Environmental and Social Due Diligence Report

Project Number: 47083-004
January 2022

INDIA: Accelerating Infrastructure Investment Facility in India – Tranche 3 Shamlaji Expressway Private Limited (Part 4 of 34)

Prepared by India Infrastructure Finance Company Limited for the India Infrastructure Finance Company Limited and the Asian Development Bank.

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Table 2.33: New Minor Bridges/Minor bridges to be Reconstructed over Irrigation Canal

Sl. No.	Road/ Name of Bridge	Bridge No.	Existing Chainage (km)	Design Chainage (km)	Proposed Structural Configuration	Proposed Structure Type	Proposed Span Arrangement (c/c bridge) (m)	Length of Bridge	Total Width of Structure (m)
1	NH-8	(LCW + RCW)	469.95	516.135	New 6-lane Bridge	PSC I Girder	1x40	40	2 x 15.20

Source: - Executive Summary for the proposed project

Note: - The Span arrangement of irrigation channel shall be prepared in consultation with State Irrigation Department.

Table 2.34: New Minor Bridges on Service Road

Sl. No.	Road/ Name of Bridge	Bridge No.		Existing Chainage (km)	Design Chainage (km)	Proposed Structural Configuration	Proposed Structure Type	Proposed Span Arrangement (c/c bridge) (m)	Length of Bridge	Total Width of Structure (m)
1	NH-8	403/2	Left	402.75	448.9	New Service Lane Bridge	Solid Slab	2x10.70+1x10.20	31.6	10.2
			Right					3x10.0	30	10.2
2	NH-8	412/3	Left	411.805	457.955	New Service Lane Bridge	RCC T Girder	2x15.22+1x19.80	50.24	10.2
			Right					2x15.22+1x19.80	50.24	10.2
3	NH-8	433/1	Left	432.35	478.5	New Service Lane Bridge	Solid Slab	2x5.3+1x5.0	15.6	10.2
			Right					2x5.3+1x5.0	15.6	10.2
4	NH-8	443/1	Left	442.6	488.75	New Service Lane Bridge	RCC T Girder	1x13.0	13	10.2
			Right				Solid Slab	2x6.0	12	10.2
5	NH-8	460/2	Left	459.4	505.55	New Service Lane Bridge	Solid Slab	1x8.0	8	10.2
			Right					1x8.0	8	10.2
6	NH-8	467/3	Left	466.8	512.95	New Service Lane Bridge	Solid Slab	1x7.9	7.9	10.2
			Right					1x7.9	7.9	10.2
7	NH-8	468/1	Left	467.1	513.25		Solid Slab	1x6.7	6.7	10.2

Sl. No.	Road/ Name of Bridge	Bridge No.		Existing Chainage (km)	Design Chainage (km)	Proposed Structural Configuration	Proposed Structure Type	Proposed Span Arrangement (c/c bridge) (m)	Length of Bridge	Total Width of Structure (m)
			Right			New Service Lane Bridge		1x6.7	6.7	10.2
8	NH-8	468/2	Left	467.65	513.8	New Service Lane Bridge	Solid Slab	1x8.7	8.7	10.2
			Right					1x8.7	8.7	10.2
9	NH-8	490/1	Left	490.25	536.4	New Service Lane Bridge	RCC T Girder	1x16.8	16.8	10.2
			Right					3x5.6	16.8	10.2

Source: - Executive Summary for the proposed project

Note: - GAD for bridges on Irrigation canal may be approved as required from the Irrigation Department for Irrigation/Protection work.

Table 2.35: Minor Bridges where Widening is Proposed

Sl. No.	Road/ Name of Bridge	Bridge No.	Existing Chainage (km)	Design Chainage (km)	Proposed Structural Configuration	Proposed Structure Type	Proposed Span Arrangement (c/c bridge) (m)	Length of Bridge	Total Width of Structure (m)
1	NH-8	468/1 (LCW)	467	513.285	Widening of Existing Bridge	RCC Solid Slab	1x6.7	6.7	13.4
		468/1 (RCW)	467	513.285					
2	NH-8	468/2 (LCW)	468	513.835	Widening of Existing Bridge	Frame Type	1x8.7	8.7	13.4
		468/2 (RCW)	468	513.835					

Source: - Executive Summary for the proposed project

Due to widening of the NH-8, the Pipe Culverts to be widened which are detailing given in **Table 2.36**.

Table 2.36: Details of Pipe Culverts (Which are to be Widened)

Sl. No.	Existing Chainage (km)	Design Chainage (km)	Details of Proposed Structure	
			Type of Culverts	Span Arrangement (m)
1	402.447	448.632	HPC	3 x 0.9

Sl. No.	Existing Chainage (km)	Design Chainage (km)	Details of Proposed Structure	
			Type of Culverts	Span Arrangement (m)
2	404.324	450.509	HPC	1 x 0.9
3	404.535	450.720	HPC	2 x 0.9
4	404.743	450.928	HPC	1 x 0.9
5	404.817	4512.000	HPC	4 x 0.9
6	405.505	451.690	HPC	1 x 0.9
7	405.748	451.933	HPC	1 x 0.9
8	406.889	453.074	HPC	2 x 0.9
9	407.905	454.090	HPC	3 x 0.9
10	408.747	454.932	HPC	4 x 0.9
11	410.144	456.329	HPC	5 x 0.9
12	414.286	460.471	HPC	3 x 0.9
13	414.808	460.993	HPC	2 x 0.9
14	415.560	461.745	HPC	3 x 0.9
15	420.395	466.580	HPC	2 x 0.9
16	421.350	467.535	HPC	2 x 0.9
17	423.450	469.635	HPC	2 x 0.9
18	424.340	470.525	HPC	3 x 0.9
19	425.170	471.355	HPC	2 x 0.9
20	426.095	472.280	HPC	2 x 0.9
21	427.165	473.350	HPC	2 x 0.9
22	427.815	4740.000	HPC	1 x 1.2
23	429.170	475.355	HPC	3 x 0.9
24	431.280	477.465	HPC	1 x 0.9
25	433.075	479.260	HPC	2 x 0.9

