EXECUTIVE SUMMARY

1. Introduction

Highway projects aim at improving the socio-economic status of the areas through which they pass. In doing so, sometimes, the immediate environment both physical and environmental is affected during construction and operation activities. An Environment Impact Assessment (EIA) study aims at identifying the problems before the construction is started, so as to effectively minimize and/or mitigate the environmental effects.

The National Highways Authority of India (NHAI) has been the pioneer organization in construction and improvement of both National Highways as well as Expressways in India since its inception as an Act of Parliament in 1988 under the Ministry of Road, Transport & Highways (MoRT&H).

The current highway project from Gobindpur in Dhenkanal district to Tangi in Cuttack district of Odisha is a project of the NHAI under the NH (O) scheme of the Government of India. NHAI have entrusted the work to **M/s. Chaitanya Projects Consultancy Ltd.** to carry out the Feasibility study, the Detailed Project Report and EIA study, vide consultancy agreement signed on 30/11/2017 and Letter of Acceptance of CRRR-2 is issued vide Letter No. NHAI/Planning/EC/2016/DPR/Lot-3/Odisha Jharkhand/Package-3/105092 dated 30.08.2017 for this alignment.

The new highway starts from its junction with NH-55 near Gobindpur village, Dhenkanal and terminating at its junction with NH-16 Kolkata -Chennai Highway at Tangi near Bandalo Toll Plaza in Cuttack district in the State of Odisha. The length of the proposed alignment is approx. 40.33 km. The main objective of the proposed project is to give connectivity to Dhenkanal, Angul and bypass the major habitation of Bhubaneswar and Cuttack as this alignment is the second part of Capital Region Ring Road. The project lays emphasis on development of these areas and to make them available with the socio-economic benefits that accrue with the development of highways.

According to new EIA Notification issued on the 14th September, 2006 by the MoEF&CC, GOI and amended Notification on 22nd August, 2013 on Highway projects, the proposed new highway project is falling under Category -A Project (Schedule -7f of Notification) attracts the Environment clearance. The EIA & EMP report is prepared in accordance to the Terms of Reference (ToR) issued by MoEFCC, New Delhi, vide letter no. F. No. 10/74/2023-IA.III, and Proposal No. IA/OR/INFRA1/444879/2023 dated 16th February 2024.

The EIA study of the project has been carried out with the following objectives i.e. to;

1. **Identify**: Sources of Pollution and Resource Utilization during Construction and Operation phases of the project.
2. **Assess**: Extent of Environment Degradation and Resource Utilization.
3. **Devise:** Cost Effective, Environment Friendly, Technically Feasible mitigation measures to offset or mitigate the adverse impact on Valued Eco System Components.
4. **Develop:** Environment Management and Monitoring Plan to ensure effective implementation of mitigative measures and to check whether predicted impacts are within predictable limits.

2. Project Description and Project Features

The proposed project alignment starts from Ch. 70+995 near Gobindpur village in Dhenkanal tehsil of Dhenkanal district and ends at Ch. 111+327 in Tangi village near Bandalo Toll Plaza in Tangi tehsil of Cuttack district of Odisha state of total length of 40.33 km. The proposed highway is of a 6 lane Configuration. This is a complete greenfield alignment. The entire alignment has a 60 m of proposed ROW except 1 km stretch in Kapilash Wildlife Sanctuary, which has a 45 m of proposed ROW to reduce the impact of the sanctuary. The alignment runs through plain terrain with Agricultural land at most of the locations.

The project highway is a 6 lane greenfield highway that follows highway standards as per IRC: SP:84: -2019. The various aspects of design that have been considered in the development of design for the proposed highway are discussed below:

- The proposed highway shall be a 6 lane greenfield highway with paved shoulders of 1.5-2.0 m width and a median of 5.0 m width. Each lane of the proposed highway will be of 3.5 m width.
- The project corridor passes through mainly plain terrain. The adopted design speed is 100 kmph throughout the stretch.
- The proposed project stretch is passing through total no. of 2 districts (Dhenkanal and Cuttack), 3 tehsils (Dhenkanal, Athagarh and Tangi) and 45 villages. The detailed list of villages is given in Chapter 2 of the report.
- The proposed land acquisition for the project is around 267.57 ha.
- An accurate estimate of the traffic that is likely to use the project road is very important as it forms the basic input in planning, design, operation and financing. Hence, detailed traffic surveys are carried out to assess the baseline traffic characteristics on the project road. As per new circular provided by GOI, Ministry of Shipping, Road Transport & Highways, 5% traffic growth rate as given in approved MCA is to be considered for determination of lane requirement/project preparation and also for viability of the project. So, the Growth rate has been taken 5% for all class of vehicles. The entire Project road has one homogeneous section. Total traffic projection for each Homogenous section for every year starting from 2025-26 (Project operation year) till 2059-60 has been given in Chapter 2 of the report. A detailed traffic flow study has been conducted and has been presented in **Annexure 2-3.**
- A total of 125 structures are proposed to be provided in the entire length of the proposed project which includes major bridges, minor bridges, ROBs, VUP, LVUPs, SVUPs, EUPs, Interchanges and Culverts. The structure details are given below (Table-2).

Table 2: Summary of New Proposed Structures

S. No.	Type	Nos.
2.	Major Bridge	2
3.	Minor Bridge	23
4.	ROB + Main carriageway	2
	ROB + Ramp	2
5.	Interchange	1

6.	Viaduct	3
7.	Elephant Underpass (EUP)	2
8.	VUP	5
9.	LVUP	16
10.	SVUP	3
11.	Culvert	56
12.	Additional Culverts	10
Total		**125**

- Flexible pavement has been proposed for main carriageway and Service road/Slip road for 200 MSA and 20 MSA with Granular sub base and Reinforced WMM for 8% CBR.
- Unlined drain is proposed alongside the highway (without Service Road) in rural areas. In Urban areas lined drains with footpath are proposed at the extreme outside of Service Road.
- RE/Retaining walls and protection works has been proposed at hazardous locations and high fill areas.

Project Cost

The Base Civil Construction Cost and Total Project Cost of the proposed project work out to be 1742.25 Crores and 2392.34 Crores respectively. The Total EPC Cost includes GST, Contingencies, Supervision Charge and Agency Charge as per MoRTH circular dated August 2021. Details of Project cost are mentioned in chapter 2 of this report.

Project Facilities

Various project features are proposed to be constructed, such as truck lay-byes, way side amenities, highway mini nest, etc. at various locations. Details of project facilities are mentioned in chapter 2 of this report.

3. Description of Baseline Environment

Construction and operation of a highway may have both adverse and positive impacts on the physical and biological environment of an area it passes through viz. topography, micro climate, drainage pattern, floral and faunal habitats. Environmental Impact Assessment study becomes necessary to assess the possible adverse impact and find ways to mitigate them creating a balance between anthropogenic and natural settings. It is essential to consider environmental and socio economic aspects while planning or designing a road so as to let the benefits reach the community.
Primary data has been collected within 500 meters on either side of the proposed alignment. Primary baseline environment monitoring was carried out for the period of one season from March, 2024 to May, 2024. Secondary data such as meteorological data and census data were collected from the various departments of the government as well as published literature. Primary data was obtained through field sampling of environmental parameters such as air, water, noise, soil, etc. Field surveys were also conducted to get primary information on the major environmental features such as settlements, water bodies, forest areas, trees within the RoW, etc. The details of baseline environmental conditions are given below.

