National Highways Authority of India

(Ministry of Shipping, Road Transport & Highways)
Government of India

Consultancy Services for Preparation of Feasibility cum preliminary design report for 2-Laning to 4-Laning of NH-22 From Solan to Shimla in the State of Himachal Pradesh Under NHDP Phase - III.

August 2012

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

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INTRODUCTION

1.1. INTRODUCTION

The Ministry of Road Transport and Highways (MORTH) on behalf of Govt of India engaged in the development of National Highways through the Govt body represented by National Highways Authority to develop the National Highways under NHDP (National Highways Development Programme). As a part of endeavour the National Highways Authority of India has decided to undertake four laning of section from Solan (km 106.000) to Dhalli (km156.507,existing chainage) of NH-22 through Public Private Partnership (PPP) on Design, Build, Finance, Operate and Transfer (the "DBFOT") basis. The project, complementing the NHDP, seeks to connect high-traffic density stretches, state capitals and tourism centres to the NHDP Phase III. The study corridor is the section of NH-22 and lies in the State of Himachal Pradesh connecting to state capital Shimla to Solan and subsequently to Chandigarh and Ambala.

This chapter describes the project background, need for the project, nature, and size, location of the project and structure of the report.

1.2. BACKGROUND OF THE PROJECT

Infrastructural development, particularly faster movement and transportation of goods in a country like India, is a guiding factor for economic development. Proper transportation of goods requires comprehensive transport systems and increasing road traffic requires better riding quality of roads and uninterrupted movement. Hence it becomes necessary to develop new roads.

In the recent liberalized economic environment of India, transport system in general and road transport in particular is considered to improve the international competitiveness of exports and attract foreign investments. Considering the above benefits more attention is being given now to road projects by national and multilateral funding agencies. The ongoing ambitious National Highway Development Project (NHDP) of the Government of India and likewise massive expansion of state roads and rural roads are indicative of road sector development in India. Such engineering projects also accompany with attendant human and environmental problems which need to be addressed and integrated to produce sustainable streams of social and economic benefits.

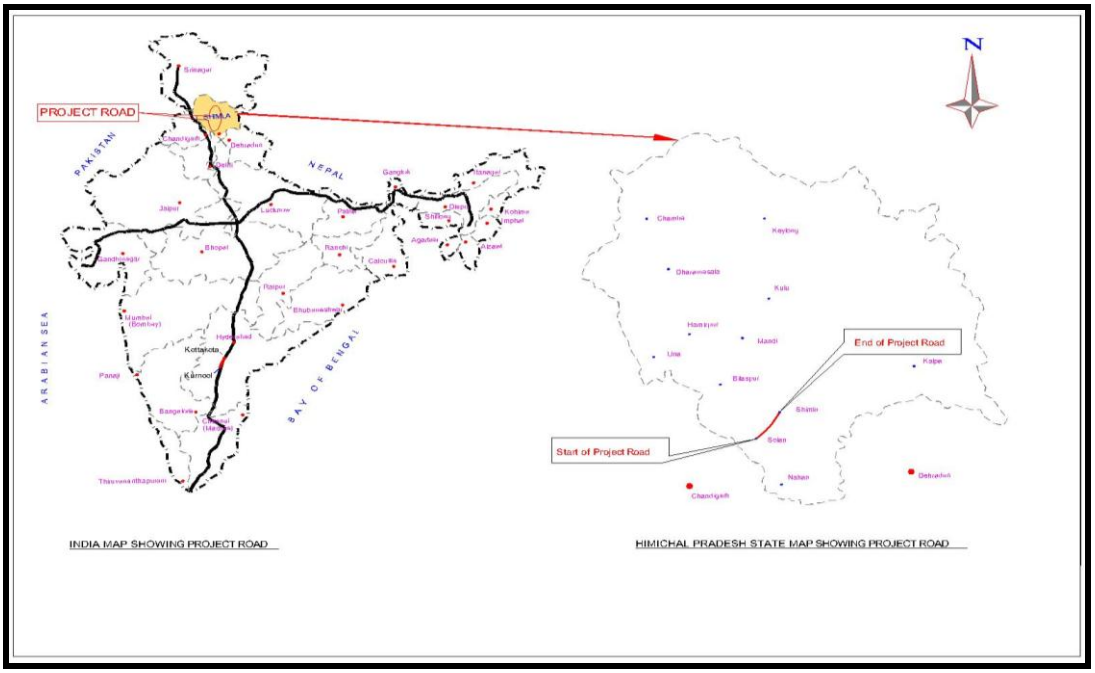
There is a growing recognition that people, communities and institutions are crucial to development outcomes and these social safeguard policies form the basis for social development. This agenda emphasizes a broader view of development, stronger ownership by stakeholders, and wider partnerships among the private sector, civil society and multilateral funding agencies.

Considering the neglect of road infrastructure backlog and growing recognition of its tremendous impact on economic development within the globalizing environment, the Government of India has taken new initiatives in the road sector development and in particular the national highways. Projects in the road sector in India consist largely of upgrading and/or improvements of existing national/state highways and rural access roads.

In the view of the above, National Highways Authority of India (NHAI) has decided to construct the 4 lane highway, covering the section of NH-22 from Solan to Shimla. This section passes through the districts of Solan and Shimla of Himachal Pradesh. The length of the proposed project is 50.507 km. The project road stretch is a part of tourist route and connects the cities of Kalka, Shimla, Parvanoo, Ambala, Chandigarh, etc. Shimla is the capital city of Himachal Pradesh. Solan is an important town of Himachal Pradesh as it has many industries, and bulk trading market of apple. This project road carries a significant heavy traffic to and from Shimla and other parts of the State. There is thus an immediate necessity to widen the existing road to enhance the economic capability of the area.

Location of the project in India and Himachal Pradesh map is shown in **Figure 1.1**.

Figure 1.1 Location Map of Project Road



Implementing Agency

The National Highways Authority of India is the implementing agency of the project. The Consultancy services for Preparation of Feasibility-Cum-Preliminary Design for 4 Laning of Solan- Shimla section of NH 22 in the State of Himachal Pradesh to be executed as DBFOT (Toll) Project on DBFOT Pattern under NHDP Phase III have been entrusted to Meinhardt Singapore Pte Ltd.

1.3. BENEFITS OF THE PROJECT

The project will have multiple benefits. It will reduce the travel time substantially between Solan and Shimla, the two primary cities of Himachal Pradesh. The proposed alignment also reduces the distance between Solan and Dhalli by about 16.6 km due to planned bypass for Shogi and Shimla. In addition the improved road will provide other benefits like

- Fast and safe connectivity resulting in savings in fuel, travel time and total transportation cost to the society;
- Employment opportunity to people;
- Development of local industry, agriculture and handicrafts;
- Development of tourism and pilgrimage;
- Transporting, processing and marketing of agricultural products;
- Reduction in accidents;
- Reduction in pollution;
- Opening up of opportunities for new occupations;
- Better approach to Medical & Educational services and quick transportation of perishable goods like fruits , vegetables and dairy products; and
- Improved quality of life for people and so on.

1.4. THE DESCRIPTION OF THE NATURE, SIZE & LOCATION OF THE PROJECT ROAD

The project is a linear project aimed to provide faster transport to vehicular traffic. The total length of the project road is 50.507 km. Project road starting point is Solan (Km 106.000) and

the termination point is near Dhalli (Km 156.507). The Project road portion from km 106.000 to km 129.007 runs in Solan district and from km 132.230 to End point in Shimla District. The existing road is of two-lane configuration. There are 3 minor bridges and 185 culverts on the road. The proposed project will have 11 major bridges 8 minor bridges and 256 culverts. The project plans to have four tunnels. The road alignment has sharp curves at few locations.

The existing road passes through 6 major settlements, some of which do not have sufficient RoW to be widened to 4-lane facility hence bypass for Kandaghat and Shogi, Shimla and Dhalli have been proposed to avoid these congested settlements and uninterrupted movement of traffic. At such locations realignment has been proposed for geometric improvement and also to protect/ save environmentally sensitive places. The proposed improvement will aim at improving riding quality and journey speed and reducing traffic congestion on the highway. The options of concentric widening and left or right side widening have also been considered for the improvement project so as to utilize the existing right-of-way (RoW) as far as possible and minimize acquisition of additional land. However, land acquisition will be required as the existing ROW is 25 m only.

In addition, 15 number of Bus bays have been proposed at big villages where the frequency of the bus stoppages are more and at all other village locations. Truck lay bye has been proposed at two locations.. Toll plaza has been proposed at one location.

1.5. ENVIRONMENTAL IMPACT ASSESSMENT IN THE PROJECT

1.5.1 Objective and Need of Environmental Impact Assessment

Review of the existing legislation, institutions and policies relevant to the Environmental Impact Assessment at the National and State levels has been done and clearance requirements for the project at various stages of the project have been identified. In terms of the provision of Ministry of Environment and Forests (MoEF) 2006 notification, this project will get classified as a category 'A' project of the said notification because of the following features of the road:

- The project road is more than 30 km in length;
- The proposed bypasses and the widening along the existing alignment involve substantial acquisition of land; (>20 m) and
- The project road is a National Highway (NH).

Therefore the project will require prior environment clearance for execution.

The objective of environmental impact assessment study is to identify the adverse and positive impacts due to project implementation, suggest avoidance, mitigation and enhancement measures in project design and to prepare Environmental Management Plan (EMP) for pre-construction, construction and operation phases of the project.

1.5.2 Scope of EIA Report

The scope for the environmental impact assessment has been decided based on past experience of consultants of similar projects and Terms of Reference of consultants. The outcome of the environmental screening study carried out by the consultants also helped in finalising the scope for the EIA study. The EIA study being undertaken will meet all requirements of National and State Level statutory undertakers. The EIA Study also complies with the TOR approved by MoEF

1.6. ENVIRONMENTAL REGULATORY FRAME WORK

The Environmental Regulatory Framework in India is controlled by "The Environment (Protection) Act, 1986. Under this Act, Environmental Impact Assessment (EIA) Notification - 2006 has been issued by the Ministry of Environment and Forest (MoEF), Government of India. Under the Environment Protection Act 1986 an Environmental Impact Assessment Notification 2006 has been issued by the Ministry of Environment and Forest for the prior environmental clearance for projects /activities. The activities requiring prior environmental

clearance have been listed in Schedule of this Notification. The road projects have been listed at serial no. 7 (f) of this Schedule.

The clearances and permissions required under existing environmental legislation to implement the Project are summarized below in **Table -1.1**

Table -1.1: Clearances and Permissions Required for the Project

S. No	Description	Authority to Accord Clearance	Act/ Rules	Remarks
1	Tree felling and removal from non-forest areas	District Level Committee constituted by the State Govt. and chaired by the District Collector, and DFO	Tree removal will be guided as per state government rules.	Applicable
2	Setting of hot mix plants, crushers and batching plants	Himachal Pradesh Pollution Control Board	Air (Prevention and Control of Pollution) Act, 1981 and the Noise Pollution (Regulation and Control) Rules, 2000	Applicable
3	License to store HSD and Explosives at Construction camp by the contractors from Chief Controller of Explosives under Petroleum Acts and Rules	Regional office of Chief Controller of Explosives, Nagpur	The Petroleum Act, 1934 and The Petroleum Rules,1976	Applicable
4	Permission to withdraw water for construction from surface water sources such as canals and rivers	Himachal Irrigation Department		Applicable
5	Permission to withdraw water for construction from ground	Central Ground Water Board		Applicable
6	Permission for sand mining from river bed	Department of mining, Govt. of Himachal Pradesh. The Collector of the district will grant short-term mining lease.	Existing State Rules and Regulations	Applicable
7	Establishment of workers camp, equipment and storage yards	Himachal Pradesh Pollution Control Board	Environment Protection Act, 1986 and Manufacturing, Storage and	Applicable

S. No	Description	Authority to Accord Clearance	Act/ Rules	Remarks
			Import of Hazardous Chemicals Rules, 1989	
8	Storage, handling and transport of hazardous materials	Himachal Pollution Control Board	Hazardous Waste (Management and handling) Rules, 1989 and Manufacturing, storage and Import of Hazardous chemical Rules, 1989	Applicable
9	Waste water discharge from labor camps	Himachal Pradesh Pollution Control Board	Water (Prevention and Control of Pollution) Act, 1974	Applicable
10	Disposal of bituminous wastes	Local Civil Body to identify solid waste disposal sites	Hazardous Waste (Management and Handling) Rules, 1989	Applicable
11	Opening up new quarries	Department of Commerce and Industries, Govt. of Himachal Pradesh.	Mines and Minerals (Regulation and development) Act, 1957 as amended in 1972	Applicable

1.7. STRUCTURE OF THE EIA REPORT

This EIA report has been presented as per requirements of approved TOR for the EIA study and EIA Notification of Ministry of Environment and Forests (MOEF) Government of India.

Chapter - 1: Introduction: The present chapter deals with the purpose of the report, identifying the project and project components, giving brief description of nature, size and location of the project and its importance to the country, region and scope of work.

Chapter - 2: Description of the Project: This chapter condensely describes about the project.

Chapter - 3: Description of the Environment: This chapter describes the study area and meteorological conditions, existing baseline environmental scenario in detail. The sections on Meteorological baseline, components of the biophysical and natural environment, cultural properties along the corridor and quality of life add up to give a comprehensive picture of the existing environment along the project road and its area of influence.

Chapter - 4: Anticipated Environmental Impacts and Mitigation Measures: This chapter details out environmental impacts, mitigation, avoidance and enhancement measures including Environmental Management Plan. In addition to the avoidance and mitigation measures for the biophysical and natural environmental components, this chapter discusses various environmental enhancements suggested by the project including the enhancement of common property resources such as community water bodies and cultural resources along the project road.

Chapter - 5: Analysis of Alternatives: this chapter covers various alternatives considered in finalisation of the project road and bypass alignments with and without project scenario.

Chapter - 6: Environmental Monitoring Programme:

This Chapter gives the Environmental Monitoring Plan for pre construction, construction and operation phases to check the efficacy of EMP.

Chapter - 7: Stakeholders' Consultations and Public Hearing: This chapter gives an overview of the Community Consultation carried out during the project preparation stage. It also provides an insight into the processes involved, its importance to project design and methods adopted to document the entire exercise.

Chapter - 8: Project Benefits: This chapter describes the improvements viz physical infrastructure, social infrastructure, employment potential and other tangible benefits

Chapter - 9: Environmental Management Plan (EMP): This chapter suggests institutional requirements for ease of implementation of the environmental component of the project. It goes on to describe the set-up required, a reporting system and Environmental management plan. The environmental monitoring plan has also been described.

Chapter - 10: Summary and Conclusion: This chapter discusses the result of the EIA.

Chapter - 11: Road Safety, Accident Management and Transportation of Hazardous

Chemical and Wastes: This Chapter covers safety features built into the project design. Transportation of hazardous materials and waste and accident management has also been covered in this Chapter. The applicable IRC guidelines for the safety have also been mentioned.

Chapter - 12: Disclosure of the Consultants Involved: This chapter gives the details of consultants involved in preparing of the EIA report.

CHAPTER - 2
PROJECT DESCRIPTION

CHAPTER - 2

PROJECT DESCRIPTION

2.1 GENERAL

During the last fifty years rapid development has taken place with increase in volume of traffic. The existing roads are not able to cope up with the increased traffic and there is a need to widen/upgrade this road. Present chapter gives an outlook of the present condition of the project corridor along with the proposed development.

2.2 PROJECT LOCATION

Solan and Shimla are two important cities of Himachal Pradesh. Shimla is the capital city of Himachal Pradesh. It was also a summer capital of India during British Raj. The National Highway -22(NH-22) connects these both cities. This highway has importance because it is used extensively by the tourists during the summer and winter months. This project road carries a significant heavy traffic to and from industrial units and during the transportation of apple in September-November months. Widening of this road is needed immediately to cater for future requirements. It is planned to widen this road to 4 lane configurations with geometric improvements for free flow of traffic. The project road passes through two districts namely Solan and Shimla. The proposed widening will lead to adverse and positive impacts on environment. Similar to environment there will be impacts on socio-economic environment also. The project plans to minimize negative socio-economic and environmental impacts. The public consultations are being undertaken to disseminate project information to all stakeholders, especially to the project affected persons and to invite views, comments and suggestions of stakeholders to incorporate in the project design. Location of the Project Road is shown on Survey of India (SoI) Topo sheets in **Figure 2.1.**

2.3 NEED AND OBJECTIVE

Improvement of surface connectivity helps to improve the economic and social welfare of any group or social community. Improved road connectivity can reduce travel times and lower the costs of vehicle use even in case of emergencies.

Thus it plays an important role in the sustainable and continual development of the state especially the specific districts. A capacity analysis for project road section has been carried out to define the level of service offer by road under the prevailing roadway and traffic condition.

In order to meet the challenges faced by the existing road suitable options for improvement have been proposed. Widening proposed are eccentric left, eccentric right and concentric as per availability of clear site on the respective sides and in congested places where no suitable RoW is available 1 new bypass and one realignment are proposed in order to save structure, houses, temples at congested locations.

2.4 PROJECT INTERVENTION

The project is passing through Solan and Shimla districts, district wise length of the project road is given in **Table 2.1.** The existing road passes through 8 major settlements namely Solan, Kandaghat, Waknaghat, Shoghi,Taradevi,Kacchighati, Shimla and Dhalli. Out of these Shoghi, Shimla and Kadaghat do not have sufficient RoW to be widened to 4-lane facility hence bypasss for Shoghi –Shimla Dhalli and Kandaghat have been proposed to avoid these congested settlements and uninterrupted movement of traffic. Details of location of bypasses have been given in **Table 2.2.** At other locations realignments have been planned for geometric improvement and also to protect/ save environmentally sensitive features. The proposed improvement will aim at improving riding quality and journey speed and reducing traffic congestion on the highway. The options of concentric widening and left or right side widening will be considered for the improvement of project so as to utilize the existing right-of-way (RoW) as far as possible and minimize acquisition of additional land. However, land acquisition will be required through entire stretch as the existing RoW varies between 24 to 25 m. Details of proposed widening scheme is shown in **Table 2.3**. The existing carriageway is

two lanes throughout the Stretch and it is proposed to widen to four 1-toll plaza and 2-truck laybyes, and 15 nos. of bus bays proposed to be constructed **(Table 2.4)**.

Figure 2.1:- Location Map of Project Road

Table 2.1: District Wise Length of Project Road

S. No.	Name of District	Length (km)
1	Solan	23.007
2	Shimla	27.500
4	**Total**	**50.507**

Table 2.2: Proposed Bypasses

S. No.	Bypass	Chainage	Length (km)
1	Kandaghat Bypass	km 116.780 to km 118.130	1.350
2	Shogi- Shimla Dhalli Bypass	Km129.050 to km156.507	27.457

S. No.	Bypass	Chainage	Length (km)
Total Length of Bypasses			**28.807**

Table 2.3: Proposed Widening Schedule of NH-22 (Solan- Shimla Section)

Existing chainage		Length (m)	Design chainage		Length (m)	Widening Side
From	**To**		**From**	**To**		
106.000	106A.755	1.755	106.000	107.740	1.74	Concentric Widening (Both side habitation in Solan town and rail line parallel to Road on LHS)
106A.755	108.410	1.655	107.740	108.890	1.15	Salogara Byapss (Habitated area of Salogara village and IRC non conforming geometry in the existing route)
108.410	109.000	0.590	108.890	109.210	0.320	Left Widening and geometric improvements (Habitated area to right side and IRC non conforming geometry)
109.000	109.480	0.480	109.210	109.530	0.320	Realignment to left (habituated area and IRC non conforming geometry to existing route
109.480	110.120	0.640	109.530	110.0520	0.520	LHS (IRC non conforming geometry)
110.120	110.720	0.600	110.050	110.500	0.450	Concentric widening with geometric imrovements
110.720 111.000	111.000 111.920	0.280 0.920	10.750 110.750	111.600 111.600	0.850 0.850	Realignment to left (Habitated area and IRC non conforming geometry) RHS (New carriageway Right side)
111.920	112.430	0.510	11.600	112.100	0.500	Concentric Widening with geometric imrovements
112.430	112.800	0.370	112.10	112.280	0.180	Realignment to Right (IRC non conforming geometry)
112.800	113.830	1.030	112.280	112.910	0.630	Realignment to Right with geometric imrovements
113.830	115.000	1.170	112.910	113.945	1.035	Left widening with geometric imrovements
115.000	118.700	3.700	113.945	116..365	2.42	Kandaghat bypass
118.700	120.220	1.52	116.365	117.750	1.385	Right widening with geometric imrovements
120+220	120+635	0.415	117+750	118+020	0.27	Realignment to left

Existing chainage		Length (m)	Design chainage		Length (m)	Widening Side
From	To		From	To		
120+635	121+060	0.425	118+020	118+300	0.28	Right Widening with Geometric Improvements
121+060	121+430	0.37	118+300	118+530	0.23	Realignment to left
121+430	123+075	1.645	118+530	119+950	1.42	Right Widening with Geometric Improvements
123+075	123+650	0.575	119+950	120+450	0.5	Realignment to left
123+650	124+950	1.3	120+450	121+450	1	Left Widening with Geometric Improvements
124+950	128+725	3.775	121+450	124+450	3	Geometric Improvements
128+725	129+390	0.665	124+450	124+900	0.45	Realignment to left
129+390	131+150	1.76	124+900	126+392	1.492	Geometric Improvements
131+150 156.420	141+100 159+050	41.2	126+392	153=312	26.92	Shogi-Shimla Bypass

2.5 SALIENT FEATURES

2.5.1.1 Road Condition

The Whole Project road falls in two districts namely Solan and Shimla. Waste land on hill, Agricultural land and built-up area are the major land use features along the road. Pictures of the existing road condition are shown in **Figures 2.2.** The existing road is two-lane configuration. There are 3 minor bridges and 185 culverts **(Table 2.4)** that exist on the road. There will be 11 major bridges, 08 minor bridges and 256 culverts in the proposed road alignment. Entire road is in hilly terrain. The road alignment has sharp gradient at many locations. Summary of salient features of the road has given in **Table 2.5.**

Table 2.4: Project Intervention

Structure	Existing (Nos.)	Proposed (Nos.)
Major Bridges	0	11
Minor Bridges	03	08
Culverts	185	256
Flyover	Nil	Nil
Vehicular Underpasses	Nil	Nil
Pedestrian/Cattle Underpasses	Nil	Nil
Tunnels	0	4
Truck Lay byes	Nil	2
Bus Bays	1	15
Toll Plaza	Nil	1

Table 2.5: Summary of Salient Features of Project Road

S. No.	Features	Details
1	Chainage	Existing: km 106.000 to km 156.420 Proposed: km 106.000 to km 153.312
2	Length (Km)	Existing: 66.930 km , Proposed: 50.507 km
3	Village/Towns.	Solan, Shoghi, Kandaghat, Wakanaghat, Shimla and Kacchi Ghati, Tara Devi, Dhalli
4	Borrow areas	06
5	Rivers/ Streams	Kathula ka Nalla, , Samri Nalla, Kai Ka Nalla, and Kalali ka Nalla
6	Air Monitoring Station.	AAQ-1: At the start of Project Road (km 106.000) AAQ-2: Shoghi town (Km 131.000) AAQ-3: Dhalli (Km 156.000)
7	Noise Monitoring Stations.	NL-1: At the start of Project Road (km 106.000) NL-2: Shoghi town (Km 131.000) NL-3: Dhalli (Km 156.000)
8	Water Monitoring Station	SWQ- 1: Samri Nalla near km 141.000 GWQ-1: Hand Pump at Start of Project Road (km 106.000) GWQ-2: Hand pump Close to RoW at Shoghi (km 131.000) GWQ-3: Hand pump at Dhalli(km 156.000) GWQ-4: Hand pump close to ROW at Limtara (km 64.0)
9	Soil	SQ-1 : Agriculture Field km 108.000 (RHS) SQ-2 : Agriculture Field near km 129.000(LHS) SQ-3 : Agriculture Field near km 156.000 (RHS)
10	Trees on ROW	6800

2.5.1.2 Right-of-Way (RoW)

The existing RoW of the project road varies from 12-24 m. The proposed RoW is 45 m. Kandaghat and Shogi - Shimla - Dhalli bypasses will have a new alignment and RoW of 45 m. The smaller realignments planned will also have a RoW of 45 m.

Figures 2.2: Condition of the existing Road

View of Congested Shoghi Town

Major Junction Between NH-22 And NH-88 Near Km 144+200 (Ex.)

Road and Railway Line is Passing Side By Side Near Km 141+000 (Ex.)

Blind Curve on existing Carriageway

Alligator Crakes on existing Carriageway

2.5.1.3 Bridges and Structures

The locations and technical details of major bridges/viaduct are given below:

Table 2.6: Details of Proposed Major Bridges/Viaducts

S. No.	From	To	Length	V/B	Type	Span Arangement	Pier Height	Width
1	107770	108880	1110	Viaduct	Cantilever+Simply Supported	(4*20)ss+ 3*(90+130+90)c+ (5*20)ss	50	24
2	110510	110740	230	Viaduct	Cantilever	65+100+65	20	24
3	112100	112250	150	Viaduct	Simply Supported	3*50	20	24
4	112430	112520	90	Bridge	Simply Supported	3*30	20	24
5	112810	112860	50	Viaduct	Simply Supported	1*50	20	24
6	113950	115350	1400	Viaduct	Simply Supported elevated road		25	24
7	115350	115850	500	Viaduct	Extra dosed	140+220+140	80	24
8	117810	117990	180	Viaduct	Simply Supported	4*45	15	24
9	118320	118480	160	Viaduct	Simply Supported	3*40	15	24
10	119995	120130	135	Viaduct	Simply Supported	3*45	10	24
11	120280	120370	90	Viaduct	Simply Supported	3*30	10	24
12	120560	120650	90	Viaduct	Simply Supported	3*30	10	24
13	122240	122330	90	Viaduct	Simply Supported	3*30	10	24
14	124520	124840	320	Viaduct	Cantilever	90+140+90	50	24
15	125140	125290	150	Viaduct	Simply Supported	3*50	15	24
16	125310	12510	200	Viaduct	Simply Supported	4*50	15	24
17	126620	126940	320	Viaduct	Cantilever	90+140+90	45	24
18	127040	127240	200	Viaduct	Simply Supported	4x50	20	24
19	128690	128980	290	Viaduct	Cantilever	80+130+80	40	24
20	129040	129280	240	Viaduct	Cantilever	70+100+70	40	24
21	129440	129500	60	Bridge	Simply Supported	1x60	20	24
22	129860	130240	380	Bridge	Cantilever	105+170+105	70	24
23	130675	130825	150	Viaduct	Simply Supported	3x50	25	24

S. No.	From	To	Length	V/B	Type	Span Arangement	Pier Height	Width
24	135640	135980	340	Bridge	Cantilever	90+150=90	60	24
25	137860	138060	200	Bridge	Cantilever	55+90+55	30	24
26	139080	139440	360	Bridge	Cantilever	100+160+100	80	24
27	140580	140760	180	Viaduct	Cantilever	50+80+50	60	24
28	14110	141220	120	Bridge	Simply Supported	3x40	40	24
29	142550	142620	70	Viaduct	Simply Supported	15+40+15	25	24
30	143100	143480	380	Bridge	Cantilever	105+170+105	120	24
31	145160	145220	60	Bridge	Simply Supported	3x20	10	24
32	145380	145560	180	Viaduct	Cantilever	50+80+50	40	24
33	150560	150680	120	Bridge	Simply Supported	3x40	25	

The details of culverts planned to be widened and new culverts planned on realignment and bypasses are given below:

Table 2.7: Details of Culverts to be widened and New Culverts

S. No	Proposal	Proposed Chainage	Proposal Details		Span Arrangement
			LW	RW	
1	Widening	106+106	7.5	7.5	1x1000
2	Widening	106+778	7.5	7.5	1x1000
3	Widening	106+884	7.5	7.5	1x1000
4	Widening	107+000	7.5	7.5	1x1000
5	Widening	107+200	5	5	1x1000
6	Widening	107+230	7.5	7.5	1x1000
7	Widening	107+300	7.5	7.5	1x1000
8	Widening	107+470	7.5	7.5	1x1000
9	Widening	107+640	5	5	1x1000
10	Widening	107+710	7.5	7.5	1x1000
11	New	108+900	12.5	12.5	1x1200

S. No	Proposal	Proposed Chainage	Proposal Details		Span Arrangement
			LW	RW	
12	Widening	109+060	12.5		1x1000
13	New	109+210	11	11	1x2
14	New	109+600	12.5	12.5	1x1200
15	Widening	109+700	12.5		1x1000
16	New	109+890	12.5	12.5	1x1200
17	New	110+260	12.5	12.5	1x1200
18	Widening	110+385	7.5	7.5	1x1000
19	Widening	110+785	7.5	7.5	
20	Widening	111+150		12.5	1x1000
21	Widening	111+330		12.5	1x1000
22	Widening	111+475		12.5	1x1000
23	Widening	111+585		12.5	1x1000
24	New	111+695		22	2x2
25	Widening	111+820	7.5	7.5	1x1000
26	Widening	111+935		12.5	1x1000
27	Widening	111+980	7.5	7.5	1x1000
28	Widening	112+350		12.5	1x1000
29	Widening		12.5		1x1000
30	New	112+725	12.5	12.5	1x1200
31	Widening	113+165	**7.5**	**7.5**	1x1000
32	Widening	113+230		12.5	1x1000
33	Widening	113+440	**7.5**	**7.5**	1x1000
34	New	113+630	12.5	12.5	1x1200
35	Widening	113+720	12.5		1x1000
36	Widening	113+800	12.5		1x1000

S. No	Proposal	Proposed Chainage	Proposal Details		Span Arrangement
			LW	RW	
37	New	113+850	12.5	12.5	1x1200
38	New	113+890	12.5	12.5	1x1200
39	New	116+100	12.5	12.5	1x1200
40	New	116+130	12.5	12.5	1x1200
41	New	116+270	12.5	12.5	1x1200
42	New	116+390		22	1x4.40
43	New	116+470	12.5	12.5	1x1200
44	New	116+460	12.5	12.5	1x1200
45	Widening	116+575		12.5	1x1000
46	New	116+770	12.5	12.5	1x1200
47	New	116+940		22	1x4.7
48	Widening	117+100	12.5		1x1000
49	Widening	117+210		12.5	1x1000
50	Widening	117+340	12.5		1x1000
51	Widening	117+450	15		1x1000
52	New	117+540	12.5	12.5	1x1200
53	Widening	117+58.0	12.5		1x1000
54	Widening	118+630	7.5	7.5	1x1000
55	Widening	118+720		12.5	1x1000
56	Widening	118+830		12.5	1x1000
57	New	118+930	12.5	12.5	1x1200
58	Widening	119+030	12.5		1x1000
59	Widening	119+150		12.5	1x1000
60	Widening	119+280	12.5		1x1000
61	New	119+380	12.5	12.5	1x1200

S. No	Proposal	Proposed Chainage	Proposal Details		Span Arrangement
			LW	RW	
62	New	119+410	12.5	12.5	1x1200
63	Widening	119+650	7.5	7.5	1x1000
64	Widening	119+875			1x1000
65	Widening	120+117	5	**5**	1x1000
66	New	120+565	12.5	12.5	1x1200
67	Widening	120+953	12.5		1x1000
68	Widening	121+056		**8**	1x1000
69	New	121+015	12.5	12.5	1x1200
70	Widening			11	1x1000
71	New	121+340	12.5	12.5	1x1200
72	Widening	121+425	12.5		1x1000
73	Widening	121+690		12.5	1x100
74	New	121+755	12.5	12.5	1x1200
75	Widening	121+845	12.5	12.5	1x1000
76	New	121+920		12.5	1x1200
77	Widening	122+055	12.5		1x1000
78	Widening	122+178		12.5	1x1000
79	Widening	122+370		12.5	1x1000
80	Widening	122+500	12.5		1x1000
81	New	122+575	12.5	12.5	1x1200
82	Widening	122+869	7.5	7.5	1x1000
83	Widening	122+985	06012.5		1x1000
84	New	123+060	12.5	12.5	1x1200
85	New	123+185	12.5	12.5	1x1200
86	Widening	123+390	12.5		1x1000

S. No	Proposal	Proposed Chainage	Proposal Details		Span Arrangement
			LW	RW	
87	Widening	123+800	5	10	1x1000
88	Widening	124+000	12.5		1x1000
89	Widening	124+140	10		1x1000
90	Widening	124+170	12.5		1x1000
91	New	124+225		22	1x1200
92	Widening	124+255		15	1x1000
93	Widening	124+262	12.5		1x1000
94	Widening	124+325	12.5		1x1000
95	Widening	124+460		18	1x1000
96	New	124+515	12.5	12.5	1x1200
97	New	124+945	12.5	12.5	1x1200
98	Widening	125+060		12.5	1x1000
99	Widening	125+590	12.5		1x1000
100	Widening	125+640		12.5	1x1000
101	Widening		8.5	6.5	1x1000
102	New	126+290	12.5	12.5	1x1200
103	New	126+380	12.5	12.5	1x1200
104	New	128+415	12.5	12.5	1x1200
105	New	129+615	12.5	12.5	1x1200
106	New	131+320	12.5	12.5	1x1200
107	New	132+030		22	1x4
108	New	132+400	12.5	12.5	1x1200
109	New	132+575	12.5	12.5	1x1200
110	New	132+950	12.5	12.5	1x1200
111	New	134+150	12.5	12.5	1x1200

S. No	Proposal	Proposed Chainage	Proposal Details		Span Arrangement
			LW	RW	
112	New	134+330	12.5	12.5	1x1200
113	New	134+500	12.5	12.5	1x1200
114	New	135+360	12.5	12.5	1x1200
115	New	135+530	12.5	12.5	1x1200
116	New	136+145	12.5	12.5	12.5
117	New	136+400	12.5	12.5	1x1200
118	New	136+730	12.5	12.5	1x1200
119	New	137+420	12.5	12.5	1x1200
120	New	137+740	12.5	12.5	1x1200
121	New	138+140	12.5	12.5	1x1200
122	New	138+300	12.5	12.5	1x1200
123	New	138+770	12.5	12.5	1x1200
124	New	139+500	12.5	12.5	1x1200
125	New	139+820	12.5	12.5	1x1200
126	New	140+030	12.5	12.5	1x1200
127	New	140+150	12.5	12.5	1x1200
128	New	140+460	12.5	12.5	1x1200
129	New	140+870	12.5	12.5	1x1200
130	New	141+000	12.5	12.5	1x1200
131	New	141+300	12.5	12.5	1x1200
132	New	141+410	12.5	12.5	1x1200
133	New	141+800	12.5	12.5	1x1200
134	New	142+050	12.5	12.5	1x1200
135	New	142+225	12.5	12.5	1x1200
136	New	142+370	12.5	12.5	1x1200

S. No	Proposal	Proposed Chainage	Proposal Details		Span Arrangement
			LW	RW	
137	New	142+750	12.5	12.5	1x1200
138	New	142+900	12.5	12.5	1x1200
139	New	144+050	12.5	12.5	1x1200
140	New	144+350	12.5	12.5	1x1200
141	New	144+800	12.5	12.5	1x1200
142	New	145+030	12.5	12.5	1x1200
143	New	145+840	12.5	12.5	1x1200
144	New	146+040	12.5	12.5	1x1200
145	New	146+320	12.5	12.5	1x1200
146	New	146+700	12.5	12.5	1x1200
147	New	146+830	12.5	12.5	1x1200
149	New	147+120	12.5	12.5	1x1200
150	New	147+480	12.5	12.5	1x1200
151	New	147+850	12.5	12.5	1x1200
152	New	148+050	12.5	12.5	1x1200
153	New	148+360	12.5	12.5	1x1200
154	New	148+550	12.5	12.5	1x1200
155	New	149+420	12.5	12.5	1x1200
156	New	149+660	12.5	12.5	1x1200
157	New	149+860	12.5	12.5	1x1200
158	New	150+250	12.5	12.5	1x1200
159	New	150+060	12.5	12.5	1x1200
160	New	150+660	12.5	12.5	1x1200
161	New	150+050	12.5	12.5	1x1200
162	New	152+620	12.5	12.5	1x1200

2.5.1.4 Retaining Wall

At deep cut locations 2 to 3 m high breast walls are proposed and at fill locations 2 to 16 m high retaining walls are proposed.