Sl. No.	Existing Chainage (km)	Design Chainage (km)	Details of Proposed Structure	
			Type of Culverts	Span Arrangement (m)
26	433.355	479.540	HPC	2 x 0.9
27	434.745	480.930	HPC	2 x 0.9
28	435.455	481.640	HPC	2 x 0.9
29	436.302	482.487	HPC	1 x 0.9
30	437.483	483.668	HPC	2 x 0.9
31	437.995	484.180	HPC	2 x 0.9
32	438.308	484.493	HPC	2 x 0.9
33	439.025	485.210	HPC	2 x 0.9
34	439.225	485.410	HPC	1 x 0.9
35	439.775	485.960	HPC	3 x 0.9
36	442.765	488.950	HPC	3 x 0.9
37	442.895	489.080	HPC	4 x 0.9
38	443.246	489.431	HPC	1 x 0.9
39	443.949	490.134	HPC	4 x 0.9
40	444.468	490.653	HPC	4 x 0.9
41	445.370	491.555	HPC	4 x 0.9
42	446.478	492.663	HPC	2 x 0.9
43	447.774	493.959	HPC	2 x 0.9
44	449.536	495.721	HPC	2 x 0.9
45	451.608	497.793	HPC	2 x 0.9
46	451.947	498.132	HPC	1 x 0.9
47	452.030	498.215	HPC	1 x 0.9
48	453.921	500.106	HPC	3 x 0.9
49	454.633	500.818	HPC	1 x 0.9

Sl. No.	Existing Chainage (km)	Design Chainage (km)	Details of Proposed Structure	
			Type of Culverts	Span Arrangement (m)
50	455.080	501.265	HPC	1 x 0.9
51	455.299	501.484	HPC	3 x 0.9
52	455.833	502.018	HPC	2 x 0.9
53	456.202	502.387	HPC	1 x 0.9
54	456.425	502.610	HPC	2 x 0.9
55	458.317	504.502	HPC	2 x 0.9
56	458.695	504.880	HPC	2 x 0.9
57	459.105	505.290	HPC	1 x 0.9
58	459.975	506.160	HPC	2 x 0.9
59	460.489	506.674	HPC	1 x 1.2
60	460.814	506.999	HPC	3 x 0.9
61	460.913	507.098	HPC	1 x 0.9
62	461.619	507.804	HPC	2 x 0.9
63	462.048	508.233	HPC	2 x 0.9
64	462.786	508.971	HPC	2 x 0.9
65	463.282	509.467	HPC	2 x 0.9
66	464.129	510.314	HPC	2 x 0.9
67	464.393	510.578	HPC	2 x 0.9
68	464.801	510.986	HPC	2 x 0.9
69	465.600	511.785	HPC	2 x 0.9
70	469.207	515.392	HPC	2 x 0.9
71	469.661	515.846	HPC	3 x 0.9
72	470.123	516.308	HPC	1 x 1.2
73	470.441	516.626	HPC	1 x 0.9

Sl. No.	Existing Chainage (km)	Design Chainage (km)	Details of Proposed Structure	
			Type of Culverts	Span Arrangement (m)
74	471.087	517.272	HPC	4 x 0.9
75	471.275	517.460	HPC	1 x 1.2
76	472.222	518.407	HPC	4 x 0.9
77	472.854	519.039	HPC	2 x 0.9
78	473.759	519.944	HPC	2 x 0.9
79	474.356	520.541	HPC	4 x 0.9
80	474.624	520.809	HPC	2 x 0.9
81	474.930	521.115	HPC	2 x 0.9
82	475.947	522.132	HPC	4 x 0.9
83	476.918	523.103	HPC	4 x 0.9
84	477.800	523.985	HPC	4 x 0.9
85	479.386	525.571	HPC	4 x 0.9
86	481.305	527.490	HPC	2 x 0.9
87	481.899	528.084	HPC	2 x 0.9
88	482.294	528.479	HPC	2 x 0.9
89	482.931	529.116	HPC	2 x 0.9
90	483.554	529.739	HPC	1 x 1.2
91	484.013	530.198	HPC	2 x 1.2
92	484.575	530.760	HPC	2 x 0.9
93	485.448	531.633	HPC	4 x 0.9
94	485.737	531.922	HPC	2 x 0.9
95	488.190	534.375	HPC	2 x 0.9
96	489.642	535.827	HPC	2 x 0.9
97	490.573	536.758	HPC	2 x 0.9

Sl. No.	Existing Chainage (km)	Design Chainage (km)	Details of Proposed Structure	
			Type of Culverts	Span Arrangement (m)
98	491.245	537.430	HPC	3 x 0.9
99	492.050	538.235	HPC	4 x 0.9
100	492.865	539.050	HPC	2 x 0.9
101	494.177	540.362	HPC	4x 0.9

Source: - Executive Summary for the proposed project

Due to widening of the NH-8, the Pipe Culverts over Irrigation Canal to be widened which are detailing given in **Table 2.37**.

Table 2.37: Details of Pipe Culverts over Irrigation Canal (Which are to be Widened)

Sl. No.	Road	Existing Chainage (km)	Design Chainage (km)	Details of Proposed Structure	
				Type of Culverts	Span Arrangement (m)
1	NH-8	438.075	484.26	HPC	2 x 0.9
2	NH-8	440.47	486.655	HPC	1 x 0.9
3	NH-8	458.88	505.065	HPC	2 x 0.9
4	NH-8	461.85	508.035	HPC	1 x 0.9
5	NH-8	472.314	518.499	HPC	1 x 1.2
6	NH-8	474.094	520.279	HPC	1 x 1.2
7	NH-8	476.31	522.495	HPC	1 x 0.9

Source: - Executive Summary for the proposed project

Note: In addition to above culverts, the Concessionaire shall also propose suitable remedial measure for culverts found, if any. The drawing for structure provided across irrigation channel shall be prepared in consultation with State Irrigation department.