Climate

The State has a tropical climate, characterized by high temperature, high humidity, medium to high rainfall and short and mild winters. The minimum and maximum temperature recorded throughout the year are 11.7°C to 35.9°C respectively. The minimum and maximum rainfall recorded throughout the year are 7.6 mm to 322 mm. Humidity levels in Odisha typically range from 50% to 70%, with coastal areas experiencing higher levels compared to inland regions.

a. Air Environment

Air sampling was carried out at 5 locations for the proposed alignment option for estimating the concentration of various AAQ parameters such as PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, O_3 and others. In the proposed alignment. PM_{10} varies between 68.9-78.9 µg/m^3. $PM_{2.5}$ is found to lie within 32.9-41.6 µg/m^3. The concentration of SO_2, NO_2, $O_3$and CO stay between 9.5-12.3 µg/m^3, 11.9-15 µg/m^3, 20.0-25.7 µg/m^3 and 0.4-0.9 µg/m^3 respectively.

All the gaseous air quality parameters were found to be well within the limits set in the National Ambient Air Quality Standards (NAAQS). The same is attached as **Annexure 3-4.** In general, ambient air quality of the region is satisfactory. The construction of the proposed highway will improve connectivity and reduce travel time which may lead to the reduction of the pollution levels of the region. Results of major parameters are given in table below along with permissible limits.

S. No.	Location code	Results					
		PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	CO (mg/m^3)	O_3 (µg/m^3)
1	AAQ-1	79.9	41.6	9.9	12.9	0.9	25.7
2	AAQ-2	78.9	37.9	9.5	12.9	0.7	25.7
3	AAQ-3	71.9	33.3	12.3	15.0	0.8	20.0
4	AAQ-4	69.9	32.9	9.5	11.9	0.5	23.3
5	AAQ-5	68.9	35.8	9.5	11.9	0.4	24.8
6	Average	73.9	36.3	10.14	12.92	0.66	23.9
7	**Permissible Limits as per CPCB guidelines**	**100**	**60**	**80**	**80**	**4**	**180**

b. Water Environment

i. Surface Water Quality

In order to assess the quality of water resources to keep in check the pollution during construction phase, sampling was carried out at 5 locations of the proposed alignment. The samples were analysed as per guidelines set in the IS: 3025 and compared with standards set in IS:10500. The values of important parameters were found to be within the acceptable limits of IS:10500.

Baseline level of some important parameters of surface water with respect to its quality is within the maximum tolerance limits as per IS:2296 for Class C water. pH was found to be within 7.19-8.23, Total Dissolve Solid between 415-1916 mg/l, Iron is BLQ (0.1) mg/l and Fluoride ranges between <0.1-0.66 mg/l and total alkalinity (as CaCO3) and total hardness (as CaCO3) were found between 134-520 mg/l and 147.4-589 mg/l respectively. Dissolved Oxygen was found to be between 6.2-7.0 mg/l and BOD

is within BLQ (2.0) mg/l. Total Coliform is not found in all sampling sites. Results of major parameters are given in table below.

Sl. No.	Parameters	Units	SW1	SW2	SW3	SW4	SW5
1	Colour	Hazen	<5.0	<5.0	<5.0	<5.0	<5.0
2	pH	-	8.23	7.45	7.42	7.64	7.19
3	Turbidity	NTU	<1.0	<1.0	<1.0	<1.0	<1.0
4	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
5	Total Dissolved Solids	mg/l	1916	690	860	730	415
6	Calcium (as Ca)	mg/l	120.4	40.5	98	69	40.4
7	Magnesium (as Mg)	mg/l	70.31	11.7	49.8	19.8	11.2
8	Fluoride (as F)	mg/l	<0.1	<0.1	0.28	0.66	<0.1
9	Chloride (as Cl)	mg/l	0.1	210	316	190	47.7
10	Nitrate (as NO3)	mg/l	BLQ (0.1)	BLQ (0.1)	BLQ (0.1)	BLQ (0.1)	BLQ (0.1)
11	Sulphate (as SO4)	mg/l	119.9	98	230	3.8	95
12	Total Alkalinity (as CaCO3)	mg/l	520	206	390	210	134
13	Total Hardness (as CaCO3)	mg/l	589	149.4	450	254	147.4
14	Cadmium (as Cd)	mg/l	BLQ (0.001)	BLQ (0.001)	BLQ (0.001)	BLQ (0.001)	BLQ (0.001)
15	Arsenic (as As)	mg/l	BLQ (0.005)	BLQ (0.005)	BLQ (0.005)	BLQ (0.005)	BLQ (0.005)
16	Zinc (as Zn)	mg/l	BLQ (0.1)	BLQ (0.1)	BLQ (0.1)	BLQ (0.1)	BLQ (0.1)
17	Mercury (as Hg)	mg/l	BLQ (0.001)	BLQ (0.001)	BLQ (0.001)	BLQ (0.001)	BLQ (0.001)
18	Nickel (as Ni)	mg/l	BLQ (0.005)	BLQ (0.005)	BLQ (0.005)	BLQ (0.005)	BLQ (0.005)
19	DO	mg/l	7	6.2	6.9	6.8	7
20	BOD	mg/l	BLQ (2.0)	BLQ (2.0)	BLQ (2.0)	BLQ (2.0)	BLQ (2.0)
21	Coliform	per 100 ml	Absent	Absent	Absent	Absent	Absent

ii. Ground Water Quality

Groundwater sampling has been carried out at 5 locations of the proposed alignment to assess the baseline quality of the groundwater of the project location. The findings are given below:

Sl	Parameters	Unit	GW1	GW2	GW3	GW4	GW5	Standard as per IS 10500:2012	
								Acceptable limits	Permissible limits
1.	Colour	Hazen	<5.0	<5.0	<5.0	<5.0	<5.0	5 Max	15 Max
2.	Odour	-	Agree-able	Agree-able	Agree-able	Agree-able	Agree-able	Agree-able	Agree-able
3.	pH	-	7.49	7.61	7.48	7.69	7.68	6.5-8.5	No Relation
4.	Turbidity	NTU	<1.0	<1.0	<1.0	<1.0	<1.0	1.0 Max	5.0 Max
5.	Taste	-	Agree-able	Agree-able	Agree-able	Agree-able	Agree-able	Agree-able	Agree-able
6.	Total Dissolved Solids	mg/l	395	385	406	390	402	500 Max	2000 Max
7.	Calcium (as Ca)	mg/l	31.3	30.5	32.2	37.3	39	75 Max	200 Max
8.	Magnesium (as Mg)	mg/l	11.3	12.8	15.9	11.3	11.8	30 Max	100 Max
9.	Fluoride (as F)	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	1.0 Max	1.5 Max
10.	Chloride (as Cl)	mg/l	53.98	91	97.9	55.9	45.98	250 Max	1000 Max
11.	Nitrate (as NO3)	mg/l	BLQ (0.1)	BLQ (0.1)	BLQ (0.1)	BLQ (0.1)	BLQ (0.1)	45 Max	No Relation
12.	Sulphate (as SO4)	mg/l	12.49	25	13.9	13.9	11.9	200 Max	400 Max
13.	Total Alkalinity (as HCO3)	mg/l	190	116	128	124	132	200 Max	600 Max
14.	Total Hardness (as CaCO3)	mg/l	125	129.32	146.2	139.9	146.2	200 Max	600 Max
15.	Copper (as Cu)	mg/l	BLQ (0.005)	BLQ (0.005)	BLQ (0.005)	BLQ (0.005)	BLQ (0.005)	0.05 Max	1.5 Max
16.	Cadmium (as Cd)	mg/l	BLQ (0.001)	BLQ (0.001)	BLQ (0.001)	BLQ (0.001)	BLQ (0.001)	0.003 Max	No Relation
17.	Iron (as Fe)	mg/l	BLQ (0.1)	BLQ (0.1)	BLQ (0.1)	BLQ (0.1)	BLQ (0.1)	0.3 Max	No Relation
18.	Arsenic (as As)	mg/l	BLQ (0.005)	BLQ (0.005)	BLQ (0.005)	BLQ (0.005)	BLQ (0.005)	0.01 Max	0.05 Max
19.	Zinc (as Zn)	mg/l	BLQ (0.1)	BLQ (0.1)	BLQ (0.1)	BLQ (0.1)	BLQ (0.1)	5 Max	15 Max
20.	Mercury (as Hg)	mg/l	BLQ (0.001)	BLQ (0.001)	BLQ (0.001)	BLQ (0.001)	BLQ (0.001)	0.001 Max	No Relation
21.	Nickel (as Ni)	mg/l	BLQ (0.005)	BLQ (0.005)	BLQ (0.005)	BLQ (0.005)	BLQ (0.005)	0.02 Max	No Relation
22.	Mineral Oil	mg/l	BLQ (0.5)	BLQ (0.5)	BLQ (0.5)	BLQ (0.5)	BLQ (0.5)	0.5 Max	No Relation

