स्थिति पर प्रभाव लंबे समय में महत्वपूर्ण नहीं होगा क्योंकि वनस्पति को हटाने की भरपाई प्रतिपूरक वृक्षारोपण द्वारा की जाएगी।

1.9.1 वायु गुणवत्ता पर प्रभाव

प्रस्तावित सड़क की निर्माण गतिविधियों के दौरान पी.एम स्तर में वृद्धि होगी, जो निर्माण गतिविधियों के खत्म होने के बाद फिर से निर्धारित सीमा के भीतर होगी। CO का स्तर बढ़ने की संभावना है। हालांकि स्तर निर्धारित मान कों के भीतर ही रहेगा।

1.9.2 ध्वनि प्रदूषण स्तर पर प्रभाव

निर्माण स्थलनिकटतम आवास एवं वन क्षेत्र से कम से कम 1000 मीटर की दूरी पर स्थापित किया जाना चाहिए। बंदोबस्त क्षेत्र के निकट कार्य के दौरान उच्च ध्वनि उत्पन्न करने वाले निर्माण उपकरणों के आस-पास अस्थायी शोर अवरोधक उपलब्ध कराए जाने चाहिए। संबंधित वायु और ध्वनि प्रदूषण को नियंत्रित करने के लिए राजमार्ग के दोनों ओर एवेन्यू वृक्षारोपण का प्रस्ताव किया गया है।

1.9.3 जल संसाधन और गुणवत्ता पर प्रभाव

प्रस्तावित परियोजना सड़कों के निर्माण और संचालन से सतह के पानी और क्षेत्र में भूजल की गुणवत्ता पर कोई बड़ा प्रभाव नहीं पड़ेगा। अभियांत्रिकी योजना जल निकायो को संभावित हद तक नुकसान से बचाने के लिये बनायी गयी है ।

निर्माण सामग्री, तेल, ईंधन और पेंट के फैलाव के कारण जल निकाय का प्रदूषण होसकताहै। यह उन जगहों के मामले में अधिक प्रमुख होगा जहां परियोजना सड़क नदियों, नालियों आदि को पार करती है ।इन जल निकायों का प्रदूषण से बचने के लिए समय सीमा योजना बनाई गई है। ईंधन से निपटने वाले क्षेत्रों के पास तेल इंटरसेप्टर प्रस्तावित हैं ।

1.9.4 पारिस्थितिक संसाधनों पर प्रभाव

R.O.W. के भीतर पेड़ प्रभावित होने की संभावना है। जिसके कारण सुक्षम पारिस्थतकी तंत्र के अस्थायी रूप से नुकसान की संभावना है। क्षतिपूर्ति वनीकरण और मार्ग के दौनों ओर पौधे लगाने से पारिस्थतकी प्रभाव को लंबे समय मे क्षतिपूर्ण किया जा सकता है। हालांकि, लंबे समय तक क्षतिपूर्ति वनीकरण और एवेन्यू बागान के मामले में प्रभावों का मुआवजा दिया जाएगा। प्रस्तावित परियोजना रोड, कैनाल, रेलवे लाइन के साथ घोसित रक्षित वन भूमि से होकर गुजरता हे परियोजना के लिए लगभग 4.108 हे. वन भूमि की आवश्यक्ता होगी

1.9.5 भूमि पर प्रभाव

प्रस्तावित परियोजना के निर्माण के दौरान, प्रोजेक्ट रोड के लिए कटौती और भरने के कारण स्थलाकृति बदल जाएगी और परियोजना से संबंधित संरचनाओं का निर्माण इत्यादि। भौतिक हैंडलिंग के लिए निर्माण यार्ड का प्रावधान मौजूदा स्थलाकृति को भी बदल देगा। स्थलाकृति में परिवर्तन परियोजना के संभावित प्रेरित विकास के कारण भी होगा।

1.9.6 सामाजिक प्रभाव

प्रस्तावित राजमार्ग के लिए लगभग 203.2 हेक्टेयर भूमि की आवश्यकता होगी। सामाजिक सर्वे की दौरान लगभग लोगो को चिन्हित किया गया जो परियोजना से प्रभावित होंगे ।

1.10 विकल्पों का विश्लेषण

परियोजना के लिए दोनों विकल्पों का विस्तृत विस्लेशण किया गया है। प्रस्तावित सड़क को मजबूती प्रदान करने से इस क्षेत्र के आर्थिक मूल्य पर सकारात्मक प्रभाव पड़ सकता है। हालांकि, कुछ पर्यावरण और सामाजिक मुद्दे हैं, इन्हें सतत विकास के साथ काम किया जाना चाहिए।

1.11 शमन परिहार एक और संवर्धन के उपाय

प्रतिकूल पर्यावरणीय प्रभावों के लिए कमी और वृद्धि उपायों की योजना बनाई गई है। कर्मचारियों के लिए शिविर का निर्माण पास के निवास स्थान से कम से कम 1000 मीटर दूर स्थित होगा। निर्माण यार्ड, HMP संयंत्र इत्यादि हवा की दिशा के आपेक्ष और निवास स्थान से 1000 मीटर से अधिक दूर स्थित होंगे। उचित क्रॉस ड्रेनेज को बनाये रखने के लिए मौजूदा क्रॉस ड्रेनेज की योजना बनाई गयी है। वृक्षों के काटने के कारण फ्लोरा पर नकारात्मक प्रभावों की भर पाई करने के लिए परियोजना 1:3 के अनुपात में क्षतिपूर्ति वृक्षारोपण की योजना बनाई गई है। इस परियोजना में सौंदर्य और छाया