Table 2.38: Details of New Rail Over Bridges (ROBs)

Sl. No.	ROB/RUB	Existing Chainage (km)	Design Chainage (km)	Name of Crossing	Existing Structure	Proposed Structural Configuration	Proposed Structure Type	Proposed Span Arrangement (m)	Total Length of Structure (m)	Total Width of Structure (m)	Remarks
1	ROB 412/1 on NH-8 (RCW)	411.15	457.335	-	-	* 3 Lane ROB	RCC T-Beams (Central Span) RCC Solid Slab (End Spans)	2 X 7.0 + 20 (Skew)	34	15.2	-
2	ROB 423/1 on NH-8 (RCW)	422.237	468.422	-	-	* 3 Lane ROB	PSC T-Beams	3 x 35.62 (skew)	106.86	15.2	-
3	ROB 431/1 on NH-8 (RCW)	430.672	476.857	-	-	* 3 Lane ROB	PSC T-Beams (Central Span) RCC T-Beams (End Spans)	2 X 16.28 + 35.62 (Skew)	68.18	15.2	-

Source: - Executive Summary for the proposed project

Note: The existing structures shall be dismantled and reconstructed at these locations.

Table 2.39: Rehabilitation/Repair of Rail Over Bridges (ROBs)

Sl. No.	ROB/ RUB	Existing Chainage (km)	Design Chainage (km)	Name of Crossing	Existing Structure	Proposed Structural Configuration	Proposed Structure Type	Existing Span Arrangement (m)	Total Length of Structure (m)	Total Width of Structure (m)	Remarks
1	412/1 (LCW)	411.15	457.335	ROB	ROB	Existing ROB is Retained	Composite RCC Deck Slab with Steel I Girder	2x7 + 20 (Skew)	34	12.1	All existing ROBs are proposed to be retained after carrying out necessary repairs and rehabilitation works. Repairs shall include but not limited to general cleaning of ROBs and area around ROBs, restoration of slopes and protective works, removal and relaying of existing wearing coat, repair and replacement of drainage spouts, construction of new crash barriers in place of old railing, reconstruction of approach slab & return wall, providing of new expans1on joints and bearings in place of old ones wherever required and repair and rehabilitation of damaged concrete of any etc. to the complete satisfaction of independent engineer.

Sl. No.	ROB/ RUB	Existing Chainage (km)	Design Chainage (km)	Name of Crossing	Existing Structure	Proposed Structural Configuration	Proposed Structure Type	Existing Span Arrangement (m)	Total Length of Structure (m)	Total Width of Structure (m)	Remarks
2	423/1 (LCW)	422.237	468.422	ROB	ROB	Existing ROB is Retained	Composite RCC Deck (Skew) Slab with Steel I Girder	3x35.62	106.86	12.1	All the repairs and rehabilitation works shall be carried out as per standards and manuals.
3	431/1 (LCW)	430.672	476.857	ROB	ROB	Existing ROB is Retained	Composite RCC Deck Slab with Steel I Girder	2 X 16.28 + 35.62 (Skew)	68.18	12.1	
4	467/1 (LCW & RCW)	466	512.185	ROB	ROB	No Action for 6 Laning	RCC T-GIRDER	2 X 18.0 + 25.1 (Skew)	61.1	2x11.0	

Source: - Executive Summary for the proposed project

CHAPTER-3.
DESCRIPTION OF THE ENVIRONMENT

3. DESCRIPTION OF THE ENVIRONMENT

3.1. INTRODUCTION

To maintain the environmental commensuration with the mining operation, it is essential to undertake studies on the existing environmental scenario and assess the impact on different environmental components. This would help in generating the baseline data before the project starts and assess how it is changing over the years when the project becomes operational. This will help Management in formulating suitable management plans and sustainable resource extraction.

Baseline data collection/generation forms a part of the Environmental Impact Assessment (EIA) study and helps to evaluate the predicted impacts on the various environmental attributes in the study area by using scientifically developed and widely accepted environmental impact assessment methodologies. Baseline data is also required in preparing an Environmental Management Plan (EMP) outlining the measures for improving the environment quality and scope of future expansions for environmentally sustainable development.

Baseline environmental status in and around enhanced project depicts the existing environmental conditions of air, noise, water, soil, biological and socio-economic environment. With this project as the centre, a radial distance of 10 km is considered as 'study area' for baseline data collection and environmental monitoring. Baseline data was collected for various environmental attributes to compute the impacts that are likely to arise due to proposed development activity.

The main aim of the impact assessment study is to find out the impact of the project on the environment. The study is carried out during the project planning stage itself, so that the proponent can implement the project in a technically, financially and environmentally viable way.

Existing environmental conditions are enumerated by collected baseline data. He estimated impact due to the enhanced project is superimposed over the existing conditions to arrive at the project scenario. The scope of the baseline studies includes detailed characterization of various environmental components, which are most likely to be influenced by setting up an industry.

1. Land Environment
2. Meteorology
3. Air Environment
4. Noise Environment
5. Water Environment
6. Soil Environment
7. Biological Environment
8. Socio-economic Environment

The relevant information and data (both primary and secondary) were collected in core as well as buffer zone (10 km distance from the project boundary) during Post-Monsoon Season (November 2018) in accordance with the guidelines for preparation of EIA studies by In Situ Enviro Care, Bhopal.