2.5.1.5 Toll Plaza Locations

The project road is proposed to be developed as a Toll road. The length of project road is only 47.312 km only; therefore, only one toll plaza will be feasible. During traffic survey it was observed that km 112 is suitable for the development of Toll Plaza system.

2.5.1.6 Slip Roads & Service Road

Since the project road is on a hilly terrain and there is limited availability of plain space, therefore, no service roads and slip roads have been planned.

2.5.1.7 Pavement Design

The recommended overlay designs for general application for the project is 50 mm DBM, 50 mm BC. The recommended design of new pavement for general application for the project is 200 mm GSB+250 mm WBM+ 100 mm DBM+ 40 mm BC.

2.5.1.8 Bus Bays & Bus Stops

Since regular bus service operates along the project road, there are a few bus stops along it. In order to ensure free movement of through traffic, these existing bus are proposed to be converted into the bus bays with proper separator islands. In addition to this bus ways have been proposed at start and end point of bypasses, major habitations and at major road crossings of bypasses. The locations of bus ways are given below:

Table 2.8: Locations of Bus Stops with Shelter

S.No	Design Chainage
1	106+200
2	106+740
3	108+890
4	113+945
5	116+365
6	123+135
7	121+500
8	124+450
9	126+300
10	128+600
11	132+200
12	136+400
13	145+700
14	151+150
15	153+312

2.5.1.9 Tunnels

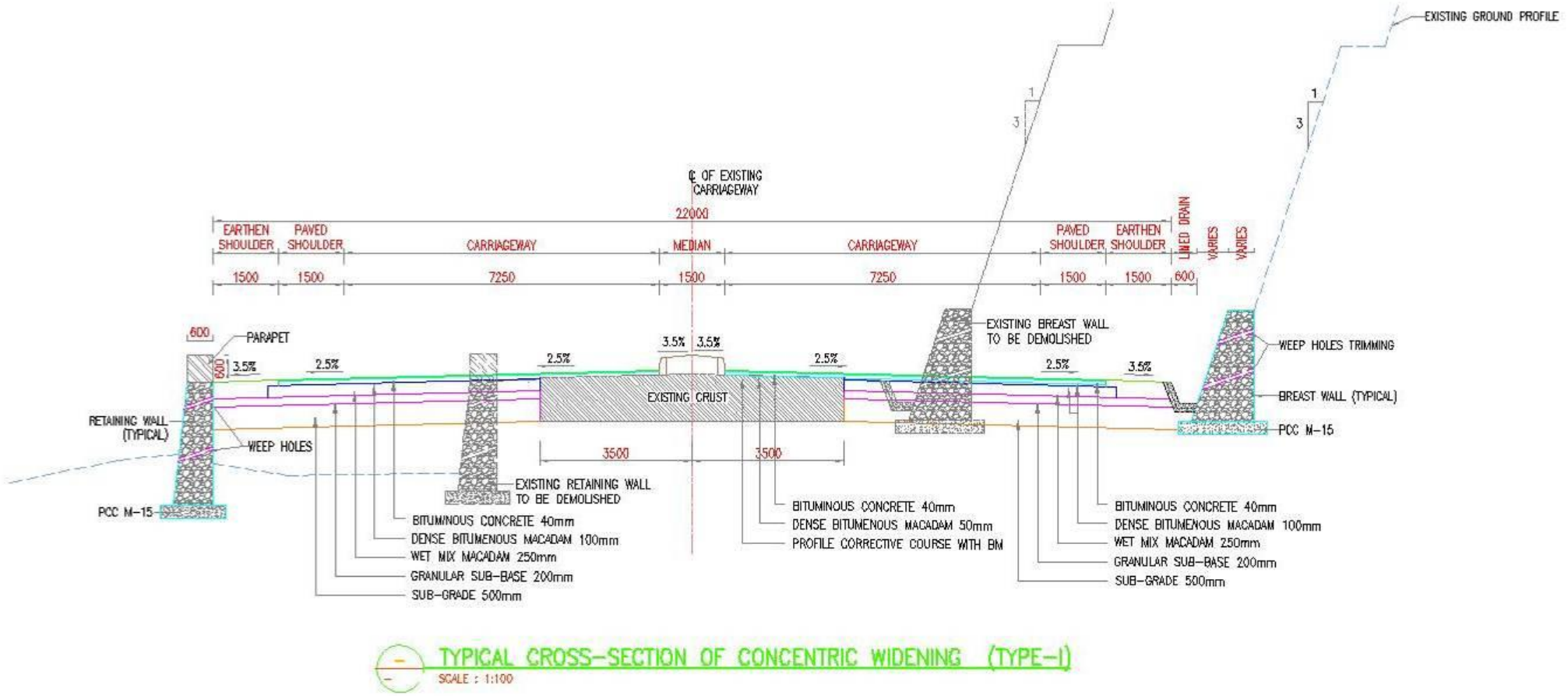
Four no of tunnels are proposed in Project as per following details:

S. No	From	To	Length (km)
1	117.600	118.060	0.460
2	130.190	130.880	0.690
3	135.930	137160	1.230
4	156.350	156.450	0.100

2.5.1.10 Cost Estimate

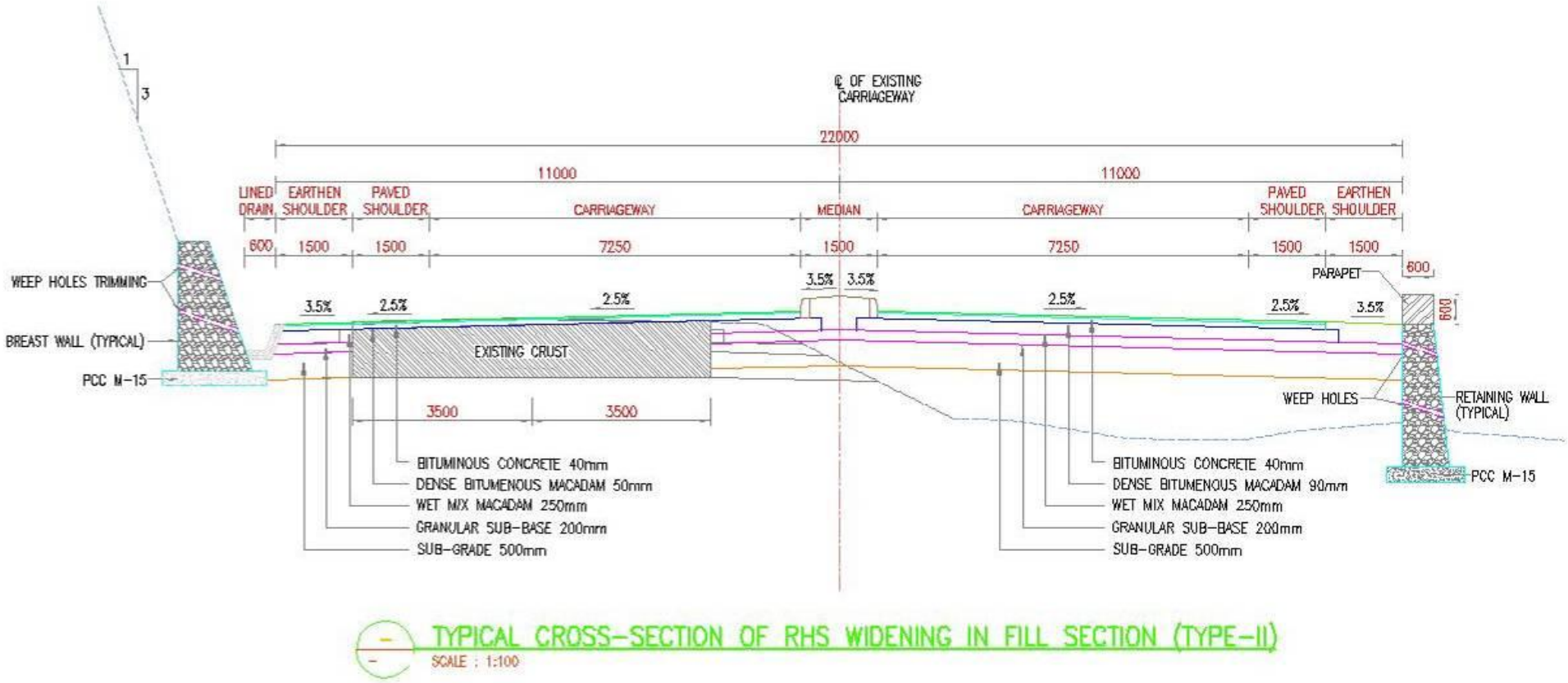
Total cost civil works for the project is estimated at INR 1786 Corers.

Annexure 2.1 : Typical Cross Section



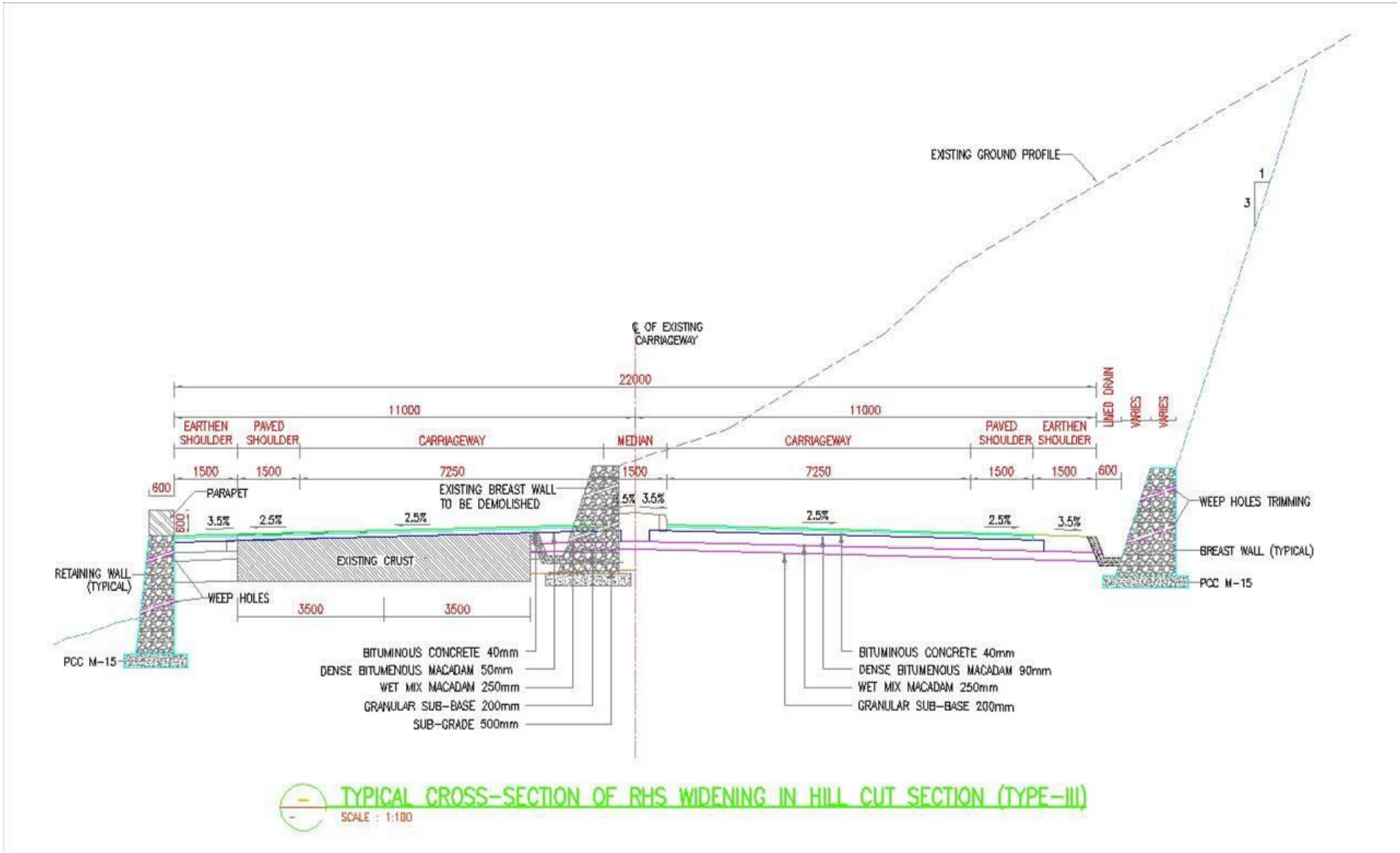
TYPICAL CROSS-SECTION OF CONCENTRIC WIDENING (TYPE-I)

SCALE : 1:100



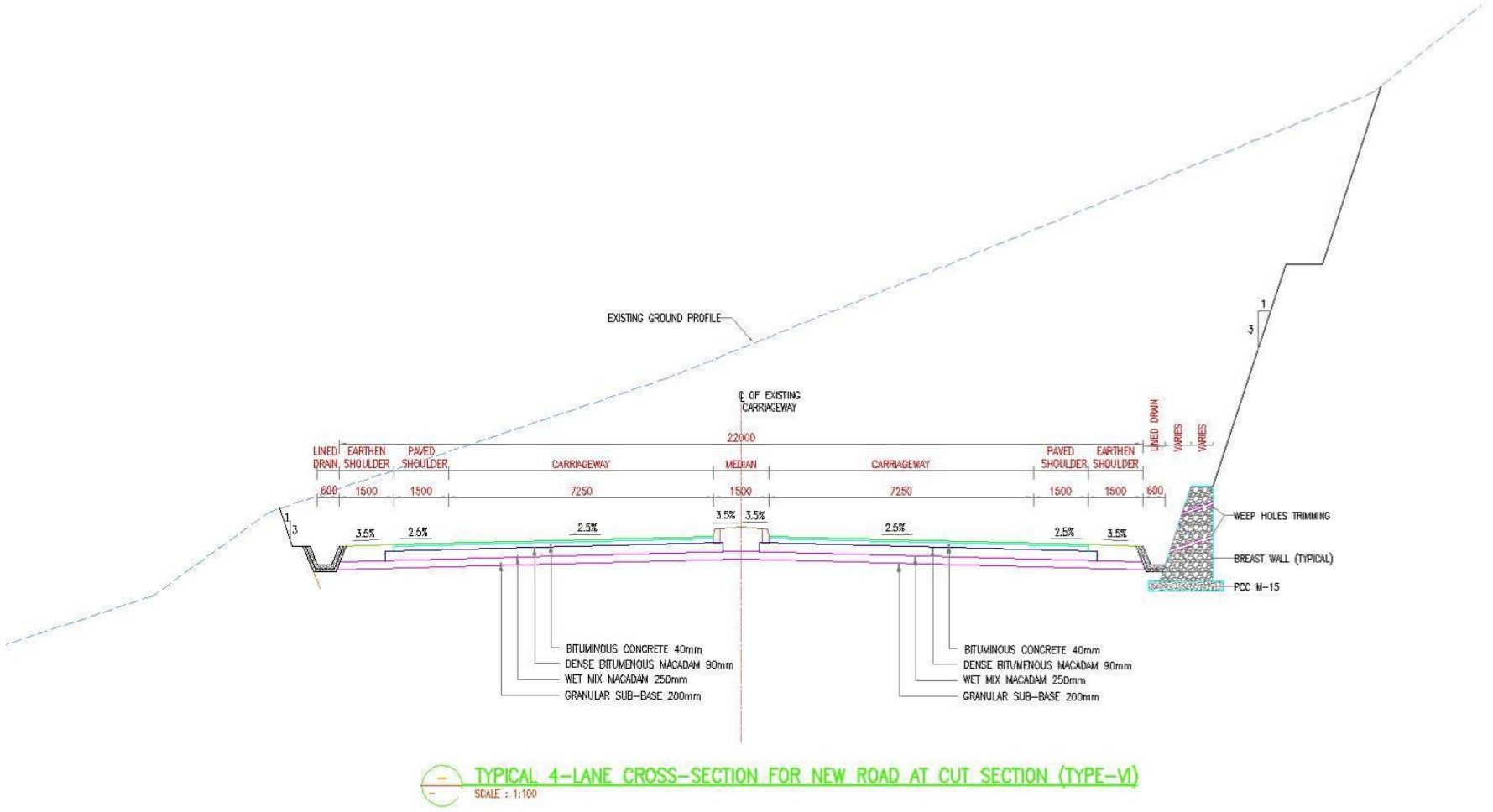
TYPICAL CROSS-SECTION OF RHS WIDENING IN FILL SECTION (TYPE-II)

SCALE : 1:100

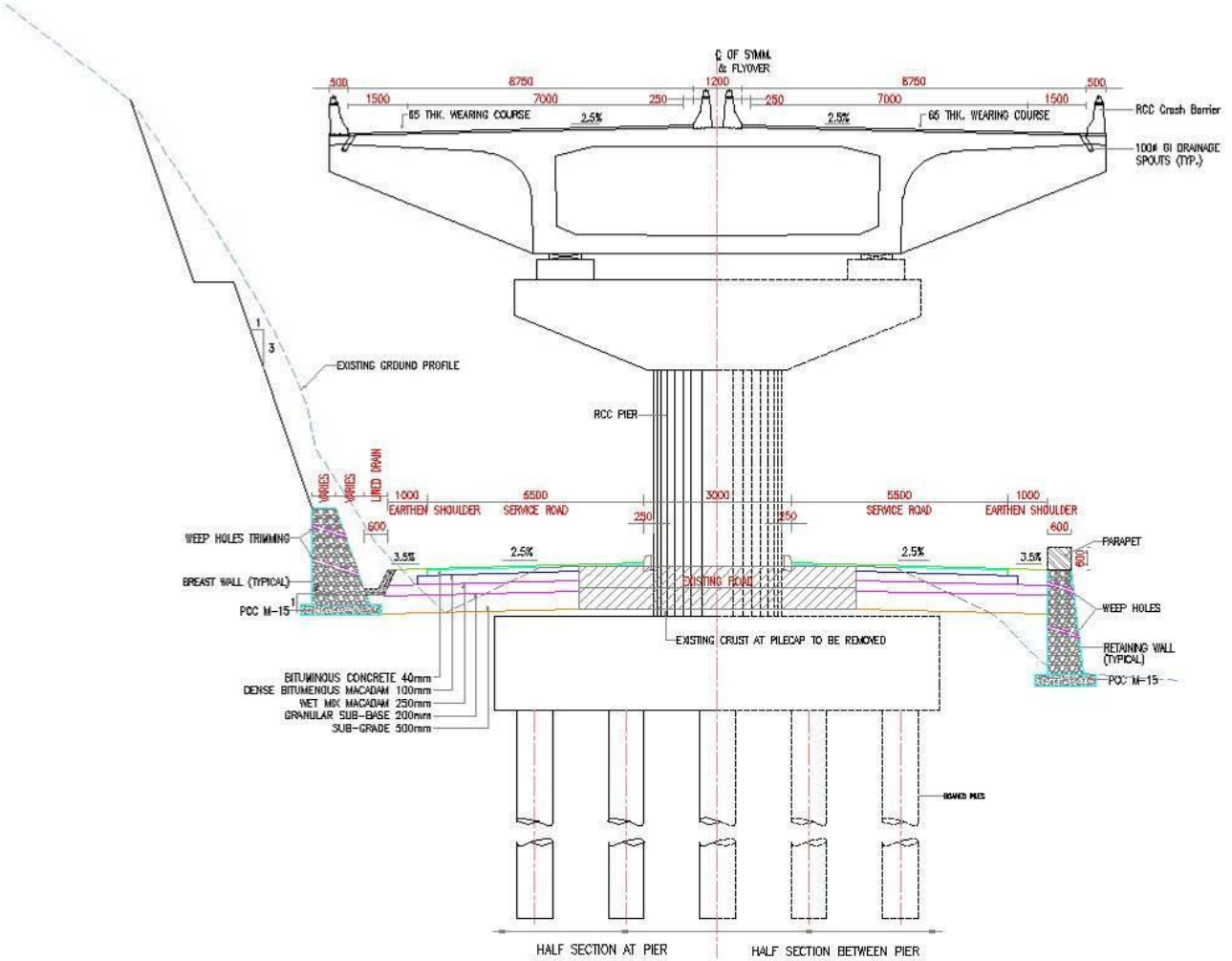


TYPICAL CROSS-SECTION OF RHS WIDENING IN HILL CUT SECTION (TYPE-III)

SCALE : 1:100

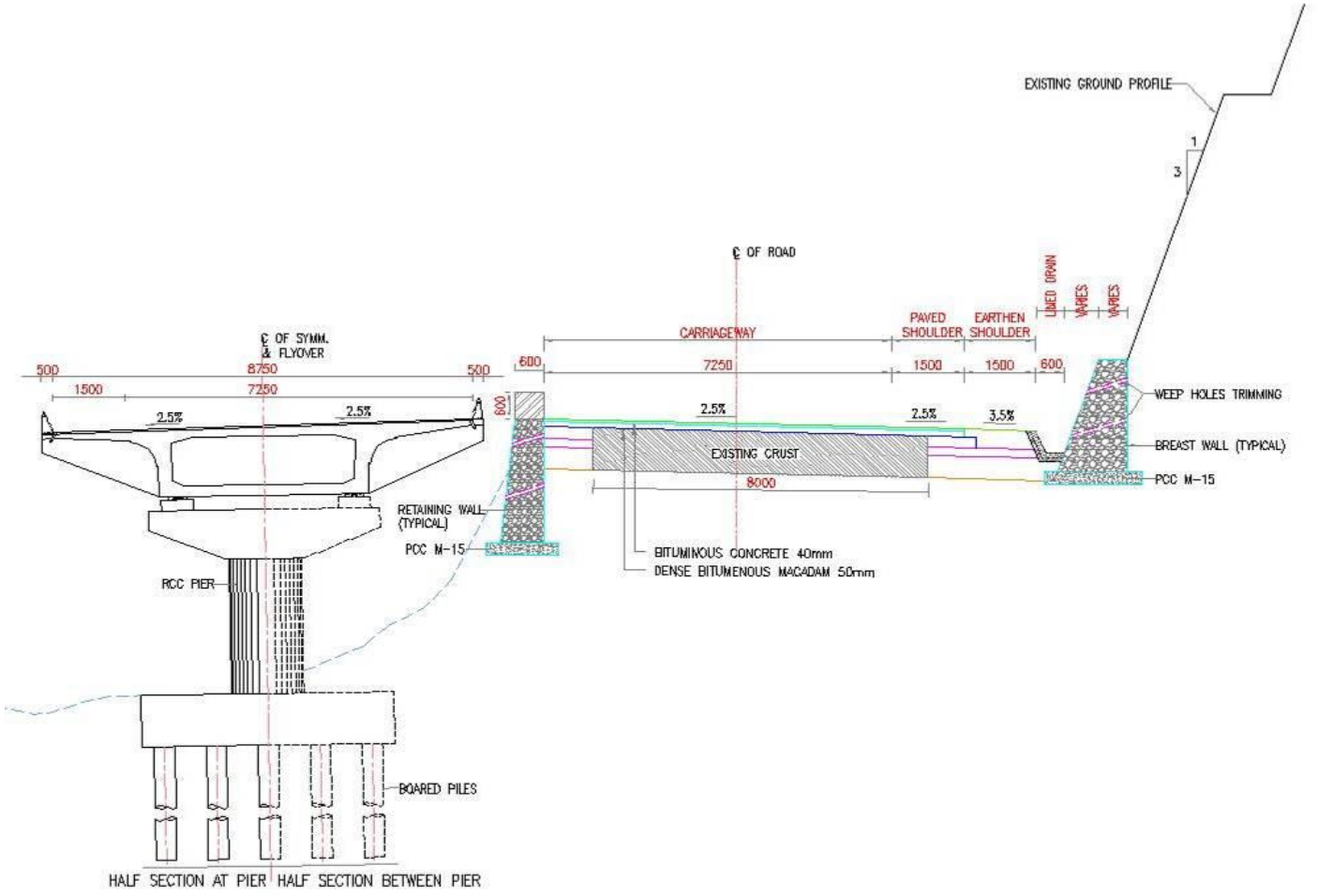


TYPICAL 4-LANE CROSS-SECTION FOR NEW ROAD AT CUT SECTION (TYPE-VI)
SCALE : 1:100



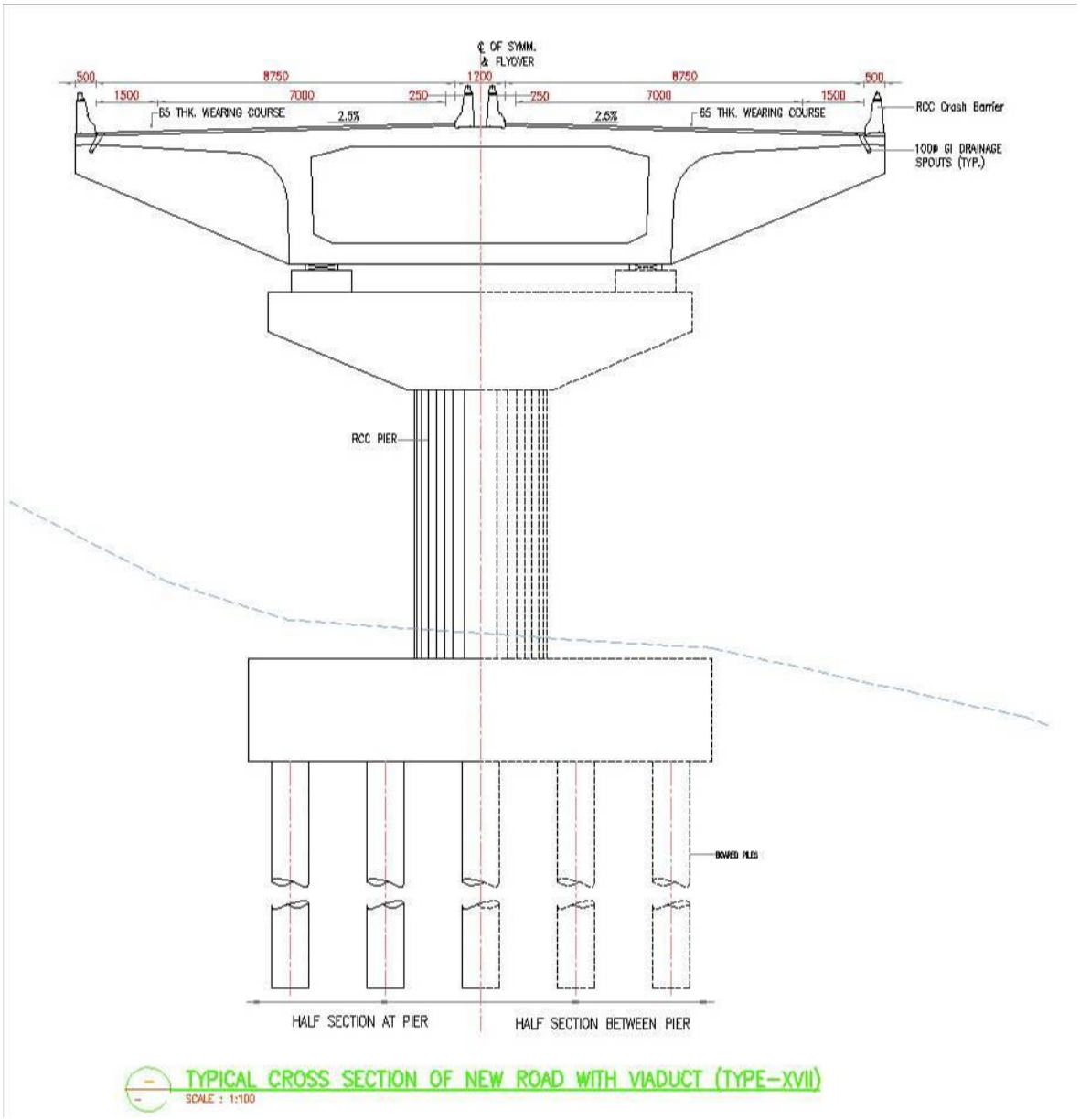
TYPICAL CROSS SECTION OF CONCENTRIC WIDENING WITH FLYOVER + SERVICE ROAD (TYPE-XIII)

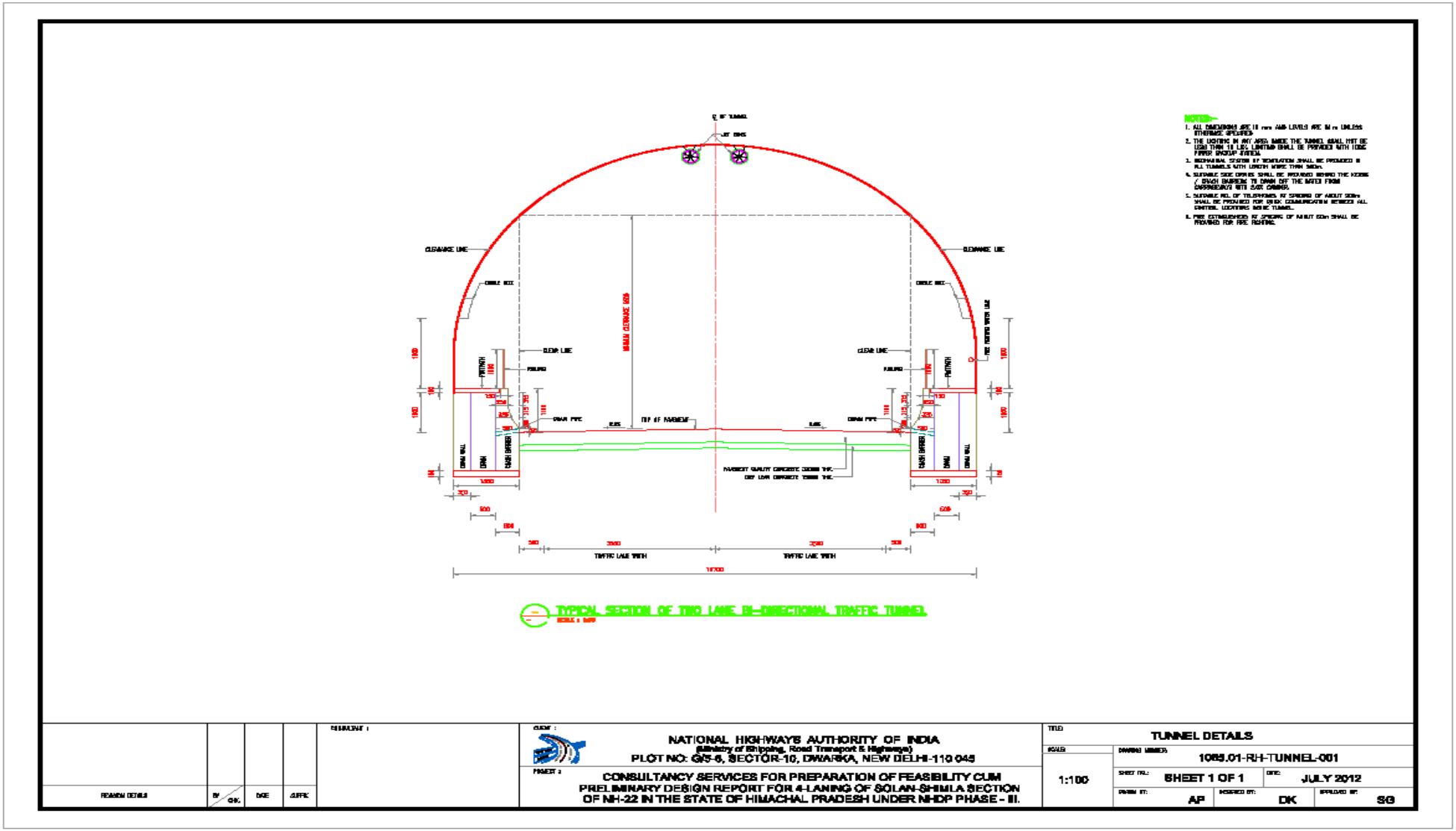
SCALE : 1:100



TYPICAL CROSS-SECTION FOR ROAD LHS WIDENING WITH VIADUCT (TYPE-XIV)

SCALE : 1:100


℄ OF SYMM.
& FLYOVER
500
8750
1200
8750
500
1500
7000
250
250
7000
1500
65 THK. WEARING COURSE
2.5%
2.5%
65 THK. WEARING COURSE
RCC Crash Barrier
100ø GI DRAINAGE SPOUTS (TYP.)
RCC PIER
BOXED PILES
HALF SECTION AT PIER
HALF SECTION BETWEEN PIER
TYPICAL CROSS SECTION OF NEW ROAD WITH VIADUCT (TYPE-XVII)
SCALE : 1:100


NOTES:-
1. ALL DIMENSIONS ARE IN mm AND LEVELS ARE IN m UNLESS OTHERWISE SPECIFIED.
2. THE LIGHTING IN ANY AREA WHERE THE TUNNEL SHALL NOT BE LESS THAN 10 LUX. LIGHTING SHALL BE PROVIDED WITH HIGH PRESS SODIUM SYSTEM.
3. MECHANICAL SYSTEM OF VENTILATION SHALL BE PROVIDED IN ALL TUNNELS WITH LENGTH MORE THAN 500m.
4. SUITABLE SIDE DRAINS SHALL BE PROVIDED BEHIND THE KERBS / SLOPE BARRIER TO DRAIN OFF THE WATER FROM CARRIAGEWAY WITH SUCH CHANNELS.
5. SUITABLE NO. OF TELEPHONES AT SPACING OF ABOUT 500m SHALL BE PROVIDED FOR QUICK COMMUNICATION BETWEEN FAR CONTROL LOCATIONS WITHIN TUNNEL.
6. FIRE EXTINGUISHERS AT SPACING OF NOT MORE 100m SHALL BE PROVIDED FOR FIRE FIGHTING.
CLEARANCE LINE
CLEAR LINE
TOP OF PAVEMENT
TRAFFIC LANE WIDTH
TYPICAL SECTION OF TWO LANE BI-DIRECTIONAL TRAFFIC TUNNEL
NATIONAL HIGHWAYS AUTHORITY OF INDIA
(Ministry of Shipping, Road Transport & Highways)
PLOT NO: G/5-6, SECTOR-10, DWARKA, NEW DELHI-110 045
CONSULTANCY SERVICES FOR PREPARATION OF FEASIBILITY CUM PRELIMINARY DESIGN REPORT FOR 4-LANING OF SOLAN-SHIMLA SECTION OF NH-22 IN THE STATE OF HIMACHAL PRADESH UNDER NHDP PHASE - III.
TUNNEL DETAILS
1:100
1069.01-RH-TUNNEL-001
SHEET 1 OF 1
JULY 2012
AP
DK
SG

CHAPTER – 3

DESCRIPTION OF THE ENVIRONMENT

CHAPTER - 3
DESCRIPTION OF ENVIRONMENT

3.1 INTRODUCTION

Environment embraces all the three components like the physical, biological and the socio-economic environment. EIA is a formal process for identifying the likely effects of particular activities or projects on the environment and human health and welfare. EIA also encompasses the development of mitigation measures to address these impacts and suggested approaches for implementation of mitigation and monitoring measures. EIA is not to be regarded as an academic exercise as this has to ensure that environmental values and factors have to be integrated into the decision-making process. EIAs convey information about environmental effects of a project to decision makers at a stage when such information can materially affect the output. 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 of the physical and biological parameters in the Direct and Indirect Area of Influence. Details of baseline environment parameters are required for decision making for the project.