प्रदान करने के लिए पेड़ों के वृक्षारोपण को भी देखा जाएगा। चूंकि क्षतिपूर्ति वनीकरण के लिए जगह परियोजना सड़क के साथ पर्याप्त नहीं हो सकती है, इसलिए यह वृक्षारोपण जंगल विभाग द्वारा 5 साल तक पौधों को बढ़ाने और बनाए रखने के लिए भुगतान किया जाएगा। परियोजना क्षेत्र के सौंदर्य में सुधार के लिए पर्यावरणीय वृद्धि उपायों को प्रदान करने का अवसर लेगी। नियोजित पर्यावरणीय वृद्धि उपायों में ROW में उपलब्ध स्पष्ट स्थान, जल निकायों के संवर्द्धन आदि में वृक्षारोपण शामिल है। भंडारण क्षेत्रों और निर्माण यार्ड में सिल्ट फेंसिंग, ऑयल इंटरसेप्टर प्रस्तावित किए गए हैं। प्रभावित परिवारों कोउचित मुआवजे और पारदर्शिता का अधिकारभूमि अधिग्रहण, पुनर्वास और पुनर्स्थापन अधिनियम 2013 में पात्रता मैट्रिक्स के अनुसार मुआवजा दिया जाएगा।

1.12 संस्थागत आवश्यकताओं और पर्यावरण निगरानी योजना

शमन उपायों को लागू करने की ज़िम्मेदारी पर्यावरण टीम की होगी जो की ठेकेदार के द्वारा नियुक्त की गयी है। निर्माण और संचालन चरण के दौरान पर्यावरण कार्यों की समग्र निगरानी सलाहकार की मदद से NHAI द्वारा की जाएगी। प्रस्तावित विकास और माप के संभावित नकारात्मक प्रभावों को कम करने के लिए शमन उपायों के प्रदर्शन, पर्यावरण निगरानी और प्रबंधन के लिए योजना विकसित की गई है। उचित पर्यावरण निगरानी योजना ,निर्माण और इसका कार्यान्वयन परियोजना के लिए समग्र सफलता की कुंजी है।

1.13 पर्यावरण प्रबंधन योजना

परियोजना, कार्यान्वयन और पर्यवेक्षण जिम्मेदारियों के निर्माण चरण के दौरान प्रस्तावित उपायों के कार्यान्वयन को सुनिश्चित करने के लिए परियोजना विशिष्ट पर्यावरणीय प्रबंधन योजना तैयार की गई है। निर्माण के दौरान पर्यावरणीय प्रबंधन के लिए आने वाली लागत को ई.एम.पी में सांकेतिक किया गया है। प्रस्तावित परियोजना प्रभाव और प्रबंधन योजना का सारांश अगले खंड में किया गया है।

1.14 पर्यावरण प्रभाव और प्रबंधन मैट्रिक्स

तालिका 3 : पर्यावरण प्रभाव और प्रबंधन मैट्रिक्स

विवरण	चरणों	संभावित प्रभाव	शमन के उपाय
भौतिकविज्ञानपर्यावरण			
तलरूप	पूर्व निर्माण और निर्माण	• सड़क के विस्तार और सुधार के कारण थोड़ा बदलाव अपेक्षित हैं • प्रभाव मामूली, लेकिन स्थायी हैं।	• जितना हो सके भूमि सुधार करने की उचित योजना बनाना। • परियोजना के लिए कोई नई खदान का उपयोग नहीं करना।
भूगर्भशास्त्र	पूर्व-निर्माण और निर्माण	• रेत के निष्कर्षण की वजह से मामूली प्रभाव होगा।	-
जलवायु			
तापमान / बारिश /आर्द्रता	पूर्व-निर्माण और निर्माण	• वृक्ष गिरने से क्षेत्र के सूक्ष्म-जलवायु पर असर पड़ेगा	• काटे जाने वाले पेड़ों के 1:3 के अनुपात में प्रतिपूरक वृक्षारोपण होगा।