3.2. STUDY AREA & PERIOD

According to Appendix III of EIA Notification, 2006 and its amendment till date, study area was selected from 10.0 km radius from the project boundary. The area was selected to do the studies and collect the baseline data as ambient air, water, soil, noise, meteorology, hydrogeology, hydrology, land-use, ecological and socio-economic data etc. The study was conducted in Post-Monsoon Season (November 2018). The study area map is given as **Figure 3.1**.

3.3. METHODOLOGIES ADOPTED

The baseline data for environmental parameters were collected as per standard Terms of Reference for the relevant category of the project. The data was also authenticated or validated from the secondary data collected from regarding departments of agencies. The detailed methodology is as given below.

3.3.1. PRIMARY DATA COLLECTION METHODOLOGIES

The baseline study was conducted during the Post-Monsoon Season (November 2018). A detailed field monitoring study of the project study area was carried out for baseline environment assessment of the project area.

Baseline data was generated for various environmental parameters including air, water (surface and groundwater), land and soil, ecology and socio-economic status to determine quality of the prevailing environmental settings. Sampling of soil and water, monitoring of air quality and noise level and other field data collection were carried out by the team operating from this field station. The field team consisted of technical personnel viz. environmental scientists and social experts along with the field staff. The noteworthy activities completed during the field visit were as follows:

- A meteorological station was setup on the roof top a house in a village Tigoda which is near to the project site. Wind speed, wind direction, dry and wet bulb temperature, relative humidity and general weather conditions were recorded throughout the study period in an automated data logger.
- To assess the Ambient Air Quality (AAQ), samples of ambient air were collected by installation of Respirable Dust Sampler and Fine Particulate Sampler at different locations from the study area during study period and analysed for primary air pollutants to work out the existing status of air quality.
- Groundwater samples were collected during the study period from the existing hand-pumps and bore wells, while surface water was collected from nearest pond, rivers and lakes. The samples were analysed for parameters necessary to determine water quality (based on IS: 10500: 2012 and APHA 21st Edition for ground water, water quality criteria classified by CPCB for surface water) and those which are relevant from the point of view of environmental impact of the proposed site.
- Soil samples were collected and analysed for relevant physical and chemical characteristics to assess the impact of the proposed plant on soil.

- The noise level measurements were also made at two locations in different intervals of time with the help of sound level meter to establish the baseline noise levels in the impact zone.
- Ecological data was procured from both primary and secondary sources. A primary data was collected through survey and walkover by ecological experts.
- Socio-economic data was collected from field studies and secondary sources like Census of India 2011, BPL Lists, Revenue Department data, etc.
- Ground material exits the Mill through the discharge grate which prevents grinding balls from leaving the mill. A proportion of material, mostly fines, comes out of the mill through gravity. The final product is the cement, which is either stored temporarily or packed in bags.

3.3.2. SECONDARY DATA COLLECTION

Secondary data are those collected over the years that can be used to understand the existing environmental scenario of the study area. The secondary data is required to authenticate the primary data as the primary data was collected over the short period which should be comparing to know the trend of baseline data to compete the understanding of baseline scenario of the study area. The secondary sources used for reference for this project are given in **Table 3.1.**

Table 3-1: Detailed of Secondary Data Collection

Sl. No.	Area	Description	Source	Reference of data
1	Meteorology	Temperature, humidity, rainfall, wind speed, Wind Direction	IMD Station Ahmedabad (1971-2000)	Primary recorded data was verified with secondary data available with IMD Ahmedabad.
2	Ambient Air Quality	Particulate matter, Gaseous pollutants	Comprehensive Environment Pollution Abatement Action Plan of GPPCB	--
3	Water Quality	Surface & Ground Water	Comprehensive Environment Pollution Abatement Action Plan of GPPCB	--
2	Soil Quality	Physical & chemical characteristics	Comprehensive Environment Pollution Abatement Action Plan of GPPCB	District Agricultural Handbook
3	Nature of terrain	Land-use	Survey of India (Toposheet), National Remote Sensing Centre (Satellite image)	Data from various sources were updated after ground trothing for features and land-use verification.

Sl. No.	Area	Description	Source	Reference of data
4	Hydrogeology	Geological formation and analysis, hydro-geological analysis	District Ground Water Information Booklet, Gandhidham & Sabarkantha District, Gujarat	--
5	Seismic Data	Seismic zone, presence of faults, thrust	Vulnerability Atlas of India (2006)	Discussion were carried out with local people to verify the frequency of occurrence of earthquake in the area
6	Biological Environment	Inventory of flora & fauna, endemic species, migratory routes	District Forest Department	--
7	Socio-economic status	Demographic profile, household, occupation status	Census data (2001 & 2011)	The census data was verified with the primary data collected during field visit and the data collected from district office. It is projected using Annual Average Growth Rate