From the analysis results of various parameters of Groundwater given in the above table, it is clear that the parameters are well within the permissible limits as prescribed in IS:10500. The pH ranges from 7.48-7.69, Total Dissolved Solids are found to be within 385-406 mg/l. The concentrations of Iron, Magnesium, Fluoride, Total Alkalinity, Total Hardness are as follows BLQ (0.1) mg/l, 11.3-15.9 mg/l,

<0.1 mg/l, 116-190 mg/l, 125-146.2 mg/l, respectively and all are found to be within standards. All the metals (like Mn, Cu, Fe, As and Hg etc.) and all pesticide residues (like DDT, DDE and HCH etc.) were found below level of quantification and also found well below the standards as per IS:10500.

c. Noise Environment

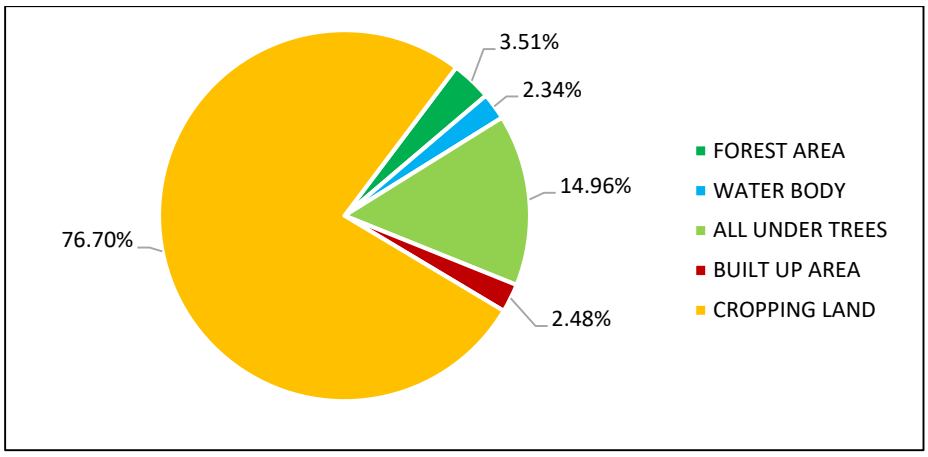
The noise monitoring was carried out at 5 locations in the proposed alignment. The locations were categorized as per norms set in the Noise Pollution (Regulation and Control) Rules, 2000 of the CPCB, which is given in Chapter-3 of the EIA report. The equivalent noise levels in the area through which the proposed alignment will pass varies between 34 dB(A) and 65 dB(A) at day time and stays between 29 dB(A) and 40 dB(A) at night. The results were found to be complying with the norms.

d. Land Environment

i. Land Use

The proposed alignment passes through a large part of greenfield area, agricultural fields, and some revenue forest areas across all the districts at identified project locations. Area required for the construction of the proposed alignment is approximately 267.75 ha. out of which majority is agricultural land, and around 30.59 ha. is revenue forest land.

The detailed land use map of the proposed alignment with 500m buffer length on either side has been prepared in 1:25000 scale based on recent satellite imagery, which have been presented as Annexure 3-2 for proposed alignment. The land use of the 500 m study area indicates that cropping land occupies the largest share of the total area, comprising nearly 76.70% of the total land. Forest Area, Water Body, and Built Up Area make up smaller portions, with Forest Area contributing 3.51%, and Water Body and Built Up Area contributing 2.34% and 2.48% respectively. Area under Trees (forests, orchards, etc.) accounts for 14.96%, indicating a significant portion of land is covered by trees. The graphical representation of land use in the study area is given in the figure below.



Moreover, a detailed ground survey map was prepared on a scale of 1:2000 as per requirement of ToR, showing proposed structures which is presented as Annexure 3-3.

ii. Soil Quality

The soil of the project area is mostly of sandy clay type with average value of sand, silt and clay in all sampling sites are 70.92% of sand, 5.8% of clay and 23.4 % of silt respectively which indicate that the

soil of the study area is sandy clay in nature. pH of soil along proposed project area was found in ranges from 7.58 to 7.95 which indicate neutral to slightly alkaline nature. Porosity is range from 26% to 36%, water holding capacity is range from 42% to 45 %, organic carbon is range from 0.45 % to 0.95%, available nitrogen is range from 138 mg/kg to 142 mg/kg, available phosphorous is range from 2.6 mg/kg to 12 mg/kg and potassium is range from 3 mg/kg to 12 mg/kg. The summarized data of specific soil parameters are given in table below.

S. No	Parameters	Units	SQ1	SQ2	SQ3	SQ4	SQ5
Physical Characteristics							
1	Sand	%	71	62	76	72.6	73
2	Silt	%	6	9	4	6	4
3	Clay	%	23	29	20	22	23
4	Porosity	%	32	29	26	34	36
5	Bulk Density	g/cc	1.19	1.19	1.16	1.12	1.19
6	Water Holding Capacity	%	43	42	45	42	40
Chemical Characteristics							
1	pH	-	7.86	7.58	7.63	7.95	7.63
2	Electric Conductivity	µs/cm	416	149	283	146	195
3	Total Alkalinity	mg/kg	216	143	216	216	202
4	Organic Carbon	%	0.45	0.68	0.85	0.85	0.95
5	Calcium	mg/kg	675	318	436	386	419
6	Magnesium	mg/kg	126	163	196	138	216
7	Potassium	mg/kg	20	3	9	4	6
8	Phosphorous	mg/kg	12	4.6	4	2.6	4.9
9	Nitrogen	mg/kg	138	140	142	142	139

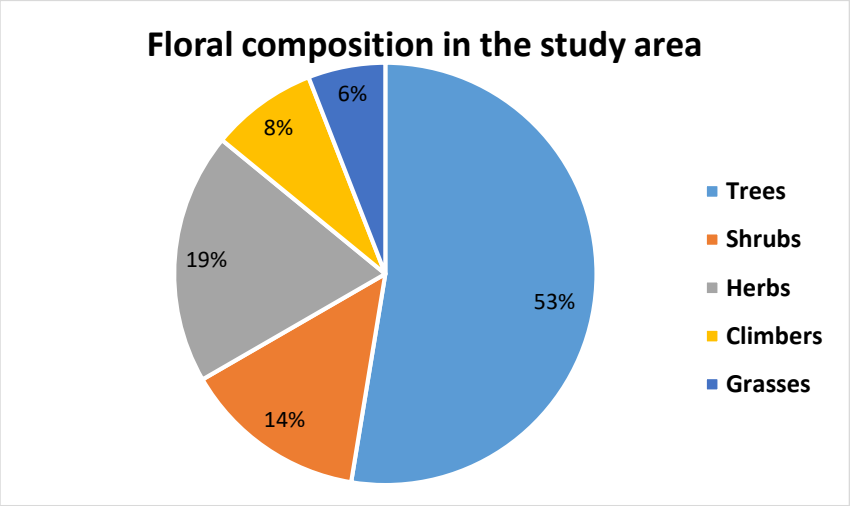
e. Biological Environment

Primary baseline study for ecology and biodiversity has been carried out in the month of May, 2024. Field visits in various landscapes viz. forest land, wasteland, agriculture land etc. have been carried out to get the maximum diversity of flora and fauna found in the study area.