विवरण	चरणों	संभावित प्रभाव	शमन के उपाय
		• पक्की सड़कों में वृद्धि के कारण हीट द्वीप प्रभाव बढ़ेगा • प्रभाव काम समय और कुछ छेत्र तक ही सिमित रहेगा	• प्रस्तावित एवेन्यू बागान योजना के कारण, परियोजना गलियारे का सूक्ष्म वातावरण अच्छा हो जाएगा।
भूमि			
वन और पेड़ का नुकसान	पूर्व-निर्माण औरनिर्माण	• संपत्ति और आजीविका का नुकसान	• एल.ए.आर.आर, 2013 के अनुसार मुआवजा
अनुमानित विकास	पूर्व-निर्माण और निर्माण	• भूमि उपयोग पैटर्न में महत्वहीन परिवर्तन	• नागरिक विनियामक मौजूदा ढांचे का उपयोग कर के किसी भी अनुमानित विकास की योजना बनाने के लिए मार्गदर्शन करना।
मिट्टी			
मृदा अपरदन	पूर्व निर्माण, निर्माण और संचालन	• सड़क ढलानों में और नुक़सान के कारण • उत्खनन क्षेत्रों में क्षरण	• पिचिंग और टर्फिंग के माध्यम से तटबंध संरक्षण • उत्खनन क्षेत्रों में नियमित पानी छिड़कावसे
मृदाकाप्रदूषण	पूर्व-निर्माण, निर्माण औरसंचालन	• कंटियाचारकोलकचरे • तेल और डीजल का बिखरना • इमल्शन स्प्रेयर और गर्म मिश्रण डालना • गर्म मिश्रण का उत्पादन और अस्वीकृत सामग्री • मजदूरों और अधिकारियों के लिए आवासीय सुविधाएं	• खतरनाक वेस्ट प्रबंधन और हैंडलिंगनियम, 2016 लागू किया जाएगा। • तेल और डीजल के आकस्मिक फैलाव के लिए भंडारण क्षेत्रों में तेल इंटर सेप्टर प्रदान किया जाएगा • परामर्शदाता के निर्देश के अनुसार ही अस्वीकृत सामग्री को दूसरे स्थान पर डाला जाना चाहिए। • अपशिष्ट निपटान के लिए सेप्टिक टैंक का निर्माण किया जाएगा।
पानी			
जल संसाधन पर प्रभाव	डिजाइन, पूर्व निर्माण, निर्माण औरसंचालन	• भूजल रिचार्ज की कमी • शिविर क्षेत्र में ईंधन और स्नेहक और अपशिष्ट निपटान से प्रदूषण • सड़क निर्माण क्षेत्र से बारिश म बहने वाला सतही जल प्रणाली	• जहां भी हो सके, पानी की संग्रहण / कटाई संरचना का प्रावधान • निर्माण शिविर में तेल इंटर सेप्टर और सेप्टिक टैंक • खतरनाक अपशिष्टों का प्रबंधन और हैंडलिंगनियम, 2016 • सड़कों से बारिश में बहने वाला जल को उचित रूप से दोनों तर

विवरण	चरणों	संभावित प्रभाव	शमन के उपाय
		का प्रदूषण	फनाली बनाकर निकलना
वायु			
धूल उत्पादन	पूर्व-निर्माण और निर्माण	• उपयोगिताओं का स्थानांतरण, पेड़ों और वनस्पतियों कोह टाने, सामग्री का परिवहन	• पानी का नियमित छिड़काव • परिवहन और भंडारण के दौरान, सड़क बनाने की सामग्री को पूरी तरह से कवर किया जायेगा। • HMP को नीचे की ओर से कम से कम 1000 मीटर की दूरी के साथ नीचे हवा की दिशा में स्थापित किया जाना चाहिए। • परिवेश वायु में कण पदार्थ की नियमित निगरानी
गैसीय प्रदूषक	पूर्व निर्माण, निर्माण और संचालन	• सामग्री परिवहन वाहन के संचालन और HMP का संचालन	• वायु प्रदूषण मानदंड लागू किए जाएंगे। • केवल PUC प्रमाणित वाहन तैनात किया जाएगा • मजदूरों को मुखौटा प्रदान किया जाएगा। • परिवेश हवा में नियमित गैसीय प्रदूषण जांच की जाएगी
परिवेश वायु गुणवत्ता	ऑपरेशन	• यातायात से वायु प्रदूषण • CO स्तर में वृद्धि होने की संभावना है	• Statuary नियामक आवश्यकताओं के साथ अनुपालन
शोर			
पूर्वनिर्माणगतिविधि	पूर्वनिर्माण	• मनुष्य, सामग्री और मशीनों का संचालन • श्रम शिविरों, ऑनसाइट कार्यालयों, गोदाम और निर्माण संयंत्रों की स्थापना	• हॉर्नजोनव स्पीड बाधाओं के सूचक संवेधनशील रिसेप्टर्स के पास नहीं लगाए जाएंगे • नो हॉर्न जोन साइन, संवेदनशील रिसेप्टर्स के पास स्पीड बाधाएं • शिविरवास स्थान उपनिवेश /से 1000 मीटरसेअधिकदूरस्थापितकियाजाएगा ।
निर्माण गतिविधि	निर्माण	• HMP, डीजल जेनरेटर आदि जैसे उच्च शोर उपकरणों का संचालन • कार्यक्षेत्र के पास रहने वाले लोग।	• शिविर हवाओं की दिशा में, वास स्थान से 1000 मीटर से अधिक दूर स्थापित किया जाएगा। • शोर प्रदूषण विनिय मन की निगरानी और उन्हें लागू किया जाना चाहिए।
ऑपरेशनचरण	ऑपरेशन	• संवेदनशील क्षेत्र के पास हॉर्न का	• हॉर्न के अनावस्यक उपयोग पर प्रतिबंध