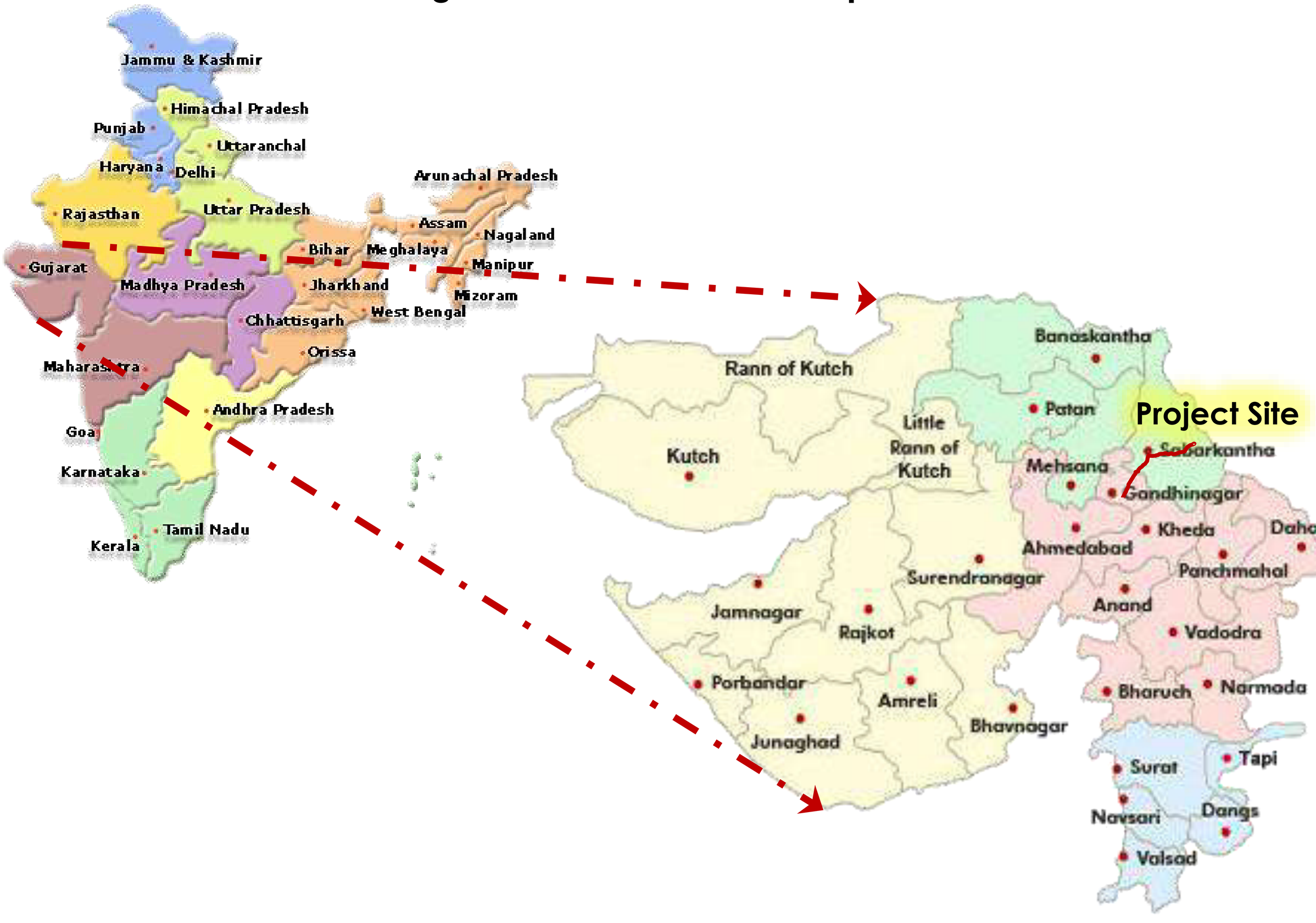
3.4. PROJECT LOCATION

The proposed project (Package-6) starts from Rajasthan/Gujarat Border (Km 401.200 of NH 8/design chainage 447.385) and ends near Ahmedabad (Km 494.400 of NH-8/design chainage 540.595). The road passes through the Aravali, Sabarkantha, Gandhinagar and Ahmedabad District of Gujarat. The existing road is part of NH-8. The land-use pattern of the project area is mainly agriculture land, settlements, industrial and commercial areas including hilly terrain at some locations along the project road.

3.5. ENVIRONMENT SENSITIVITY

There are no wildlife sanctuaries, national park, elephant corridors or archeological monuments within 10.0 km radius of the project site. There are also no forest lands in the project area. The environment sensitivity is detailed in **Section 2.4 of Chapter 2 (Project Description).**

Figure No.: 1.1 Location Map



3.6. SEISMOLOGY

The site falls under zone III (as per IS 1893 (Part-I):2002), as per the Seismic Zone Map of. However, some faults specifically Neo-tectonic faults are present throughout Gujarat which could trigger earthquakes.