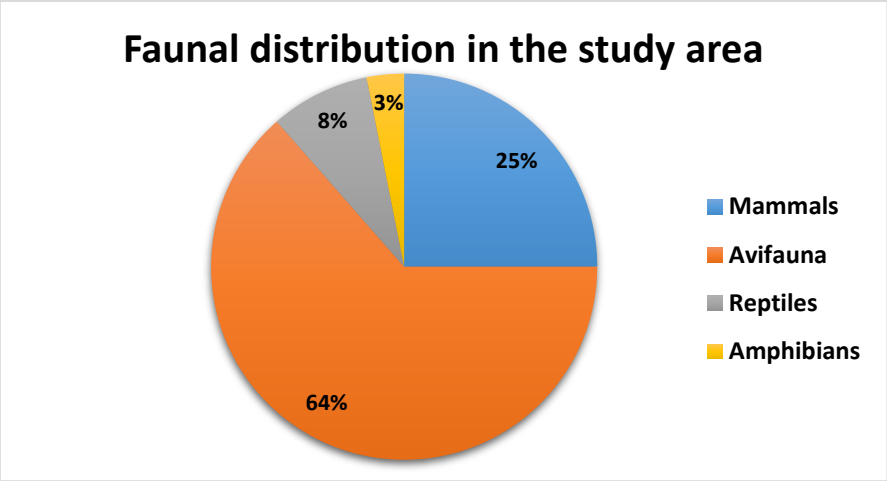
As per Champion and Seth classification of forest types (1968), the study area represents two main forest types viz; 5b/C2 Northern Dry Mixed Deciduous Forest and 5B/C1C Dry Peninsular Sal Forest. In some parts mainly tropical moist deciduous and semi-evergreen forests are also found.

Analysis of the flora revealed that there are 134 plant species falling under 41 plant families. The most dominant plant family is Fabaceae (23 species) followed by Poaceae (8 species), Anacardiaceae (6 species) and Combretaceae (6 species). Among 134 floral species, 70 species of trees, 19 species of shrubs, 26 species of herbs, 11 species of climbers and 8 species of grasses were recorded. The dominant tree species observed in the study area are Sal, Mohul, Terminalia species, Indrajao, Earleaf Acacia, Tal Palm, Char, Kadamba, Bahada, Neem, Pipal, Coconut, Sajana and Ber. Whereas dominant shrubs and herbs are Kaincha, Arakha, Wild Karanda, Goat Weed, Madaranga Sag, Green Chiretta, Common Wireweed, Bhui-amla, Water Hyacinth and Tridax Daisy, etc. No rare, Endangered and

Threatened (RET) species of flora were found in the study area. Percentage distribution of floral species in the study area is shown in the Figure below.



Total 96 numbers of faunal species recorded from the study area. Among faunal species, 24 species of mammals, 61 species of avifauna, 8 species of reptiles and 3 species of amphibians are recorded in the study area. The most common faunal species observed in the study area are Hanuman Langur, Rhesus Macaque, Five-Striped Palm Squirrel, Coppersmith Barbet, Rose-Ringed Parakeet, Rock Pigeon, Spotted Dove, Common Moorhen, Red Wattled Lapwing, Black Drongo, House Crow, Red Vented Bulbul, Indian Garden Lizard, Bark Gecko, Common Snake, Skunk and Common Asian Toad. Percentage distribution of faunal species in the study area is shown in the Figure below.



Regarding the conservation status of the fauna, 16 faunal species (12 mammals, 1 avifauna and 3 reptiles) are identified from the study area which belong to Schedule-I species as per Wildlife Protection (Amendment) Act, 2022. Most of them are common and widely distributed and the range of occurrence extended to wide geographical area.

The proposed project alignment traverses both the core and eco-sensitive zones of the Kapilash Wildlife Sanctuary (as per the final ESZ notification for the sanctuary (S.O. 1659 (E) dated June 17, 2015). The alignment, from Chainage 76+420 km to Chainage 77+500 km, covers 1.080 km and falls within the core zone of the Kapilash WLS. Additionally, the alignment from Chainage 75+580 km to

Chainage 76+420 km and from Chainage 77+500 km to Chainage 78+030 km, covering 1.370 km, lies within the ESZ of the Kapilash WLS. In total, 5.13 ha fall within the core zone, and 8.14 ha are within the ESZ of the sanctuary.

As per the specific condition no. 3 of the ToR granted by the MoEF&CC, a detailed wildlife Conservation and Mitigation Plan is prepared by CEMC in collaboration with Wildlife Institute of India (WII, Dehradun) to understand the biodiversity of the proposed project area as well as to develop a conservation and mitigation action plan on selected species. The report's recommendations for implementation of wildlife mitigation measures would be implemented at the project site along with the budgetary provisions. A detail study is attached in Annexure 3-5.

f. Social Environment

Baseline socio-economic status of the project area helps to identify the present condition of the project area as well as provide some key indicators which may be considered important to mitigate the issues arising during the construction of the proposed highway. Primary survey along with secondary sources of socio-economic data like Directorate of Economics and Statistics, GoI and other such websites served to prepare the baseline socio-economic report of the project area.

The baseline socio-economic report revealed the following points:

- The state of Odisha is mainly a Hindu dominated state, with 93.63% Hindus and 2.17 % Muslim population. Christianity is followed by 2.77 % of the people of the state.
- The Gender ratio of the Project Influence Area (PIA) of the proposed alignment is 940 in Dhenkanal district and 965 in Cuttack district. In the same context, the sex ratio of the project districts Dhenkanal and Cuttack stands out with 947 and 940 respectively, while that of Odisha is 979. In comparison, the sex ratio of India is 940.
- The population density of the project districts viz. Dhenkanal and Cuttack are 721 persons/sq. km and 667 persons/sq. km respectively, which are more than the national average of 382 persons per square kilometer.
- The sex ratio in Odisha stands at 979 females per 1000 males, which is higher than the national average of 943, according to the 2011 Census. The sex ratio of the project districts Dhenkanal and Cuttack were 947 and 940 respectively.
- The literacy rate in Odisha has shown an upward trend, reaching 72.87%, project districts Dhenkanal and Cuttack have literacy rates of 78.76% and 85.5% respectively. The PIA of the proposed alignment had a cumulative average literacy rate of 66.5%.
- As per Census 2011, project district wise data reveal that, among the four categories, other workers have maximum shares and household workers have minimum shares. As per district stats, maximum cultivators are recorded in Cuttack district with 14.8% shares whereas maximum household worker also recorded in Cuttack district with 5.5% shares.