विवरण	चरणों	संभावित प्रभाव	शमन के उपाय
		अंधाधुंध बजाना	• हॉर्न नहीं संकेत सूचक
• परिस्थितिकी			
फ्लोरा	पूर्वनिर्माण, निर्माण	• वनस्पति कवर का नुकसान • लगभग 1678 पेड़ो का कटाव	• केवल अपरिहार्य पेड़ों की फेलिंग • 1:3 केअनुपात में पेड़ो का वनीकरण
पशुवर्ग	पूर्वनिर्माण, निर्माण और संचालन	• पेड़ों के गिरने के कारण कीट, पक्षी और छोटी स्तनधारी प्रजातियोंका नुकसान • दुर्घटनाग्रस्तरन	• नए पेड़ लगाना • संवेदनशील क्षेत्रों में धीमी गति से संबन्धित संकेत सूचक।
• सामाजिक			
सामाजिक पर्यावरण	डिजाइन, पूर्व निर्माण और निर्माण	• संपत्ति और आजीविका का नुकसान • सीपीआर का नुकसान, धार्मिक संरचनाएं	• एल.ए.आर.आर, 2013 के मुताबिक मुआवजा • सी.पी.आर, धार्मिक संरचनाओं का स्थानांतरण उपयुक्त जगह पर
• सार्वजनिक स्वास्थ्य और सड़क सुरक्षा			
स्वास्थ्य औरसुरक्षा	• पूर्वनिर्माण, निर्माण और संचालन	• परियोजना से प्रभावित लोगों पर मनोवैज्ञानिक प्रभाव • कामगारों के मजदूरों/ से स्वच्छता से प्रवास समस्या संबन्धित बीमारी से होने उत्पन्न लिए के कारको उत्पन्न स्थिति अनुकूल है। सकती हो • हवा और शोर प्रदूषण से उत्पन्न असुविधा • दुर्घटना के खतरे	• उचित मुआवजे और पुनर्वास के त्वरित निपटान के लिए परियोजना से प्रभावित व्यक्तियों और सक्षम प्राधिकारी के साथ सतत परामर्श। • पानी और वेक्टरों से उत्पन्न होने वाली बीमारी को रोकने के लिए निर्माण शिविर में स्वच्छता उपायों को सुनिश्चित किया जाएगा। • कान के प्लग, दस्ताने,गमबूट औरमुखोटा जैसे उचित व्यक्तिगत सुरक्षात्मक उपकरणो केलिएप्रावधान। • निर्माण क्षेत्र में सुरक्षित यातायात प्रबंधन। • विद्यालय, अस्पताल इत्यादि जैसी सामुदायिक सुविधाओं के पास धीमी गति और गतिवाधाओं के संकेतसूचक की व्यवस्था ।

1.15 निष्कर्ष

ई.आई.ए अध्ययन और परियोजना के लिए किए गए सर्वेक्षणों के आधार पर यह निष्कर्ष निकाला जा सकता है कि ई.आई.ए. रिपोर्ट में बताए गए उपायों के पर्याप्त कार्यान्वयन से संबंधित संभावित प्रतिकूल पर्यावरणीय प्रभावों को स्वीकार्य स्तर पर कम किया जा सकता है। पर्यावरणीय बजट में सुझाए गए पर्यावरणीय शमन और निरीक्षण आवश्यकताओं और उनसे संबंधित लागत को पूर्ण करने के लिए परियोजना में पर्याप्त प्रावधान किए जाएंगे। प्रस्तावित परियोजना सड़को में सुधार के साथ साथ आर्थिक विकास भी लाएगी। परियोजना वायु और शोर गुणवत्ता से संबन्धित संभावित जोखिम स्तर में काफी सुधार लाएगी।

ENGLISH SUMMARY

Development of 4 lane Bakarpur-Manikpur Section, Starting from design km 0.000 at Sitalpur bypass of NH-19 near village Bakarpur in district Saran and terminate at design km 38.813 near village Manikpur merge into SH-74 in district Muzaffarpur in the state of Bihar (Total length-38.813km)

Project Proponent : National Highway Authority of India
Ministry of Road, Transport & Highways, Govt. of India

Environmental Consultant: P and M Solutions

March 2023

For National Highway Authority of India

P and M Solutions

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1 EXECUTIVE SUMMARY

1.1 Introduction

National Highway Authority of India (NHAI) is responsible for management of national highways and is the nodal agency of Ministry of Road Transport and Highways (MoRTH), Government of India. NHAI aims at provision and maintenance of national highways network to meet user expectations in the most time-bound and cost-effective manner within the strategic policy framework. NHAI is the nodal authority/proponent for the Development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojana.

The proposed Bakarpur – Manikpur 4 lane highway as Feeder Corridor in the state of Bihar under Bharatmala Pariyojana highway starts from Sitalbari bypass (Ch: 0+000) near Bakarpur village in Saran district and terminate at (Ch 38+813) at SH-74 near Manikpur village in Muzaffarpur district of Bihar State. The proposed alignment traverses through the Tarwan Mangerpal, Manpur, Sarnarayan, Darihara nasikh, Darihara chaturbhuj, Bailka, Bhagwanpur, Keshopur, Manpura, Basarh, Harpur Basant, Birpur and Manikpur villages/towns in Sara, Vaishali and Muzaffarpur districts in the state of Bihar.

1.2 Need of the Project

The proposed project will improve connectivity from Patna, Saran, Vaishali and Muzaffarpur in the state of Bihar. The development of proposed highway will improve the connectivity between disricts of Bihar. The proposed highway will act as a significant axis of entry to / from different part of Bihar. The key highlights of the scheme are:

- Improving the quality of existing roads
- The main stress will be given on the construction and development of Greenfield highway for better management of traffic and freight.