Period of Study

The Environment Impact Assessment Study has been carried out from December 2011 February 2012.

3.2 SITE SETTING AND STUDY AREA

Solan and Shimla are the two important cities of Himachal Pradesh. Shimla is the capital city of Himachal Pradesh. The National Highway -22 (NH-22) connects these both cities. Shimla is a very popular tourist destination of the country. This used to be summer capital during British Raj. The project road has importance from defense point of view as it provides connectivity to China border beyond Shimla. The route is also used to transport apples from the State to the plain land.

Direct Influence Area

The direct project influence area has been considered the Right of Way (RoW) of proposed project and 500 m on either side from the edge of the road. The Proposed Right of Way (ROW) of project road is 45 m in the entire stretch of project road.

Indirect Influence Area

The indirect influence extends from boundary of the direct area of influence and up to 15 km from the boundary of RoW of project road.

3.3 ESTABLISHMENT OF BASELINE

The environmental baseline has been established for components of valued Ecosystem. The environment setting is established by collection of secondary data from various sources and by generating primary data wherever secondary data was not available. The baseline has been established for physical environment, biological environment and socio-economic environment.

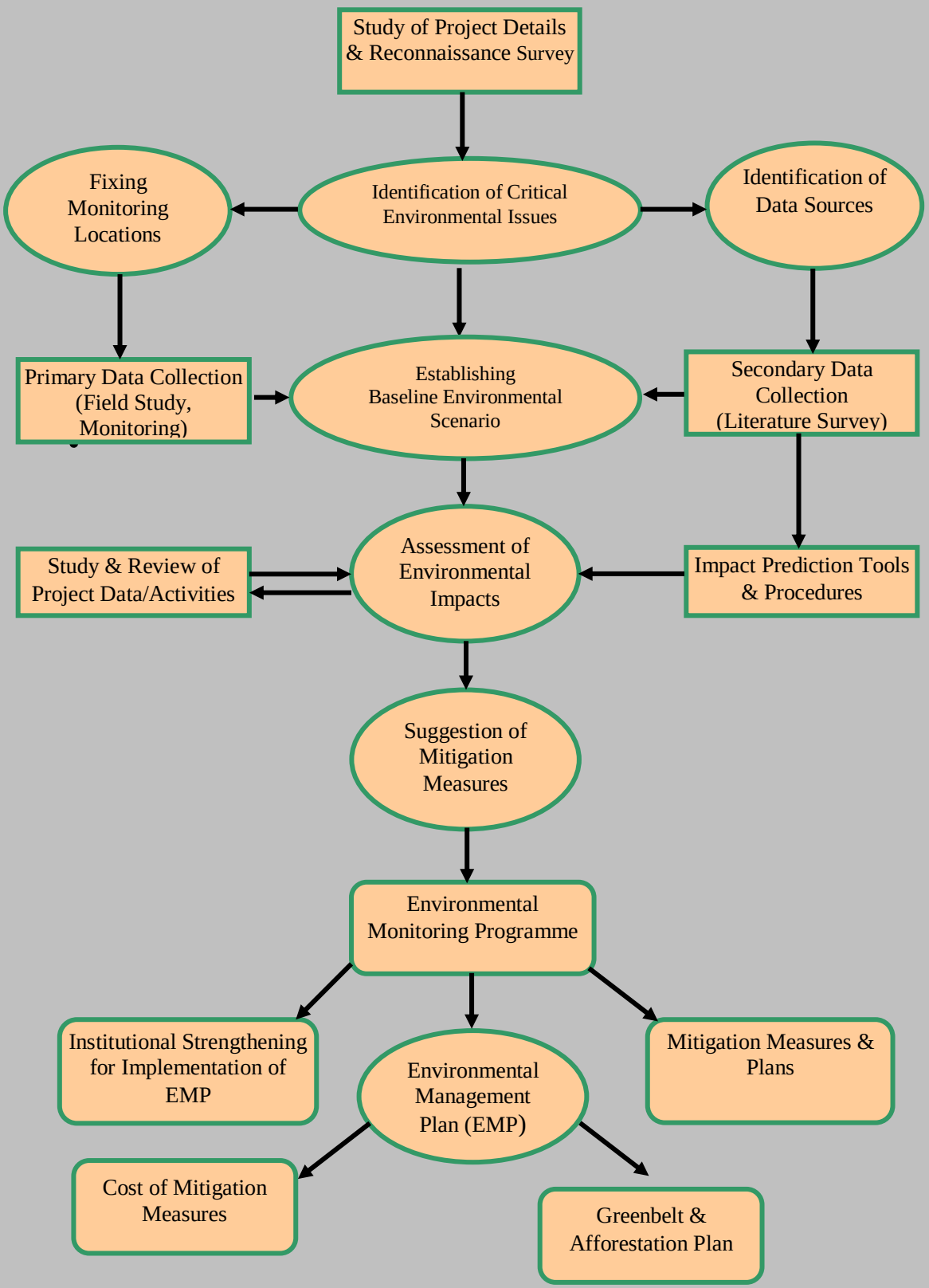
3.4 EIA METHODOLOGY

The EIA procedure preceded simultaneously with design of the project road and methodology is shown in **Figure 3.1**.The important findings of the assessment gave important feedback to the design team, especially in terms of the sensitive receptor utilities /facilities to be impacted and locations of religious properties. It helped modify the designs at locations where impacts had to be avoided and incorporate mitigation measures wherever the impacts were

unavoidable due to other constraints. The steps covered in the preparation of EIA are as follows:

- Review of Documents; the documents of Rules, Guidelines, Acts of Government of India and Government of Himachal Pradesh, Prototype studies were reviewed viz a viz proposed project.
- Reconnaissance Surveys; the team of professionals took the reconnaissance of the site to have a feel of the area and to identify the likely Environment issues associated with the project.
- Collection of Secondary Data and Generation of Primary Data; The Secondary data was collected from different sources about components of valued Eco-system like Climate, Physiographic, Soil type, Ecology of the area. The gaps in secondary data were filled by generating primary data like Ambient Air Quality, Water Quality, Noise Levels and Surface Hydrology etc
- Documentation of Baseline Conditions;
- Assessment of Potential Impacts; The Potential impacts on Components of Valued Eco System have been assessed based on previous prototype studies, different prediction models and Past Experiences. The predication has been both qualitative and quantitative.
- Identification of Mitigation and Enhancement Measures;
- Analysis of Alternatives; All alternatives were considered and adverse impacts of each alternative were studied before selecting the proposed alignment
- Public Consultations; and
- Preparation of the Environmental Management Plans. Environment Management Programme has been developed suggesting mitigative measures for various impacts on components of Valued Eco Systems to offset the adverse impacts or to mitigate the adverse impacts and bring them to acceptable levels. The monitoring programme specifies the monitoring mechanism, frequency etc. A detailed budget has also been prepared for implementation of Environment Management and Monitoring Programme.

Figure 3.1: Methodology of EIA



3.5 PHYSICAL ENVIRONMENT

3.5.1 Topography

Himachal Pradesh topography includes landforms of mountain ranges, plateau region and plain land areas. The plain land area is not much. The topography of project road is undulating and hilly. The project road elevation varies from 1493 m to 2250 m from the mean sea level.

3.5.2 Geology

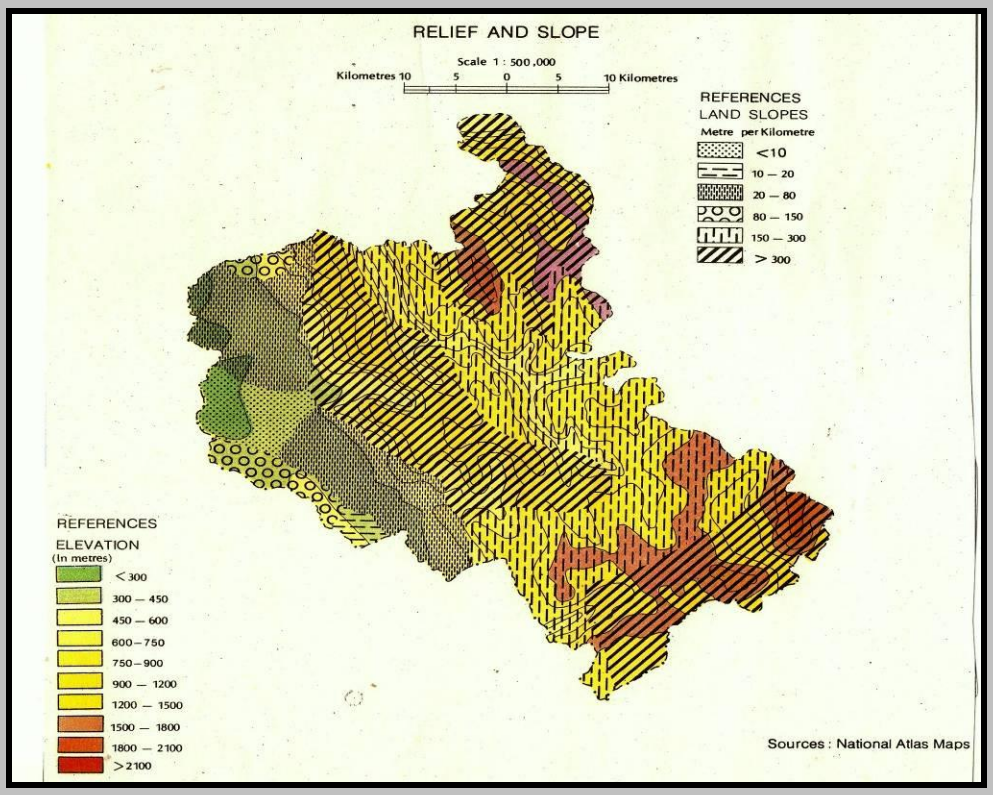
The project road surroundings comprise rocks of Shali formation of Shimla group. The stratigraphic setting of shali formation of rocks from top to bottom consists of the Pamalli member, Marki Member, Tattapani Member, Sorghawari member. Khatpul member, and Khaira member. Most of these members comprise of quartzites, shales, phyllitic shales and dolomites.

3.5.3 Physiography

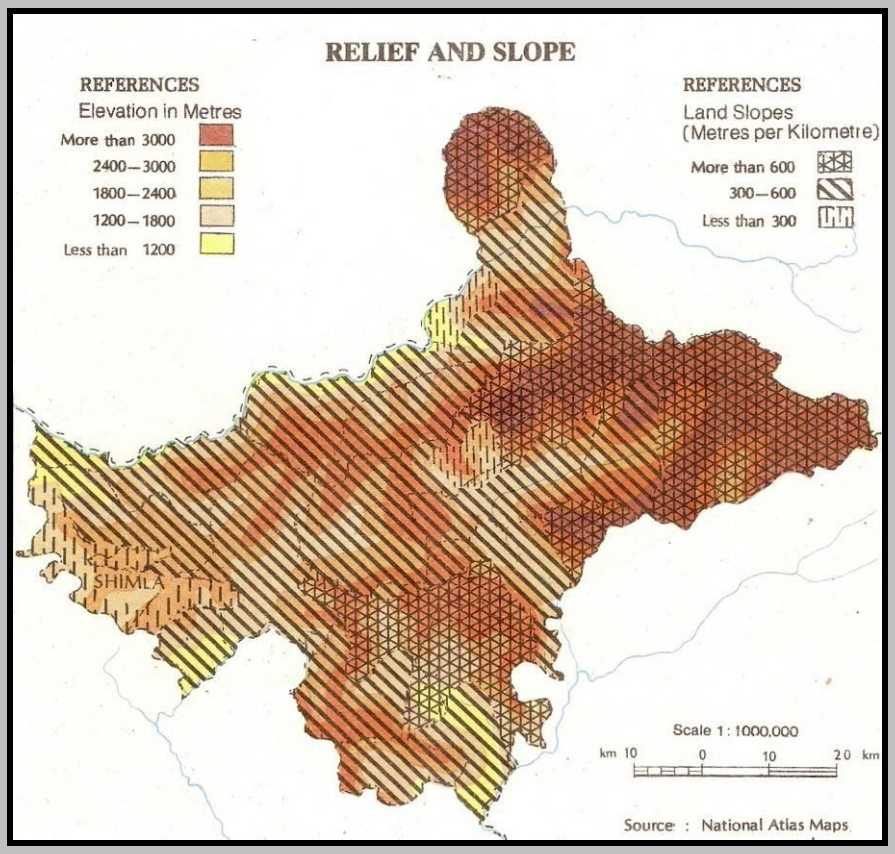
The topography of the project area around the project road alignment is gently undulating which becomes medium to highly undulating in Shoghi- Shimla - Dhalli bypass alignment. The area forms part of mountainous Himalayan terrain and exihibits a rugged topography. Deep strike valleys towards Dhalli and Shimla are the common physiographic features of project road alignment surroundings. The project road does not cross any river. There are some local drains that control the drainage of the area. The drains that are crossed by the project road are Kathulu Ka Nalla (km 131.800), Samri Ka Nalla (km 137.500), Kair Ka Nalla (km 147.570) and Kalali Ka Nalla (km 156.165).

General elevation of the project area ranges from 1493 m to 2250 m and slope range is between 300 m to 400m per km in Shimla District and 100 to 300 m per km in Solan District**.**

Map 3.1: Relief and slope features of District Solan and Shimla



Solan District



Shimla District

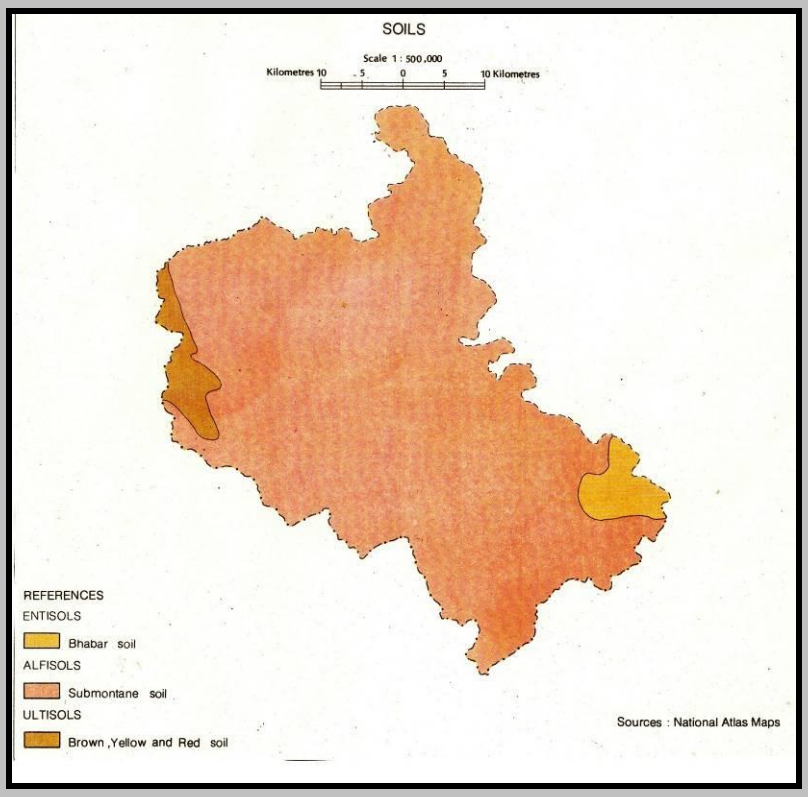
3.5.4 Soils

Solan: The soil is generally sandy loam in valley areas of the district and rest of the hilly and mountainous area soil skeletal, soil depth is generally shallow except in areas having good vegetative covers. It is generally dry shallow and deficient in organic matter. Landslides are common in mountainous terrain and soils are generally fertile.

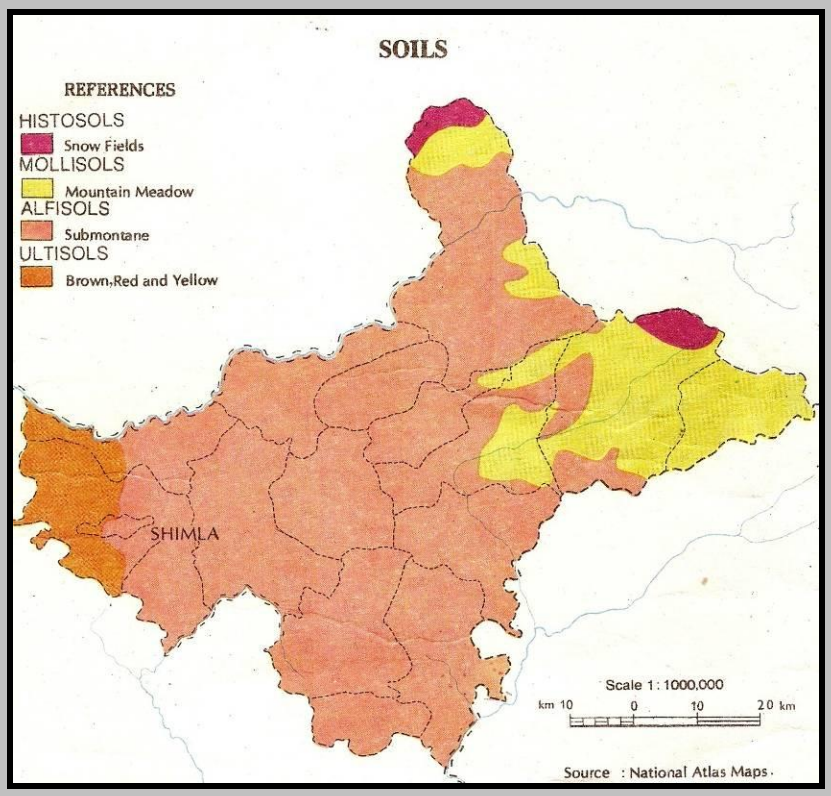
Shimla: The soils in the district are alluvium formation. These soils comprise of sand pebble and clay.Soil depth is generally shallow except in areas having good vegetative covers. It is generally dry shallow and deficient in organic matter. Landslides are common in mountainous terrain and soils are generally fertile.

The consultants have collected district planning maps developed by National Atlas and Thematic Mapping Organisation (NATMO), Department of Science and Technology Government of India. . Soil groups of the project area are shown on the maps of Solan and Shimla districts. As per these maps the soils along the project road alignment are submontane soils.

Map 3.2: Soil of Solan and Shimla Districts



District Solan



District Shimla

In order to characterize the soil quality in project area soil samples were drawn from the project area. The results of samples are given below:

Parameter	**Agriculture Field near km 108.000 (RHS)**	**Agriculture Field near km 129.000(LHS)**	**Agriculture Field near km 156 (RHS)**	***Quality Standards***	
Colour	**Brownish**	**Brownish**	**Brownish**	***Normal***	***High***
pH	7.5	8.3	8.3	6.3	>8.3
Electrical Conductivity (umhos/ cm)	82.60	88.45	90.60	1.0 to 2.0	>2
Textural Class	Clayey -Loam	Clayey- Loam	Clayey-Loam	-	-
Sand (%)	20	23	21	-	-
Slit (%)	35	35	32	-	-
Clay (%)	45	42	47	-	-
Bulk density (gm/cc)	1.43	1.42	1.44	-	-
Water Holding Capacity (%)	56.3	51.20	54.80	-	-
Nitrogen (%)	0.06	0.07	0.09	-	-
Phosphorus (%)	0.21	0.20	0.18	9 to 22	>22
Potassium available (mg/100 gm.)	53,8	62.40	65.4	50 to 120	>120
Organic Carbon (%)	0.20	0.30	0.28	0.5 to 0.75	>0.75
Lead as Pb (mg/kg.)	ND	ND	ND	-	-
Arsenic (mg/l)	ND	ND	ND	-	-
Iron (kg/hec)	36.5	42.3	40.60	-	-
Sulphate (kg/hec)	115.80	131.20	116.00	-	-
Chloride (mg/kg)	84.3	88.25	0.14	-	-
Calcium (mg/kg)	56.9	58.20	62.60	-	-
Copper (mg/kg)	<0.01	<0.01	<0.01	-	-
Zinc (mg/kg)	0.79	0.86	1.01	-	-
Mangnese (mg/kg)	<0.01	<0.01	<0.01	-	-
Moisture (%)	1.80	1.77	1.7	-	-
Porosity (%)	44	43	46	-	-
Na2CO3/NaCl	301/32	32/34	35/36	-	-
Infiltration capacity (inch/hr)	20	21	21	-	-
Alkalinity(ppm)	72	69	71	-	-
Acidity(ppm)	Nil	Nil	Nil	-	-
SAR	10.3	9.45	10.20	-	-

Note: ND – Not Detected

It is clear from the results that soils are moderately fertile and are not contaminated with pollutants.

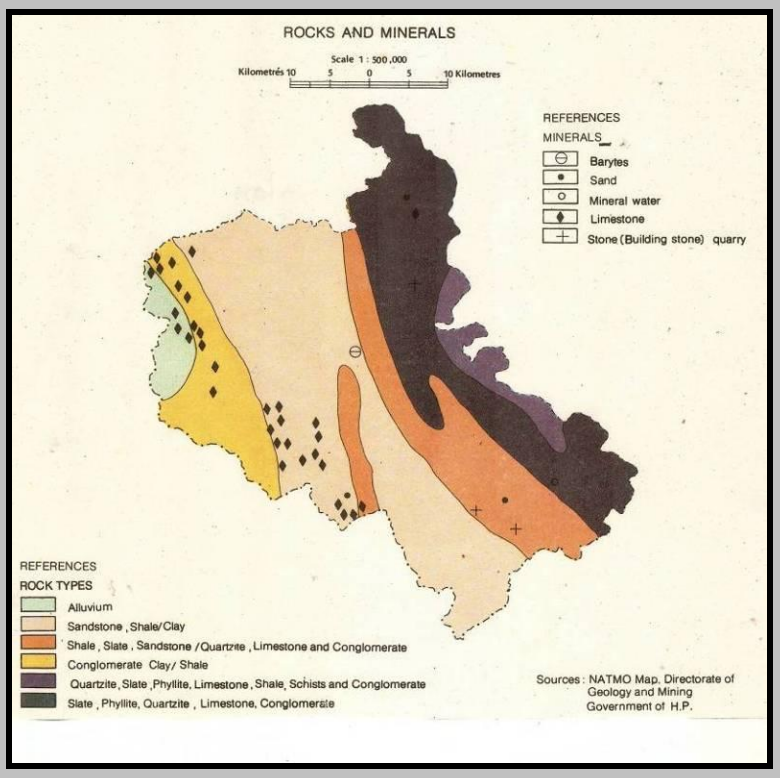
3.5.5 Mineral Resources

Solan: The district plays an important role in the mineral production of the State of Himachal Pradesh. High grade limestone is available which attracts Cement plants in the district. The other mineral sources are mineral water, sand and Stone (Building stone) quarry.

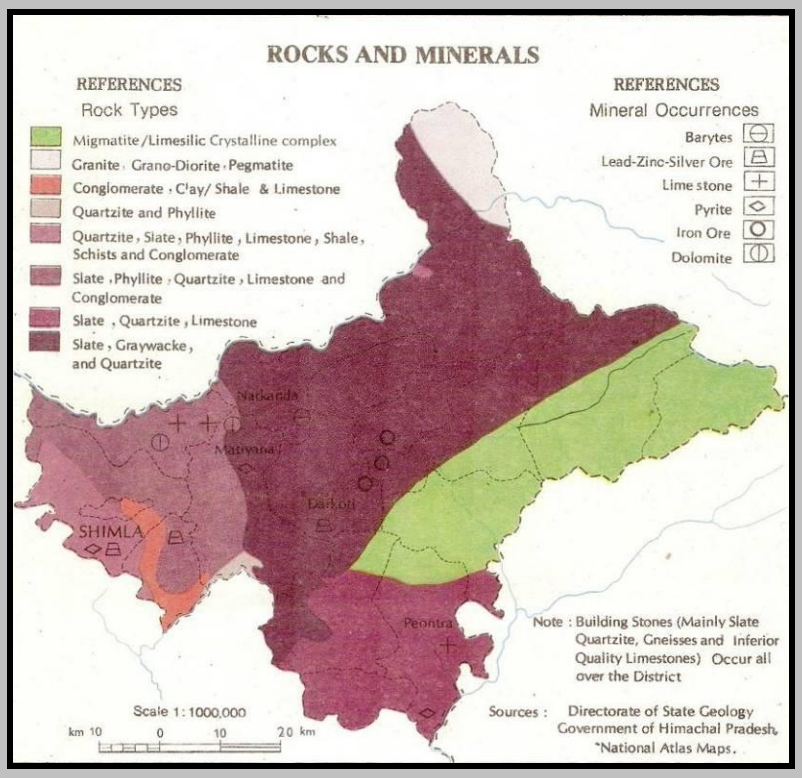
Shimla: According to NATMO map Shimla district has more number of mineral resources. The mineral resources in Shimla district are lead-zinc- silver ore, lime stone, pyrites, dolomite and Barites.

Mineral and Rock of the project area are shown on **Map 3.3.**

Map 3.3 Minerals and Rocks of Districts Solan and Shimla



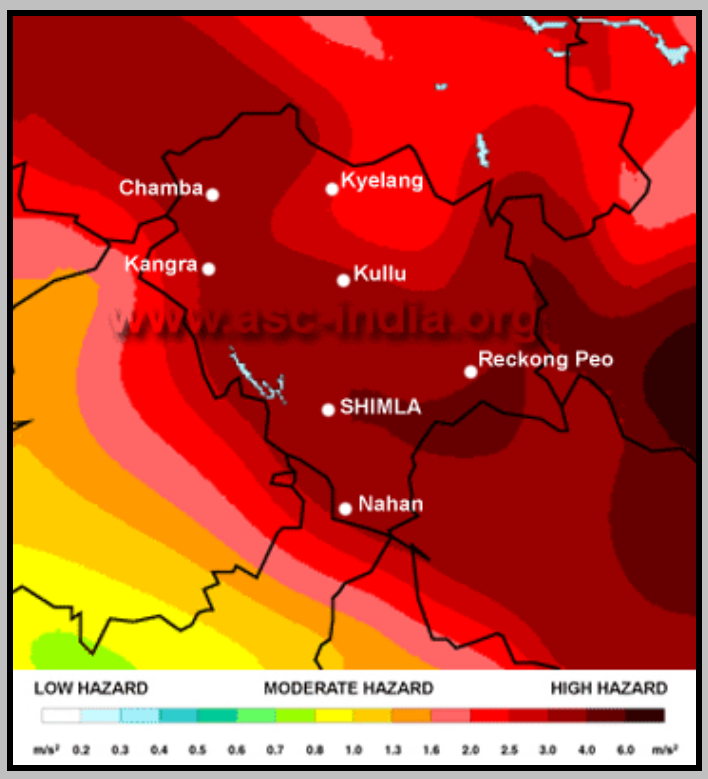
District Solan



District Shimla

3.5.6 Earthquake Zone / Sensitivity

The seismic hazard map of India was updated in 2000 by the Bureau of Indian Standards (BIS). Apart from the merging of Zones I and II into Zone II in the latest map, there are no major changes from the BIS 1984 map



Map 3.4 :Seismic Hazard Map of Himachal Pradesh

According to GSHAP data, the state of Himachal Pradesh falls in a region of high seismic hazard zone. It is clear from the above map that entire length of project road falls in Zone- IV of seismic hazards. Hence project road design should take into consideration this aspect.

3.5.7 Borrow Areas

Eleven borrow areas and 06 stone quarries have been identified along the road to meet the requirement of soil and aggregates for construction of road. The details are given in the following **Table 3.1.**

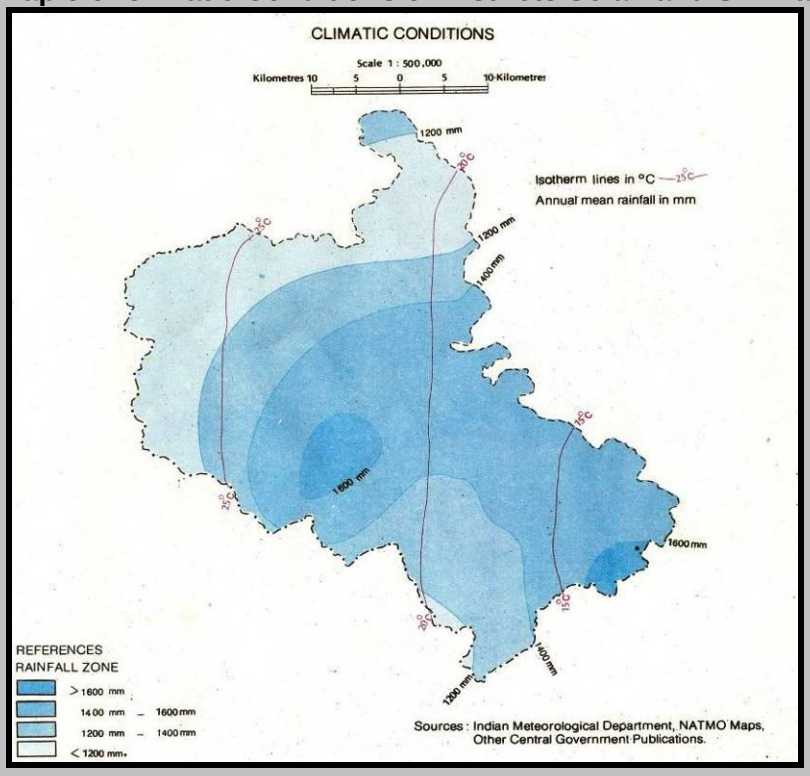
Table 3.1: Details of Borrow Area

S. No.	Chainage/	Stone Quarry/Borrow Area	Lead(km)	Quantity (M3)
1	13.000	Stone quarry Panchkula	37	200,000
2	107	Borrow Area	1.0	400,000
3	109	Borrow Area	0	450,000
4	132.40	Borrow Area	0.50	420,000
5	146.0	Borrow Area	3.50	400,000
6	152.0	Borrow Area	4.0	500,000
7	156.00	Borrow Area	5.0	450,000
8	Dyothi	Fine sand quarry	37	6,000
9	Dyothi	Coarse sand quarry	37	6,000

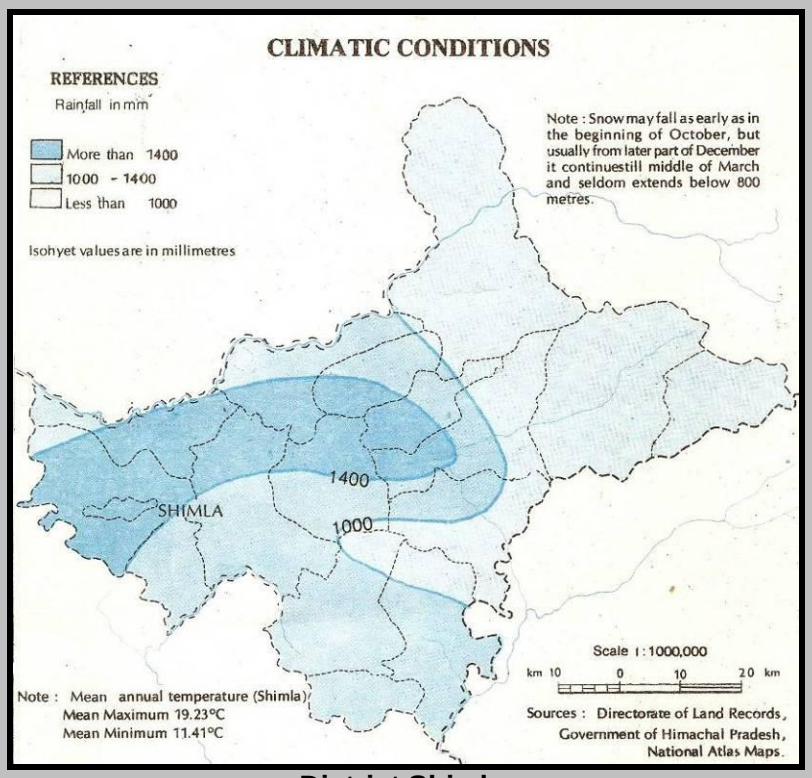
3.5.8 Climate and Meteorology

Regional meteorological conditions and the project corridor air basin is of high significance in road development projects because the transportation and diffusion of all ambient air pollutants generated during project implementation and/or operational phase. The data plays significant role in location of hot mix plants and other construction activities that lead fugitive emissions.