  In project influence area of Cuttack, people are engaged maximum as agricultural labourers and minimum in household works, whereas in Dhenkanal district, maximum workers are engaged in other works and household workers are minimum. Shares of cultivators are maximum in Cuttack district (20.6%) and minimum in Dhenkanal district (17.5%). Agricultural labourers are recorded more in Cuttack district (40.3%) than Dhenkanal district (37.8%). In other workers categories, people of Dhenkanal district have greater contribution (44.2%) than those of Cuttack (35.4%).

- Agricultural profile of the PIA suggests that the main crops grown are paddy, potato, sesamum, mustard and maize. Vegetable such as tomatoes, brinjals and leafy vegetables are also grown. Mango, banana, papaya, jackfruit, etc. Among crops, rice is cultivated in the largest area, followed by potato, rapeseed and mustard, sesame and maize.
- Odisha's rich mineral reserves constitute 28% Iron ore, 24% coal, 59% Bauxite and 98% Chromite of India's total deposits. Apart from large scale industries, major type of MSME operating in the state such as food & allied, chemical & allied, electrical & electronics, engineering & metal based, forest & wood based, glass & ceramics and miscellaneous manufacturing etc. According to recent data, there are 892246 registered MSMEs in Odisha, employing millions of people and contributing significantly to the state's GDP. As per the MSME udyam registration details, total 14636 no. of MSME are registered in project districts.
- As per the specific condition no. 3 of the ToR granted by the MoEF&CC, a comprehensive socio-economic assessment study with emphasis on impact of ongoing land acquisition on the local people living around the proposed alignment is undertaken by the School of Social Sciences, Punjabi University, Patiala.

4. Anticipated Impacts and Mitigation Measures

The impacts of the proposed project and their probable mitigation measures, wherever required have been studied for ease in construction of the road. The impacts have been categorised regarding four main environmental parameters, viz. air, water, soil and noise. Impacts during construction as well as operation phase and their corresponding mitigation measures have been discussed in this section.

a. Impacts on Air Quality

Air Quality of the project area may be impacted due to various construction activities such as removal of old structures, use of heavy machinery, mixing of road materials and transport of raw materials from quarry to site, earth filling on alignment, thereby increasing the amount of particulate matter (PM_{10} & $PM_{2.5}$). The movement of heavy machinery, oil tankers will most probably generate exhaust gases. High concentrations of harmful gases like SO_2, NO_2 as well as HCs likely to be generated from hot mix plant operations.

A mathematical air pollution dispersion modelling was performed using AERMOD and CALINEpro software, to assess the spread of the various pollutants during the construction phase (year 2024-25) as well as during the operation phase (year 2059-2060) to better mitigate the effects of air pollution. As per the modelling prediction, the increased air pollution levels will be within the prescribed limits set in the NAAQS of CPCB. Summary is given in Chapter 4 and the detailed modelling report has been presented as **Annexure 4-1**.

Mitigation measures include water sprinkling on haul roads to manage dust, regular pollution checks, plantation of broad-leaved trees which may absorb high concentration of pollutants and others.

b. Impacts on Water Resources and Water Quality

The water resources (surface and ground) may be affected due to various factors such as increased runoff due to deforestation, blocking of natural flow of water bodies, contamination of groundwater

by seepage of harmful chemicals, etc. Mitigation measures include proper design of the proposed highway, proper management of solid and liquid wastes, provision of silt fencing, provision of adequate drainage systems, etc.

c. Impacts on Soil Quality

The soil quality of the proposed project area may be degraded following excavation of earth for construction of the road, removal of large numbers of trees, soil compaction due to movement of large vehicles, soil contamination due to improper waste disposal, etc. Mitigation measures include proper handling of the top soil after excavation, limited number of tree felling, proper management of wastes, etc.

d. Impacts on Noise Quality

The ambient noise levels will increase due to the various construction activities as well as movement of vehicles both during the construction phase as well as the operation phase. Mitigation measures such as provision of adequate noise barriers, proper maintenance of vehicles, etc. is absolutely necessary for effective control of noise pollution due to the construction of the road.

Mathematical prediction modelling for noise pollution has been done using dhwaniPRO software, using various point sources such as crusher, hot mix plant, DG sets, etc. as sources during construction phase and traffic data for operation phase. The baseline noise monitoring locations were considered as receptors for estimating the incremental values of noise during construction phase. The noise levels will be within the permissible limits during construction and operation period of the project. The details are given in Chapter 4 and **Annexure 4-2.**

e. Impacts on Biological Environment

The flora and fauna as well as the plantations or forest area falling in the project area will be affected due to the felling of trees to make way for the construction of the road. These impacts can be effectively mitigated through the use of proper fencing to avoid the animals wandering into the construction site, felling of minimum number of trees, provision of adequate number of cattle/animal underpasses, culverts so as to minimise the habitat fragmentation, etc.

Diversion of Forest Land- The alignment is passing through 2 districts namely Cuttack and Dhenkanal. The forest area with in the PROW of the alignment is 30.59 ha. Total 9300 trees will be affected in total including forest areas.

The proposed project alignment traverses both the core and eco-sensitive zones of the Kapilash Wildlife Sanctuary (as per the final ESZ notification for the sanctuary (S.O. 1659 (E) dated June 17, 2015). The alignment, from Chainage 76+420 km to Chainage 77+500 km, covers 1.080 km and falls within the core zone of the Kapilash WLS. Additionally, the alignment from Chainage 75+580 km to Chainage 76+420 km and from Chainage 77+500 km to Chainage 78+030 km, covering 1.370 km, lies within the ESZ of the Kapilash WLS. In total, 5.13 ha fall within the core zone, and 8.14 ha are within the ESZ of the sanctuary.

During Construction Phase, major impact of concern is the fragmentation of habitat. The construction of the new road may fragment the forest areas and cause disruption to the movement of wildlife,

threatening their survival. Construction near forest areas may lead to accidents due to human-wildlife conflict, which will result in the loss of life or workers or animals. No considerable impact is expected to occur in the operation phase of the project. And as the WL conservation and mitigation plan will be implemented by NHAI.

f. Impacts on Socio-Economic Environment

The proposed project will impact around 1312 families and 6035 persons. Due to major part of the proposed alignment passing through plain areas and agricultural fields, people will lose their livelihood. But the proposed project will also have some beneficial effects in the socio-economic characteristics of the region such as increase in income of small businesses, establishment of hotels, restaurants, hospitals, markets and others in the interchange locations and WSA locations, etc. Traffic may get congested on the pre-existing roads that the proposed highway is supposed to cut through in short term.

All these beneficial impacts are very much welcome for the betterment of the local community. As for the other non-beneficial impacts, some mitigation measures need to be put in such as proper compensation for the persons affected, provision of adequate service roads to maintain connectivity, provision of safety measures and traffic management systems, etc. The overall impact of the project during construction/operation phase is presented below.