Further, the proposed project will have multi-fold benefits for the local and regional economies as follows:

- Connectivity to the important towns
- Lower transport costs for freight and passengers of motorized and non-motorised vehicles;
- Improved Road network connectivity to the villages in the vicinity of the road;
- Enhanced traffic facilities and volume in the project road;
- Enhancement in economic opportunities/activities of the local people;
- Enhanced basic amenities to the villages along the proposed road;
- Rural prosperity of the project influence area;
- Elevate tourism
- Improve the economy of the area like agriculture, commerce, education, health, social welfare and public safety

1.3 Project Area

The proposed development of four lane highway starts from Sitalbari bypass (Ch: 0+000) near Bakarpur village in Saran district and terminate at (Ch 38+813) at SH-74 near Manikpur village in Muzaffarpur district of Bihar State. Total length of the proposed alignment is 38.813km. List of project affected villages are givem in below table.

Table 1: List of affected villages along the Project Highway

S. No.	District	Name of the Taluk	Name of the Village
1	Saran	Dariyapur	Barwa
2		Dariyapur	Darihar Bhualpur/538
3		Dariyapur	Darihara Nisakh
4		Dariyapur	Darihara Chaturbhuj
5		Dariyapur	Konhwa
6		Dariyapur	Belhar Janki
7		Dariyapur	Belhar Fattu
8		Dariyapur	Khushihal pur
9		Dariyapur	Mangarpal Murtuza
10		Dariyapur	Mangarpal Nuran
11		Dariyapur	Manpur
12		Dariyapur	Saraia
13		Dariyapur	Sarnarayan
14		Sonepur	Akilpur
15		Sonepur	Baqarpur
16		Sonepur	Chitarsenpur
17		Sonepur	Dariyapur
18		Sonepur	Gobind Chak
19		Sonepur	Ismail Chak
20		Sonepur	Makhdumpur
21		Sonepur	Parmanandpur
22		Sonepur	Shikarpur
1	Vaishali	Lalganj	Etwarpur Jagir
2		Lalganj	Etwarpur Nizamat
3		Lalganj	Jalalpur Gopi Mal
4		Lalganj	Jalalpur Gopi Milki/109
5		Lalganj	Jalalpur urf Bishunpur Gamhir/ 113
6		Lalganj	Jalalpur/112
7		Lalganj	Khanjahan Chak urf Saidanpur/ 102
8		Lalganj	Pirapur Urf Shahabad
9		Lalganj	Tajpur / 105
10		Lalganj	Sararia Urf Saranthi Chhapra B
11		Lalganj	Yusufpur
12		Vaishali	Bailka
13		Vaishali	Basarh urf Vaishali/43
14		Vaishali	Basra urf Chak Ramdat
15		Vaishali	Bhagwanpur
16		Vaishali	Harpur Basant
17		Vaishali	Jafraha
18		Vaishali	Keshopur
19		Vaishali	khijirpur
20		Vaishali	Manpura
21		Vaishali	Munimchak
22		Vaishali	Parsurampur
23		Vaishali	Rukanpur/18
1	Muzaffarpur	Saraiya	Abu Chak
2			Anandpur Singh
3			Chak Abdul Rahim
4			Manikpur
5			Manikpur
6			Pipra Ghaus

1.4 Project Proponent

National Highways Authority of India (NHAI), an autonomous agency of the Government of India, is responsible for management of the network of national highways across the country. It is a nodal agency of the Ministry of Road Transport and Highways (MoRTH), Government of India. NHAI vision is to meet the nation's need for the provision and maintenance of national highways network to global standards and to meet user expectations in time-bound and cost-effective manner, within the strategic policy framework set by the Government of India and thus promoting economic well-being and quality of life of the people.

NHAI is the nodal authority / project proponent for the development of the highway project under present study.

1.5 Environmental Impact Assessment (EIA) Study

The study methodology for the EIA employs a simplistic approach in which the important environmental issues have been identified before initiation of the baseline study. Based on the identification baseline data along the proposed projectwas collected during the study period from December 2022 to February 2023 by Shree Krishna Analystical Services Pvt. Ltd., which is approved by MOEF&CC. This data has analysed to predict and quantify the impacts and suggest best suited mitigation measure to mitigate the identified impacts.

1.6 Policy, Legal and Administrative Framework

As part of the project execution, the following clearances and NOCs has to be obtained by NHAI & the Contractors:

- Prior Environmental Clearance from MoEF&CC under the purview of EIA Notification 2006 & its subsequent amendments, as the proposed project is a development of new national highway
- Forest clearance as the proposed alignment is passing through strip plantation along the existing roads/canals
- Prior permission for felling of trees from Forest dept. / District Authorities
- Compensate the affected households as per entitlement matrix based on Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation & Resettlement Act 2013. Following due procedure in th NH act 1956.
- Prior Environmental Clearance from MoEF&CC / SEIAA by the Contractors for sand and aggregate quarries, wherever and if required
- NOC and Consents under Air & Water Acts for establishing and operating the construction plants including but not limited to hot mix plants, WMM, crushers etc. from StatePollution Control Board
- NOC under the Hazardous and Other Wastes (Management and Trans-boundary Movement) Rules, 2016 & amended thereof from SPCB
- PUC certificate for use of vehicles for construction from Transport department
- NOC for water extraction for construction and allied works from Irrigation department
- Conversion of land use from the revenue department for setting camps and plants
- Approval of Independent Engineer / Supervision Consultant / Authority Engineer for location and layout of Camps & plants before start of Construction
- Approval of Independent Engineer / Supervision Consultant / Authority Engineer for Traffic Management Plan before start of Construction

- Approval of Independent Engineer / Supervision Consultant / Authority Engineer for the Emergency Action Plan for accidents responding to involving fuel & lubricants before the construction starts

1.7 Baseline Environmental Profile

1.7.1 Physical Environment

Climatology

In summer the climate of the project area is hot and dry but winter months are quite cool andpleasant. Winter comes towards the middle of October after the rains are over. The temperaturebegins falling and January is the coldest month of the year with mercury falling to about 5ºC. Theblowing of westerly wind accompanied by dust storms about the middle of March marks thebeginning of hot weather. The mercury starts shooting upward and May is the hottest month of the year when the maximum temperature goes up to 45ºC.