Map 3.5 Climatic Conditions of Districts Solan and Shimla



District Solan



District Shimla

The climate of both the districts through which the project road is passing is subtropical in the valley and tends to be temperate in hilltops. There are four major seasons. The winter season commences from November and ends in March; summer season extends from March and ends in June. The monsoon period starts from July and ends in September.

In order to characterize the meteorological conditions of the project region the data from the IMD observatory Shimla was referred. This is the closest observatory from the project site.

The data of this observatory has been described below:

Temperature

The temperature during summers ranges from 14ºC to 28.2ºC while temperature during winter months varies from 1.7 ºC to 14.8ºC. In monsoon season 14.8 to 28.2 ºC.

Rainfall

The average annual rain fall in the districts Solan and Shimla is 1450 and 1253 mm respectively. In the winter season precipitation occurs as snow fall also occurs in higher reaches up to 1000 m elevation and rain fall in low hills and valleys of the district.

Wind Speed and Wind Direction

The wind speed ranges from 1.7 to 3.8 kmph. The highest wind speed has been recorded in the month of April followed by January. Although the year SE is the most dominant wind direction followed by south and south west. The calm conditions in the project region (wind speed 0-1.8 kmph) region occur about 29 % in day time 16 % during night time.

Relative Humidity

Relative Humidity range is between 33-91%. The maximum humidity occurs during July month and least during the month of September.

3.5.9 Land Use Pattern

The Solan and Shimla districts have geographical areas of 193700 and 513100 Ha. The area under various land uses for both the districts is presented in the **Table 3.2.**

Land use pattern along the project road is also mixed type dominated by agriculture, barren and residential areas. The land use maps of project area are given in **Map 3.6.**

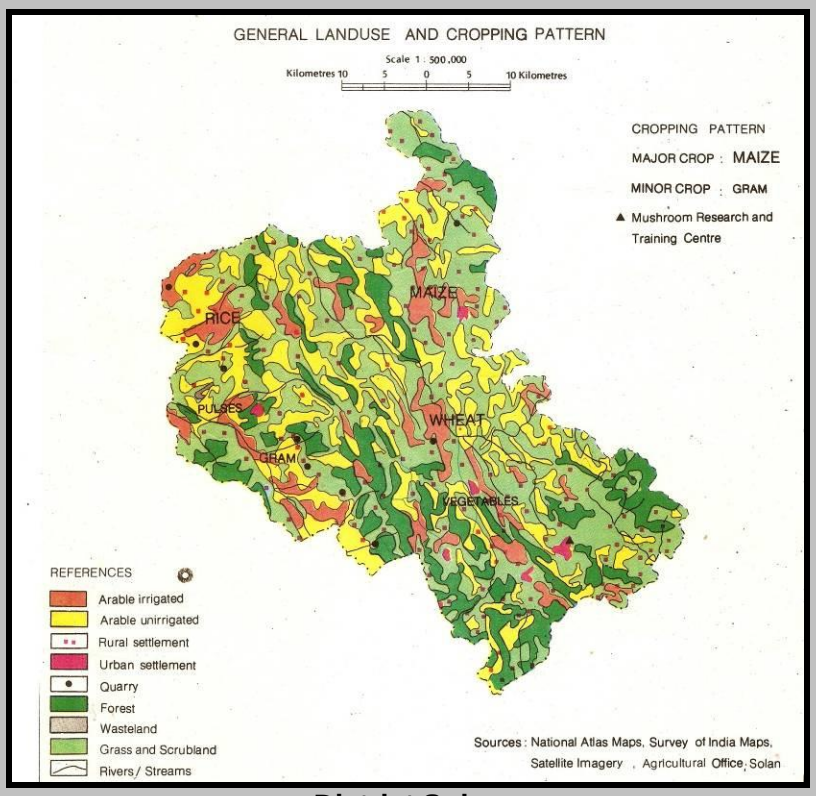
Table 3.2: Land Use Pattern in the State

Land Use	Shimla	Solan
Total Geographical area	513100	193700
Forests	128509	20290
Barren and Cultivable land	13293	14405
Land put on agriculture uses	13777	9602
Permanent pasture and other grazing land	248660	78572
Land under Miscellaneous tree crop Groves included in area sown	3221	855
Culturable waste land	14827	12186
Other fallow land	5574	1172
Current Fallows	9853	5574

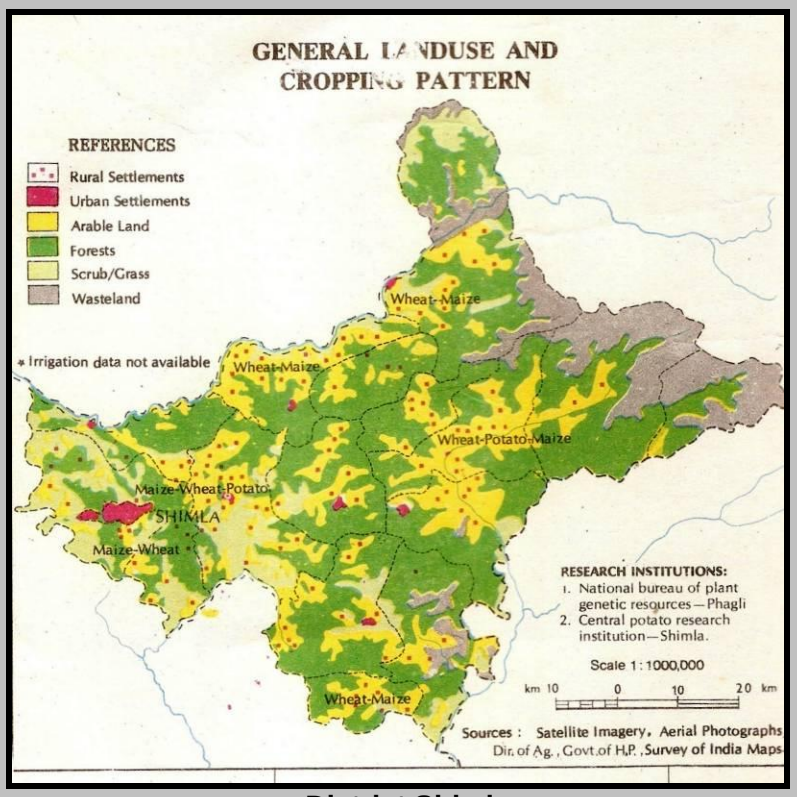
Land Use	Shimla	Solan
Net Area sown	41447	38267
Area sown more than once	28126	25787
Total Cropped area	97399	64054

The land use along the Shoghi- Shimla - Dhalli bypass is open, barren and partly cultural waste land. In the portion of project road along the existing road, alignment the land use comprises of the built up area.

Map 3.6 Land use and Crop Patterns in Districts Solan and Shimla



District Solan



District Shimla

3.6 WATER RESOURCES

The rivers flowing through the Solan district are Gambhar, Sirsa, Giri and Assan rivers, whereas rivers flowing through Shimla district are Sutlej, Giri and Pabbar. Out of the above mentioned rivers none these crosses project road. The surface water sources crossing the project are Kathulu Ka Nalla (km 131.800), Samri Ka Nalla (km 137.500), Kair Ka Nalla (km 147.570) and Kalali Ka Nalla (km 156.165). None of these is perennial.

Hydro geologically, the unconsolidated valley valley fill or alluvial formation occurring in the valley area, semi unconsolidated formations belonging to Siwalik group and older consolidated hard rocks form aquifer in the project area. Intergranular pore spaces in the sedimentary formations and secondary fissured porosity in hard rocks , topographical set up coupled with precipitation in the form of rain and snow , mainly govern occurrence and movement of ground water. Porus alluvial formation occurring in the valley area forms the most prolific aquifer system where as the sedimentary semi consolidated formations and hard rocks form aquifer of low yield prospect. In the terrace deposits along with major rivers pore spaces between sand and gravel and tallus material also form the avenue for ground water movement.

Major part of Solan and Shimla districts is hilly and mountainous with highly dissected and undulating terrain. These areas are underlain by semi consolidated and consolidated hard rocks. Ground water potential in such areas is very low due to its hydro geomorphic set up. Springs are main ground water structures that provide water for domestic and irrigation in major rural and urban centers.

The springs in the project area mainly gravity, contact or fracture type and springs located along major thrust/faults or structurally weak planes are highly yielding. The springs, locally called Chasma, discharges vary from 9-10 liters per second. Bowries,, a type of dug well, are another structure constructed in the hill slopes to tap the seepages. Such Bowries are very common and are observed in the project area and surroundings. In both the districts shallow bore wells have been dug by the Government and these have been fitted with hand pumps to supply domestic water in some villages. The hand Pump have depth up to

average of 50-60 m depth. These hand pumps have low discharge and this discharge is about 1 liter per second.

In Shimla district, Central Ground Water Board has dug a deep tube well to understand the aquifer of hard rock. This tube well has been dug 302 m below ground level. This well has a discharge of about 1173 lpm with draw down of 24.62 lpm/m and transmissivity of 70.39 m^3/day.

3.6.1 River Basin

The Solan district is drained by streams/rivers forming part of the drainage basins of the Sutlej, the Yamuna and the Ghaggar rivers. However, major part of the district is drained by tributaries of Sutlej namely Ghambar and Sirsa. Ghambar River flows almost from the central part of Solan district towards North West in the Nallagarh valley. The Girri River and its tributary Assan flows towards south in the eastern part over a small area and are part of Yamuna river basin. Ghaggar River flows towards south west and make the south eastern boundary of the district. Most of the river /streams/Khads maintain base flow for major part of the year. In hilly terrain, the drainage density is high and fine but it becomes coarse in foothill, and valleys.

The Shimla district is drained by streams/Rivers forming part of drainage basins of the Sutluj, the Yamuna, the Pabbar and Tons rivers. However, major part of the district is drained by tributaries of Sutluj River. The Satluj River is the longest river traversing along the northern boundary of the district and the Giri river which is the tributary of Yamuna river originate from the eastern part and runs in SW direction. The tributaries of Tons River flow in the southern parts and the Pabbar River in the eastern parts of the district. In general density of drainage is moderate to high and is not uniform all over the district.

3.6.2 Status of Ground Water Development

The ground water development in Shimla district is low due to poor potentialities in hard rock areas and hilly sloppy terrain. In the project, area and surroundings major water supply and sources of water are ground water based such as perennial springs, Bowries, and Hand Pumps. The springs are tapped at the source so that water can be supplied under gravity. No area or block has been notified critical for ground water development point of view.

In Solan district, particularly in valley areas the ground water development is on moderate scale. In these areas, all major irrigation, industrial and domestic water supplies depend on ground water. In rest of the district, area due to poor potentialities in hilly hard rock and hilly sloppy terrain ground water development is poor. However, in these areas also major water supply and sources of water are ground based viz. perennial springs, Bowries and hand pumps. The springs are tapped at source so that water can be supplied under gravity. All major towns and villages are supplied from ground water sources. Large scale ground water development is mainly restricted to Nallagarh valley only where wells and tube wells are feasible. The stage of ground water development in Nallagarh valley of the district is 15 % only. No area or block has been notified critical for ground water development point of view.

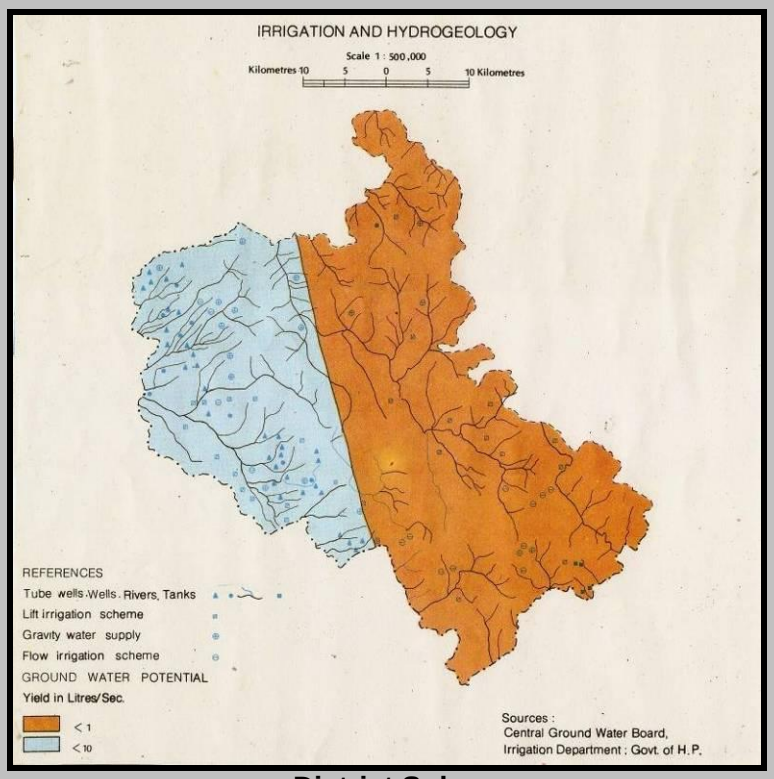
3.6.3 Water Quality

Water quality along the road is good as reported by the local communities. Rivers and springs and hand pumps are important in local context and therefore their water quality was monitored to assess the impacts due to the project, if any. For generating data on surface water quality parameters and drawing up the baseline scenario in the study corridor, one representative surface water quality-monitoring stations (designated as **SWQ-1)** was selected. This is because the water was available only in one stream. Surface water quality monitoring location is shown in **Table 3.3A** and the analysis results are shown in **Table 3.4A.**

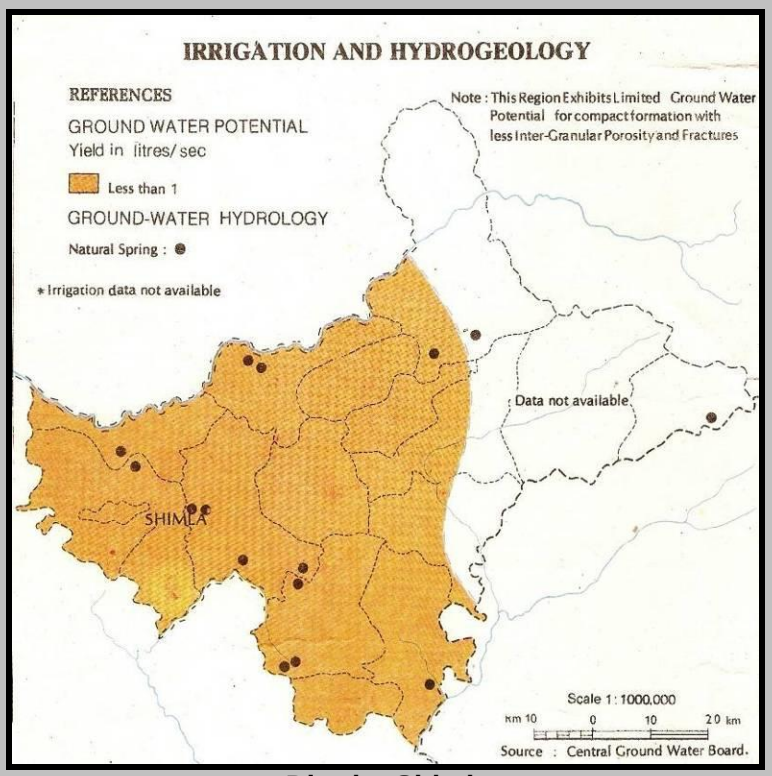
Ground water has been found to be an important source for catering to the local needs of water consumption for various purposes, mainly domestic. Therefore, any kind of deterioration in the quality of ground water owing to the developmental activities will pose

threat to the concerned population and attention needs to be paid towards maintaining the quality of water using all possible tools such as monitoring with spontaneous remedial suggestions, if required.

Map 3.7 Irrigation and Hydrology in Districts Solan and Shimla



District Solan



District Shimla

Keeping in view the importance of ground water to the local population, 3 representative ground water quality-monitoring stations (designated as **GWQ-1, GWQ-2, and GWQ-3,**) (hand-pumps) in the study corridor had been identified for the monitoring and assessment of ground water quality. The location and brief description of the ground water quality monitoring stations are listed in **Table- 3.3B.** Water quality analysis results are shown in **Table 3.4B**.

Table 3.3A: Surface Water Sampling Location

Location Code	Nearest Chainage (km)	Source	Distance From Project Road (km)	Justifications For Selection	Environmental Setting Representation
SWQ- 1	137.500	Samari Nalla	At location of Crossing of Shogi-Shimla - Dhalli bypass alignment	To establish baseline scenario of surface water source being crossed by Project Road	Rural and open

Table- 3.3B: Ground Water Sampling Locations

Location Name (Code)	Nearest Chainage (km)	Source	Distance From Project Road (km)	Justifications For Selection	Environmental Setting Representation
Solan (GWQ-1)	106.000	Hand Pump at Start of Project Road at Solan	0.200	To establish baseline scenario for ground water quality at start of project road in built up area.	Urban
Shoghi (GWQ-2)	131.00	Hand pump Close to RoW at Shogi	0.100	To establish baseline scenario for ground water in Semi Urban area	Semi Urban
Dhalli (GWQ-3)	156.000	Hand pump Water near Dhalli	0.400	To establish ground water quality baseline scenario in rural and open area	Rural

Table- 3.4A: Analytical Results of Surface Water Quality Monitoring

Parameter	Samri Nalla (137.500 km)	Limits IS: 10500
pH	7.80	6.6 to 8.5
Temperature (deg C)	24.0	-
Electrical Conductivity (umhos/cm)	412	-
Total Suspended Solids (mg/l)	34	-
Total Dissolve solids (mg/l)	180	500
Chlorides as Cl (mg/l)	25	250
Sulphates as SO_4 (mg/l)	4.1	200
Calcium as Ca (mg/l)	15.3	75
Magnesium as Mg (mg/l)	14.1	30
T. Hardness (mg/l)	105	300
Nitrate as NO_3 (mg/l)	0.57	45
Oil & Grease (mg/l)	<1	-
Ammonical Nitrogen as N (mg/l)	0.2	-
Total Phosphate (mg/l)	<0.01	-
Chemical Oxygen Demand (mg/l)	5	-
Biological Oxygen Demand (3 days at 27°C (mg/l)	1.1	-
Dissolve Oxygen (mg/l)	7.9	-
Total Iron (mg/l)	0.010	0.3

Parameter	Samri Nalla (137.500 km)	Limits IS: 10500
Lead Pb (mg/l)	<0.001	.05
Arsenic (mg/l)	<0.001	0.05
Fluorides as F (mg/l)	0.45	1
Faecal Coliform MPN/100 ml	ND	
T.Alkalinity (mg/l)	43	200

ND: Not Detected

Table- 3.4B: Analytical Results of Ground Water Quality Monitoring

Parameter	GWQ-1	GWQ-2	GWQ-3	Desirable Limit as per BIS 10500	Permissible limit as per BIS 10500 in absence of alternate source
pH	7.7	7.9	8.01	6.5-8.5	No Relaxation
Colour	Colourless	Colourless	Colourless	-	-
Odour	Odourless	Odourless	Odourless	-	-
Temperature (deg C)	24	23	24	-	-
Turbidity (NTU)	<1	<1	<1	5.0	10.0
TSS	<1	4	6	-	-
Total Dissolve solids (mg/l)	199	205	227	500	2000
Total Hardness (mg/l)	245	238	266	300.0	600
Total Alkalinity(mg/l)	82	81	79	200	600
Total Iron (mg/l)	0.01	0.01	0.01	0.30	1.00

Parameter	GWQ-1	GWQ-2	GWQ-3	Desirable Limit as per BIS 10500	Permissible limit as per BIS 10500 in absence of alternate source
Chlorides as Cl(mg/l)	46	55	61	250.0	1000
Sulphates as SO_4 (mg/l)	8	18	22	200.0	400
Nitrate as NO_3 (mg/l)	0.9	1.0	0.9	45.0	100
Nitrite as NO_2 (mg/l)	ND	ND	ND	-	-
Fluorides as F (mg/l)	0.44	0.50	0.54	1.0	1.50
Phosphate as PO_4 (mg/l)	0.40	0.66	0.42	-	-
Magnesium as Mg (mg/l)	12	15	15	30	100
Heavy Metals as Pb (mg/l)	<0.001	<0.001	<0.001	0.05	No Relaxation
Zinc as Zn (mg/l)	0.12	0.10	0.12	5.0	15.00
Chromium as Cr (mg/l)	<0.001	<0.001	<0.001	0.05	No Relaxation
Arsenic (mg/l)	<0.001	<0.001	<0.001	-	-
Total Coli/100ml)	ND	ND	ND	-	-

ND- Not Detected

The chemical quality data of ground water ground and surface water sample shows that water is alkaline in nature and suitable for both domestic and irrigation use. All the parameters analysed are well within the permissible limits of safe drinking water as per Bureau of Indian standards (BIS).

3.7 AIR QUALITY

Both the cities being on hill have good ambient air quality. The project road alignment also has no polluting industry along it. There is congestion due to traffic in all the built up areas along the project. This leads to vehicular exhaust emissions and deterioration. To reduce congestion widening to four lanes has been planned. In order to establish base line ambient air quality in the project area and surroundings, the ambient air quality monitoring has been carried out during the winter season of the year 2011/2012 (December 2011 and January and February 2012)**.** The selected locations of ambient air monitoring and details of surroundings are presented in **Table-3.5.** The location description and detailed results are presented in **Annexes 3.1**

Table 3.5: Air Quality Monitoring Locations

Location Code	Chainage	Location Name	Category As per AAQ Standards	Distance From Project Road (km)	Environmental Setting and Justification for Selection
AAQ-1	Km106.000	Solan	Urban Residential	0.070	The monitoring instruments were put on the roof of the house in the Solan town near the start point of project road. The monitoring at Solan is justified as this location is the start point and an urban location along the project road.
AAQ - 2	Km 131.150	Shogi	Semi urban	0.050	The monitoring station is located in a semi urban area. The location is justified as. This will characterise AAQ in town for which bypass has been planned.
AAQ – 3	km 156.000	Dhalli	Rural Residential	0.050	The ambient air quality location is in rural area and data of AAQ at this location will characterise ambient air quality in Rural area in project region. The location is also at the end of project road.

The parameters selected for ambient air quality monitoring are PM10, PM2.5, SO2, NOx, and CO. Each monitoring station was monitored twice a week on non consecutive days and total 24 samples were collected in the entire season. The samples were brought back to laboratory in Delhi and were analysed following the methods prescribed by CPCB. Ambient Air Quality Monitoring Results are given below.

The summary of ambient air quality results for the project stretch is presented below:

S. No.	Location	Range of Measured Concentration				
		SO2	NOx	PM10	PM2.5	CO (PPM)
1	Solan	8-11	13-18	31-43	8-14	0.4-0.9
2	Shogi	ND-10	13-17	32-40	8-12	0.5-0.9
3	Dhalli	6-10	13-17	33-37	9-12	0.6-0.90

It is clear from the results that concentrations of PM10, PM2.5 SO2, NOx and CO are well within the limits. The concentrations at Solan have been found higher due to traffic congestion and commercial activities.

3.8 NOISE QUALITY

Noise is an important environmental attribute in all road projects because vehicular traffic is a source of noise pollution. Three monitoring sites were identified for noise monitoring to characterize the baseline noise levels in the project area. The description of environmental settings of noise monitoring is given in **Table 3.6** and the results of monitoring are given in **Table 3.7**.

Table 3.6: Ambient Noise Level Monitoring Locations

Location Code	Nearest Chainage (km)	Noise Level Measurement Location	Distance From Project Road (km)	Environmental Setting	Reason for Selection
NL-1	Km106.000	Start Point of Project Road at Solan	0.070	Urban and Residential	To establish baseline in Urban and commercial areas
NL - 2	Km 131.150	Shogi Town	0.050	Semi urban	To establish baseline in semi urban area
NL – 3	km 156.000	Dhalli	0.050	Rural Residential	To establish baseline at rural area

The above monitoring locations have been selected to cover all types of land use in project area. The noise level measurements were carried out in December 2011. The hourly noise levels were computed from 5 minutes values recorded by the instruments. These hourly values were then used to arrive at 'Day' and 'Night' average values.

Table: 3.7: Ambient Noise Level Monitoring Results along the project road

S. No.	Monitoring Locations	Leq dB (A) Day	Leq dB (A) Night	*Limits in Leq dB (A)*	
				Day Time	*Night Time*
NL1	Solan	62	52	65	55
NL 2	Shogi	52	43	55	45
NL 3	Dhalli	50	42	55	45

Source: Consultants' Field Monitoring

It is clear from this table that noise levels are well within the stipulated limits of respective land uses at all locations of noise label measurements. Photographs of ambient air quality, water quality, soil quality and noise level monitoring are shown in **Annexure 3.2**

3.9 ECOLOGICAL RESOURCES

3.9.1 Cropland Ecosystem

This is also known as manmade ecosystem or artificial ecosystem because of man grows and develops this system to meet daily human needs The common crops in crops land ecosystem in project surroundings are *Oryzha sativa, Eluceana, Zea maize, Triticum vulgare, Triticum Diococcum, Sorghum vulgare,* which are mainly dependent on rainwater during monsoon season, canal irrigation and river. In the crop land ecosystem in addition to the crop raised, a number of weeds like *Cynodon dactylon ,Euphorbia hirta , Cyperus rotundus, Digetaria sp and Alyscicarpus sp* also contributing to the primary production . Apart from that commercial crops like *ground nut, sunflower goossypium* and several vegetable *red chillies, Brinjal, Bhendi and leafy vegetable crops* could also grown in this region.

3.9.2 Terrestrial Ecosystem

Natural vegetable is mostly restricted to herb Layer having drought resistance. Other than herb layer the major portion of project area surroundings is almost devoid of major forest type tree except agro forestry types and commercial plantation such as *Eucalyptus hybrid, Acacia leucophloe, Leucena leucophloe. Phoenix aculis, Azadirachta indica, Ficus sp, Acacia sp* and Zizyphus jujube euphorbia sp which are mainly restricted to waste and culturable waste lands and in case of near villages and in case of agricultural lands, *Delonix regia, Peltoforrum ferrusinum, Albizia procera, Albizic lebbeck, Dalbergia sissoo, Terminalia catapa, and Tamarindus Indica* are Predominant. About 250 Plant species were recorded from 65 families during Study.

3.9.3 Composition and Condition of the Forests in the Study Area

The major portion of the study area belongs to Champaghat, and Kandaghat in Solan district portion of project road and Masobra division in Shimla bypass. Due to wide variations in altitude, aspect of soil depth and texture and available moisture, the vegetable met with in the tract also shows great variations. *Chil, khair, bamboos* and other broad leafed species like *Chhal, Simbal, Jhingam, etc.* are the most important species met in the area. Biotic interferences like excessive grazing, fires, grass cutting and felling of trees also bring about great changes in the vegetation even within a limited area. Natural regeneration of all species is generally deficit, though good plantation of *Chil plantations* are met within the area brought under artificial regeneration and the areas are away from habitations and are not subjected to adverse biotic influences. The forests in the study area and surroundings can be divided into the following groups.

(a) Tropical Dry Deciduous Forests

Northern Tropical Dry deciduous Forests

1. Northern dry mixed deciduous forests
2. Dry deciduous scrub
3. Dry bamboo brake

Tropical Thorn Forests

Northern Tropical Thorn Forests

4. Tropical Euphorbia scrub

Tropical Euphorbia Scrub

Tropical Pine Forests

5. Type C1. Himalayan sub –tropical chill Pine forests

a. Lower Shivalik Chil Pine forests

b. Upper or Himalayan Chil Pine forests

Himalayan Moist Temperature Forests

6. C1 Lower Western Himalayan Temperate forests

a. Ban Oak forests (Quercus incana)

For the sake of description the forests have been divided into the three categories (a) Mixed Deciduous Forest (Scrub), Mixed Deciduous Forest (Bamboos) and Thorn Forests or Euforbia Scrub Forests . The brief description of these is given below:

Mixed Deciduous Forests (Scrub)

This type occurs on altitudes from 300m to 1300m and extends even up to 1500 m on warmer aspects and scraps slopes. They are at their best at sites with deep soil with thin favorable soil moisture conditions. The upper canopy is usually a very open with thin shrubby under growth. During the lot weather the trees are leafless and the soil is fully exposed, whereas during the monsoons it is fully covered with vegetation. In most areas, due to adverse biotic influences, the crop has been reduced to a few scattered trees only. The principal species met with the top canopy are *chhal* (*Anoegeissus latifolia*), *Jhingan (Lannea coramandalica), Siric (Albizzia lebback), Albizzia procera, Albizzia odarattissimae, simal (Bambox cieba)pula (kydia calcine), Barnasi (Forenia Limonia, Amaltes (Cassia fistula), Chamror (Ehretia leavis), Sandan (ougania oojensis), Kaim(mitragyna parviflora), kangu (Flacartia indcia), Khair (Acaciacatechu),Iaman (Syzygium cumini), Chilla (Caseria tomentosa),Amla (Emlica Officinalis), Kachnar (Bauhinia spp) Toon (cedrela toona*) in depressions*, Dhaman (Grewia spp), Shingar (Boernemeria regulosa),* very common seen locally on the moist soils*, Kamal (Mallotus phillippines), Blojho (Sapium insigne), Ber (Zyzyphus mauritiana), Bel (Agle marmelos) and Dhak (Butea monosperma) are* seen in dry patches*.*

Under growth consist of *Harsinghar (Nyctanthes arbortristis), Karunfa (Carissa apaca), Dhavi (Woodfordia fruticosa), Basuti (Adhatoda vasica), Mehendru (Dodonaea) and Kear (holarrhena antidycenterice)*.

The important grasses are *Bhabar (Ishammum augustifolium), Makora (Heteropogon contortus), Dub(Cynodon Dactylon), Dhaulu (Chrysopogon montanatus), Labb (Cymbopogon martini) and Munj (Erianthus munja).*

The climbers include Tour *(Bauhinia vahlii), Salary (Pueraria tuberose), Karingham (Caesalpina, sepiera), Kurar (Accia Pinnata), Dhudi (cytolepis bulchanani).*

Natural regeneration of almost all the species is deficient, primarily due to adverse biotic factors mainly excessive grazing. In some of these forests *Khair* has been successfully introduced after clearing of the existing growth.

Mixed Deciduous Forests (Bamboos):

This type occurs upto 1000 m elevation on well drained and loose textured Shivalik formations. It closely resembles the foregoing type; the only difference being that case, *bamboos (Dendrocalamus strictus)* is met within the top canopy. The floristic characteristics are same as that of mixed deciduous type.

Thorn forests or Euphorbia Scrub forests:

Generally these are degenerated dry deciduous forests. Heavy incidence of grazing and frequent fires has played as significant part in their present bad condition. The low broken soil cover of shrubby growth 3to 6 m high including some tree species is met with. Some bamboos are also present in patches. The tree growth is here very sparse or even non-existent and only the very hardy and uneconomic species are found still standing. On extensive areas, only *Thor* is seen standing. The grasses occur throughout ,the main floristic composition is as under:

Top Story:

Khair (Acacia catechu), jhingan (lannea conamandalica), Amaltas (Cassia fistula), Bel (aegle

Marmelos), Baranasi (Feronia limonia0, Kangu (Flacourtia indica).

Under growth:

Thor (Euphorbia royleana), Phil lark (Lantana camara), Karunda (Carissa apica), Ghandela (Murraya koenigii and kuri (Nyctanthes arortristis).

Grasses:

Makora (Heteropogon montanus), Bubba (Cynodon dactylon), Dhaulu (Chrysopogon montanus), and Labb (Cympogon martinii)

(b) Chil Pine Forests:

These are most important forests of the tract occurring between 800 to 1800 m in elevation. Biotic influences play an important part in the regeneration and distribution of this species. With favorable soil conditions and on northern and eastern aspects, *Chil* comes down to even 800 m elevation or it can extend upto 1800 m or more in elevation. The pine, generally, wall stand singly or in groups with the scattered lower deciduous tree storey along its lower altitudinal limit where there is usually a fairly continuous low scrub growth of Xeropytic shrubs. Regeneration can naturally establish itself easily, if proper protection is afforded and mother trees are well distributed over the area.