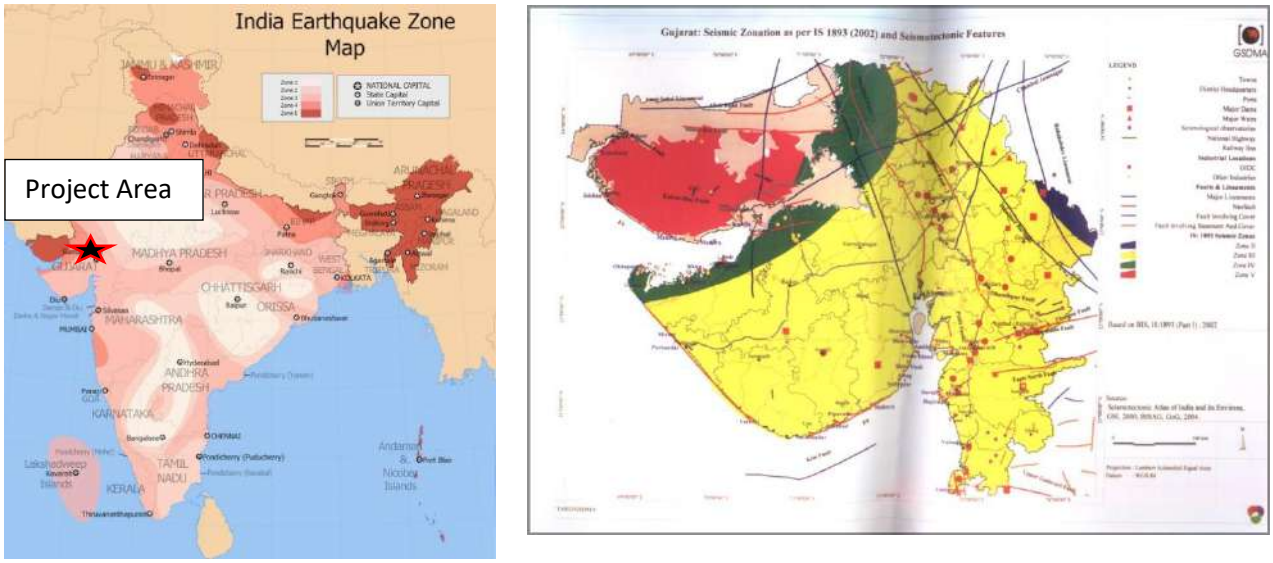


Figure 3.2 Seismicity Map of India & Gujarat

3.7. PHYSICAL ENVIRONMENT

3.7.1. TOPOGRAPHY & GEOLOGY OF GUJARAT & REGION[1]

The well-known agriculturally rich alluvial basin of Gujarat rises from the estuarine tracts between Narmada and Tapi rivers and extends 250 miles (402 km) northwards merging into the desert plains of Rajasthan and the Rann of Kutch. It is roughly 75 miles (121 km) wide. The eastern border of the basin is bounded by Aravali, Vindhya, Satpura, and Sahyadri hill ranges.

The topography of the land is obviously controlled by the geological formations. The eastern part of the south Gujarat bordering the alluvial tract has a typical Deccan trap scenery up to Narmada valley. The hills are formed by circumdenudation leaving wide plateau at top, and a step like feature because of horizontal lava-flows and their differential weathering. Trap topography in the Narmada valley is, however, different; hills are hogback shaped, as many of them are composed of wide and long dolerite dykes. On the north of Narmada, areas which are occupied by sedimentaries of Baghs or lametas in patches, form table lands with low hills.

[1] *The Topography & Geology has been taken from the GEOLOGY OF GUJARAT by V N Kulkarni (Sr. Geologist, Engineering Research Institute, PWD, Gujarat State.*

North and NE part of the State is occupied by quartzites, phyllites and schists. Quartzites being hard and resistant to weathering action, form steep narrow ridges with serrated tops arranged along the trike, while valleys and plains are occupied by phyllites and schists, these being soft. Granites typically form low to high hills with loose boulders of large dimensions standing insitu; thus, granite country can easily be recognized from a distance.

GUJARAT REGION-ARCHAEANS

These are the oldest groups of rocks forming the basement for later formations. They are mineral bearing and thus have importance from the point of view of potential wealth. The details of formations under this group are:

a) **BANDED GNEISSIC COMPLEX:** Rocks are of highly intricate and varied gneissic complex; they are mostly of igneous origin, but because of interfoliar injection, they have a general northerly foliation strike, and are continuous with gneissic complex of Central Mewar. These occur around Chhota Udepur, Bodeli and east of Sankheda.

b) **ARAVALI SYSTEM (INCLUDING CHAMPANERS):** The rocks of this system are metamorphic and have been affected by tectonic forces forming folds. Basal conglomerates, some impure calcareous facies generally dolomitic in composition, quartzite, phyllites, slates and schists are the rocks under this system. Phyllites are common rocks and occupy large areas with quartzite as intercalations:

phyllites grade into schists. The regional strike of these formations is NNW-SSE with a dip at high angles of 700 to 800 to the WSW. These rocks mainly occur in Panchmahals and Sabarkantha districts; there are few small outcrops in Baroda and Banaskantha districts. Quartzites being very hard and resistant to weathering, form narrow, long and steep hill ranges, while valleys and plains are occupied by softer rocks like phyllites and schists.

CREATCEOUS SYSTEM (INFRATRAPPEANS)

The geological formations of this system are divided into four groups; viz:

- Himatnagar sandstone
- Lameta beds
- Bagh beds, and
- Nimar sandstone.

A. HIMATNAGAR SANDSTONE

These are composed of thick massive beds of undisturbed, horizontal sandstones with intercalated shales and conglomerates. These vary in colour between white, different shades of pink, red and brown. They occur SE of Himatnagar and between Kapadvanj and Dakor. These are well known building stones and are extensively used.

B. LAMETA BEDS

Numerous lenticular outcrops of the lameta beds form narrow fringes along the base of the Deccan trap. These beds are fresh water deposits, consisting of a conglomeratic formation with a siliceous or calcareous matrix at the base, overlain by earthy to massive limestones with cherty and chalcedonic stringers and veinlets. It is mottled with limonitic spots. The thickness of these formations comes to above 15 ft (5m). These Lameta beds occur near Balasinor (Kaira district), Parbia (near Virpur), jhalod, Dohad and Jhabua (near Bariya) in Panchmahals district, and Gabat (Sabarkantha District). Limestones from Balasinor are used for cement manufacture at Sevalia Cement Factory by M/s. A.C.C. Ltd. Dohad limestone is burnt for manufacture of lime.

C. BAGH BEDS

These are the products of marine transgression in the Cretaceous age. Bagh beds consist of calcareous rocks underlain by beds of sandstone, below which conglomerates are found. Marine fossils are usually found in the uppermost limestones. The thickness is normally up to 70 ft. (21 m) but in the Narmada valley, it is over 1,000 ft (305 m.)

These rocks too, occur as narrow fringes along the margin of Deccan trap in Vajiria, Agar, Naswadi, Boriad and Amba Dungar area where famous fluorite deposits are found. The rocks looking like Limestones around Amba Dungar are classified as carbonatites by R.N. Sukheswala and G.R. Udas. According to them fluorine emanations, which on reaction with Bagh limestone have given rise to

8 fluorite (CaF2) deposits of the Amba Dungar, appear to have been derived out of the alkaline magma widely exposed in this region. Sandstones near Songir are the famous building stones, from where stones for palaces in Baroda were brought.