Topography

The proposed alignment mostly follows „plain" terrain. The elevation varies from~58 m to ~47 m above MSL at different locations. Average elevation of the project stretch is ~52 m above MSL.

Geology

Project region geological formation is Indo Gangetic alluvium. The silt brought down by the river Ganges and its tributaries since time immemorial has created the plains in project area. In the older alluvium, nodular segregations of the carbonate of line, known as knakar, are found. In many places the soil is Saliferous from which saltpeter is extracted.

Soil

The soil of the project affected area is found to be Clayey in nature.Soil samples were collected from 3 representative locations for assessment of soil characteristics for proposed project. pH of soil along project section were found in the range of 7.52 to 7.82, therefore the soil is slightly basic. Conductivity of soil in the proposed study area is found to be in the range of 298 µm/cm to 362 µmhos/cm. Available phosphorous in soil samples along the study area ranges from 45.5 mg/kg to 65.5 mg/kg. Potassium content as K in soil samples in the study area is found in the range of 152.5 mg/kg. to 174.5 mg/kg.

Ambient Air Quality (AAQ)

Ambient air quality monitoring has been done at evenly distributed 3 locationsalong the proposed alignment. The results indicate that all air quality parameters are within the standards specified in the NAAQS in absence of any major pollution generation activities near study area.

Ambient Noise Level (ANL)

Noise monitoring has been carried out once during the entire study period at 3 locations along the proposed alignment for a period of 24 hours. Day & Night-time Leq has been computed from the hourly Leq values as per standards. The Noise quality result shows that Leq Day time varies from from 46.2 to 47.1 dB(A) and LeqNighttime varies from 37.7 to 38.1 dB(A) and it is found well within the Standards.

Surface Water

Surface water quality along the project stretch was monitored at 3 representative locations along the proposed alignment as per the parameters laid down by Central Pollution Control Board for surface water quality criteria. The surface water results for project section showed that the pH of the collected Surface water in the study area was found to be in the range of 7.29 to 8.29. The value of TDS found to be in the range from 143 to 233 mg/L. The chloride and Sulphate values of the samples were observed from 24.5 to 37.5 mg/L and from 7.9 to 16.5 mg/L respectively. Dissolved

oxygen found from 7.9 to 8.1 mg/L. Most of the trace metal concentration is observed below limit of quantification.

Ground Water

Keeping in view the importance of ground water to the local population, 3representative ground water sampling locations along the proposed alignment were identified and samples were analysed for assessment of ground water quality.

The results for project section shows that pH was found ranging from 6.93 to 8.04 in ground water samples taken along the proposed alignment. The chloride content varied between 28.49 to 52.49 mg/l. The Fluoride content was found within the maximum permissible limit (1.0 mg/l) in drinking water as prescribed by BIS. The concentration of Nitrate ranges between 2.0 to 4.3 mg/l. The concentration of iron in ground water has been found within the permissible limits at all locations.

1.7.2 Biological Environment

Protected Areas

The proposed alignment is neither passing through nor falling within 10.0km radius of the propsoed alignment. Therefore, Wildlife clearance is not required under Wildlife (Protection) Act, 1972.

Forest

As per the India State of Forest Report, 2019, the state of Bihar has only 6.9% of forest cover to its total geographic area. Legally this area has been classified into "Reserved Forest, Protected Forests, and Unclassified Forest" and their areas are 693 sq. km (0.75%), 5779 sq. km (6.14%) and 1 sq. km (0%) respectively. Per capita forest area in the state is 0.01 ha against the national average of 0.07 ha.

The proposed alignment is passing through strip plantation along the exiting roads/canals, which is declared as protected forests. The total protected forest area is approx. ~4.1 ha, hence, there will be diversion of forest land and necessary clearances shall be obtained as per requirements under Forest (Conservation) Act, 1980.

1.7.3 Social Environment

Census Profile

As per Census 2011, As per Census 2011, the total population of Bihar is 104,099,452 with the density as 94163 per sq.km. Sex ratio of Bihar is (918 females per 1000 males) is lower than that of many district falling along the proposed project road.

Table 2: Demographic Profile of the Project districts

Sl. No.	State	District	Population	Population Density (per sq.m.)
1.	Bihar	Saran	3951862	2641
2.		Vaishali	3,495,021	1717
3.		Muzafarpur	4,801,062	1514

Workforce in Project area

The people in the villages are mostly engaged in the agricultural work and economy is largely based on agricultural activities. Some people are also working in nearby industries and brick kilns.

1.8 Public Interactions & Consultation

Public Interactions & consultations were conducted during the project preparations. The main purpose of these consultations was to know the community's reaction to the perceived impact of proposed project on the people at individual and settlement level.