Upper Storey

Chil ((Pinus roxburghii)

Middle Storey

Kanto (Pyres pasha), Ban Oak (Quercus incana), Kamal (Mallotus Phillipines), Amla (Emblica officinalis), Khair (Accacia Catechu), and Dare (punic guarantee)

Under Growth

Karaunda (Carissa apica), Mehnder (Dodonia viscosa), Akha (Rubus ellipticus), Chhota Jhunjra (Myrsine Africana), Dhavi (Woodfrodia fruticaosa), Padar(Colebrookia spp), Kashmal (Berberis lycium), Kathi (Indigofera pulchela) and Gandhela (Murraya koengii).

Grasses

Chrysopogon fulvus, chrysopogon sp., Dichanthium annultum, Heteropgon contortous and Thermedia anathera

Climbers

Very few *Gulab (Rosa moschatus)* is the most common.

Cryptogamic Vegetation

The project area surroundings show many algae, fungi, bryophytes and ferms. Algae are present in aquatic bodies or in marshy places. Fungi particularly from ascomycetes and and basidiomycetes are located on ground or epiphytically. Lichens of crustose, foliose and fruticose types are present on different substances). Barophytes occur in wet areas and occasionally on barks of old trees and old walls of houses.

Figure 3.2 Locations of Ambient Air Quality, Water Quality, Soil Quality and Noise Level Monitoring

3.9.4 Flora

The tree enumeration has been done in the RoW as per widening schedule, realignments and Shogi- Shimla - Dhalli bypass realignments. The total numbers of trees that need to be cut are 6734. The detailed is separately prepared and is submitted to forest department for tree cutting permission.

Trees to be cut in the Right of Way (RoW)

S. No.	Road	0 to 30 cm	30 to 60 cm	60 to 90 cm	90 to 120 cm	Above 120cm	Total
1	Solan- Shimla L.H.S	267	784	1021	1874	567	4513
2	Solan- Shimla R.H.S	112	225	506	1121	257	2221
3	**Grand Total**	**379**	**1009**	**1527**	**2995**	**824**	**6734**

Source: Tree Enumeration by the Consultants

3.9.5 Fauna

The project road length under widening (from start point to start point of Shimla bypass passes through the congested and built up area in most portion, therefore , fauna in this stretch is domesticated. The Shogi- Shimla - Dhalli bypass alignment does not pass through any Wild Life sanctuary or bird sanctuary. The alignment passes through mostly open and barren area and in some portion through agriculture land. The forest area is also degraded and is not habitat of any wild life. The commonly occurring fauna includes the Himalayan black beer the carnivora and the Ghoral and the barking deer are the herbivora in and around the project site surroundings. The non game animals include the jackal, mongoose, the Jangli billi, monkeys & langurs etc. The game birds include jungli murga, kabutar, ghughi, dhaula teetar ,kolsa, etc.

3.9.6 Wildlife

No Wildlife Sanctuary or National Park is located in the direct/indirect influence area of the project. There is no endangered/protected species found in the direct/indirect area of the project. No migratory routes of Wild Life are reported in the project area.

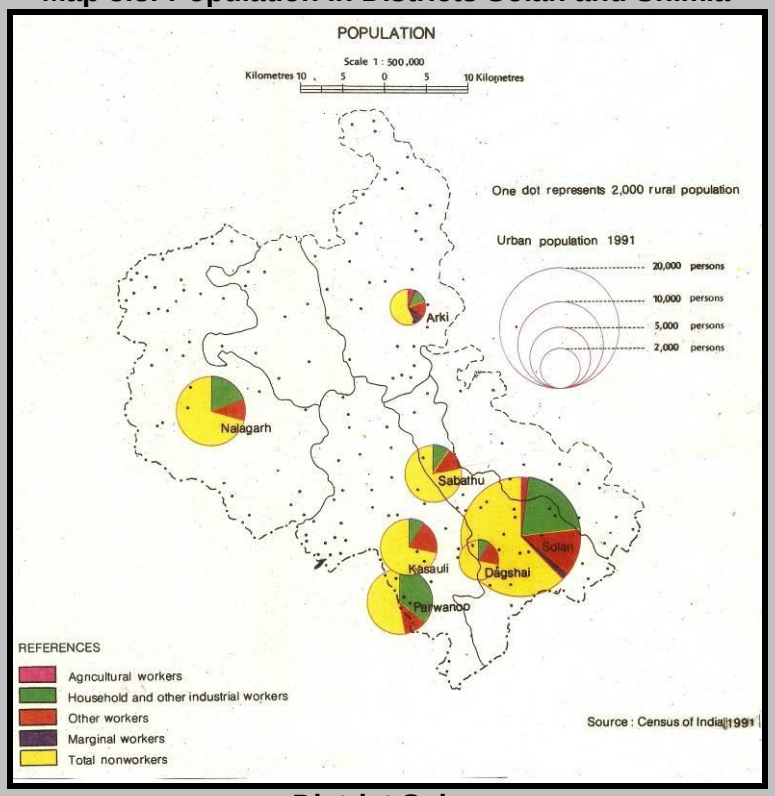
3.10 SOCIO-ECONOMIC ENVIRONMENT

The present road passes through two districts of Himachal Pradesh namely Solan and Shimla. The project road has been design in such a way that the major settlements are bypassed to minimize the rehabilitation and relocation.

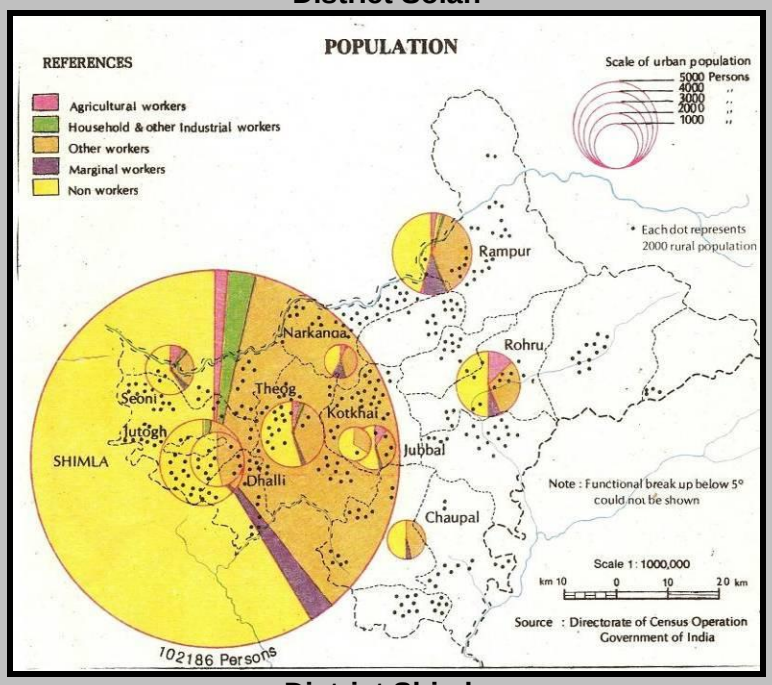
In the recent liberalized economic environment of India, transport system in general and road transport in particular is considered to improve the international competitiveness of exports and attract foreign investments. Considering the above benefits more attention is being given now to road projects by national and multilateral funding agencies. The ongoing ambitious National Highway Development Project (NHDP) of the Government of India and likewise massive expansion of state roads and rural roads are indicative of road sector development in India. Such engineering projects also accompany with attendant human and environmental problems which need to be addressed and integrated to produce sustainable streams of social and economic benefits.

There is a growing recognition that people, communities and institutions are crucial to development outcomes. And these social safeguard policies form the basis for social development. This agenda emphasizes a broader view of development, stronger ownership by stakeholders, and wider partnerships among the private sector, civil society and multilateral funding agencies.

Map 3.8: Population in Districts Solan and Shimla



District Solan



District Shimla

Considering the neglect of road infrastructure, backlog and growing recognition of its tremendous impact on economic development within the globalizing environment, the Government of India has taken new initiatives in the road sector development and in particular the national highways. Projects in the road sector in India consist largely of upgrading and/or improvements of existing national/state highways and rural access roads.

In the view of the above, National Highways Authority of India (NHAI) has decided to construct the 4 lane highway covering the districts of Solan and Shimla. District wise total population as per 2011 Census is given below:.

District	Road Length (Km)	No. of Tehsils	Population		
			Male	Female	Total
Solan	23.007		306162	270508	576670
Shimla	27.500		424486	388898	813384

Social issues and accompanied impacts of road widening and improvements projects are less discussed in resettlement literature and dialogue in comparison to fairly well known big development projects like dams, new towns and mining that acquire large land and cause huge displacement of families. The linear nature of road projects and the impacts confined largely within few meters of RoW/ Corridor of Impacts (CoI) did not attract much attention of resettlement experts and other citizen groups in India. In road projects, people affected are found to have lost land, houses, roadside shops/businesses, employment, income, and sources of livelihoods. In most of the earlier road construction and enhancement projects many of the affected people are typically "illegal" occupants and/or encroachers on the right-of-way (RoW) or within corridor of impact. Roadside communities are often more vulnerable as new or improved road network systems bring development to previously undeveloped areas. Indigenous/tribal communities who depend largely on forest/natural resources and inhabit remote areas are found to be severely affected with respect to loss of livelihood, weakened social network, adaptation to new social and cultural environment, during various stages of project development and implementation. Such marginalized groups living or deriving their livelihood while settled in Corridor of Impact become more vulnerable after they are displaced from such settings.

Developing and enhancing the human capital of the area is the underlying aim of all development projects undertaken including road construction and enhancement. Quality of Life is based on Health Care, Status of Women, basic infrastructure and amenities available to people and the presence of indigenous people or Scheduled Tribes in the project area.

3.10.1 Settlement and Properties

The project road is passing through major settlements of Solan, Shimla (out skirts), Dhalli, Wakanaghat, Shogi, Taradevi, and Kachchighati, etc.

3.10.2 Quality of Life

The **physical quality-of-life index** (PQLI) is an attempt to measure the quality of life or well-being of a country. The value is the average of three statistics: basic literacy rate, infant mortality, and life expectancy at age one, all equally weighted on a 0 to 100 scale. It was developed for the Overseas Development Council in the mid-1970s by Morris David Morris, as one of a number of measures created due to dissatisfaction with the use of GNP as an indicator of development. PQLI might be regarded as an improvement but shares the general problems of measuring quality of life in a quantitative way. It has also been criticized because there is considerable overlap between infant mortality and life expectancy.

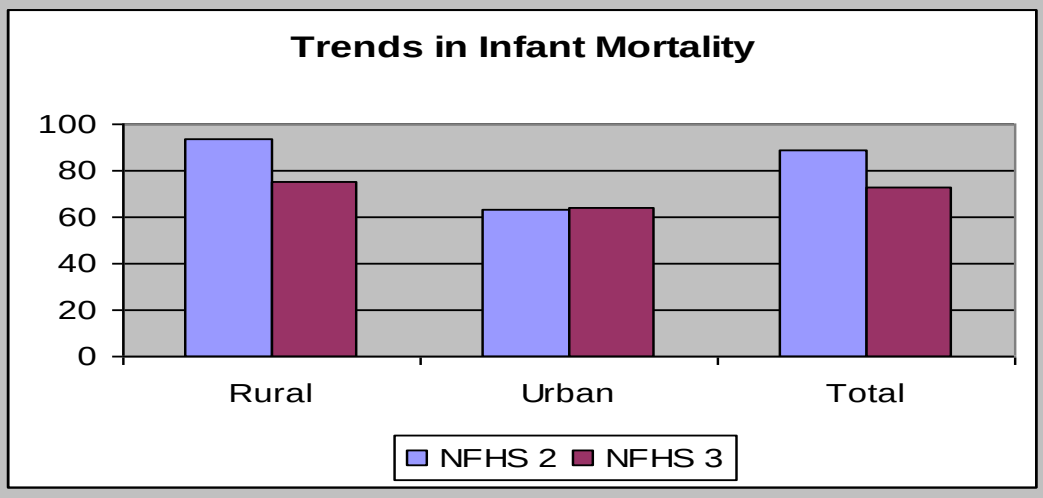
Planning Commission has constructed the quality of life index **(coefficients of quality of life)** for different districts of India. Out of the 2 districts in the project area, district of Shimla (being the capital city) and Solan shows higher value of index of 0.743, and 0.723 respectively. The Human Development Index (HDI) is another parameter used for indication of quality of life. The HDI indices for Shimla and Solan districts are 0.518 and 0.454 respectively.

3.10.3 Health Status

Infant and Child Mortality

In the State of Himachal Pradesh, health parameters are as follows: "The infant mortality rate (41.50) is lower than the average performance of the country (81.40)." (NFHS, 2008) The infant mortality rate is highest in Uttar Pradesh and lowest in Kerala. After the first month of life and before completing five years of age, girls face a higher risk of mortality than boys;

consequently the under-five mortality rates for girls are higher than that of boys." (NFHS, 2008)



Disease Pattern

Anemia among Children: Based on international standards, 36.5 % of children under the age of three years in Himachal Pradesh are under weight, 38.6 % are stunted and 10.3 % are wasted." (NFHS, 2008). The national figure for under weight, stunted and wasted are 42.50, 48 and 19.80 % respectively. This shows that Children health on these parameters is better than national level figure and other states. The anemia in children in Himachal Pradesh is 69.5 % . The national level for anemia is 54.7%. Hence on anemic front children are low.

HIV Prevalence

The HIV prevalence rate is low in Himachal Pradesh than the national figures. In Himachal Pradesh 817 cases of HIV/AIDS in 2003-04. This number has increased to 4374 in 2009-10. The state being a popular tourist destination of national and international tourists is more vulnerable to HIV/AIDS exposure.

3.10.4 Status of Women

After an overview of the health status of people of Himachal Pradesh, two important indicators need to be highlighted. They are Sex Ratio of the population and sex ratio of the 0-6 year age group. Both are important indicators of health status of women, their position in the society and also hint at the social attitudes towards them. Ideally, all populations should have almost equal numbers of males and females in their population, but it is rarely so especially in a patriarch cal society like India, especially North and Central India.

Sex Ratio and under six sex ratio		
	Sex Ratio (No. of females per 1,000 males)	**Under six Sex Ratio (No. of females per 1,000 males in the age group 0-6 years)**
India	**933**	**927**
Solan	884	881
Shimla	916	902

This is clear from the table that both the districts of project road show a sex ratio lower than the national average. Lower sex ratio may have a long drawn effect on the project implementation and execution as special focused programmes would have to be implemented to ensure that women both during the project and after it are empowered and participate in the process of resettlement and rehabilitation. More importantly, child sex ratio of the project area shows that girl child needs to be special care both in health care and education facilities also so that the road to their empowerment is strengthened. Lower sex ratio is also an indication of more female mortality at time of birth.

3.10.5 Basic Amenities and Infrastructure Available

Availability of basic amenities and infrastructure to people is not only their basic human right and thus integral to their social well being but it creates conditions conducive to improving their quality of life and which in effect results in enhancing their capabilities and generating better human capital required for development process.

State Scenario

In the state of Himachal Pradesh, only 12% of the households live in pucca houses. 78% of the households have electricity. 12% of the households have no toilet facility, 100% of the households get drinking water from a borehole or tubewell and get water from the Government supplied source.. 20% of the households use solid fuels for cooking.

Project Area Scenario:

Housing Characteristics: There are three types of houses available to people: Permanent, Semi-Permanent and Temporary. Housing conditions available to people is to a large extent defined by urban or rural nature of the settlement. In the project area, the district of Shimla having an urban character (being the State capital) show high proportion of permanent house type. But, having permanence of housing is a basic human right of people and goes a long way in determining their social well being and protection. Access to semi-permanent (one of the roof, wall or floor is temporary in nature) and temporary structure for living results in deprivation and is a threat to safety.

Project Area: Housing Characteristics			
District	**Permanent**	**Semi-Permanent**	**Temporary**
Solan	78.45	12.64	8.91
Shimla	91.26	5.74	3.0

Source: Census of India, 20011 (P)

Drinking Water Supply: In the project area, villages in most of the districts have an access to safe drinking water supply. The interesting fact is that districts of Himachal Pradesh there is a total coverage of all villages in terms of drinking water supply, i.e., not all inhabited villages have an access to drinking water supply.

District	**Percent to Total Inhabited Villages having Drinking Water Facility**
Solan	100
Shimla	100

Medical Facility: Access to medical facility is easily available in the project area and surroundings. The number of medical institutions in Solan and Shimla are 225 and 365 respectively. The number of beds available is 125 per lakh population in Solan district and 271 beds per lakh in Shimla district. The Himachal Pradesh State overall has 2672 medical

institutions and 134 beds available per lakh population.

Education Infrastructure: Access to Education is a human right and a precondition for improving the quality of life in an area. Elementary Education to all is a fundamental right in India. In the project area, this basic amenity is also not available to many people. In Solan district there is availability of 186 schools per lakh population. In Shimla district, this number is higher and 281 schools are available per lakh population.

Post, Telegraph and Telephone facility: In terms of other important services like post, telegraph and telephone facility, the project area performs well. All villages and habitations have access to communication facilities as there exists good mobile telephone net work. There is availability of 43 post offices per lakh population in Shimla district and 32 post offices per lakh population in Solan district. . Access to such facilities improves connectivity amongst people and is thus important for improving quality of life. Distance to such facilities of communication diminishes their effectiveness. In all urban centers, there is availability of internet facilities also.

3.10.6 Religious Structure

There are some religious places located in the settlements, however these location have been bypassed. So there is no major impact is emphasized on the religious or cultural properties of the project area.

3.10.7 Agriculture and Forestry

Agriculture, and fruit production is the basis of State's economy. The State being hilly, the area available for sowing the crops are 13.297% in Shimla and 0.66 % in Solan. The main cultivated areas are found in the foothills of the State.

3.10.8 Transportation

Transportation system is a key factor in the socio-economic development of any state. In comparison with other Indian states, Himachal Pradesh performs better with transport and communications facilities. The total road length in the state is 33722 km. The road lengths in Solan and shimla districts are 2743 and 5066 km respectively. State has about 60.57 km of roads per 100 sq. km, as amongst an all India average of 62 km per 100 sq. km. The State provides good connectivity to the Jammu and Kashmir.

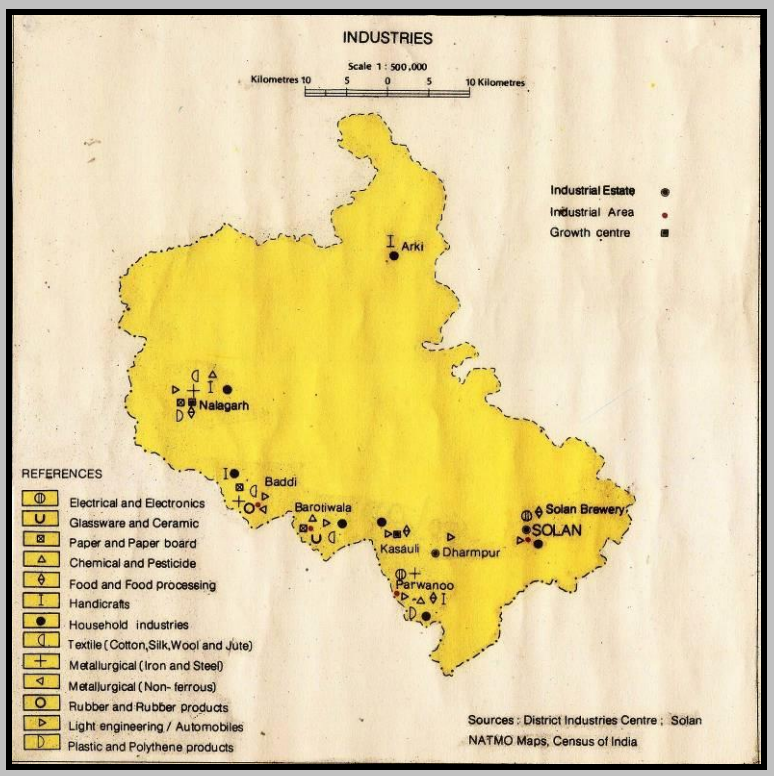
3.10.9 Archaeological and Cultural Sites

The UNESCO World heritage rail line from Kalka to Shimla is running very close and parallel to the project road at same or different elevation up to the start point of Shogi-Shimla-Dalli bypass. Other than this, there is Archaeological structure.

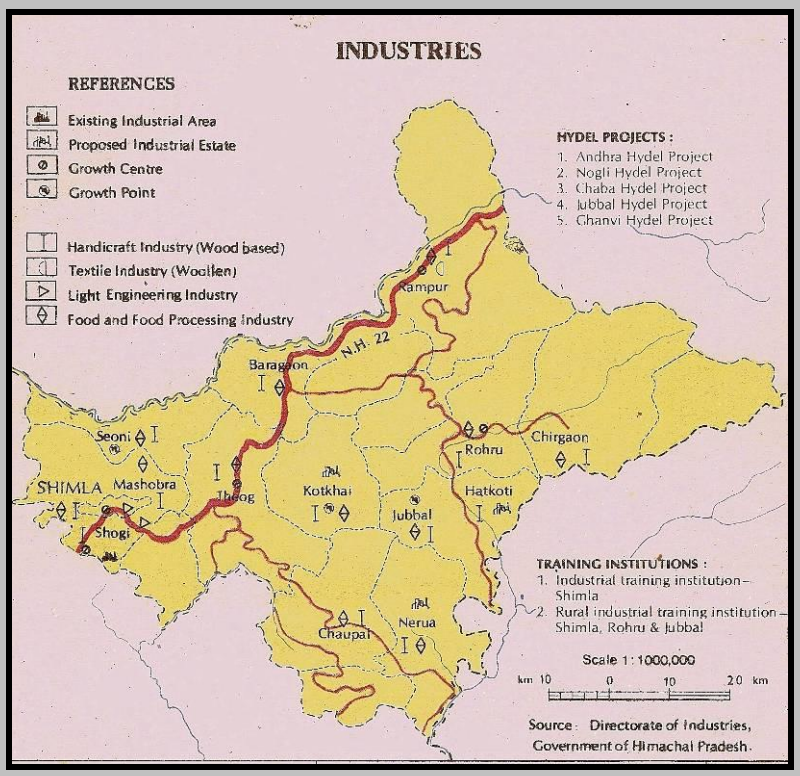
3.10.10 Industries

The state has 26773 large medium and small scale enterprises with an investment of over Rs.10,000 cores giving direct employment to over 659479 persons. The spur in the industrial and tourism growth has consequently led to an increase in environmental pollution. The major industrial centers in the State are located Solan, and Una districts. The state has many small hydro power projects. The number of factories in Shimla district are 167 employing workers, whereas number of factories in Solan district are 1952, employing 167716 workers. The Solan district ranks number one in industrial establishment. Baddi, Barotiwala is a major industrial hub in the state.

Map 3.9: Industries in Districts Solan and Shimla



Solan District



Shimla District

Annexure 3.1: Air Sampling Location and Monitoring Results

Location Code	Chainage	Location Name	Category As per AAQ Standards	Distance From Project Road (km)	Environmental Setting and Justification for Selection
AAQ-1	Km106.000	Solan	Urban Residential	0.070	The monitoring instruments were put on the roof of the house in the Solan town near the start point of project road. The monitoring at Solan is justified as this location is the start point and an urban location along the project road.
AAQ - 2	Km 131.150	Shogi	Semi urban	0.050	The monitoring station is located in a semi urban area. The location is justified as. This will characterise AAQ in town for which bypass has been planned.
AAQ – 3	km 156.000	Dhalli	Rural Residential	0.050	The ambient air quality location is in rural area and data of AAQ at this location will characterise ambient air quality in Rural area in project region. The location is also at the end of project road.

*Note**: - Sampling criteria** Sampling @1 hourly for CO during early sunrise hours. Twice a week 24 hourly sample for three months of summer season for TSPM, SO_2, NOx and RPM*

Ambient Air Quality Monitoring Results for Winter Season (December -2011, January & February 2012)

Reading					
	PM 2.5(µg/m³)	PM10 (µg/m³)	SO_2 (µg/m³)	NO_x (µg/m³)	CO (ppm)
	AAQ-1- Solan (km 106.000)				
Air Quality Standards	***60***	***100***	***80***	***80***	***2.0***
01	15	34	10	15	0.8
02	12	33	9	13	0.5
03	11	31	10	14	0.4
04	10	33	8	16	0.5
05	13	38	11	17	0.5
06	11	32	8	15	0.8

Reading					
	PM 2.5(µg/m³)	**PM10 (µg/m³)**	**SO_2 (µg/m³)**	**NO_x (µg/m³)**	**CO (ppm)**
07	10	29	9	14	0.9
08	11	36	10	15	0.5
09	12	35	8	14	0.4
10	9	39	9	13	0.5
11	14	40	7	13	0.4
12	8	34	9	16	0.5
13	11	32	10	18	0.6
14	10	33	8	17	0.5
15	11	37	11	15	0.6
16	12	40	8	14	0.7
17	11	43	9	16	0.8
18	12	42	11	15	0.9
19	10	38	10	14	0.8
20	12	39	9	16	0.6
21	11	40	10	14	0.8
22	10	37	9	15	0.7
23	12	34	8	17	0.6
24	11	31	10	15	0.5
Minimum	8	31	8	13	0.4
Maximum	14	43	11	18	0.9
Average	11.3	35.83	9.2	15.0	0.6
P_{50} Value	11.3	35.8	9.2	15.0	0.6
P_{98} Value	14	43	14	18	0.9
	AAQ - 2 Shoghi Town (km 131.150)				
Air Quality Standards	***60***	***100***	***80***	***80***	***2.0***
01	9	34	9	14	0.5
02	10	39	10	15	0.7
03	11	36	9	14	0.8
04	10	38	8	15	0.8
05	12	40	9	16	0.8
06	11	39	ND	15	0.7
07	10	36	6	13	0.9
08	9	40	8	16	0.8
09	9	37	8	16	0.8
10	10	37	10	15	0.7
11	11	38	6	14	0.8
12	10	36	7	16	0.8

Reading					
	PM 2.5(µg/m³)	**PM10 (µg/m³)**	**SO_2 (µg/m³)**	**NO_x (µg/m³)**	**CO (ppm)**
13	9	39	6	16	0.7
14	10	40	7	17	0.8
15	10	35	9	16	0.8
16	9	37	8	15	0.8
17	11	36	ND	16	0.7
18	10	36	6	15	0.8
19	10	38	8	17	0.7
20	8	32	8	15	0.8
21	9	35	9	16	0.9
22	9	36	07	15	0.8
23	11	38	6	16	0.6
24	10	37	09	15	0.7
Minimum	8	32	ND	13	0.5
Maximum	12	40	10	17	0.9
Average	9.91	37	7.2	15.33	0.76
P_{50} Value	9.91	37	7.2	15.33	0.7
P_{98} Value	12	40	10	17	0.9
	AAQ – 3 Dhalli (km 156.000)-End of Project Road				
Air Quality Standards	***60***	***100***	***80***	***80***	***2.0***
01	11	37	9	14	0.8
02	10	39	8	15	0.8
03	9	34	10	13	0.8
04	9	34	9	15	0.9
05	10	35	8	17	0.8
06	9	34	8	16	0.7
07	10	37	10	14	0.6
08	9	33	6	16	0.6
09	10	36	7	15	0.6
10	11	35	9	17	0.7
11	12	33	8	16	0.8
12	10	37	06	14	0.6
13	10	34	08	15	0.6
14	10	35	07	15	0.7
15	9	34	6	16	0.6
16	10	35	7	15	0.6
17	11	36	9	15	0.7
18	9	35	10	16	0.6

Reading					
	PM 2.5(µg/m³)	**PM10 (µg/m³)**	**SO_2 (µg/m³)**	**NO_x (µg/m³)**	**CO (ppm)**
19	9	34	8	17	0.8
20	10	35	9	15	0.6
21	9	36	10	14	0.7
22	10	35	9	15	0.6
23	8	34	8	16	0.7
24	10	36	10	16	0.6
Minimum	9	33	6	13	0.6
Maximum	12	37	10	17	0.9
Average	9.8	35.13	8.3	15.3	0.67
P_{50} Value	9.8	35.13	8.3	15.3	0.67
P_{98} Value	12	57	10	17	0.9

ANNEXURE-:3.2
Photographs of Environmental Monitoring

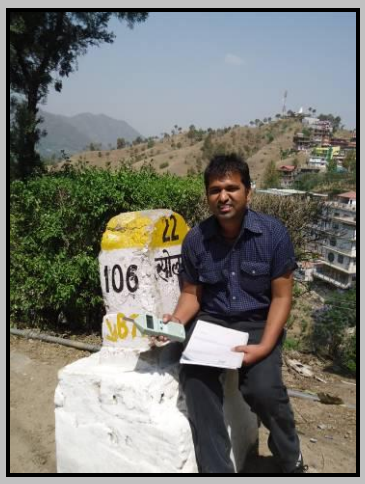
Air Sampling Photographs

Air Sampling at Solan

Air Sampling at Shoghi

Air sampling at Dhalli

Noise Monitoring Photograph



Noise Sampling at Solan

Noise Sampling at Shogi

Noise Sampling at Dhalli

Soil sampling Photograph

Soil Sampling Solan

Water Sampling Photographs

Water Sampling at Solan

Water Sampling at Shoghi

Water Sampling at Dhalli

CHAPTER – 4

ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

CHAPTER – 4

ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1 BACKGROUND

This chapter assesses the nature, type and magnitude of the potential impacts likely to occur on the various relevant physical, biological and cultural environmental components along the NH 22 (Solan- Shimla Section). The description of the impacts on the individual components has been structured as per the discussion in Chapter 3: (Description of Environment) of this report.

Road construction related impacts occur at three stages of the project:

i) Planning and Design

ii) Construction

iii) Operation

Planning and Design covers the alignment finalisation for Solan- Shimla stretch of NH-22, detailed highway design, identification of construction material sources, statutory clearances, etc. that ultimately decides the impact during later phases. Most of the impacts are during pre construction, construction and operation phases. While some of the construction phase impacts are temporary, some Operation phase impacts are continuous in nature.

Other important criterion for identification of impact is the identification of the impact zone. For present project, the direct project influence area has been considered the Right of Way (RoW) of proposed project and 500 m on either side from the edge of the road. The Proposed Right of Way (RoW) of project road is 45 m in the entire length. The indirect influence area extends from boundary of the direct area of influence and up to 15 km from the boundary of RoW of proposed road.

Environmental parameters are broadly classified into three groups.

i) Physical Environment

ii) Biological Environment

iii) Human Environment

Physical environment includes water resources, water quality, air quality, noise and land environment, Biological environment includes, flora, terrestrial fauna, avifauna, aquatic flora, fauna and plantations. Human environment includes the social environment rehabilitation, employment, agriculture, housing, culture etc. Social impact has been covered in detail in the Resettlement Plan being prepared separately.

The chapter also gives mitigation measures for the adverse impacts.

4.2 PHYSICAL ENVIRONMENT

4.2.1 Topography

(a) Impacts

Construction Stage

During the construction of the proposed project, the topography will change due to excavation of borrow areas, cutting of hill and fills for project related structures such as bridges, Tunnels, RoB, culverts, grade separators, etc.. Establishment of construction camps for material handling will also alter the existing topography temporarily. There will be visible change in topography due to cutting of hills. These changes will be more visible in Shimla bypass alignment as this a totally new construction.

Operation Stage

The change in topography will also be due to the probable induced developments of the project. These induced developments will be in the form of tourism and commercial establishments and residential complexes close to RoW. The change in topography will be visible due to land slide and damage to side slope and breast wall during monsoon months.

(b) Mitigation Measures

Construction Stage

The borrow areas will be opened, operated and closed as per clause no 305.2.2 of Specifications for Road and Bridge Works of Ministry of Road Transport and Highways (MoRTH). The borrow areas are to be filled with the rejected waste and then finally a layer of Top Soil is to be spread over it before carrying out plantation, turfing, etc. The cutting of hill slope will be done as per MoRTH specifications/Hill road manual. The surplus leftover will be disposed off at identified dump sites.

Operation Stage

During operation stage, maintenance of embankment will be carried out, so that the embankment is not affected due to soil erosion. The side slopes/ breast wall if damaged due to land slide will be repaired promptly. Benefits in the form of land levelling and tree plantations in the vicinity of the project road shall enhance the local aesthetics. The side slopes will also established through plantation of shrubs and vegetation.

4.2.2 Geology

(a) Impacts

Construction

The impact on geology may be from extraction of minerals; however, the quantity of material required is not much to impact the geology of the project region. About 78537 cum of aggregates and 2098230 cum of borrow soil will be required for construction of Solan- Shimla section of NH-22. The quantity of material required is not much to impact the geology of the project region. It may be worth to mention that alignment is not passing through any area being used for extraction of minerals. The surplus generated will be disposed off at land identified for dumping. The proposed twin tunnels at two locations is Shogi –Shamla – Dhalli bypass will further avoid hill cutting and hence minimum impact on geology of the area.

Operation Stage

The project area is not passing through mining area and in operation phase of the project no impact is anticipated on geology of the area.

(b) Mitigation Measures

Construction Stage

No new quarries are proposed to be opened for this project. The material will be obtained from the quarries which have valid permits and which are presently in operation. These have been identified at Panchkula.

Operation Stage

Since no impacts have been identified, therefore, no mitigation measures are warranted.

4.2.3 Seismicity

(a) Impacts

During Construction

The project road is a part of NH-22 and is located in hills. The project road is located in Zone IV. Road construction in the project region will not have any impact on its overall

earthquake potential since no blasting is envisaged at the construction site. The Zone IV is the most hazardous zone and earthquake of severe intensity may be felt. Hence all project related structures are subjected to damage during earthquake if a proper earthquake coefficient is not considered in the design.

During Operation

No Impact on seismicity is anticipated during operation phase unless there is an occurrence of earthquake and damage to the project road.