Impact Assessment Matrix

Environmental Parameters	Nature of Potential Impact during Construction & Operation phases										
	Local	Regional	Short Term	Long Term	Reversible	Irreversible	Adverse	Beneficial	No Impact	Significant	Insignificant
Meteorology	✓		✓		✓						✓
Topography	✓			✓		✓					
Drainage	✓			✓	✓						✓
Soil	✓				✓						✓
Water Resources	✓		✓		✓						✓
Water Quality	✓				✓						✓
Land Use	✓			✓		✓		✓			✓
Air Quality	✓		✓		✓						✓
Noise	✓		✓	✓	✓						✓
Flora	✓		✓	✓		✓	✓			✓	
Fauna	✓		✓	✓		✓	✓			✓	
Employment	✓		✓	✓		✓		✓		✓	
Aesthetics	✓		✓	✓		✓				✓	

5. Analysis of Alternatives

A comparative analysis of the various alternatives considered for alignment selection, to avoid, prevent and minimize the impacts that would be inevitable if technically (based on design speed and geometrics) if best-fit alignment is followed. The consideration of alternatives to a proposal is a requirement of the EIA report. During the scoping process, alternatives to a proposal can be generated

or refined, either directly or by reference to the key issues identified. The alternatives the presented during ToR meeting and suggestions and modifications by the EAC, MoEF&CC are incorporated.

Construction of the Gobindpur to Tangi (Capital Region Ring Road-2) for Six Laning with Paved shoulder NH Configuration - in the State of Odisha (Lot 3/Odisha & Jharkhand- Package - 3) by NHAI (Total length: 40.33km) was considered after finalization of various options. Odisha State Governments recommendations were also taken.

Selection of Alternatives

Alignments were initially studied by preliminary desk studies using satellite imageries, SoI toposheet, revenue maps, etc. to identify the salient features followed by initial site visits and detailed ground reconnaissance by the consultants revealed that by and large the selected alignment is acceptable.

Three alternative alignments were presented during the grant of ToR meeting and these have been considered for analysis and are as follows:

i. **Option 1**: Option 1 is basically considered as a Brown field alignment and the widening of the existing NH-55 and NH-16 from Gobindpur to Tangi.
ii. **Option 2**: Option 2 is basically considered as a new Green field alignment from Gobindpur to Tangi. The alignment is slightly closer and passes through to the Kapilash WLS, (**Proposed alignment)**.
iii. **Option 3:** This option also starts from Gobindpur to Tangi and passes through Greenfield area and ends at near Tangi in Cuttack district, the alignment is much closer and passes through to the Kapilash WLS in the northern sections.

Keeping in view of alignments having less/minor effect on environmental and social components, alignment **Option-2** has been fixed and it seems more feasible as compared to the other options. It will also provide better alternative for connection to the existing NH-16 and 55 coming to Tamilnadu and going upto Kolkata and bypassing the major towns of Khordha, Bhubaneshwar and Cuttack. It will lead to less impact on Environment & Social components than other two. The ring road will further reduce the traffic congestion in the existing cities and reduce the urban pollution loads in these cities.

Further MoEF&CC in its ToR has instructed and recommended to carry the following studies:

i. The proponent, with the help of an independent institution of national repute like WII/ZSI, shall carry out the impact studies (covering minimum two season) of proposed alignment on biodiversity with focus on mammals, birds and endemic flora and wetlands/water bodies within 10 km distance of proposed alignment and prepare a detailed Conservation Plan along with adequate mitigation measures. The plan shall be duly prepared in consultation of Chief Wildlife Warden of Odisha.

ii. The proponent, with the help of an independent institution of national repute, 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 should have social indicators which can reflect on impact of acquisition on fertile land. The Social Impact Assessment shall take into consideration of key parameters like people's dependency on fertile agricultural land, socio-economic spectrum, impact of the project at local and regional levels.

In this regard, NHAI has conducted these studies with the help of reputed institutions. The detailed biodiversity assessment and conservation and mitigation plan for Kapilash WLS has been prepared by CEMC, Bhubaneshwar and WII Dehradun. Socio-economic study is carried out by the Department of Social Studies, Punjabi University, Patiala. Mitigation measures in the project area have been incorporated in the alignment with provision of 2 Elephant under passes and around 60 culverts for water and smaller animals.

Salient features of the alternative alignments studied

Parameters/Issues	Option 1 Existing NH-55 (Green Colour)	Option 2 (Pink Colour) (Proposed alignment)	Option 3 (Blue Colour)
Length (km)	42+300	40+330	61+400
Proposed RoW (m)	60 m in revenue and 45 m in forest		
Total land required (ha)	72.97	267.57	405.24
Forest (RF/PF) ha.	11.00	30.285	44.00
Area under protected / important or sensitive species of flora or fauna/Wildlife Sanctuary	Around 3.5 km length is passing through various RF, and ESZ of Kapilash WLS, with total forest area of approx. 11 ha.	Approx. 1.0 km length and around 4.369 ha. of Kapilash WLS RF is encountered and 1.5 km in ESZ of Kapilash WLS.	Around 6.0 km length is passing through the Kapilash WL Sanctuary, 10 km length in ESZ and 44 ha of RF is encountered.
No. of trees impacted	5500	9300	11500
Impact on flora and fauna	Medium impact on WL and flora as forest area is less and following existing highway	Medium to Less Impact on WL and flora as forest area is encountered.	Maximum Impact on WL and flora as maximum forest and WL length is met.
Area under water bodies (ha)*	0.40	2.50	1.00
No of structures to be affected	85	34	75
No of families to be impacted	750	1312	2550
Land Use	Heavily Built-up area and agricultural area.	Less Built-up area and agricultural area	Partially Built-up & Agricultural area
Civil Cost (Crore Rs.) (Including Utility)	1836.26	1750.74	2665.40
LA & Pre-construction cost (Crore Rs.)	244.74	233.34	355.25

Tentative Project cost (Crore Rs.) including other expenses.	2509.20	2392.34	3642.19

Impact Scoring Matrix

An impact scoring matrix involves all the variables that may affect the local area through which the alignment passes. Various aspects (five) are analysed in this matrix i.e.: Natural environment, Biological environment, Physical environment, Social environment and engineering considerations. Various micro attributes are further analysed in each of the major 5 aspects. Scores are then allocated to each of the attributes and all the analysed three alignment options.

Overall Scoring for the three alignments

Scoring Criteria	Total Weight	Option-1	Option-2	Option-3
		Score	Score	Score
Natural Environment	80	20	20	33
Biological Environment	80	13	16	19
Physical Environment	50	26	16	16
Social Environment	60	27	23	23
Engineering	130	71	67	82
Total	**400**	**157**	**142**	**173**

The option with the least score is the one that has the least impact on the local environment. The overall scoring matrix shows that Option-2 has the least score with 142 points followed by Option-1, and last is Option-3. Increasing number showing the increasing environmental, social impact due to the said option, hence option-2 has the lowest impact overall and is considered for construction.

New Materials and Technologies in Road Construction

The proposed project will use latest construction materials and methodologies to reduce the material usage and reduce the carbon foot print during construction period. New guidelines and notifications have been issued by the MoRTH, MoEF&CC, IRC to use new materials, use recycled materials in road construction, reduce wastage, etc. IRC guidelines are now available for use of Cement Treated Base (CTB), Cement Treated Sub-base (CTSB), Recycling, Fly-ash, Waste Plastic, Geo-Synthetics, modified Bitumen (CRMB, Polymer modified, Natural Rubber), Soil stabilization, embankment stabilization through coir mats, grasses, etc. in highway construction. It is necessary to promote these materials/technologies in construction and maintenance of National Highways for harnessing potential time and cost savings and reducing the environment impacts.

6. Environmental Monitoring Programme

The environmental monitoring program is a vital process of any Environmental Management Plan (EMP) of a development project for review of indicators and to take immediate preventive action. This helps in signalling the potential issues resulting from the proposed project activities and will allow for prompt implementation of corrective measures. NHAI has keen interest in environmental monitoring

as it is an integral part towards better environmental management of air, noise, water, soil, etc., during construction and operation phase.