1.9 Potential Environmental Impacts

The environmental components are mainly impacted during the construction and operational stages of the project and must be mitigated for and incorporated in the engineering design. Environmental mitigation measures represent the project's endeavour to reduce its environmental footprint to the minimum possible. These are conscious efforts from the project to reduce undesirable environmental impacts of the proposed activities and offset these to the degree practicable. Enhancement measures are project's efforts to gain acceptability in its area of influence. They reflect the pro-active approach of the project towards environmental management.Slight change in the micro-climate of the area is expected due to heat island effect as unpaved area will be converted into the paved road. However, Impact on the climate conditions from the proposed road project will not be significant in long run as removal of vegetation will be compensated by compensatory plantation.

1.9.1 Impact on Air Quality

There will be rise in PM levels during the construction activities, which shall again be within prescribed limit after the construction activities are over. The level of CO is likely to be increased, however, level shall remain within prescribed standards.

1.9.2 Impact on Noise Levels

The area is likely to experience an increment in noise level due to increase in vehicle density after road strengthening. Construction camp shall be established at least 1000m away from nearest habitation and forest area. Temporary noise barriers should be provided surrounding the high noise generating construction equipment during work near to settlement area. Avenue plantation have been proposed on either side of the highway to control the associated air and noise pollution.

1.9.3 Impact on Water Resources and Quality

The construction and operation of the proposed project roads will not have any major impacts on the surface water and the ground water quality in the area. Design made to avoid physical loss to the water bodies to the extent possible. Contamination to water bodies may result due to spilling of construction materials, oil, grease, fuel and paint in the construction camp. This will be more prominent in case of locations where the project road crosses drains, ponds, etc. Silt fencing shall be provided along the major canals and pond. Oil interceptors are proposed near fuel handling areas.

1.9.4 Impact on Ecological Resources

Trees within ROW are likely to be affected due to the proposed development leading temporally loss of micro ecosystem. However, on the long run the impacts will be compensated in terms of compensatory and avenue plantation. The proposed alignment is passing through strip forests declared as protected forests alongside roads, canals and railway lines and approx. 4.1 ha. diversion of forest land is required.

1.9.5 Impact on Land

During the construction of the proposed project, the topography will change due to cuts & fills for project road and construction of project related structures etc. Provision of construction yard for material handling will also alter the existing topography. The change in topography will also be due to the probable induced developments of the project.

1.9.6 Social Impacts

About 203.2 ha total land is required for proposed project. Total 463 PAP has been identified during the social survey.

1.10 Analysis of Alternatives

Detailed analyses of the alternatives have been conducted taking into account both with and without project. The proposed development of partially greenfield highway is likely to have a positive impact

on the economic value of the region. However, there are certain environment and social issue, these needs to be mitigated for sustainable development.

1.11 Mitigation Avoidance & Enhancement Measures

Mitigation and enhancement measures have been planned for identified adverse environmental impacts. The construction workers camp will be located at least 1000 m away from nearby habitations. Hot mix plants, batching plants, etc. will also be located more than 1000 m away from habitations and in downwind directions. Existing cross drainage structures have been planned to maintain for proper cross drainage. In order to compensate negative impacts on flora due to cutting of trees the project plans compensatory plantation in the ratio of 1:3 i.e. for every tree to be cut, ten trees will be planted. The project shall also witness the plantation of trees for providing aesthetic beauty and shade. As the space for compensatory plantation might not be adequate along the project road, this plantation shall be taken up by the forest department, after payment of the cost for raising and maintaining the saplings for five years. The project will take an opportunity to provide environmental enhancement measures to improve aesthetics in the project area. The planned environmental enhancement measures include plantation in available clear space in ROW, enhancement of water bodies etc. In order to avoid contamination of water bodies during construction Silt fencing, oil interceptors at storage areas and at construction yard have been proposed. The affected households shall be compensated as per the entitlement matrix based on Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation & Resettlement Act 201, following due procedure in NH Act 1956.

1.12 Institutional Requirements & Environmental Monitoring Plan

The responsibility of implementing the mitigation measures lies with environment team duly appointed by the Contractor/Concessionaire. The overall supervision of Environmental monitoring works during construction and operation stage shall be carried out by NHAI with the help of the Monitoring Consultant / Supervision Consultant / Authority Engineer.To mitigate the potential negative impacts of proposed development and measurement the performance of mitigation measures, an Environmental Monitoring and Management Plan is developed. The formulation of an appropriate environmental monitoring plan and its diligent implementation are keys to overall success for the project.

1.13 Environmental Management Plan

Project specific environmental management plan have been prepared for ensuring the implementation of the proposed measures during construction phase of the project, implementation and supervision responsibilities. The cost forenvironmental management during construction has been indicated in EMP. The project impacts and management plan suggested thereof are summarized in next section.