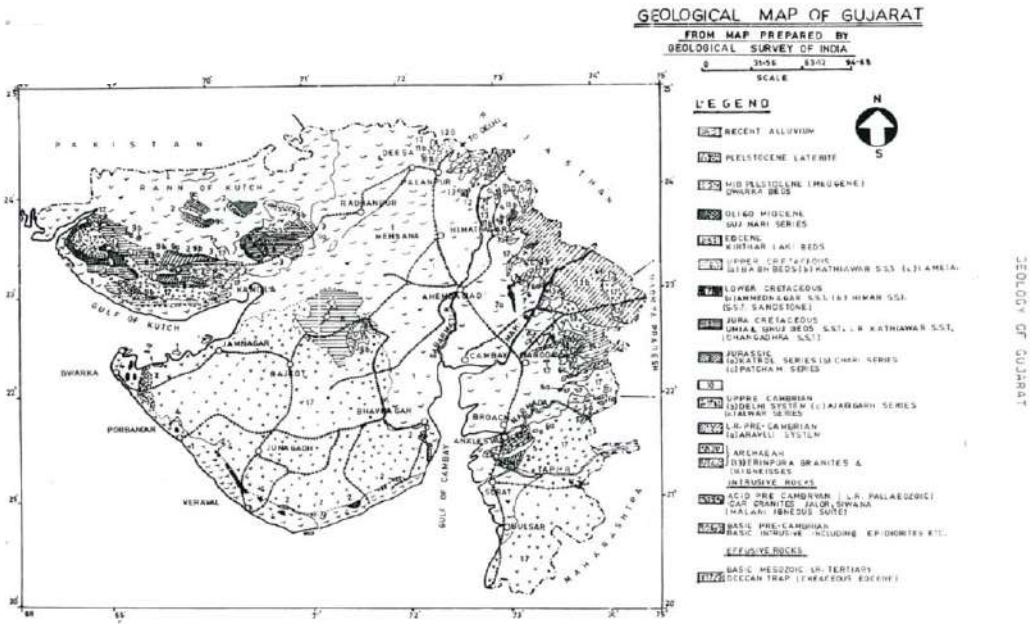
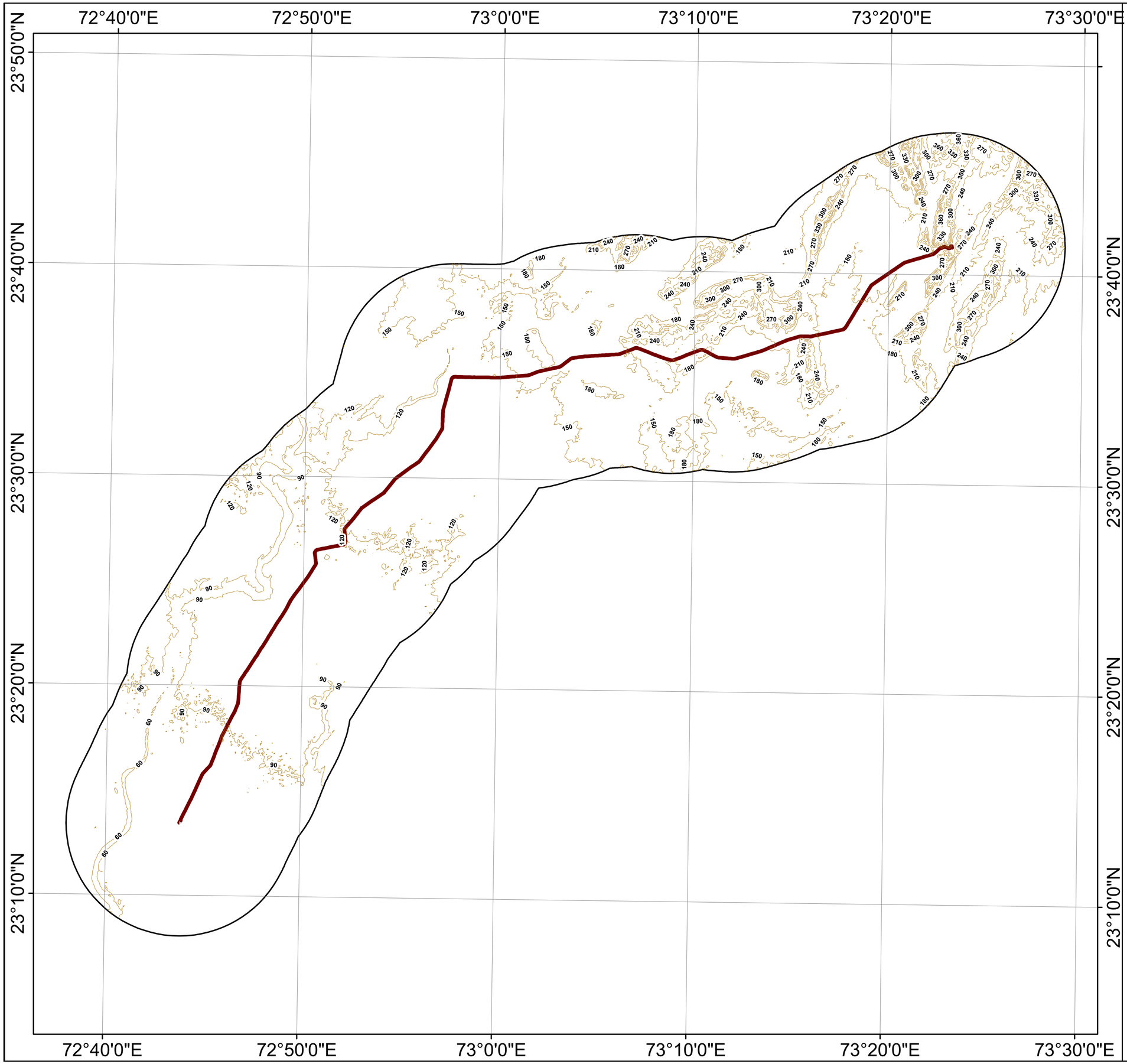