The proposed project's main activity envisages construction of road. Construction phase of the project is likely to be completed within 30 months. Thrice in a year monitoring for all the parameters excluding monsoon season is envisaged during construction and operation phase.

For air, important monitoring parameters like PM_{10}, $PM_{2.5}$, SO_2, NO_2, O_3, CO, etc. are to be monitored during construction and operation phase. For noise the sound decibel in dB is to be monitored for day and night time values. For soil various parameters like pH, electric conductivity, NPK values, various organic and inorganic chemicals are to be monitored. For water (surface and ground water) important parameters like pH, BOD, DO, TDS, Pb, Oil & Grease, Total Hardness, Sulphate, Chloride, Fe, Fl, etc. are to be monitored as per the sample.

Other aspects like local management of Ecology & Biodiversity, comprising of knowledge of indigenous plant species, local flora and fauna is to be monitored. Management of compensatory avenue and median plantation is to be followed. Proper adherence to local Disaster management, Health & Safety laws, protocols and procedures have also to be followed at project site.

Formation of an Environment Management Cell with role and responsibilities will be decided before the commencement of work. The environment management cell / unit will ensure implementation and monitoring of environment safeguard during construction.
All the monitoring parameters have to be carried out by NABL certified private or government agency/laboratory. Prior finalising the sensitive locations of the project site the construction camps, Hot mix plants, crusher plant, batching plants, construction site, haul roads, borrow areas, sensitive ecology and environmental locations like forest areas, river/streams, wells, habitations, etc. where monitoring has to take place. The total environmental monitoring budget is calculated at around Rs.23.06 lacs.

7. Additional Studies

Additional studies have been undertaken as per the EIA Notification, 2006 and its amendments thereafter. These include public consultations, Social Impact Assessment, Census and Socio-Economic Survey, preparation of Disaster Management Plan & Risk Assessment as well as preparation of Resettlement Action Plan (RAP) and Resettlement and Rehabilitation (R&R) Budget. A total of 45 villages, 1312 families and 6035 persons will be impacted due to the proposed highway.
Consultations with the individual villagers and village headmen provided an insight into the view of the affected villagers with respect to the proposed project. More or less, the affected people are very welcoming to the proposed highway considering the economic benefits that will naturally come with it. The only major concern of the villagers was the provision of adequate connectivity between the villages and the agricultural fields as well as timely payment of compensation of land and affected structures. A total of 267.75 ha. of land will have to be acquired for the proposed alignment.
Preliminary survey indicates that a total of 34 structures will be impacted due to the construction of the proposed alignment. Most of these structures are pucca structures, and are mainly owned by individual owners, majority of whom have joint families.

Majority of the Project Affected Population (PAP) are found to have an education level upto college graduation. The sex ratio in the affected area is 946 which is close to the rural sex ratio of the project districts.

Around 97.18% of people of the proposed alignment belong to the Hindu religion followed by 1.83% Christians and 0.99 % people of the proposed alignment are Muslims. Other religious persons did not feature in the survey.

Majority of the PAFs belong to the General category, followed by Other Backward Castes (OBCs), Scheduled Tribes (STs) and Scheduled Castes (SCs) and Most of the persons belong to the 21-30 age group. Majority of the PAPs are found to be housewives followed by agriculturists.

The majority of the PAFs of the proposed alignment fall in the 50001-100000 income slab followed by 100001-500000 income slab. This may also be attributed to the fact that villagers tend not to disclose this aspect and mention lesser annual incomes.

A comprehensive risk assessment has been performed and a disaster management plan has also been prepared taking into account every possible risk and hazard and their mitigation measures to effectively manage the hurdles due to any disaster wither natural or anthropogenic.

An R&R budget has been worked out which comes out to be around INR 200 Cr. for the proposed alignment. This budget includes the compensatory cost for land to be acquired, cost for replacement of structures as well as cost for assistance to PAFs. The detailed break-up of the R&R budget has been presented in Chapter 7 of the EIA report.

As per the specific condition no. 3 of the ToR granted by the MoEF&CC, a comprehensive socio-economic assessment study with emphasis on impact of ongoing land acquisition on the local people living around the proposed alignment is undertaken by the School of Social Sciences, Punjabi University, Patiala.

8. Project Benefits

As the proposed project is a greenfield project in rural area, it's aimed towards the overall development of the physical infrastructure of the region with creation of new road surface with superior quality, advanced safety features, high speed connectivity, reduction in travel times, access controlled and other way side amenities and facilities. Highway will further lead to the socio-economic development of the region with potential for increase in tourism, and agriculture activity. The highway will also lead to enhanced local employment generation during construction and operation phase. Additionally, this highway will reduce the traffic load on the existing NH 16, thereby reducing the deterioration of the environmental parameters such as AAQ, Noise, biological environment, etc. around 30-40% of the heavy vehicular traffic will then bypass the cities of Khordha, Bhubaneshwar and Cuttack in long term entire through traffic will use the ring road. Improved highway geometrics, avenue and median plantations along the highway will further improve the local environment and add to enhancing the local environment and green cover.

9. Environment Management Plan

Environmental Management Plan (EMP) is a necessary part of any developmental project to ensure that environmental impacts are kept well below the acceptable limits, as well as to improve environmental conditions of the project area at pre-construction, construction as well as operation phases, through comprehensive mitigation measures.

In general, NHAI, with assistance from Contractor and Monitoring Consultant, is responsible for carrying out mitigation measures as and when required. The PIU/Independent Engineer/Authority engineer has to ensure, through periodic audits and monitoring, so that all EMP requirements and mitigation measures are being implemented correctly by the contractor during various stages of the project.

The main components of EMP are: EMP Implementing Agency, Monitoring the Implementation of EMP, Training for correct implementation of EMP and Budgetary provisions for EMP implementation

The EMP to be implemented at various stages of the project i.e. Pre-construction, Construction and Operation are given in details in individual sections.

Checklist of Statutory Obligations

Project Proponent is required to attain a number of statutory as well as obey the provisions laid down by the Acts, Rules, Notifications and Orders relevant to the project. Some important National Acts which aim at prevention and control of industrial and urban pollution are:

- Water (Prevention and Control of Pollution) Act, 1974, amended 1988
- Air (Prevention and Control of Pollution) Act, 1981, amended 1987
- Environment (Protection) Act, 1986, (EPA)
- The Wildlife (Protection) Act, 1972
- The Forest (Conservation) Act, 1980 (With Amendments made in 1988)
- Forest (Conservation) Rules, 2003 (With Amendments made in 2004)
- Fly Ash Notification, 2009
- EIA Notification, 2006 and further amendments
- Ancient Monuments and Archaeological Sites and Remains Rules, 1959

Some other important acts/rules/notifications which are relevant to the highway projects are:

- National Highways Authority of India (Amendment) Act, 2013
- Motor Vehicles Act, 1988
- Central Motor Vehicle Rules, 1989
- Control of National Highways (Land and Traffic) Act, 2002
- National Highways Act, 1956

Environment Management Action Plan

The Environmental Management Action Plan is the synthesis of all proposed mitigation and monitoring actions, to be implemented within a time frame with specific responsibility assigned and follow-up actions defined. It contains all the information for the project proponents, the contractors and the regulatory agency to implement the project within a specified time frame.

The EMP is a plan of action for avoidance, mitigation and management of the negative impacts of the project. The Environmental Enhancement is also an important component of EMP. The EMP refers to all implementable task at different stages of project, namely, Pre-Construction Phase, Construction Phase, and Operation Phase. The EMP includes a list of all project-related activities and impacts and a clear reporting schedule.