1.14 Environment Impact & Management Matrix

Table 3: Environment Impact & Management Matrix

Particulars	Stages	Potential Impacts	Mitigation Measures
Physiographic Environment			
Topography	Preconstruction & Construction	• Slight changes are expected due to development of the road • Impacts are marginal, but permanent.	• Proper planning to keep the land reformation upto bare minimum • No new quarry for the project
Geology	Preconstruction & Construction	• Impacts are moderate because of extraction of sand	-

Particulars	Stages	Potential Impacts	Mitigation Measures
Climate			
Temperature / Rain fall / Humidity	Preconstruction & Construction	• Tree felling will have an impact of micro-climate of the area • Heat island effect due to increase in paved roads • Low spatially restricted short-term impact	• Compensatory plantation in 1:3 ratio of the trees to be cut • With the proposed avenue plantation scheme, the micro climate of the project corridor will be smoothened
Land			
Loss of Other Land	Design, Preconstruction & Construction	• Loss of Property & Livelihood	• Compensation applicable as per section RFCTLARR act
Induced Development	Preconstruction & Construction	• Insignificant change in the land use pattern	• Civil authorities to plan and guide any induced development under regulatory framework
Soil			
Soil Erosion	Preconstruction, Construction & Operation	• In Road slopes and spoils • Erosion in excavated areas	• Embankment protection through pitching & turfing • Regular water sprinkling in excavated areas
Contamination of Soil	Preconstruction, Construction & Operation	• Scarified bitumen wastes • Oil and diesel spills • Emulsion sprayer and laying of hot mix • Production of hot mix and rejected materials • Residential facilities for the labour and officers	• Hazardous and Other Wastes (Management and Trans-boundary Movement) Rules, 2016 • Oil Interceptor will be provided in storage areas for accidental spill of oil and diesel • Rejected material to be laid as directed by monitoring consultant. • Septic tank to be constructed for waste disposal.
Water			
Impact on Water Resource	Design, Preconstruction, Construction & Operation	• Depletion of ground water recharge • Contamination from fuel and lubricants & waste disposal in camp area • Contamination of surface water system due to run-off from road construction area	• Provision of Storage/harvesting structure of water, wherever feasible • Oil Interceptor and Septic tank in construction camp • Enforcement of Hazardous and Other Wastes (Management and Trans-boundary Movement) Rules, 2016 • Both side drain facility to suitably divert the run-off from roads
Air			

Particulars	Stages	Potential Impacts	Mitigation Measures
Dust generation	Preconstruction& Construction	• Shifting of utilities, removal of trees & vegetation, transportation of material	• Regular Sprinkling of Water • Fine materials to be completely covered, during transport and stocking. • Hot mix plant to be installed in down wind direction with at least 1000m distance from nearby settlement. • Regular monitoring of particulate matter in Ambient Air
Gaseous pollutants	Preconstruction, Construction & Operation	• Operation of Hot mix plant and vehicle operation for material transportation	• Air pollution Norms will be enforced. • Only PUC certified vehicle shall be deployed • Labourers will be provided with mask. • Regular gaseous pollution monitoring in ambient air
Ambient air quality	Operation	• Air pollution from traffic • CO level is likely to increase	• Compliance with statuary regulatory requirements
Noise			
Pre-Construction Activity	Pre-Construction	• Man, material and machinery movements • Establishment of labour camps, onsite offices, stock yards and construction plants	• No Horn Zone sign, Speed Barriers near sensitive receptors • Camps will be setup more than 1000m away from settlements.
Construction Activity	Construction	• Operation of high noise equipment like hot mix plant, diesel generators etc. • Community residing near to the work zones.	• Camp will be setup more than 1000m away from the settlements, in down wind direction. • Noise pollution regulation to be monitored and enforced.
Operation Stage	Operation	• Indiscriminate blowing of horn near sensitive area	• Restriction on use of horns • No Horn Zone sign.
Ecology			
Flora	Preconstruction, Construction	• Loss of vegetation cover • Felling of ~1678 of trees in non forest area	• Felling of only unavoidable trees • Compensatory Plantation in the ratio of 1:3

Particulars	Stages	Potential Impacts	Mitigation Measures
Fauna	Preconstruction, Construction & Operation	• Loss of insect, avian and small mammalian species due to felling of trees • Impact on protected areas Conservation Reserve (if any) • Impact on migratory birds in wildlife Sanctuaries (if any) • Accidental run over	• Compensatory Plantation • Speed breaker, Signage and limit in sensitive areas • Construction of bridge over water channels
Social			
Socio Environment	Design, Preconstruction & Construction	• Loss of Property & Livelihood • Loss of CPRs, Religious Structures	• Compensation applicable as per section of RFCTLARR act following due procedure in NH act 1956 • Relocation of CPRs, Religious Structures to suitable place
Public Health and Road Safety			
Health and safety	• Preconstruction, Construction &Operation	• Psychological impacts on project affected people • Migration of worker may lead to sanitation problem creating congenial condition for disease vectors • Discomfort arising of air and noise pollution • Hazards of accident	• Continued consultation with PAPs and the competent authority for speedier settlements of appropriate compensation package and resettlement. • Ensuring sanitary measures at construction camp to prevent water borne disease and vector borne disease. • Provision for appropriate personal protective equipment like earplugs, gloves gumboot, and mask to the work force. • Safe traffic management at construction area. • Drive slow sign and speed barriers near community facilities like school, hospital, etc.

1.15 Conclusions

Based on the draft EIA study and surveys conducted for the proposed project, it can be safely concluded that associated potential adverse environmental impacts can be mitigated to an acceptable level by adequate implementation of the measures as stated in the draft EIA Report. Adequate provisions shall be made in the Project to cover the environmental mitigation and monitoring requirements, and their associated costs as suggested in environmental budget. The proposed project shall improve trade efficiency and bring economic growth. In terms of air and noise quality, the project shall bring considerable improvement to possible exposure levels to population.