Mitigation Measures

Construction Stage

All the project related structures will be made earthquake resistant, for this necessary design factor has been taken into the project design.

Operation Stage

In the event of occurrence of earthquake and damage to project road structures, necessary mitigation measures will be taken to repair damage to project road.

4.2.4 Physiography

(a) Impacts

During Construction

The impact of road construction on physiography is a function of the terrain of the area. It is most drastically altered in case of a hilly terrain or where extensive cut-and-fill operations are involved. The impact on physiography will be felt at the stretches where there are realignments, new bypasses and at locations of tunnels. The visual impacts will be felt during construction period. The change in physiography will be limited within the RoW of the project. The impacts on physiography will be felt at Kandaghat bypass, Shogi-Shimla - Dhalli bypasses and realignments proposed at 7 locations to improve the geometrics of the road.

During Operation

No impact on physiography is anticipated during operation phase.

(b) Mitigation Measures

Construction Stage

Since change in physiography will be pleasing to the eyes due to landscaping and compensatory afforestation, no mitigation measures are warranted except provision for adequate cross drainage structures that have been provided.

Operation Stage

During operation stage landscaping and plantation of side slopes will be maintained. The cross drainage structures will also be maintained.

4.2.5 Soil Erosion

(a) Impacts

The soils in the study area are limited due to hilly terrain and these are moderately fertile having clayey loam soil mixed with fine sand and humus. Therefore the potential for erosion is low. However, soil erosion cannot be ruled out during the torrential rains.

Pre Construction

The soil erosion may take place due to the following:

- Site preparation may involve demolition of building, clearing of brushwood, tree removal and temporary rerouting of utilities. This brings risks of erosion to the exposed ground or stored topsoil.

- Setting up of workers camp near habitations close to RoW may lead to loss of productive soils and impact the soil productivity especially at micro level.

During Construction

The soil erosion may take place at the slopes of the construction sites of cross drainage structures due to rains, at borrow areas and at construction sites which has been exposed during monsoon. The soil erosion in the present case is more likely during the hill cutting.

During Operation

The soil erosion in the present case will be due to storm water runoff at side slopes, due to damages to breast wall and on account of landslides.

(b) Mitigation Measures

Design Stage

The project road is located in a hilly terrain. The slope of the project road at has been fixed at 1:2 to 1:3 which is fairly stable and reduces the possibilities of slope failure. To check soil erosion on slopes and uphill, retaining wall and breast wall turfing with grasses and shrubs will be carried out, in accordance with the recommended practice for treatment of embankment slopes for erosion control, IRC: 56-1974. Since slopes are steep, therefore retaining wall on valley side and beast wall on hill side are proposed. The detailed chainages of these have been proposed below:

(i) Breast wall for 4 lane

Right Side					Left Side				
S. No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
					1.000	108790	108816	25.693	2.000
					2.000	109060	109100	40.000	2.000
					3.000	109269	109293	24.350	3.000
					4.000	109375	109510	135.000	2.000
					5.000	109580	109590	10.000	2.000

(ii) Breast wall for 2 lane

Right Side					Left Side				
S. No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
1	109630.000	109650.000	20.000	2.000		109590	109650	60.000	2.000

(iii) Breast wall for 4 lane

Right Side					Left Side				
S. No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
1	112565	112594.722	29.722	2.000	1	110390	110400	10.000	2.000
2	112730	112735	5.000	2.000	2	110450	110478	27.845	2.000
3	117300	117320	20.000	2.000	3	110540	110600	60.000	3.000
4	117390	117410	20.000	2.000	4	110630	110680	50.000	3.000
5	117880	117920	40.000	3.000	5	111183.7188	111212.8922	29.173	2.000

Right Side					Left Side				
S. No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
6	118020	118070	50.000	2.000	6	111235	111240	5.000	2.000
7	118240	118323.6196	83.620	3.000	7	111725	111780	55.000	2.000
8	118385	118440	55.000	2.000	8	111830	112060	230.000	2.000
9	119061.2571	119110	48.743	2.000	9	112370.4989	112444.887	74.388	3.000
10	119221.8427	119230	8.157	2.000	10	112580	112650	70.000	3.000
11	119270	119345	75.000	2.000	11	112730	112750	20.000	2.000
12	119480	119525	45.000	2.000	12	112840	112915	75.000	2.000
13	120715.4216	120720	4.578	2.000	13	112970	112986.2709	16.271	2.000
14	120800	120851.2048	51.205	3.000	14	113225	113275.6536	50.654	2.000
15	121050	121060	10.000	2.000	15	113320	113330	10.000	2.000
16	121100	121125	25.000	2.000	16	113400	113410	10.000	2.000
17	121330	121415	85.000	2.000	17	113430	113469.4993	39.499	2.000
18	122070	122085	15.000	2.000	18	113550	113620	70.000	2.000
19	122360	122370	10.000	2.000	19	114008.8537	114010	1.146	2.000
20	122540	122570	30.000	2.000	20	114410	114520	110.000	2.000
21	122820	122840	20.000	2.000	21	114610	114660.0807	50.081	2.000
22	122980	123000	20.000	2.000	22	115000	115170	170.000	3.000
23	123195	123200	5.000	2.000	23	115540	115550	10.000	2.000
24	123448.9255	123490	41.075	2.000	24	116220	116265	45.000	3.000
25	123553.4273	123625	71.573	3.000	25	117440	117595	155.000	3.000
26	123700	123800	100.000	2.000	26	118060	118090.3392	30.339	3.000

Right Side					Left Side				
S. No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
27	123855	123900.2152	45.215	2.000	27	125380	125395	15.000	2.000
28	124035	124100.8285	65.828	3.000	28	125836.4727	125850	13.527	2.000
29	124120	124155.1067	35.107	2.000	29	127430	127450	20.000	2.000
30	124300	124310	10.000	2.000	30	128155	128170	15.000	2.000
31	124463.7179	124480	16.282	2.000	31	128931.837	129025	93.163	3.000
32	125075.3516	125100	24.648	2.000	32	129390	129500	110.000	3.000
33	125200	125230.8971	30.897	2.000	33	129990	130050	60.000	2.000
34	125380	125405	25.000	2.000	34	130170	130180	10.000	2.000
35	125620	125720	100.000	3.000	35	130880	130960	80.000	3.000
36	125995	126140	145.000	3.000	36	131300	131350	50.000	2.000
37	127240	127280	40.000	2.000	37	132220	132360	140.000	3.000
38	127895	127945	50.000	3.000	38	132390	132400	10.000	2.000
39	127955	128035	80.000	3.000	39	133430	133470	40.000	3.000
40	129190	129250	60.000	3.000	40	133550	133570	20.000	2.000
41	129980	130000	20.000	3.000	41	134250	134263.0117	13.012	2.000
42	136980	136990	10.000	2.000	42	135910.7864	135925	14.214	2.000
43	145445	145465	20.000	2.000	43	137160	137215	55.000	3.000
44	148100	148125	25.000	2.000	44	138130	138160	30.000	2.000
45	154510	154540	30.000	2.000	45	138400	138550.4816	150.482	2.000
46	156160	156166.8537	6.854	2.000	46	138724.9592	138855.9935	131.034	3.000
47	156270	156327.1918	57.192	3.000	47	139310	139370	60.000	3.000

Right Side					Left Side				
S. No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
					48	140700	140760	60.000	2.000
					49	142155	142185	30.000	2.000
					50	142260	142285.4778	25.478	2.000
					51	144420	144450	30.000	2.000
					52	144632.1978	144666.3701	34.172	3.000
					53	144680	144713.9174	33.917	3.000
					54	144772.3139	144840.3653	68.051	3.000
					55	144960	144990.9717	30.972	2.000
					56	145045	145090	45.000	3.000
					57	145650	145660	10.000	2.000
					58	146015	146045	30.000	2.000
					59	147670	147790	120.000	3.000
					60	148255	148355	100.000	3.000
					61	148400	148455	55.000	2.000
					62	148536.3829	148561.1476	24.765	3.000
					63	148690	148743.8966	53.897	2.000
					64	148870	148890	20.000	2.000
					65	149010	149111.5174	101.517	3.000
					66	149200	149210	10.000	2.000
					67	149305.727	149320	14.273	2.000
					68	149390	149400	10.000	2.000

Right Side					Left Side				
S. No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
					69	150070.3597	150074.7999	4.440	2.000
					70	150090	150105	15.000	2.000
					71	150240	150250	10.000	2.000
					72	150700	150775.024	75.024	3.000
					73	152400	152450	50.000	2.000
					74	154545	154860	315.000	3.000
					75	154885	154935	50.000	2.000
					76	154950	155050	100.000	3.000
					77	155175	155183.33	8.330	2.000
					78	155596.4968	155640	43.503	2.000

(iv) *Retaining* Wall for Service Road

Right Side					Left Side				
S.No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
1	270	285	15	3	1	40	50	10	3
2	330	340	10	3	2	70	134	64	6
3	360	367.778	7.778	3					
4	570	790	220	7					
5	810	1181.299	371.2995	15					

(v) Retaining wall for 4 lane Elevated Portion

Right Side					Left Side				
S. No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
1	106054.825	106170.000	115.175	8.000	1.000	106045.000	106170.000	125.000	8.000
2	106785.868	106980.000	194.132	9.000	2.000	106785.000	106980.000	195.000	9.000
3	107110.000	107115.000	5.000	3.000	3.000	108180.000	108185.000	5.000	5.000
4	107140.000	107255.089	115.089	16.000	4.000	108260.000	108270.000	10.000	14.000
5	107310.000	107400.000	90.000	15.000					
6	107430.000	107540.000	110.000	10.000					
7	107610.000	107627.836	17.836	6.000					
8	107666.408	107775.000	108.592	15.000					
9	107803.335	107843.927	40.592	8.000					
10	107870.000	107890.000	20.000	9.000					
11	108014.885	108020.000	5.115	3.000					
12	108040.000	108050.000	10.000	12.000					
13	108110.000	108311.487	201.487	18.000					
14	108405.000	108455.000	50.000	4.000					
15	108470.000	108480.000	10.000	3.000					
16	108515.000	108535.000	20.000	3.000					
17	108555.000	108580.000	25.000	5.000					
18	108664.141	108680.000	15.859	4.000					

(vi) *Retaining* wall for 2 lane

Right Side					Left Side				
S. No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
Retaining wall for 2 Lane Left side									
1	108405.000	108455.000	50.000	4.000					
2	108470.000	108480.000	10.000	3.000					
3	108515.000	108535.000	20.000	3.000					
4	108555.000	108580.000	25.000	5.000					
5	108664.141	108680.000	15.859	4.000					
6	109706.288	109750.000	43.712	7.000	1	109715	109730	15.000	3
7	109765.000	109790.000	25.000	11.000					
8	109900.000	109935.000	35.000	20.000					
Retaining wall for 2 Lane Right side									
Right Side					Left Side				
S. No.	FROM	TO	LENGTH	MAX.HT	S.No.	FROM	TO	LENGTH	MAX.HT
1	108390.992	108420.000	29.008	15.000		108391	108420	29.008	15.000
2	108530.000	108590.000	60.000	12.000		108530	108590	60.000	7.000
1	109500.000	109530.000	30.000	11.000		109573	109590	17.001	9
2	109570.000	109590.000	20.000	9.000					

(vii) Retaining wall for 4 lane

Right Side					Left Side				
S. No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
1	108590.000	108670.124	80.124	8.000	1	108915	108940	25.000	3.000
2	108680.000	108780.000	100.000	3.000	2	108995	109010	15.000	9.000
3	108796.252	108872.545	76.293	15.000					
4	108972.591	108980.000	7.409	3.000					
5	109120.000	109250.000	130.000	12.000					
6	109270.000	109300.000	30.000	3.000					
7	109305.000	109335.000	30.000	3.000					
8	109390.000	109500.000	110.000	20.000					
1	109817.787	109820.000	2.213	3.000	1	110610.000	110615.000	5.000	3.000
2	110044.260	110090.000	45.740	7.000	2	110820.000	110833.912	13.912	3.000
3	110400.000	110470.000	70.000	11.000	3	110837.824	110840.000	2.176	3.000
4	110550.000	110560.000	10.000	4.000	4	113080	113110	30.000	5.000
5	110575.388	110675.000	99.612	17.000	5	113295	113305	10.000	7.000
6	110754.594	110760.000	5.406	3.000	6	113860	113920	60.000	15.000
7	110770.000	110780.000	10.000	3.000	7	115320	115325	5.000	7.000
8	110850	110855	5.000	3.000	8	115736.3207	115840	103.679	18.000
9	110960	110970.2455	10.245	4.000	9	116545	116550	5.000	3.000
10	111110	111140.9716	30.972	3.000	10	116810	116880	70.000	12.000
11	111250	111290	40.000	4.000	11	116885	116905	20.000	12.000

Right Side					Left Side				
S. No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
12	111330	111344.583	14.583	3.000	12	118120	118140.3392	20.339	3.000
13	111380	111394.9812	14.981	5.000	13	118225	118270	45.000	8.000
14	111414.9812	111425	10.019	3.000	14	118391.8351	118430	38.165	4.000
15	111430	111445	15.000	3.000	15	118485	118541.6427	56.643	4.000
16	111585	111670	85.000	20.000	16	118640	118680	40.000	18.000
17	111685	111710	25.000	3.000	17	118745	118765	20.000	3.000
18	111725	111780.0366	55.037	20.000	18	119870	119895	25.000	9.000
19	111855.7494	111860	4.251	3.000	19	119985	120010	25.000	3.000
20	111890	111915.5278	25.528	18.000	20	120160	120180	20.000	3.000
21	111920	111950	30.000	3.000	21	120185	120240.9554	55.955	13.000
22	111970	111980	10.000	3.000	22	120290	120420	130.000	12.000
23	112020	112047.9918	27.992	7.000	23	120426.5592	120520	93.441	16.000
24	112070	112075	5.000	3.000	24	120590	120630	40.000	11.000
25	112200	112215.4349	15.435	9.000	25	120910	120970	60.000	17.000
26	112280	112310	30.000	20.000	26	121050	121070	20.000	12.000
27	112385	112430	45.000	20.000	27	121095	121100	5.000	5.000
28	112510.6359	112514.1463	3.510	8.000	28	121790	121800	10.000	3.000
29	112540	112545	5.000	3.000	29	121920	121950	30.000	3.000
30	112640	112650.4148	10.415	3.000	30	122100	122163.8989	63.899	9.000
31	112685	112690.9098	5.910	20.000	31	122245	122255	10.000	3.000
32	112740	112775	35.000	5.000	32	122280	122295	15.000	3.000

Right Side					Left Side				
S. No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
33	112870	112950	80.000	20.000	33	122370	122445	75.000	14.000
34	113080	113085	5.000	3.000	34	122520	122580	60.000	11.000
35	113270	113390	120.000	16.000	35	122610	122705	95.000	3.000
36	113420	113430	10.000	3.000	36	122825	122830	5.000	3.000
37	113440	113450	10.000	3.000	37	122870.2773	122885.367	15.090	3.000
38	113710	113750	40.000	10.000	38	123310	123357.5446	47.545	13.000
39	113770	114095	325.000	20.000	39	123440	123446.2188	6.219	3.000
40	114141.8778	114160	18.122	3.000	40	123557.4211	123561.6606	4.240	4.000
41	114247.5675	114260.2121	12.645	3.000	41	123610	123640	30.000	3.000
42	114694.5806	114720	25.419	13.000	42	123733.4891	123745	11.511	3.000
43	114770	114800	30.000	3.000	43	123840	123900	60.000	13.000
44	114980	115010	30.000	13.000	44	123990	124013.816	23.816	3.000
45	115050	115095	45.000	12.000	45	124070	124072.9758	2.976	3.000
46	115140	115180	40.000	13.000	46	124160	124205	45.000	11.000
47	115250	115263.3439	13.344	3.000	47	124520	124620	100.000	15.000
48	115375	115385	10.000	3.000	48	124665	124790	125.000	12.000
49	115480	115490	10.000	3.000	49	124855	124910	55.000	7.000
50	115541.6696	115560	18.330	4.000	50	124920	124925	5.000	3.000
51	115570	115725	155.000	18.000	51	125000	125055	55.000	12.000
52	115735	115865	130.000	12.000	52	125285	125290	5.000	3.000
53	115920	115925.3311	5.331	3.000	53	125294.7533	125355	60.247	12.000

Right Side					Left Side				
S. No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
54	115940	116030	90.000	20.000	54	125445	125500	55.000	15.000
55	116106.6548	116425	318.345	12.000	55	125663.547	125670	6.453	3.000
56	116455	116565	110.000	19.000	56	126280	126285	5.000	3.000
57	116590	116725	135.000	20.000	57	126418.8558	126430	11.144	3.000
58	117160	117180	20.000	10.000	58	126654.6637	126680	25.336	3.000
59	117950	117966.1789	16.179	3.000	59	126690	126810	120.000	12.000
60	120010	120020	10.000	3.000	60	126980	127050	70.000	8.000
61	120745	120785	40.000	3.000	61	127070	127214.1902	144.190	18.000
62	121920	121970	50.000	3.000	62	127620	127635	15.000	3.000
63	122214.1028	122240	25.897	4.000	63	127715	127800	85.000	18.000
64	123980	124013.4033	33.403	3.000	64	127815	127840	25.000	3.000
65	124355	124390	35.000	3.000	65	127875	127915	40.000	3.000
66	124845	124875	30.000	3.000	66	128100	128140	40.000	3.000
67	125537.5554	125545	7.445	4.000	67	128450	128563.198	113.198	19.000
68	125885	125895	10.000	3.000	68	128620	128890	270.000	8.000
69	126960	126963.9671	3.967	3.000	69	129050	129070	20.000	12.000
70	127597.0981	127600	2.902	3.000	70	129330	129332.8492	2.849	3.000
71	128270	128310	40.000	3.000	71	130115.6466	130130	14.353	3.000
72	128423.4103	128835.4895	412.079	20.000	72	131470	131595	125.000	15.000
73	128880	128890	10.000	5.000	73	131690	131730	40.000	16.000
74	129150	129170	20.000	16.000	74	131940	131955	15.000	7.000

Right Side					Left Side				
S. No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
75	129300	129650.1714	350.171	14.000	75	132070	132080	10.000	8.000
76	129750	129790	40.000	8.000	76	132130	132190	60.000	17.000
77	129880	129950	70.000	12.000	77	132590	132600	10.000	3.000
78	130732.0234	131115	382.977	16.000	78	133110	133145	35.000	13.000
79	131185	131440	255.000	20.000	79	133390	133405.8859	15.886	11.000
80	131460	131775	315.000	17.000	80	134814.2343	134890	75.766	20.000
81	131890	132965	1075.000	15.000	81	135115	135150	35.000	6.000
82	133210	133237.8452	27.845	12.000	82	135800	135840	40.000	4.000
83	133370	135190	1820.000	16.000	83	137260	137370	110.000	11.000
84	135390	135690	300.000	14.000	84	138580	138597.1025	17.102	14.000
85	137065	138340	1275.000	14.000	85	138640	138660	20.000	11.000
86	138373.8446	138415	41.155	16.000	86	138885	138907.526	22.526	5.000
87	138460	138520	60.000	20.000	87	139220	139230	10.000	10.000
88	138695	138727.2275	32.228	20.000	88	140390	140400	10.000	3.000
89	139040	139130	90.000	19.000	89	140420	140480	60.000	11.000
90	139220	140385	1165.000	9.000	90	140830	140880	50.000	7.000
91	140430	140720	290.000	10.000	91	141430	141450.5522	20.552	7.000
92	140750	141485	735.000	17.000	92	142710	142730	20.000	3.000
93	141505	141690	185.000	10.000	93	142865	142885	20.000	12.000
94	141735	141970	235.000	20.000	94	143220	143256.0626	36.063	11.000
95	142020	142600	580.000	14.000	95	143520	143560	40.000	14.000

Right Side					Left Side				
S. No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
96	142620	142705	85.000	14.000	96	143630	143640	10.000	4.000
97	143040	143315	275.000	14.000	97	143795	143811.3545	16.354	4.000
98	143335	143400	65.000	15.000	98	144500	144510	10.000	3.000
99	143420	144265.4969	845.497	20.000	99	145960	145986.6864	26.686	7.000
100	144305	144580	275.000	19.000	100	147040	147060	20.000	4.000
101	144615	144770	155.000	18.000	101	148165	148225	60.000	20.000
102	144790	144800	10.000	14.000	102	148475	148500	25.000	8.000
103	144811.3854	144820	8.615	5.000	103	149450	149455	5.000	4.000
104	144920	145430	510.000	13.000	104	149925	149935	10.000	10.000
105	145514.0837	145825	310.916	20.000	105	150290	150320	30.000	12.000
106	145844.033	146165	320.967	17.000	106	152514.0168	152590	75.983	6.000
107	146230	146727.3241	497.324	11.000	107	153570	153600	30.000	11.000
108	146810	146880	70.000	15.000	108	154244.3602	154270	25.640	3.000
109	147490	147520	30.000	19.000	109	155070	155075	5.000	5.000
110	147540	147910	370.000	11.000	110	155140	155144.5068	4.507	6.000
111	147923.9017	148063.0689	139.167	20.000	111	155775	155784.9975	9.997	4.000
112	148190	148220	30.000	4.000	112	156280	156290	10.000	10.000
113	148290	148335	45.000	7.000	113	156450	156480.85	30.850	3.000
114	148400	148510	110.000	8.000					
115	148565.813	148595.813	30.000	9.000					
116	148610	148811.4402	201.440	20.000					

Right Side					Left Side				
S. No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
117	148840	148875	35.000	4.000					
118	148915	148993.3878	78.388	14.000					
119	149031.3555	149225	193.644	14.000					
120	149270	149335	65.000	14.000					
121	149372.9687	149590	217.031	6.000					
122	149610	149620	10.000	4.000					
123	149650	149700	50.000	18.000					
124	149745	149780	35.000	16.000					
125	149823.2309	150075	251.769	14.000					
126	150095	150365	270.000	12.000					
127	150395	150700	305.000	20.000					
128	150725	151010	285.000	13.000					
129	151025	151131.8487	106.849	20.000					
130	151152.5575	152010	857.442	13.000					
131	152020.0111	152180	159.989	10.000					
132	152285	152671.3889	386.389	14.000					
133	152715	152870	155.000	18.000					
134	152980.3295	153010	29.671	8.000					
135	153393.9446	154090	696.055	17.000					
136	154325	154365	40.000	20.000					
137	154430	154480	50.000	8.000					

Right Side					Left Side				
S. No.	**FROM**	**TO**	**LENGTH**	**MAX.HT**	**S. No.**	**FROM**	**TO**	**LENGTH**	**MAX.HT**
138	154562.263	154693.7987	131.536	20.000					
139	154700	154705	5.000	3.000					
140	154770	154780	10.000	3.000					
141	154865	154895	30.000	17.000					
142	154960	155000	40.000	14.000					
143	155120	155235	115.000	20.000					
144	155300	155604.6852	304.685	20.000					
145	156100	156120	20.000	15.000					

Construction Stage

Prior to the start of the relevant construction, the contractor shall submit to the Independent Engineer for approval of his schedules for carrying out temporary and permanent erosion / sedimentation control works as are applicable for the items of clearing and grubbing , drainage excavation, embankment / subgrade construction, bridges and other structures across water courses, pavement courses and shoulders. Contractor shall also submit for approval his proposed method of erosion / sedimentation control on service road / inspection road and borrow areas and his plans for disposal of waste materials. Work shall start only when the Engineer has approved the erosion / sedimentation control schedules and methods of operations for the applicable construction.

The construction works of retaining wall and breast wall will be taken up per the chainages given in the above tables.

The surface area of erodible earth material exposed by clearing and grubbing and, excavation, borrow and fill material operations shall be limited to the extent practicable. The contractor will provide immediate permanent or temporary erosion control measures to prevent soil erosion and sedimentation that will adversely affect construction operations, damage adjacent properties or cause contamination of nearby watercourses and ponds etc.

Operation Stage

The turfing shrubs plantation and maintenance of breast wall and retaining wall shall be monitored regularly and in case of any sign of damage of retaining wall and breast wall immediate action will be taken to restore. Any loss of grass and shrubs on side slopes will also be made up before onset of monsoon season.

4.2.6 Compaction of Soil

(a) Impacts

Pre-Construction Stage

Compaction of soil will occur in the pre-construction phase due to movement of the construction equipment and machinery and during the setting up of construction camps. The road being on hill, this impact is of no significance as surface in the entire length is rocky.

Construction Stage

Compaction will be beyond the main carriageway and service roads and within the vegetated area of the RoW by the movement of vehicles and heavy machinery. Movement of vehicles during road construction is the major cause of soil compaction and this may also occur along haul road and near borrow areas during cartage of borrow materials. This impact is direct and will be the most in the RoW. It is necessary to ensure that there is no adverse impact of soil compaction in areas other than the RoW, where vegetation can grow and rain infiltration will take place. It may be mentioned that for cartage of borrow areas there will be usage of designated road due to presence of undulating surface and hills and hence chances of compaction in open land around RoW or borrow raes is unlikely.

Operation Stage

During the operation period compaction will be restricted to the carriageway of the project road and service roads. Compaction cannot be said to be an impact of the operation stage as the pavement itself is a function of compacted base and sub base.

(b) Mitigation Measures

Pre-Construction Stage

During pre- construction stage, establishment of construction camp and installation of

plants and machinery at campsite, machinery and equipment will be unloaded and kept at campsite only. All construction vehicles will move and be parked at the designated locations only. The movement of construction machinery and plants preferably will be limited to RoW. All Haul roads shall be constructed and maintained in good condition.

Construction Stage

During Construction phase all construction vehicles will ply within the RoW and identified routes. In no case these shall ply through open land or agriculture fields.

Operation Stage

No mitigation measures are warranted.

4.2.7 Contamination of Soil

(a) Impacts

Pre-Construction Stage

Contamination of soil in the pre-construction stage may be considered as a short-term residual negative impact. Soil contamination may take place due to solid waste contamination from the labour camp set up during pre-construction stage. This impact is significant at locations of construction camps; stockyards, hot mix plants, etc. as these will come up in this stage.

Construction Stage

Contamination of soil during construction stage is primarily due to construction and allied activities. The sites where construction vehicles are parked and serviced are likely to be contaminated because of leakage or spillage of fuel and lubricants. Pollution of soil can also occur in hot-mix plants from leakage or spillage of asphalt or bitumen. Refuse and solid waste from labour camps can also contaminate the soil. Contamination of soil during construction might be a major long-term residual negative impact. Unwarranted disposal of construction spoil and debris will add to soil contamination. This contamination is likely to be carried over to water bodies in case of dumping being done near water body locations. In the current case the surplus generated will also contaminate or occupy the land if disposed off improperly on productive agriculture land.

Operation Stage

During the operation stage, soil pollution due to accidental vehicle spills or leaks is a low probability but potentially disastrous to the receiving environment, should they occur. These impacts can be long term and irreversible depending upon the extent of spill. However, monitoring of soil quality will be done during construction & operation phases. The soil contamination may take place if there is head on collision with the tankers carrying hazardous substance with another vehicle or there is overturning of tankers on curves.

(b) Mitigation Measures

(i) Contamination of Soil from Fuel and Lubricants

Construction Stage

At various construction sites, the vehicles and equipment will be maintained and refuelled in such a fashion that oil/diesel spillage does not contaminate the soil. It will be ensured that the fuel storage and refuelling sites are kept away from drainage channels and important water bodies. At the wash down and refuelling areas, “Oil Water Separators” shall be provided. All spills and discarded petroleum products shall be disposed off in accordance to the Himachal Pradesh Pollution Control board Guidelines. Fuel storage and refuelling areas will be located at least 500 m from all water bodies crossing the alignment.

In all fuel storage and refuelling areas located on agricultural lands or productive lands, the topsoil preservation shall be carried out.

Operation Stage

Probability of contamination of soil being only from the road runoff, which is directed into nearest water bodies through well-designed drains, no impact on the soil during operation stage except in case of accidents, is anticipated. Accidental spillage will be handled as per established emergency procedure. This emergency procedure will be developed by the concessionaire once project road is opened for vehicular traffic.

(ii) Contamination of Soil from Construction Wastes and Quarry Materials

Construction Stage

It will be required that earth works are carried out strictly in accordance to the design drawings. Unsuitable earth, if required, will be dumped in approved areas. The spoils will be used to reclaim borrow pits and quarries, low-lying areas in barren lands and in settlements along the project corridors. All spoils will be disposed off and the site will be fully cleaned before handing over. The construction wastes will be dumped in selected dump sites. These dump sites will be developed in consultation with State Pollution Control Board. Non-bituminous wastes from construction activities will be dumped in borrow pits and covered with a layer of the conserved topsoil. Bituminous wastes will be disposed off in approved dumping site.

Operation Stage

In operation stage no mitigation measures are warranted as no impacts have been identified. The dump sites identified will be properly reclaimed and closed. These shall be secured with fencing and side slopes of these dumping sites will also be stabilised through plantation of shrubs.

4.2.8 Loss of Productive Soil

(a) Impacts

Design stage

Loss of productive soil takes place if alignment is passing through agriculture area. The project road section is passing through hilly terrain for almost its entire length. Hence, loss of productive soil is not anticipated much as the strata is rocky.

Pre-construction stage

Loss of productive soil, albeit during the construction stage only, is envisaged at locations of workers' camps, stockyards, storage godowns, etc. if these are located on fertile areas. The chances of these being located on productive agriculture field are not there as entire alignment is passing through agriculture fields.

Construction stage

Loss of productive soil of RoW will take place. Total requirements for earth works have been estimated as **2098230 m^3.**

Operation Stage

No Impact is anticipated in operation phase.

(b) Mitigation Measures

Design Stage

To the extent possible alignment of project road has been selected to minimise acquisition of productive agricultural land. In the selection of borrow areas for the project, productive agricultural areas have been avoided for borrowing of materials unless and until unavoidable.

Traffic detours, temporary diversions required during construction will be finalized so as to avoid or minimise temporary acquisition of productive agricultural lands.

Pre Construction Stage

The camps will be sited on unproductive land only unless unavoidable. Topsoil in case of

productive land will be stripped to a depth of 150mm and stored as per IRC guidelines. After completion of work these areas shall be restored.

Construction Stage

At location of alignment in agriculture areas, at construction camps, borrow areas in productive lands and all areas to be permanently covered, the top soil will be stripped to a specified depth of 150 mm and stored in stockpiles of height not exceeding 2m. The stockpiling will be done in slopes of 2:1, to reduce surface runoff and enhance percolation through the mass of stored soil. The locations of top soil storage will be identified by the Independent Engineer.

The stored topsoil will be spread back to maintain the physico-chemical and biological activity of the soil. The stored topsoil will be utilized for:

- Covering all disturbed areas including for the redevelopment of borrow areas;
- Top dressing of the embankments and fill slopes;
- Filling up of tree pits, proposed as part of compensatory afforestation; and
- Filling up of the median for shrub plantation
- To prevent any compaction of soil in the adjoining productive lands, the movement of construction vehicles, machinery and equipment will be restricted to RoW / Construction Camps.

4.2.9 Borrow Pits for the Project

(a) Impacts

The total quantity of earthworks for Solan Shimla section project road widening is about 2098230 m3. As many as 6 borrow areas have been identified within a maximum lead distance of 8 km from the proposed project alignment. The details of these have been given in. **Table- 3.1** It has been estimated that the volume of earth available is sufficient for the earthworks.

Construction Stage

Cartage of the borrow materials to the construction sites is of significance, as almost all such areas are accessible through dirt tracks only and therefore, spillage and compaction of soil along these tracks will be a significant impact. Proper protections measures need to be worked out for minimising such impacts during the haulage of borrow materials.

Rehabilitation of borrow areas from which earth has been excavated, is a potential problem which needs to be addressed. In addition to visual blight, safety issues shall also be considered. Opening of borrow areas may result in loss of productive soil. Moreover, the borrow area pits, if not treated properly after the borrowing is complete, can form stagnant pools and pose health hazards. To prevent such occurrences, redevelopment of borrow areas need to be worked out. Additionally, they can also act as breeding ground for vectors like mosquitoes especially just after monsoon.

(b) Mitigation Measures

Design Stage

For borrowing of earth for the project, 6 borrow area locations have been identified and recommended.

Following precautions will be taken to restrict unauthorised borrowing by the contractors

- No borrow area shall be opened without permission of the Independent. Engineer. The borrowing shall not be carried out in cultivable lands, unless and until, it shall be agreed upon by the Independent Engineer that there is no suitable uncultivable land in the vicinity for borrowing, or there are private landowners willing to allow borrowing on their fields. The contractor has to ensure that, there is no loss of productive soil and the requisite environmental considerations are met with.

- Location of source of supply of material for embankment or sub-grade and the procedure for excavation or transport of material shall be in compliance with the environmental requirements of the MoEF, MoRTH and as specified in IRC: 10-1961.
- Redevelopment of the identified borrows areas worked out, as part of the project preparation will be implemented to mitigate the impacts.

Construction Stage

To avoid any embankment slippages, the borrow areas will not be dug continuously. In case borrow areas other than specified are selected, the size and shape of borrow pits will be decided by the Engineer. Borrowing of earth shall be carried out at locations recommended as per IRC: 10-1961 The mitigation measures to be adopted for borrow areas at different land uses are given below:

- **Non-Cultivable lands**: Borrowing of earth will be carried out upto a depth of 1.0 m from the existing ground level. Borrowing of earth shall not be done continuously. Ridges of not less than 8m width shall be left at intervals not exceeding 300 m. Small drains shall be cut through the ridges, if necessary, to facilitate drainage. Borrow pits shall have slopes not steeper than 1 vertical to 4 horizontal.
- **Public or Private agricultural lands**: Borrowing of earth shall not be carried out on productive lands. However, in the event of borrowing from productive lands, topsoil shall be preserved in stockpiles. A 150mm layer of the top soil shall be stripped off from the area designated for borrowing and it shall be stored in stock piles in a designated area of height not exceeding 2m and side slopes not steeper than 1:2. At such locations, the depth of borrow pits shall not exceed 45 cm and it may be dug out to a depth of not more than 30 cm after stripping the 15 cm top soil aside.
- **Borrow pits on the riverside**: The borrow pit shall be located not less than 15m from the toe of the bank, distance depending on the magnitude and duration of flood to be withstood. Precautionary measures like the covering of vehicles will be taken to avoid spillage during transport of borrow materials. To ensure that the spills likely to result from the transport of borrow and quarry materials do not impact the settlements, it will be ensured that the excavation and carrying of earth will be done during day time only. The unpaved surfaces used for the haulage of borrow materials will be maintained properly.