Figure 3.3 Geology of Gujarat



Legend

- Contour
- Project Site
- 10km Buffer

Figure No. : 3.4
Contour Map
(within 10km radius)

Proposed Six Laning of Shamla Ji to Mota Chilodha

National Highways Authority of India

From Km 401.200 to Km 494.410 Section of NH-8 in the State of Gujarat under NHDP Phase–V on Hybrid Annuity Mode

Source:

1. Survey of India Toposheets
2. Layout Plan Provided by PP
3. Google Satellite Imagery, 2018
4. Data Provided by FAE (LU)

Software Used:

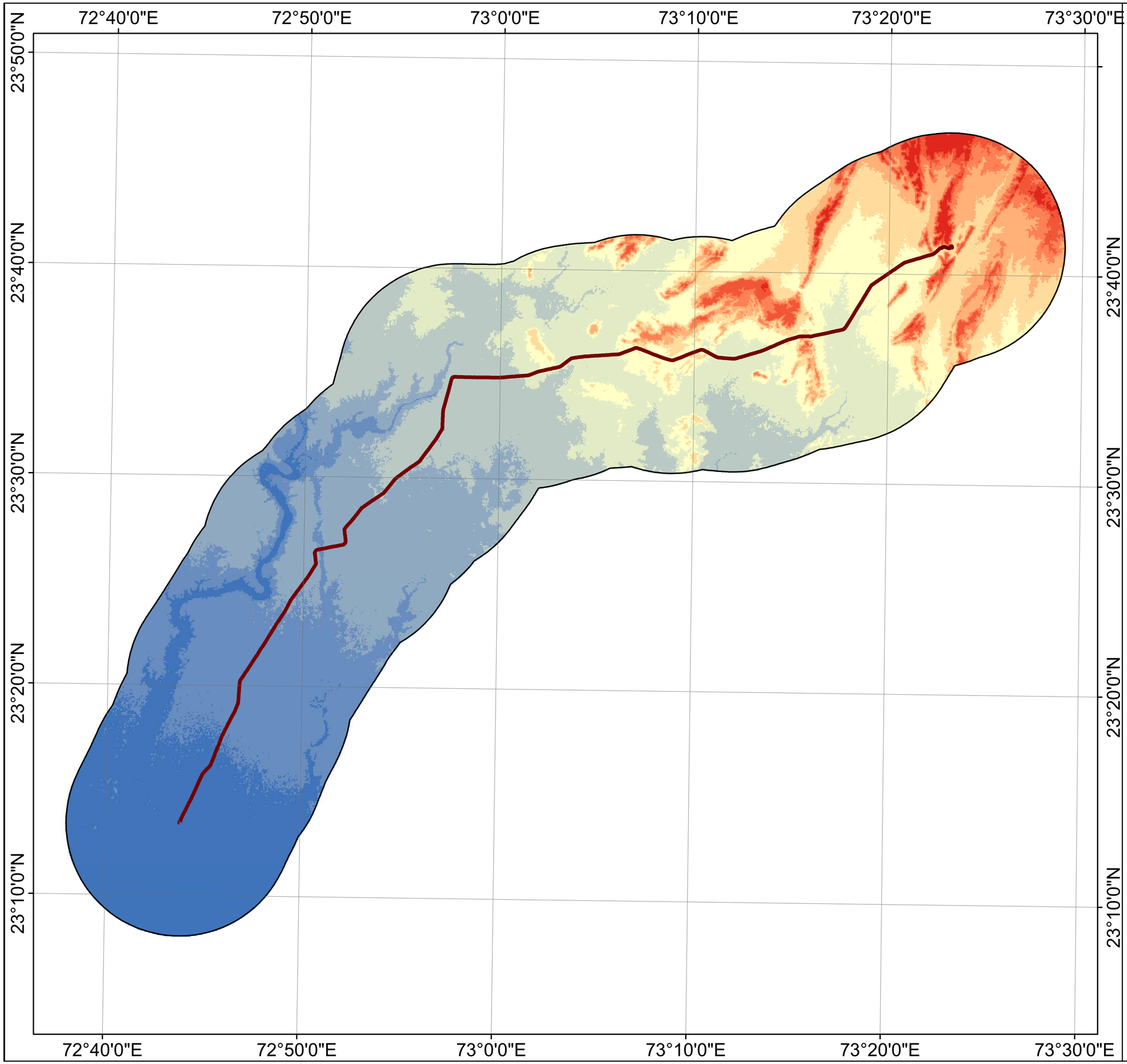
1. ArcGIS 10.1, 2. ERDAS Imagine, 3. Global Mapper

Note:

No National Park, Wildlife Sanctuary, Biosphere Reserves, Wild Life Corridors exists within 10 km from Project Site.

Scale:

0 5,400 10,800 16,200 21,600 27,000 m



N
W E
S

Legend

- Project Site
- 10km Buffer

Elevation Profile (m)

- 41 - 87
- 87.1 - 108
- 108.1 - 131
- 131.1 - 152
- 152.1 - 173
- 173.1 - 194
- 194.1 - 217
- 217.1 - 245
- 245.1 - 278
- 278.1 - 320
- 320.1 - 410

Figure No. : 3.5
Elevation Profile Map
(within 10km radius)

Proposed Six Laning of Shamla Ji to Mota Chilodha

National Highways Authority of India

From Km 401.200 to Km 494.410 Section of NH-8 in the State of Gujarat under NHDP Phase–V on Hybrid Annuity Mode

Source:

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No National Park, Wildlife Sanctuary, Biosphere Reserves, Wild Life Corridors exists within 10 km from Project Site.

Scale:

0 5,400 10,800 16,200 21,600 27,000 m