Pre-Construction Stage

The pre-construction stage involves various technicalities and approvals as follows:

- Obtaining all necessary clearances/NOC's/consents from concerned regulatory authorities such as Environmental Clearance, Forest Clearance, Wildlife Clearance, etc.
- Identifying and selecting the sources of gathering materials for construction such as quarry, water, sand, etc.
- Fulfilling the conditions laid down by the respective NOCs.

Construction Stage

The construction stage involves various technicalities such as:

- Stone crushing and screening plants, hot mix plants, concrete batching plants etc. shall be located sufficiently away from habitation, agricultural operations.
- Precaution shall be taken to reduce the levels of noise, vibration, dust and emissions from plants.
- The contractor shall not use or generate any materials in the works which are hazardous to the health of person, animals or vegetation.
- Provision of protective clothing or appliances to workers
- Provision of drinking water for workers shall be made available.
- The use of firewood shall not be permitted.
- All equipment shall be provided with proven efficiency.
- Plants, equipment and instruments provided shall have adequate sensitivity facility for calibration to desired level and shall be robust.

Operation stage

The operation stage involves various technicalities such as:

- Road development may lead to establishment of petty shops and other commercial pursuits by the local people. The project proponent should prevent development of squatter settlements and encroachments on the vacant portions of the RoW of the road.
- There is possibility of accidents in the project stretch as a greater number of vehicles are expected in this road stretch. In the event of spillage of hazardous chemicals, a spillage containment mechanism will be developed along with the participation of police and the fire department.
- Avenue and median plantations along the stretch will improve the aesthetics of the project corridor. Public amenities and parking places are proposed in project design for long distance travelers.
- Traffic noise significantly affects human health, especially for people living in the vicinity to major roads/highways. There will be significant noise impact due to traffic which include different categories like small private vehicles to large goods vehicles.

Enhancement of Natural Environment

The natural environment can be improved by plantation of ornamental and shade providing avenue trees on the roadside, the shrubs and some important herbs besides developing ponds and providing bore wells along the roadside.

Plantation of Trees, Shrubs and Herbs along the proposed Highway

The plantation of trees can be done in different densities depending on the Habitat and soil type, Water table depth, Availability of indigenous species, Survival rate of plants and Forest department/People's choice.

Enhancement of Water Bodies

There are some surface water bodies crossing the project corridor. The water bodies are used for various purposes including bathing, washing, fishing, growing water-fruits, livestock drinking and often irrigating the agricultural fields. The landscape treatment includes, Provision of stepped access to the edge of water, Providing flat boulders for washing, Stone pitching for slope for high embankment stabilization, Plantation of trees and shrubs for stabilization of pond edge.

Conservation Status and Biodiversity Management

The proposed project alignment traverses both the core and eco-sensitive zones of the Kapilash Wildlife Sanctuary (as per the final ESZ notification for the sanctuary (S.O. 1659 (E) dated June 17, 2015). The alignment, from Chainage 76+420 km to Chainage 77+500 km, covers 1.080 km and falls within the core zone of the Kapilash WLS. Additionally, the alignment from Chainage 75+580 km to Chainage 76+420 km and from Chainage 77+500 km to Chainage 78+030 km, covering 1.370 km, lies within the ESZ of the Kapilash WLS. In total, 5.13 ha fall within the core zone, and 8.14 ha are within the ESZ of the sanctuary. Proper mitigation measures have been adopted for biodiversity conservation and mitigation and WL movement.

Threats to Biodiversity in the Project Site

The major threats are enumerated as follows: Shrinkage of wildlife habitat, Environmental pollution and habitat destruction due to economic development activities, tourism. Anthropogenic activities, over exploitation of species and spread of invasive alien species.

Physical Environment

Physical changes to the landscape will also include creation of NHAI Nest shops, Way side amenities, toll plazas, truck lay-byes, etc. All will be designed so as to be aesthetically pleasing with green shade and ornamental plantations. Quarries and borrow areas would also be maintained as per directives like removal of top soil, digging upto 2-3 m only, maintaining the embankment slopes, barricading, etc. Temporary structures like Camps, offices, ware houses, Hot mix plant, RMC plant, Kitchens, etc. will also be present during the construction stage.

Borrow areas will be properly closed and further use of the same for agriculture, irrigation pond, water recharging, aqua culture, tourism, etc. will be ensured.

Various pre-construction activities like tree cutting, utility shifting, Statutory clearances, plant and machineries, vehicles, labour, water, camps, traffic management etc. will be the responsibility of the contractor and will be further supervised by the PMU, Independent/Authority engineer and NHAI.

During construction activities like utility shifting, Land Acquisition, Slope protection, water use, drainage, flora and fauna, wildlife issues, environmental monitoring, traffic movement, safety of workmen, signage's, pollution control and monitoring, green belt development, etc. will be the

responsibility of the contractor and will be further supervised by the PMU, Independent/Authority engineer and NHAI.

Environmental Management Plan Budget

The cost of environmental protection measures has been estimated at Rs. 30.56 Cr. as per the following table.

Component	Stage	Items	Estimated Rate	Total Cost (Rs)
Environmental Training	Construction	Training of project staff	Lump Sum	20,00,000
Environmental Monitoring	Construction and Operation Period	Monitoring of air, water, soil, noise and Soil (Refer Table 6.2)	As per environmental monitoring plan	23,06,250
Air	Construction	Dust Suppression at the project site @ Rs 1800/trip x 2 trips/day x 365 days x 2.5 years	40.3km (1 package)	32,85,500
Solid waste	Construction	Demolition wastes and bituminous scrap disposal as per C& D rules 2016	Lump Sum	10,00,000
Soil	Construction	Provision for providing Oil Interceptors	1 Nos	2,25,000
Surface water	Construction	Silt Fencing for water bodies (2000m)	1500 Rs/mt	30,00,000
Noise Barrier	Construction	Provision of Noise Barrier (4000m)	7,500 Rs/mt	3,00,00,000
Flora	Construction	Plantation of trees along the proposed highway i.e. 12000 trees to be planted	Rs 2000/tree including tree guard	2,40,00,000
		Maintenance period of 2.5 years including causality replacement of tree	Lump Sum	24,00,000
		Ornamental Plantation on Cross Sections.	Lump Sum	30,00,000
		Shrub Plantation and grass carpeting in median	Lump Sum	30,00,000
Wildlife	Construction	Signage for wildlife	Lump Sum	1,00,000
	Operation	WII, Dehradun proposed wildlife management plan (As per approval/Approx.)	Lump Sum	21,00,00,000
Safety	Construction	Demarcation of borrow areas clearly, using fencing if needed.	Lump Sum	10,00,000

		Provision of Hoarding /Posters at construction camps and provision of health checks at construction sites	Lump Sum	5,00,000
		Provision for helmet, gumboots, jackets, goggles etc. to labours	Lump Sum	5,00,000
Construction Camps	Construction	Sanitary Facilities (Bio-Toilet, Septic Tank, Soak pit, etc.	Lump Sum	5,00,000
Rain Water Harvesting	Construction and operation	Construction of RWH Structures as per site Geological condition	Approx. 40	20,00,000
		Maintenance of Rainwater Harvesting Structures during defect liability period	Lump Sum	2,00,000
Renewable energy	Construction	Installation of Solar Panel, and LED bulbs at project site (Camp area)	Lump Sum	20,00,000
Total				**29,10,16,750**
Contingency @ 5%				**1,45,50,838**
Total				**30,55,67,588**

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