The contractor shall evolve site-specific redevelopment plans for each borrows area location. These site specific borrow areas redevelopment plans will be approved by the Engineer.

4.2.10 Quarries

(a) Impacts

The excavation of quarries and borrow pits used for obtaining rocks, soil and aggregate materials for road construction can cause direct and indirect long-term adverse impacts on the environment. Although the cut operations shall generate ample soil material it is likely that material from quarry and borrow areas could be needed depending on the appropriateness of the material quality. The impacts of quarrying operations could be significant at various stages of road construction. Quarrying and crushing could have a critical impact especially on the air quality of the area especially the area in the downwind direction of the quarry. The stage wise impacts are as described below:

Pre Construction Stage

Existing quarries that are already in operation have been identified and have been recommended for this project. No new quarries have been proposed. The bulk of the materials needed for the construction of the embankments will be procured from the existing quarries. These quarries have been identified at Panchkula in Haryana. As these quarries are already in operation with the requisite environmental clearances and redevelopment plans, no major impacts, which arise in making new quarries operational, are likely. Necessary environmental mitigative measures recommended by the Haryana

Pollution Control Board are being followed at these quarries.

Construction Stage

A major source of dust during the construction stage is from stone crushing operations from the crusher and the vibrating screen. The dust, in addition to being an eyesore, reduces visibility thereby increasing safety concerns. Dust is generated due to procurement and transport of raw materials from quarries and borrows sites to the road construction area. These impacts will persist till the activity ceases. The regions especially downwind to the quarries/borrow areas are more vulnerable to air pollution.

As no new quarry needs to be opened for this project, therefore, no new impacts are likely to arise due to quarrying operations. The material from these quarries and crushers will be transported from Panchkula through the existing highway.

(b) Mitigation Measures

Design Stage

As part of the project preparation process, an evaluation of all existing quarries along the corridor has been carried out and the status in terms of the suitability of the quarry material and their legal status have been assessed. The crushers operating at quarries at Panchkula have already been identified by the design team.

Construction Stage

It will be ensured that quarries from where material is taken have all valid permits & licenses and the haul road network is properly maintained.

Operation Stage

No mitigation measures from project end are warranted.

4.2.11 Land Use

(a) Impacts

Pre - Construction and Construction Stage

There will be change of landuse for land falling within the RoW of the project road. The predominant landuse of RoW is Hilly terrain and waste land. There will be acquisition of land to the extent of 210 ha for the project. This comprises of 164 Ha private lands and 46 Ha Government land. .

Operation Stage

In operation stage no impact on land use changes in RoW of project road is anticipated. However, there may be induced land use changes close to RoW near urban areas and bypass/ realignments.

Mitigation Measures

The compensation for land acquisition will be made as per the provisions in the resettlement Plan.

4.2.12 Meteorological Parameters

(a) Impacts

Construction Phase

The entire alignment of Solan-Shimla section of project road is located in a region that experiences typical tropical climate with marked monsoon effects. Though no change in the macro-climatic setting (precipitation, temperature and wind) is envisaged due to the project, the microclimate is likely to be temporarily modified by vegetation removal and the creation of paved surface for road and its structures construction. This microclimatic change may result in reduced precipitation and slight increase in temperature. The increased in temperature may be felt localised.

Although the impact is significant and long-term and reversible in nature and shall be compensated for by compensatory plantation of trees, it must be noted that the impact is

unavoidable. However, it may be pointed out that the project has taken due care to minimise tree felling in the RoW by realigning the alignment to save dense tree plantation stretches and habitation areas.

Operation Phase

In the operation phase no impact on meteorological parameters is anticipated.

(b) Mitigation Measures

Design and Construction Stage

Avoidance measures, as the minimising of the number of trees to be cut, have been worked out as part of the design finalisation. The project will involve significant cutting of trees in the RoW. Though no change in the macro-climatic setting (precipitation, temperature and wind) is envisaged due to the widening of NH-22 section from Solan to Shimla, the microclimate is likely to be temporarily modified by vegetation removal, and due to construction of paved pavement surface.

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 three trees will be planted. There is planning to plant 20352 trees as compensatory plantation. Compensatory afforestation in the available space of RoW, planting along the median and turfing of side slopes proposed shall help in restoring the green cover along the project corridor. The project proponent as part of DPR will prepare a detailed tree plantation and turfing plan as part of project implementation.

4.2.13 Ambient Air Quality

The ambient air quality of project influence area will be affected during pre construction, construction and operation phases. Pre Construction and construction phase impacts will be intermittent in nature and will change from location to location as work progresses and continues. These types of emission sources cannot be categorised point, area or line sources. The quantification of emission is difficult for pre construction and construction phases. During operation phases vehicular emissions emitting from traffic will be from line source. The emissions from these vehicles have been quantified and modeled.

(a) Impacts

Air quality along the project corridor will be adversely impacted both during the construction and operation stages. Construction stage impacts will be of short term and have adverse impacts on the construction workers as well as the settlements adjacent to the road, especially those in the downwind direction. Construction stage impacts will be confined generally to a band of width ranging from 50 to 100m from the edge of the Proposed Right of Way. However, they will continue for the entire life of the project. The following sections present the impacts of the project activities on this component.

Generation of Dust

Pre Construction & Construction Stages

Generation of dust is the most likely impact during these stages due to:

- Site clearance and use of heavy vehicles, machinery, etc.;
- Procurement and transport of raw materials and quarries to construction sites; the impacts will mostly be concentrated in the RoW. It is likely that impacts due to dust generation are felt downwind of the site rather than on the site itself.

As the entire project corridor has a soil type with significant silt content and the 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 also likely to be generated due to the various construction activities including:

- Stone crushing operations in the crushers;
- Handling and storage of aggregates in the asphalt plants;

- Concrete batching plants; and
- Asphalt mix plants due to mixing of aggregates with bitumen.

Generation of dust is a critical issue and is likely to have adverse impact on health of workers in quarries, borrow areas and stone crushing units. This is a direct adverse impact, which will last almost throughout the construction period.

Operation Stage

No dust generation is envisaged during the operation stage as the project road shall be paved and there will be turfing on side slope and plantation on shrubs. More over project site remains moist during winter month due to snow fall or frost.

Generation of Exhaust Emissions

Pre Construction & Construction Stages

Generation of exhaust gases is likely during the pre-construction stage due to movement of heavy machinery for clearance of the RoW for construction. This impact is envisaged to be insignificant during the pre-construction stage.

High levels of SO_2, HC and NO_x are likely from hot mix plant operations. Toxic gases are released through the heating process during bitumen production. Although the impact is much localised, it can spread downwind depending on the wind speeds. The Environmental Management Plan needs to ensure that adequate measures are taken especially for health and safety of workers such as providing them with pollution masks during working hours. Also, the contractor should ensure that hot mix plants, stockyards, crushers etc. are away from residential areas and residential quarters of all workers. If adequate measures are taken, impacts from generated gases can be considered negligible.

Operation Stage

The major impact on air quality will be due to plying of vehicles. Increase in air pollution is also identified by the public as one of the most undesirable impacts of any new road development project. 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. Excess discharge of exhaust gases can occur due to (i) inadequate vehicle maintenance; (ii) use of adulterated fuel in vehicles and/or (iii) poor road conditions. To predict air quality in the vicinity of the project road alignment during operation phase air pollution modelling has been carried out to quantify the impacts incorporating all these variables.

Air Quality Prediction Mathematical Model

The incremental concentrations of pollutants such as CO and NOx have been computed using CALINE-3 model. This model has been developed by California Transport Department. However, it has been adopted for project route conditions by using emission factors prevalent in India. The CALINE-3 model requires emission rates, wind speed and weather conditions as input data. The worst meteorological conditions (wind speed 1m/s, stability-F during night time and wind speed 1m/s, stability-D during day time) have been used in the predictions.

Composite emission factors have been used to calculate emission rates from vehicles. The basic information on the emission factors has been derived from Indian Institute of Petroleum Publication “Vehicle Emissions and Control Prespective in India”. These since have been adopted by CPCB as emission norms for vehicles from 2000 AD onwards.

The emission factors are given in **Table 4.1** below:

Table -4.1: Speed Corrected Emission Factors (in gm/km/vehicle)

Diesel Vehicle Trucks Speed (gm/km)								
Pollutant	10	20	30	40	50	60	70	80
CO	37.80	18.80	12.53	9.40	7.52	6.27	5.37	4.70
NO_x	66.83	33.42	22.28	16.71	13.37	11.14	9.55	8.36

Petrol Vehicles (Independent of speed)			
Pollutant	Cars	Two Wheelers	Three Wheelers
CO	2.72	2.0	4.0
NO_x	0.58	0.05	0.05

Operative speeds have been assumed 80 kmph up to the horizon year 2017 and 60 km ph Beyond 2017.
The predicted values at locations of ambient air quality are given in **Table- 4.2**

Table-4.2: Predicted Ambient Air Quality for Operation Phase

S. No.	Location	Baseline Levels (ug/m3)		Predicted Incremental Values		Operation Phase Predicted Values	
				2017	2032	2017	2022
1	Solan	CO	1032	21.84	76	1054	1108
		NOx	18	8.4	29.24	27	38
2	Shogi	CO	1032	19.60	47.04	1052	1079
		NOx	18	7.60	18.70	26	37
3	Dhalli	CO	1032	10.56	27.03	1043	1059
		NOx	18	4.03	10.31	22	29

It is clear from the above table that predicted concentrations are well within the limits of Rural and Residential areas till the end of the project life.

(b) Mitigation Measures

Based on the baseline ambient air quality at the various locations along the project road, prediction of the pollutant concentrations for the projected traffic due to the project was carried out using CALINE-3. The results indicate that the ambient air quality will not exceed the standards now applicable at most of the locations even at the end of project life. The compensatory plantation planned will attenuate the gaseous and particulate matter concentrations in the environment.

Construction Stage

The asphalt plants, crushers and the batching plants will be sited at least 1 km in the downwind direction from the nearest human settlement.

All precautions to reduce the level of dust emissions from the hot mix plants, crushers and batching plants and other transportation of materials will be taken up which include vehicles delivering loose and fine materials like sand and fine aggregates shall be covered to reduce spills on existing roads. Water will be sprayed on earthworks, temporary haulage and detour roads on a regular basis. During and after compaction of the sub-grade, water will be sprayed at regular intervals to prevent dust generation. The hot mix plant will be fitted with dust extraction units. It shall be ensured that the dust emissions from the crusher and vibrating screen at the stone quarries do not exceed the emission standards set by Central Pollution Control Board.

To ensure the control of exhaust gas emissions from the various construction activities, the contractor shall take up the following mitigation measures:

- An adequate cyclone/scrubber to control emissions from the stack of hot mix plants will be provided in the event of the emissions exceeding the Himachal Pradesh

Pollution Control Board norms. Other potential measures include plantation around periphery of the hot-mix plants.

- To ensure the efficacy of the mitigation measures suggested, air quality monitoring shall be carried out at least once a season during the period the plant is in operation.
- All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the Himachal Pradesh Pollution Control Board norms. A vehicle maintenance schedule prepared by the contractor and approved by the Engineer shall be adhered to.
- Contractor will take necessary consent from state pollution control board for location of hot mix plants.

4.2.14 Water Resources

(a) Impacts

The project road crosses Kathulu Ka Nalla at km 131.800, Samri Nalla at km 137.500, Kair Ka Nalla at km 147.570 and Kallali Ka Nalla at km 156.165. There are no road side ponds or lake along the project road alignment. All the drains except Samari Nalla are seasonal. These surface water bodies can be subject to adverse impacts due to the various construction activities as well as during the operation stage of the project.

Contamination to water bodies may results due to spilling of construction materials, oil, grease, fuel and paint in the equipment yards and asphalt plants.

Water table along the project road is very low due to rocky strata. The construction and operation of the proposed project roads is not expected to have any major impacts on the surface water. Ground water potential is not much due to hilly terrain. The poor ground water potential will deter use of ground water for construction. Hence impact on account of project implementation on ground water is not expected.

Mitigation Measures

Design Stage

Since all the water bodies except Samri Nallah are seasonal, therefore, construction of bridges across all streams will be taken up during lean season flow. The water usage for construction will be taped either from some local spring or through these streams after permission from authorities.

Construction stage

The hand pumps coming in the proposed right of way will be replaced. The community tube wells have not been seen in the RoW. In case of these being private property the compensation will be paid as per the provisions in the R&R Plan. Required number of cross drainage structures shall be provided for maintaining the natural drainage. Labour camps shall be sited at least 1000 m away from the water body.

Operation Stage

In operation stage to avoid any impact on water resources in the NH-22 portion from Solan to Shimla storm runoff has been properly channelised through designed drainage system. The details of drainage system have been presented below in the drainage section.

4.2.15 Drainage

(a) Impacts

Impacts of road construction, which lead to alteration of drainage, are generally due to construction of cross drainage at locations of crossing. This requires river and or gully training for the period during which the bridge and cross drainage structures are to be constructed. Alteration of drainage can lead to soil erosion of adjacent areas, disturb local vegetation. If the period of alteration is long, there are chances of local ecology being impaired. However, as mostly cross drainage works are done in summer when the water

levels are low in the rivers and streams, the impacts due to alteration of drainage can be minimized effectively with adequate mitigation measures and pre planned construction schedules. The proposed project road will not alter drainage pattern of the area as adequate cross drainage structures have been planned. At locations of realignments and bypasses the impact on drainage pattern of the area will be due to construction of the road pavement. These embankments will be an impediment to the natural drainage of the area if adequate cross drainage structures are not constructed. More over the project road being on hill will be subjected to uphill storm water drainage system. This may cause damage to project road, breast wall, retaining wall if proper drainage system is not built as part of project road.

Pre Construction Stage

No drainage modification of surface flow of local streams namely Kalali Ka Nallah, Samri Nallah, and Kair Ka Nallah is envisaged during pre-construction period hence no impacts area anticipated. In the project design side drain towards breast wall side. The drain size is 2 feet (600mm) wide and 600 mm depth. The project plans to have adequate size 89 culverts in Shogi – Shimla - Dhalli bypass. Out these 89 culverts 4 will be RCC slab culverts and balance 85 will be Hume Pipe culverts. In the existing project road widening portion (km 106.000 to km 131,085) there are 167 culverts. The project plans to retain 140 culverts and reconstruct another 27 culverts. There will be construction of new culverts in the new two lane portion and in case of widening on either side existing culverts will be widened. The project will have 11 major bridges.

Construction Stage

Though construction along the watercourses is to be carried out in the lean flow periods, as the streams mentioned will have some flow and the construction activities will necessitate diversion of the waterways. During the construction there will be some diversion of waterway. This diversion of flow may significantly harm the aquatic habitat, present if any. The waterway of the streams will become constricted due to diversion and this will caused increased velocity downstream of the bridge. This will mean increased sediment load with the flow, thereby allowing less sunlight to penetrate into the water and can reduce growth of micro flora. The impact shall be direct but short term in nature and shall last as long as construction continues.

Operation Stage

One of the unavoidable aftermaths of road construction is the increased surface run off. The addition of hard paved road surface, which essentially increase paved impervious surface, will cause increased surface runoff in the project influence area. An average width of paved surface including main carriageway is 17 m (8.5 m on either side of median). Increase in surface run-off is due to the creation of impervious surfaces that prevent the flow of water into the ground. The increased runoff from the project has been worked out as follows:

*Increase in runoff (cu.m) = increase in runoff co-efficient due to construction * annual rainfall in the area (m) * area of the newly constructed surface.*

The entire corridor traverses over hilly track with runoff coefficient of 0.55 and the black top has a run-off coefficient 0.90. The increase in the runoff co-efficient has been worked out as 0.35, i.e, the difference between the runoff co-efficient of black top surface and hilly terrain has been adopted as increased run-off co-efficient due to the project. The runoff has been calculated below. The average rain fall for the project road length has been taken as 1352 mm based on rain fall data presented in **Chapter-3**.

Increased runoff = (50.507x17)1000x0.35x1.352= 406298.51 m3.

Impacts due to surface runoff include increased soil erosion and local flooding or water logging.

It is clear from the above table that widening of project road will generate storm runoff to the tune of 406298.51 m^3. This storm runoff needs to be properly disposed off to avoid

flooding.

(b) Mitigation Measures

Design Stage

To ensure efficient cross-drainage and to prevent water logging along the sides, adequate size and number of cross-drainage structures and side drains have been provided. All cross-drainage structures have been designed to handle a 50-year peak flood level.

Construction Stage

The contractor will remove obstructions that may cause any temporary flooding of local drainage channels during construction. No spoil or construction material will be stored outside the proposed RoW or at places obstructing the natural drainage system.

Based upon the findings of field investigations supplemented with proposed cross drainage structures inventory, it has been decided that following mitigation measures planned for effective drainage.

- An effective surface and subsurface drainage system of pavement structures has been designed as stipulated in IRC: 42 as per site conditions.
- An effective drainage system has also been planned for the drainage of medians, service roads, Tunnels, toll plazas. Wayside Amenities – Services Area, Truck Lay-bye areas, and other features including the area between main carriageway and service road ensuring that there shall be no pooling of water at any time on the pavement.
- Storm water shall be directed away from the respective bridge deck by providing kerb & gutter and a chute up to the bottom of the embankment and through a system of side channel. The drainage & protective work shall be designed to avoid soil erosion.
- The roadside channels (flat bottomed) shall intercept and remove surface run- off from the RoW and the adjacent areas and will be drained to the nearest available natural drain. Adequate length of roadside channel has been proposed.
- Water course -these shall have adequate capacity for the design run-off and be located and shaped to avoid creating traffic hazard and erosion of soil.
- Drainage channels and pipe shall be installed at crossings with service pipes and utilities ensuring that conflicts do not occur.
- For draining of pavement and uphill storm water a side drain towards breast wall has been proposed in the entire length.

Mitigation Measures for Bridge Construction Sites

There will be construction of 11 major bridges/ 11 mjnor bridges/via duct/ROB, and 256 culverts structures. The mitigatory measures to be adopted during construction these structures are as follows:

- Construction will be carried out during lean flow period as far as possible;
- approach slopes will be stabilized through shrubs plantation and retaining wall construction;
- Silt fencing will be provided at base of embankment of entire water body;
- Siltation of soil into water bodies will be prevented;
- All solid waste/ construction materials will be properly disposed off from bridge sites;
- Contractor will ensure that these are not disposed off in to water body;
- No oil or lubricant will be discharged from construction yard or machinery into water body; and
- The Construction materials will be stored at a minimum distance of 500m from the water body.

Operation Stage

To maintain an efficient storm water flow, all drains will be regularly cleaned as part of the road maintenance. This cleaning will be taken up during monsoon months.

4.2.16 Loss of Water Bodies / Groundwater sources

(a) Impacts

Water table along the project road is quite low as project road is in hilly terrain. The construction and operation of the proposed project roads is not expected to have any major impacts on the surface water and the ground water quality in the area.

In the entire length no Tube well and Hand Pumps are present hence impact on these is nil.

As explained in Chapter-3 ground water potential in project area is poor and project road construction will not have impact on recharge potential of the project area.

(b) Mitigation Measures

Mitigation Measures for Ground Water

Design Stage.

Avoidance of water supply sources water taps and hand pumps been worked out in the design of the alignment. Since no water supply sources are being impacted, therefore, no mitigation measures are warranted.

Pre- Construction Stage

The relocation of private and community water supply sources if any found during the pre construction stage shall be completed prior to the commencement of the construction by the contractor, in accordance to the utility and community assets relocation plan prepared for the project. To prevent any stress on the local water sources due to the relocation, the process of dismantling shall commence only after the provision of the water supply source at the relocation site is agreed upon by the community. The contractor will identify water sources for construction, which in all probability will be local springs/streams. Necessary permission for water usage will be obtained from the competent authority.

Operation Stage

During operation stage no impact on ground water resources is anticipated hence no mitigation measures are warranted.

4.2.17 Increased Sediment and Degradation of Surface Water Quality

(a) Impacts

Pre-construction and Construction Stage

The degradation of water quality can occur during construction stage from increased sediment load into watercourses near the construction site. This may be aggravated by removal of trees and consequent increase in soil erosion. However, as the project length is relatively small to have any regional impact and will be crossing only smaller streams(no major river), the impacts due to the increased sediment load is not expected to be significant.

Degradation of water quality is also possible due to accidental discharges into watercourses from drainage of workers' camps and from spillage in vehicle parking and/or fuel and lubricant storage areas.

Operation Phase

During the operation phase, there is little chance of degradation of water quality during

normal operations. The implications of accidental discharge are potentially disastrous. However, it must be emphasised that the probability of such an accident is quite low. The design of the NH-22 portion incorporates all safety features required as per IRC requirements.

(b) Mitigation Measures

Construction Stage

To avoid contamination of the various surface water bodies and drainage channels near the construction site, construction work close to the streams or other water bodies will be avoided, especially during monsoon period. All necessary precautions will be taken to construct temporary or permanent devices to prevent water pollution due to increased siltation and turbidity. All wastes arising from the project will be disposed off, as per Himachal Pradesh Pollution Control Board norms, so as not to block the flow of water in the channels. The wastes will be collected, stored and taken to the approved disposal sites.

The vehicles and equipment will be properly maintained and refuelled, so as to avoid contamination of the water bodies and drainage channels from fuel and lubricants. The slopes of embankment leading to water bodies will be modified and re-channelised so that contaminants do not enter the water body. Oil and grease traps will be provided at fuelling locations, to prevent contamination of water. The sewage system for construction camps will be properly designed and built so that no water pollution takes place to any water body or watercourse.

Operation Stage

Proper maintenance of the side slopes, retaining wall, breast wall, median drains, side drains and protection measures near water sources would be ensured by the project proponents.

4.2.18 Flood Hazards

(a) Impacts During Preconstruction and Construction

The flood hazards in the project are not there as project road is on elevation and on hill having quick drainage system.

During construction flood hazards may be possible at bridge construction location of streams if flow is obstructed. There no chances of inundation.

(b) Impacts During operation

During operation, no impact of flooding is anticipated. For runoffs from the carriage there may be temporary local accumulation of water in case adequate side drainage structures are not provided.

(c) Mitigation Measures

Preconstruction Stage and Construction Stage

During construction local drainage at construction site will be maintained to avoid flooding.. In order to ensure free flow in the side drains, proper maintenance will be carried out at regular intervals especially just before the monsoon season.

Operation Stage

In operation phase the turfing and protection measures will stabilize the side slopes and approaches of major bridges and elevated portion in first 2-3 years. In the initial two years, proper maintenance will be carried out for any damage.

4.2.19 Hydrology

Surface Water Hydrology

(a) Impacts

Pre - Construction and Construction Stage

The construction of bridges and elevated structure will not change surface water hydrology as all bridges will be having a obstruction free cantilever beam supported bridges or suspension bridges.. Hydrological impacts may be felt at bridge construction sites if proper water way width is not maintained.

Operation Stage

(a) Impacts

During operation stage impact on surface water hydrology will be felt if side drains are not effective and tunnels do not provide adequate cross drainage. In that situation, flooding may be felt during monsoon season.

(b) Mitigation Measures

Preconstruction and Construction stage

Adequate water way width will be maintained during construction to ensure no impacts on hydrology.

Operation stage

During operation stage no impacts are anticipated due to project implementation as design takes care of mitigation measures. These mitigation measures will be implemented during construction stage. The embankment constructed for ROB and elevated portion will be maintained. All side drains will be cleaned and properly maintained before onset of monsoon each year

Ground Water Hydrology

(a) Impacts

Pre Construction and Construction Stage

The impacts on ground water hydrology due to road construction will be in RoW on account of compaction and rising of embankment.

(b) Mitigation

The project is not located in a flood prone area. As such the length of the alignment is relatively small to have any significant impact on the ground water hydrology.

4.2.20 Noise

(a) Impacts

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 (IRC: 104-1988).

The baseline noise levels monitored at various locations along the Solan- Shimla alignment indicate the baseline levels are well will within in the stipulated limits of CPCB in respect of the respective land uses of monitoring locations. Noise levels are low because in the project influence area there is rural ambience particularly agriculture fields. The noise is concern as during construction and operation phases there will be generation of significant noise.

The impacts on noise due to the project will be of significance in both the construction as well as the operation stages.

Pre-Construction stage

Noise levels during the pre construction stage are mostly expected to be indicative of prevalent baseline levels apart from localised noise levels at locations where pre construction stage activities are taking place such as establishment of workers' camps, stockyards. These increased noise levels will prevail only for a short duration during the pre construction stage. Moreover, as these activities are not likely to be placed near settlement locations the increased noise impact is bound to be negligible.

Construction Stage

Due to the various construction activities, there will be temporary noise impacts in the immediate vicinity of the project corridor. The construction activities will include the

excavation for foundations and grading of the site and the construction of structures and facilities. Crushing plants, asphalt production plants, movement of heavy vehicles, loading, transportation and unloading of construction materials produce significant noise during construction stage. The typical noise levels associated with the various construction activities and the various construction equipments are presented below in **Table 4.3.**

Table - 4.3: Typical Noise Levels of Principal Construction Equipment

CLEARING		**STRUCTURE CONSTRUCTION**	
Bulldozer	80	Crane	75-77
Front end loader	72-84	Welding generator	71-82
Jack hammer	81-98	Concrete mixer	74-88
Crane with ball	75-87	Concrete pump	81-84
		Concrete vibrator	76
EXCAVATION & EARTH MOVING		Air compressor	74-87
Bulldozer	80	Pneumatic tools	81-98
Backhoe	72-93	Bulldozer	80
Front end loader	72-84	Cement and dump trucks	83-94
Dump truck	83-94	Front end loader	72-84
Jack hammer	81-98	Dump truck	83-94
Scraper	80-93	Paver	86-88
GRADING AND COMPACTING		**LANDSCAPING AND CLEAN-UP**	
Grader	80-93	Bulldozer	80
Roller	73-75	Backhoe	72-93
		Truck	83-94
PAVING		Front end loader	72-84
Paver	86-88	Dump truck	83-94
Truck	83-94	Paver	86-88
Tamper	74-77	Dump truck	83-94

Source: U.S. Environmental Protection Agency. Noise from Construction Equipment and Operations. Building Equipment and Home Appliances. NJID. 300.1. December 31. 1971

Though the noise levels presented for the various construction activities far exceed the permissible standards, it is important to note that the construction noise is generally intermittent and depends on the type of operation, location and function of the equipment. Proper mitigation measures as to regulate the timings of construction, employing noise protection measures etc. need to be worked out.

Operation Stage

To assess the noise levels at the various sensitive receptors locations along the corridor, the prediction of noise levels[1] has been made for the years 2017 and 2032 using the FHWA Transport Noise Model.

[1] Operational noise for the highway are predicted through the model developed by Federal Highway Administration, Department of Transportation of the U.S. Likely noise levels at various receptor locations predicted through FHWA noise model in present study. The various assumptions predicting the noise levels along the corridor through the FHWA model were:

- No significant change in the vehicle characteristics is anticipated during the projected period;

The FHWA Noise Model presented below is based upon calculating the hourly L_{eq} for all category-wise vehicles separately and then adding these logarithmically to obtain the overall hourly L_{eq} as follows:

$$L_{eq}\,(hi) = Loei + {}^{10}\log \frac{Ni}{SiT} + {}^{10}\log 15^{1+\alpha} - 13 + \delta s$$

D

Where,

L_{eq} (hi)	Equivalent noise level at the hour (hi) for vehicle type (i)
L_{oei}	Reference mean energy level for (ith) vehicle type
Ni	Number of vehicles of (ith) class passing in time (T) one Hour (1 hour)
Si	Average Speed of vehicles of (ith) class (kmph)
T	Time duration corresponding to Ni, one hour
D	Perpendicular distance in (m) from centreline of the traffic lane to observer
α	Factor relating to absorption characteristics of the ground cover between roadway and observer (to be conservative, this is taken as O in actual modelling, but considered qualitatively in the final analysis)
δ_s:	Shielding factor for barrier (to be conservative, this is taken as O in actual modelling, but considered qualitatively in the final analysis)

The combined effect of all the vehicle categories can be determined at the receptor by adding the individual values using the following equation.

$$L_{eq\,(h,total)} = \log_{10} \sum_{h=i} 10^{Leq(hi/10)}$$

Reference Noise Levels

The vehicular noise emission levels significantly vary with vehicle speed. It is therefore necessary that speed dependency of noise emissions for various categories of vehicles is taken into account while using the model for noise prediction due to the roadway. In this work the speed-noise relations presented by National Environmental Engineering Research Institute (NEERI) in their report on Environmental and Social Assessment Delhi - NOIDA Bridge Project have been adopted (**Table- 4.4**).

Table -4.4: Speed-Noise Relationships for Various Motor Vehicles

Speed (kmph)	Cars (dB (A)	Trucks & Buses (dB (A))	2/3 Wheelers (dB (A))
30	56.0	73.0	58.0
40	59.0	76.0	61.0
50	63.0	80.0	66.0
60	68.0	81.0	68.0
70	68.0	81.5	70.0
80	70.0	82.0	72.0
90	72.0	83.0	74.0
100	74.0	83.5	76.0

Traffic Volumes and Speed

To arrive at the hourly distribution of the category-wise traffic over a day for the horizon years the ratio of category-wise hourly traffic to the daily traffic based on the 2011/2012 surveyed data of two homogeneous sections of project road was used.

- There are no major grade differences in the project area as it is generally a plain terrain and gentle slopes of 1% to 3%., and no significant effect of grade on the noise levels is anticipated;
- The traffic along the proposed section is assumed to flow simultaneously in both the lanes and in both directions;
- Noise from other sources apart from the highway is not being accounted for in the modelling; and
- The receptor is considered to be independent of the noise emitted from the adjacent stretches.

The predicted noise levels at locations of baseline monitoring have been given in **Table-4.5** below:

Table-4.5: Predicted Noise Levels During Operation Phase

S.No.	Location	Predicted Noise Levels 2017		Predicted Noise Levels 2032	
		Day	Night	Day	Night
1	Solan	6 5	54	69	58
2	Shogi	54	44	57	48
3	Dhalli	53	44	56	47

It is clear from above table that day time noise levels are exceeding the limits in the horizon year 2032. The predicted levels are well within the limits up to the horizon year 2017. A ROB cum elevated portion has been proposed from km 106.180 to 106.780at Solan. This elevated portion will bypass the inhabited portion along the road in Solan. Hence no impacts are anticipated on account of noise. Shogi and Dhalli towns are also being bypassed as part of Shogi- Shimla- Dhalli bypass. Hence noise levels will reduce after implementation of project due to reduction in traffic. All through traffic will be diverted to Bypass. No impacts on account of noise are anticipated at Shimla city as the city is being totally bypassed. Dhalli town habitation is also being bypassed hence no impacts are anticipated on account of noise.

(b) Mitigation Measures

Design Stage

A prediction of the future noise levels due to the project for 2017 and 2032 have been carried out using FHWA Model.

In order to avoid noise and air impacts most of the habitations have been bypassed. There is no educational institute within the RoW or in the immediate vicinity.

If any noise sensitive receptor is noticed in the immediate vicinity of RoW, the project design will have provision for noise barriers in the form of wall.

Construction Stage

The plants and equipment used for construction will strictly conform to CPCB noise standards. Vehicles and equipment used shall be fitted with exhaust silencers. During routine servicing operations, the effectiveness of exhaust silencers shall be checked and if found to be defective shall be replaced. The noise level from any item of plants (measured at one metre from the edge of the equipment in free field) such as compactors, rollers, front end loaders, concrete mixers, cranes, vibrators and saws shall not exceed 75 dB (A), as specified in the Environmental Protection Rules, 1986.

To protect construction workers from severe noise impacts, noise standards of industrial enterprises will be strictly enforced at construction site and construction camps and workers shall be provided with Personal Protective Equipment (PPE) such as earplugs and muffs.

Operation Stage

Predicted noise levels indicate that at rural areas noise levels will exceed the limits. Since all major habitations are being bypassed; therefore there will be no adverse impacts on human population.

4.3 BIOLOGICAL ENVIRONMENT

4.3.1 Terrestrial Flora

(a) Impacts

Roadside Plantations and Protected Reserved Forest Areas

The alignment of Solan- Shimla bypass is passing through reserved and protected forest

at few locations. The total forest area to be acquired is approximately 82 Ha comprising of 72 protects forest and 10 ha Protected forest. The principal impact on flora involves the removal of trees from the RoW. Cutting of about 6734 trees is expected due to the project. The scheduled tree species are Deodar, Ban, Kail, Khark, Tuni, Quhl, Kachnar,etc. There are no endangered species or rare species of flora and fauna in the project area.

The stage wise impact on RoW trees and road side plantation has been described in the following sections.

Pre Construction Stage

The project has direct and long-term impact on the trees within the RoW. The cutting of trees shall have manifold impact. Most visible impact is the loss of shade. Also, there is a possibility of the local people and fauna being deprived of tree products, such as wood, fruits, leaves etc. From the field data collected by the consultants, 6734 number of trees of various species as mentioned in **Chapter 3** will be cut within the ROW of the project alignment.

The micro-ecosystems supported by the trees are also a point of environmental concern. The removal of trees will not only lead to erosion, and depletion of the ground water table, but also to the loss of the micro-ecosystems developed in the project area. Since most of trees to be removed are in hilly open terrain. These carry not much significance except few. The division of forest land shall be taken up as be forest Act 1980.

Construction Stage

During construction stage no cutting of trees will be involved within the RoW, but there may be accidental cutting of trees by the construction workers for cooking of food near the construction camps. The compensatory plantation and plantation in median will also take place at the end of construction period.

Operation Stage

During operation stage there will be positive impact on flora as compensatory plantation in RoW will grow and shrubs plantation on side slopes will also mature.

(b) Mitigation Measures Terrestrial Flora

Design Stage

It 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 three trees will be planted. There is planning to plant 20202 trees as compensatory plantation. In addition to this compensatory plantation there will be plantation of shrubs in the median. Necessry permission will be obtained from the forest department to cut the scheduled trees.

Construction Stage

No trees out of RoW will be felled. The trees to be filled will be marked inside the RoW. Construction vehicles, machinery and equipment will move or be stationed in the designated area only to prevent compaction of vegetation. While operating on temporarily acquired land for traffic detours, storage, material handling or any other construction related or incidental activities, it will be ensured that the trampling of soil and damage to naturally occurring (RoW or Construction Camp) herbs and grasses will be avoided.

4.3.2 Aquatic Flora

(a) Construction Stage

There will minor adverse impact on aquatic flora near major bridge construction sites (21 minor bridges and 11 major bridges Nos.) especially at time of construction activities in riverbed.

(b) Operation Phase

The aquatic flora damaged during construction will grow after completion of activities. But

some minor impact is anticipated as river bed will have bridge abutments and these will prevent growth of flora near banks.

(c) Mitigation Measures Aquatic Flora

Construction Stage

Bridge construction is planned during lean flow periods. All waste materials will be disposed off at identified and safe locations away from the river.

Operation Phase

Mitigation measures are not needed as linear velocity at bridge location sites will not change increase more than 10 % as in most cases there will be no structure within the mid stream.

4.3.3 Terrestrial Fauna

(a) Impacts

No potential impact on fauna is envisaged due to construction of project road as it is not close to any of the area rich in wildlife. No Notified Wild Life Parks/ Bird Sanctuaries/ Wetland are located even within indirect project influence area of 10 km.

(b) Mitigation Measures

Construction Stage

All construction activities will be carried out in such a fashion that damage and disruption to fauna will be the minimum. The construction workers will be given instructions to conserve/protect natural resources and fauna, including wild animals and aquatic lives. The alignment of bypass of Shogi- Shimla - Dhalli is planned through the area used by the locals to travel from village to village.

Operation Stage

Although no impacts on fauna in operation stage are anticipated directly due to the project, certain measures shall be taken. In the operation phase a positive impact on fauna is anticipated due to enhanced tree cover in the RoW. The enhanced tree cover will provide a good nesting ground for the avi-fauna.

4.3.4 Human Use Values

Land Acquisition

The alignment of project road follows the existing in about 45 % project length and will have 2 major bypasses proposed Shogi, Shimla , Dhalli and Kandaghat.. In addition to these bypasses minor realignments have been proposed at seven locations for the geometric improvements. There will be marginal land acquisition along the RoW at proposed realignments and for bypasses there will be acquisition of land for the entire length.. The compensation for land acquisition will be made as per policy of Government of India (GoI) and National Highways Authority of India (NHAI). It is estimated that there will be acquisition of about 210 Ha which comprises of 164 Ha private land 46 Ha Government land.

Loss of Private Properties

There shall be loss of some private properties due to widening in the habitations. The compensation for losses will be paid as per policies of GoI and NHAI. The extent of losses of private properties has been elaborated in the Social Impact Assessment section of the R&R Plan. It has been estimated that about 270 structures will be demolished.

Common Properties Resources

In the RoW there will be loss of some permanent structures and human use values such as ponds, tube wells, hand pumps, wells, and religious structures. The compensation will be paid to the owners as per provisions in the R&R Plan. The religious structures will be relocated before start of construction with rituals and in consultation with locals. The resettlement action plan of the project being separately taken up will have more

elaborations on these aspects. The loss of common property resources, private and permanent structures has been summarised below in **Table 4.6:**

Table - 4.6: Loss of Private Properties and Common Property Resources

S. No.	Common Property Resource/Structure	Numbers
1	Hand pump	Nil
2	Tube Wells	Nil
3	Pond	Nil
4	Canal	Nil
5	Temporary Structures (including boundary walls)	52
6	Permanent Structures	270
7	Mazars and Samadhis	Nil
8	Religious Structures	07
9	Hospitals and Dispensaries	Nil

Change in land use

The development due to the Project will induce a change in the land use along the alignment. Change in land use will be sparked off as a result of land speculation. The NH 22 (Solan-Shimla Section) once constructed will be the magnet for commercial and residential development. The commercial development will be mainly related tourism such as resorts/hotels/restraints and trading hubs for fruits. This will improve economic conditions of people.

Land Speculation

Better connectivity will also mean that the value of properties adjacent to project road will rise almost overnight. The lure of business from road users is usually the main magnet.

Cropping Pattern and Crop Productivity

The proposed project is likely to bring in its wake, new townships, commercial and trading developments and changes in land use. This translates into change of land currently under agriculture to more commercial and industrial use. It is envisaged that due to this proposed change, the crop productivity in the agricultural belt immediately adjoining the RoW shall decrease. This impact is envisaged only to be valid for the agricultural land adjacent to the RoW. Although the spatial impact is likely to be insignificant, the impact will be irreversible in nature. Cropping pattern after development of road will change as farmers will switch over to cash crops as there will be availability of fast transport system to urban areas.

Exploitation of Resource base

Development of a road in areas previously not easily accessible can work like a double-edged sword for the environmental resources in the area. While the road would unlock potential value in the area, stimulate growth and make the environment hospitable, at the same time, the rapid depletion of natural resources is also possible.

Development of such vital infrastructure will lead to over exploitation of the environmental resources (stone crushing, cutting of trees from the waste land, indiscriminate disposal of waste in the streams, etc.). While the medium term impacts may not be large enough to be noticed, the long-term implications of such depletion are potentially disastrous.

4.3.5 Consumption of Natural Resources

The proposed NH-22 works for Shimla- Solan section envisage the use of significant quantities of the earth, stone and grit and sand along with bitumen. The quantities required for the project are as under:

Earthwork (Cum)	:	2098230.00
GSB (Cum)	:	76537.00
WMM (cum)		**152521.00**
DBM (cum)		**54732.00**
Sand (Cum)		55657.00
BC (Cum)	:	25879.00

4.4 SAFETY

(a) Impacts

The concern for safety stems from the proposals for faster vehicular movement along the Solan- Shimla section of NH-22. Though speedy travel is one of the objectives of the project, it also increases the intensity of loss of life in case of an accident.

(b) Mitigation Measures

Design Stage

Safety of road users as well as of the vehicles plying on the NH 22 (Solan- Shimla Section) is given highest importance and adequate measures have been incorporated in the design of the alignment. The design incorporates road side amenities, properly designed curve and slope, crash barriers and / or steel Beam Guardrails, and signages as per IRC specifications. These will be installed at outer edge of shoulder on either side. The list of ROB, elevated portion , Toll Plaza, bus bays, truck lay byes, and other structures proposed in NH 22(Solan- Shimla section) are as under**.**

Structure	Existing (Nos.)	Proposed (Nos.)
Major Bridges	0	11
Minor Bridges	3	08
Culverts	185	256 (140 New, 27 Reconstruction and widening and balance 89 will be retained)
Flyover cum RoB	Nil	021
Vehicular Underpasses	Nil	Nil
Pedestrian/Cattle Underpasses	Nil	Nil
ROB	Nil	1
Bus Bays	1	15
Bus Stops	4	Nil
Toll Plaza	Nil	1
Truck Lay byes	Nil	2

Construction Stage

Construction activities cause hindrance to traffic movement and are also hazardous for the traffic. Traffic management plans shall be prepared and temporary diversion routes will be identified to divert traffic from construction locations specially at the intersections, bridge and culvert sites etc. Signboards indicating construction sites on the road and flags shall be erected. All the signboards giving caution, barricades for diverting the traffic shall be as per MoRTH specifications.

Operation Stage

All safety measures erected at time of construction will be maintained properly. There will be special attention to the signages.

4.5 HISTORICAL, ARCHAEOLOGICAL AND CULTURAL SITES / PLACES

4.5.1 Construction Phase

(a) Impacts

There is no archaeological site/protected monument location that falls under the project influence area and within 10 km radius of proposed alignment. Hence no adverse impact is anticipated. However, UNESCO World heritage rail line from Kalka to Shimla is running very close and parallel to project road from start of project road (km 106.000) to start of Shogi-Shimla-Dhalli bypass (km 131.150). The construction related activities such as hill cutting may have adverse impact on this World Heritage line.

(b) Mitigation Measures

Since no impacts are identified, therefore, no mitigation measures are warranted. At start point where project road is crossing Kalaka – Shimla rail line elevated road cum ROB has been proposed. The length of this ROB cum elevated portion is 599.376 m. In the balance portion, widening has not been planned towards the rail line side. It has been planned on the other side.

4.5.2 Operation Phase

(a) Impacts

No adverse impact on archaeological, historical and cultural sites is anticipated due to vehicular emissions and other activities of NH 22 in Solan – Shimla section.. A positive impact due to improved connectivity is anticipated.

(b) Mitigation

No mitigation measures are needed in the light of explanation given under impacts subsection.

4.6 Tunnels

4 tunnels are proposed on Kandaghat & Shogi - Shimla - Dhalli bypass at km 117.600 to 118.060, km 135.930 to 137.160 and km 156.350 to 156.450. The construction of those tunnels will have following impact and mitigation measures.

4.6.1 Impacts

(a) Pre construction

Twin tunnels have been planned to minimize heal cutting and acquisition of land. These twin tunnels precisions are to save deodar trees near Masobara Junction and acquisition of forest land.

(b) Construction stage

During construction, stage impacts will be due to creation of tunnel. This will produce some muck. This muck if not disposed off properly will have impact on vegetation and trees in surroundings. The drainage at tunnel site if not provided properly will have impact on surroundings as waste water will get accumulated. The blast for rock cutting will produce noise. This will have impact on surroundings.

(c) Operation stage

During operation, stage impacts will be felt in traffic movements of there is no proper lighting and drainage in the tunnels. The poor light will have visibility hazards. The noise and vibration issues during traffic movement may be felt if there is no proper design and mitigations.

4.6.2 Mitigation Measures

(a) Pre construction

The planned tunnel at Masobra Junction (km 135.930 to 137.160) has saved around 60,000 Deodar trees which are move those 100 years old. The tunnels have also saved

additional acquisition of 30-35 Ha of reserved forest land. Hence proposal of construction of tunnel will have positive impact on environment.

(b) Construction

A muck generated will be utilised in the project work for filling area to the extent possible. The balance muck will be disposed off at identified dump site. This dump site will be in identified by the Independent contractor and approved by the Independent Engineer. The dump site after filling will be realigned. Adequate lighting system will be provided. Both twin tunnels are <1.5 km in length and these are normal tunnels. The drain system will be provided on either side of carriageway and it will be connected to road drainage system.

(c) Operation stage

The concessionaire will ensure that lighting system works properly during operation. The side drains will be kept clean for quick and effective drainage.

The twin tunnel systems proposed at both locations will ensure no excessive noise and vibration. The noise and vibration will be increased during the operation phase. In case access noise is felt traffic will be regulated in tunnel area.

4.7 ACCIDENTS INVOLVING HAZARDOUS MATERIALS

(a) Impacts during Pre Construction and Construction stage

The storage of the inflammable and toxic materials may result in accidents during construction phase. There will be storage of explosive at crusher site for rock blasting and cutting. Accident may result due to improper handling of explosive (s) at crusher site (s).

Impacts During operation Phase

During operation, phase impact will be due to accidental spillage of hazardous and toxic materials from a tanker of transporting this material. This, accidental spillage may occur due to vehicles overturning or due to vehicle collision specially at curves.

(b) Mitigation Measures

Pre Construction and Construction Stage

During pre construction and construction stage the storage of hazardous materials will be after obtaining permissions/ license from Chief Controller of Explosive, Nagpur. Necessary precautions as stipulated in conditions of license will be enforced. The contractor will prepare an onsite emergency plan for construction site, construction camp and crusher site. This plan will be reviewed and approved by Independent Engineer.

Operation Stage

Accidents involving hazardous chemicals will generally be catastrophic to the environment, though the probability of occurrence is low. Prevention of an accident involving hazardous material is a better way of minimising the impacts. The provisions mandated by 'The Hazardous Wastes (Management and Handling) rules, 1989' and “Manufacture Storage and Import of Hazardous Chemicals Rules” 1989 under the Environmental (Protection) Act, 1986 will be complied with. Vehicles delivering hazardous substances will be printed with appropriate warning signs.

In case of spillage due to vehicle collision, the report to relevant departments will be made. This incident will be brought under control as per disaster management plan prepared for operation phase.

4.8 CULTURAL PROPERTIES

(a) Impacts

Other cultural properties include religious structures(Temple, Mosque, Church,Mazars and Samadhis). No religious structure has been found within the proposed RoW of project road. However, in the event of discovery of any religious structure during project implementation, the structure will be appropriately relocated / reconstructed in consultation

with the local community.

Loss/ Disruption of Access/ Cultural Properties

Pre Construction

One of the impacts of project road widening and construction of Shogi- Shimla-Dhalli bypass and Kandaghat bypass is interrupted access to the cultural properties on eitherside of RoW. There are chances that users of the cultural property may face difficulty in accessing the property during the period of pre-construction.

Construction Stage

Loss of access is likely to be severe during the construction period, due to movement of construction machinery, construction equipment setting up of borrow areas, setting up of construction camps etc.

Operation Stage

During operation phase access to cultural properties will be minimal as proper signage and facility planned for crossing will ensure no inconvenience to the locals.

(b) Mitigation Measures

Design Stage

Alignment has been worked out to minimise impacts on cultural/religious properties along the corridor. As part of signages crossing locations will be marked.

Construction Stage

All necessary and adequate care will be taken to minimize impacts on cultural properties close to RoW which includes cultural sites and remains, places of worship including religious structures, mentioned above.. The contractor shall ensure that no construction activities will spill over to these property's premises and precincts.

Access to cultural properties on either side of RoW such properties from the road shall be maintained clear and clean.

4.9 SOCIO - ECONOMIC ENVIRONMENT

4.9.1 Project Affected Displaced Population

As mentioned earlier there will be acquisition of land to the extent of 210 Hectares (approx). Major portion (about 95%) of this unproductive waste land.This land acquisition will have impact on socio-economic conditions of project affected persons. The project affected persons are being identified during land acquisition. Resettlement & Rehabilitation Plan has been prepared for the project affected and displaced families under separate cover.

Impact due to Construction of Embankment

The other major social impact identified due to project is loss of access to agricultural fields and habitations on eitherside of the alignment. In many instances there will be defragmentation of agricultural fields of the same landowner. This will cause inconvenience to the locals.

4.9.2 Positive Impacts on Socio- Economic Environment

The positive social impact due to project will be faster connectivity to major urban centers of the country, generation of huge employment during construction, and fast economic development in the post construction phase. There will be availability of improved infrastructure facilities.

Mitigation Measures

The compensation to project affected persons will be paid as per the provisions in the National Rehabilitation and Resettlement Policy 2006 (NPRR) of Government of India or a better compensation adopted by the National Highways Authority of India.

4.9.3 Positive Impact on Quality of Life (QOL)

The project will improve quality of life of public living around project road markedly due to availability of huge employment potential (growth of residential townships and industrial sector) and improved and fast connectivity. The QOL/HDI coefficients indicated in previous chapter will have significant increments during construction and operation phases.

4.9.4 Health

The adverse impact on health of public living near RoW of the project is not anticipated during construction phase as construction activities will be within RoW and RoW has been kept sufficiently away from habitations. The mitigations measures stipulated in previous sections will be implemented as part of EMP to avoid any adverse impact due to movements of construction machinery and vehicles on haul roads. In operation phase there will be positive impact on health of public as project will relieve traffic congestion in Solan,Shogi, Kandaghat and Shimla. Accessibility to health facilities will improve through project road especially to those villages which are located close to Kandaghat Bypass and Shogi- Shimla-Dhalli bypass alignment.

4.10 WASTE LOAD (SOLID WASTE) LIKELY TO BE GENERATED

(a) Construction Phase

The waste load (waste material) will be generated during construction phase due to maintenance of vehicles and construction machinery, spillage of construction material and discarded low grade material at construction camps. Out of all these waste lubricant oil generated due to regular vehicle maintenance will be about 2500 litres per year. The project is likely to be divided into two packages for the ease of construction. This oil is hazardous waste as per provisions of manufactures storage and Import of Hazardous Chemical Rules, 1989. The other wastes generated will be non hazardous in nature. The quantum of waste load generation in entire construction phase will be around 0.5% of total construction material handled. This is based on current project under implementation in the country. In case of NH 22 (Solan- Shimla Section), total usage of construction materials is estimated to be 2.44×10^6 m3. Hence total waste generation (non hazardous in nature) is likely to be 0.12 million m3 (approx). This material will be recyclable for land filling or low lying area filling.

(b) During Operation Phase

During operation no significant generation of solid waste is likely except due to vehicular accidents and domestic waste at toll plaza. This generation will be between not exceed 2 to 3tonnes per year. This will be dumped to nearest municipal land fill site available.

4.11 ENVIRONMENTAL IMPACT ASSESSMENT STATEMENT (EIS)

The environmental impacts and mitigation measures have been described in previous sections due to construction and operation of Solan- Shimla section of NH-22. In order to appreciate the 'project scenario', 'no project scenario', impacts the Environmental Impact Statement has been prepared and given in **Table – 4.7.** This table also gives nature of impacts due to project on various components of environment. The impacts have been evaluated on a scale of minus 10 (-10) (for adverse impact) to plus 10 (+10) (for most positive impact) with and without EMP. This evaluation has been given in **Table – 4.8.**

Table – 4.7: Environmental Impact Statement (EIS)

Environmental Parameter	Impact Without Project Road Widening	Additional Impact Attributable to Implementation of Project Road	Nature of Impact due to Project	Mitigation Measures
A: During Pre Construction and Construction				
1. Topography	None	▪ Impacts within RoW as main carriageway and service roads are at about 1.5 m. impacts more visible at locations of bypass. Slight adverse impact at location of borrow areas	Permanent	▪ Borrow areas will be operated as per clause no 305.2-2 of specification of Road and Bridge work of MoRTH. The carriageway and service roads will not be pinching to eyes.
2. Geology	None	▪ 229058 m3 of Aggregates will be used from quarries.	Permanent	▪ Only licensed quarries planned to be used These are at Panchkula in Haryana.
3. Physiography	None	▪ No significant change in physiography as road already exists. Some visible effect Shogi-Shimla-Dhalli bypass.	Permanent	▪ Visual impact will be pleasing to eyes
4.Soil Erosion	None	▪ The side slopes and hill face exposed are prone to soil erosion. Slopes of borrow areas also prone to soil erosion.	Temporary	▪ Side slopes of roads and borrow areas will be maintained and properly compacted. Necessary protection measures in the form of breast wall and retaining wall planned.
5. Compaction Soil	None	▪ Limited in RoW and at construction camps ▪ Compaction of soil at camp sites not significant as strata is rocky due to hilly terrain.	Permanent	▪ Construction camps sites will be reinstated to original form after construction and compaction is a requirement in RoW for road construction.
6. Contamination of Soil	None	▪ At location of construction camps due to storage of construction materials and construction vehicle construction machinery maintenance	Temporary	▪ Oil-Water Separators Planned at camp site ▪ Spilled and left over construction materials will be reused in construction works

Environmental Parameter	Impact Without Project Road Widening	Additional Impact Attributable to Implementation of Project Road	Nature of Impact due to Project	Mitigation Measures
7. Loss of Productive Top soil	None	▪ Loss of productive soil in RoW and at locations of construction camps, workers' camp	Permanent	▪ Productive top soil of RoW will be stored and will be utilized during turfing of embankment. Borrow area and camps will be planned in waste land as far as possible.
8. Borrow Pits	None	▪ Adequate number of borrow pits have been identified in entire length. Loss of productive soils stagnant pools and health hazards identified impacts.	Permanent	▪ Borrow areas planned at waste lands as far as possible ▪ Will be operated as per MoRTH guidelines.
9. Quarries	Construction materials usage for other construction works.	▪ Slight additional impact on the licensed quarries to meet requirements of project road	Permanent	▪ Only licensed quarries planned to be used. These have adequate quantifies of material to meet project requirements.
10. Land Use	No change	▪ Land use of RoW will change permanently.	Permanent in RoW and Temporary at camp sites	▪ Alignments of bypasses have been avoided thorough agriculture land as far as possible ▪ Construction camp will be planned at waste land as far as possible
11. Meteorology	No change	▪ Temporary adverse impact due to cutting of Trees and vegetation from RoW of project road	Temporary	▪ Only trees from RoW will be cut. ▪ Compensatory afforestation planned
12. Ambient Air Quality	No Change	▪ Dust generation and gaseous pollutants emissions from camp sites, construction sites, quarries and borrow areas locations	Temporary	▪ Regular water spray at dust generation point.
13. Drainage	No Impact	▪ Impact on natural drainage due to construction of embankment	Temporary	▪ Adequate cross drainage structures planned

Environmental Parameter	Impact Without Project Road Widening	Additional Impact Attributable to Implementation of Project Road	Nature of Impact due to Project	Mitigation Measures
		▪ Impact on natural flow of rivers and streams at locations of bridge construction		▪ Construction of bridges planned in lean flow period.
14. Loss of water bodies and Ground water sources	None	▪ No impact on ground water and no loss of water bodies		▪ Any water source found during project implementation will be relocated first before dismantling.
15. Impact on surface water quality	None	▪ Increased sediment due to construction materials spillage in water body ▪ Waste discharges from camps and construction sites in water courses.	Temporary	▪ Silt fencing arrangements planned near water courses ▪ No construction and domestic waste planned to be disposed off in water courses.
17. Flood Hazards	None	▪ There will be no impact on flooding potential in the area.	Permanent	▪ Adequate measures planned so that no flooding at bridge location sites ▪ Regular maintenance of approaches of bridges.
18. Hydrology	None	▪ Impacts on ground and surface water hydrology almost nil.	Permanent	▪ Adequate cross drainage structures
19. Noise	None	▪ Increase in noise due to construction activities	Temporary	▪ No Noise constructions activities in Night near habitations.
20. Flora	None	▪ About 6734 tress to be cut	Permanent	▪ Compensatory plantation planned in 1:3 ratio ▪ The scheduled trees will be cut after permission from forest department.
21. Fauna	None	▪ No potential impact anticipated as no wild life park or bird sanctuary located within 10 km radius of RoW of project road	Temporary	▪ Workers will be trained not to hunt animals

Environmental Parameter	Impact Without Project Road Widening	Additional Impact Attributable to Implementation of Project Road	Nature of Impact due to Project	Mitigation Measures
		▪ Workers may hunt animals		
22. Aquatic Ecology of Samri Nallah, Kair Ka nallah, Kalali ka nalla and Kathuku ka Nallh	None	▪ Short term impacts at locations of bridge construction	Temporary	▪ Construction planned in lean flow season ▪ Adequate waterway planned bridge design
23. consumption of Natural Resources	None	▪ Requirement of 2.1 million m3 earthwork, 0.22 million m3 of stone and aggregates	Permanent	▪ Enough quantities available at Government approved quarry sites
24. Archaeologically Protected Monument	None	▪ No archeologically protected monuments located in RoW ▪ World famous Kalka – Shimla rail line close to alignment from start point to Start of Shogi-Shimla-Dhalli bypass	-	▪ No Mitigations warranted ▪ No widening planned towards Kalka-Shimla UNESCO Heritage rail line ▪ ROB cum elevated portion planned at Solan ▪ Clearance will be obtained from Department of Archaeology.
25. Cultural Properties	None	▪ No cultural property is falling within the RoW of project road	-	▪ No Mitigations warranted
26. Project Affected Persons (PAPs)	None	▪ Detailed Survey is being done to identified PAPs	Permanent	▪ Adequate compensations planned as per policy of National Highways Authority of India (NHAI)
27. Positive Social Impacts	None	▪ Employment Potential during construction locals	Temporary	▪ Locals will be benefited immensely ▪ Employment portion will be enormous for locals.
B: Operation Stage				

Environmental Parameter	Impact Without Project Road Widening	Additional Impact Attributable to Implementation of Project Road	Nature of Impact due to Project	Mitigation Measures
1. Topography	Not Applicable	▪ Positive impacts due to construction of Roads ▪ Impact due to break in embankment	Permanent	▪ No Mitigation warranted
2. Geology	None	▪ None	Not Applicable	▪ No Mitigation measures are warranted
3. Physiography	-	▪ No Impact	Not Applicable	▪ -
4. Soil Erosion	-	▪ Soil Erosion possible at approaches of bridges in the initial years of operation	Intermittent during monsoon	▪ Breast wall, retaining wall and side slopes will be regularly maintained
5. Compaction of Soil	-	▪ No impact	-	▪ -
6. Contamination of Soil	-	▪ Accidental spills of soil on pavement may cause soil erosion	Intermittent and Rare	▪ It will be recorded as per DMP
7. Loss of Productive Soil	-	▪ No Impact identified	-	-
8. Borrow Pits	-	▪ Properly rehabilitated areas will have positive impacts	-	-
9. Quarries	None	▪ No impact during operation phase		-
10. Land use	None	▪ Include changes in land use	-	▪ Positive impact on local economy ▪ Employment generation potential
11. Meteorology	None	▪ In initial years due to non growth of vegetation /trees increased temperature will be felt	Temporary	▪ Compensatory plantation planned. This plantation will grow in first three years and then problem will be subsided.
132. Ambient Air Quality	None	▪ Declaration of air quality due to vehicular emissions. Predicted values of ambient air quality within limits up to the end of project life.	Permanent	▪ Compensatory plantation planned
13. Drainage	None	▪ Increased run off due to pavement		▪ Efficient and adequate numbers of cross

Environmental Parameter	Impact Without Project Road Widening	Additional Impact Attributable to Implementation of Project Road	Nature of Impact due to Project	Mitigation Measures
		construction ▪ Flooding may result if cross drainage structures are not maintained properly		drainage structures planned. ▪ All cross drainage structures will be cleaned prior to monsoon to avoid flooding.
15. Loss of water bodies and ground water sources	None	▪ No Impact	-	▪ Positive impact on public and lost sources will be relocated during construction phase
16. Impact on Surface Water Quality	None	▪ Impact on water quality due to accidental spills of toxic /hazardous materials especially near bridge site.	Intermittent	▪ Risk assessment to be carried out by the concessionaire for accidental spills and disaster management plan will be activated.
17. Flood Hazards	None	▪ No impacts as adequate waterways have been planned.	Permanent	
18. Hydrology	None	▪ No impact	-	-
19. Noise	None	▪ Increase in noise levels in project influence area due to vehicular traffic ▪ Predicted noise levels will be within limits till end of project life	Permanent	▪ Shrubs and compensatory plantation planned will attenuate noise levels. All major habitations bypassed. .
20. Flora	None	▪ Positive impacts on flora as three times compensatory plantation planned ▪ Shrubs are also planned in the median	Permanent	▪ Positive impact
21. Fauna	None	▪ Minor adverse impact on fauna in surroundings of project road due to vehicular Traffic.	Permanent	▪ Compensatory plantation planned in available space in RoW
22. Aquatic Ecology of	None	▪ No Impact on aquatic ecology of streams as water way will not be constricted.	-	-

Environmental Parameter	Impact Without Project Road Widening	Additional Impact Attributable to Implementation of Project Road	Nature of Impact due to Project	Mitigation Measures
River Shiv Nath				
23. Consumption of Natural Resources	None	▪ No Impact	-	-
24. Archeologically Protected Monuments	None	▪ No Impact as no archeologically protected monument is located within 3km radius of RoW.	-	-
25. Cultural Properties	None	▪ No impact as no cultural property is falling within the RoW	-	-
26. Project Affected Persons (PAPs)	None	▪ A Positive impact as all PAPs will be rehabilitated Properly	Permanent	▪ PAPs will get compensation as per R and R Policy of National Highways Authority of India
27. Positive Social Impact	None	▪ Quality of life of public in surroundings of project road will improve markedly. ▪ A quick transportation of agriculture produce to agriculture markets will improve overall economy of the area	Permanent	▪ Overall economy of state will improve. ▪ Industrialization will be at faster pace ▪ Employment opportunities will be enormous

Table- 4.8: Evaluation of Impact with Mitigation and without Mitigation Measures

S .No	Environmental Parameters	Impact Attributable due to Project without EMP	Impact Attributable Due to Project with EMP
A. During Construction Phase			
1	Topography	-5	+2
2	Geology	-8	0
3	Physiography	-6	-2
4	Soil Erosion	-10	-1
5	Compaction of Soil	-6	-1
6	Contamination of Soil	-5	-1
7	Loss of Productive Soil	-10	0
8	Borrow Pits	-10	0
9	Usage of Fly Ash for Embankment	-3	0
10	Quarries	-6	-2
11	Land Use	-8	-2
12	Meteorology	-2	-2
13	Ambient Air Quality	-10	-6
14	Drainage	-10	0
15	Loss of Water Bodies and Ground Water Sources	-10	-2
16	Surface Water Quality	-6	
17	Flood Hazard	-8	-4
18	Hydrology	-6	-2
19	Noise	-6	-2
20	Flora	-8	-6
21	Fauna	-6	-2
22	Aquatic Ecology of River Ganga and Tributaries	-10	-4
23	Construction of Natural Resources	-6	-2
24	Archaeologically Protected Monument	0	0
25	Cultural Properties	0	0
26	Project Affected Persons	-6	0
27	Positive Social Impact	-2	+6
	Over all score	**-173**	**-33**
B. Operation Phase			
1	Topography	-1	+2
2	Geology	0	0
3	Physiography	0	0
4	Soil Erosion	-3	0
5	Compaction of Soil	0	0
6	Contamination of Soil	-8	-1

S .No	Environmental Parameters	Impact Attributable due to Project without EMP	Impact Attributable Due to Project with EMP
7	Loss of Productive Soil	0	0
8	Borrow Pits	0	0
9	Usage of Fly Ash for Embankment	0	0
10	Quarries	0	0
11	Land Use	0	0
12	Meteorology	-5	+5
13	Ambient Air Quality	-8	-2
14	Drainage	-6	0
15	Loss of Water Bodies and Ground Water Sources	0	0
16	Surface Water Quality	-4	0
17	Flood Hazard	-6	+2
18	Hydrology	-1	0
19	Noise	-8	-2
20	Flora	-8	-2
21	Fauna	-6	-1
22	Aquatic Ecology of River Ganga and Tributaries	-8	-4
23	Construction of Natural Resources	0	0
24	Archaeologically Protected Monument	0	+2
25	Cultural Properties	0	0
26	Project Affected Persons	0	0
27	Positive Social Impact	+2	+10
Overall Score		**-70**	**+7**

Note: *-10 to -6 -> Significant Negative Impact*
- 6 to - 2 -> Moderate Negative Impact
-2 to 0 -> Insignificant Negative Impact
0 to 2 -> Moderate Positive Impact
2 to 10 -> Significant Positive Impact

It is clear from the table that slight adverse impact will be there during construction phase even with implementation of all mitigation measures. These will be to acceptable and manageable levels. During operation phase, a positive impact due to project has been found due to immense socio-economic benefits of the project. The project will bring overall boost to economy in the State.

CHAPTER - 5
ANALYSIS OF ALTERNATIVES

CHAPTER - 5
ANALYSIS OF ALTERNATIVES

5.1. PREAMBLE

This chapter discusses the analysis of alternatives that have been considered for the four laning of Solan - Shimla section of NH-22. It also includes a discussion on the **"With**" and "**Without"** project scenario. The methodology that has been adopted for the evaluation of the alternate alignment route for construction of the highway and the selection of bypass alignments based on engineering, economic, environmental and social considerations have been highlighted. The minimisation of environmental impacts by considering design alternatives determines the extent of mainstreaming of the environmental component. An evaluation of the various alignment options has been done for arriving at the most promising alignment for the highway and the bypasses. This chapter looks at the decisions made during the project when alternatives were available and describes the rationale behind each decision. The EIA study with EMP and without EMP has also been discussed in the context of 4 laning of Solan- Shimla section of NH-22.

5.2. "WITH" AND "WITHOUT" PROJECT SCENARIO

Solan and Shimla are two important cities of Himachal Pradesh. Shimla is the capital city of Himachal Pradesh. The National Highway -22 (NH-22) connects these both cities. This highway has importance because it provides connectivity to Kalka, Chandigarh and Ambala. It is a popular tourist destination route. This project road carries a significant heavy traffic to and from industries, local fruits and vegetables transport and supply of essentials to these cities from the plain land. There is thus an immediate necessity to widen the existing road to enhance the economic capability of the area as well as complementing the NHDP that seeks to connect high-traffic density stretches, state capitals and tourism centres. The **'With' and 'without'** project scenarios are analysed with this backdrop of requirement of reliable quality infrastructure for sustained growth of State's economy and consequent well-being of its citizens.

The project will have multiple benefits. It will reduce the travel time substantially between Solan and Shimla, the two primate cities of Himachal Pradesh. In addition the improved road will provide other benefits like

- Fast and safe connectivity resulting in savings in fuel, travel time and total transportation cost to society;
- Employment opportunity to people;
- Development of local industry, agriculture and handicrafts;
- Development of tourism and pilgrimage;
- Transporting processing and marketing of agricultural products;
- Reduction in accidents;
- Reduction in pollution;
- Opening up of opportunities for new occupations;
- Better approach to Medical & Educational services and quick transportation of perishable goods like fruits , vegetables and dairy products; and
- Improved quality of life for people and so on.

The details of road cross sections have already been discussed in **Chapter – 2**.

Therefore, "With" project scenario, with its minor adverse impacts is more acceptable than the "Without" project scenario which would mean an aggravation of the existing problems. The potential benefits of the proposed road improvements are substantial and far-reaching both in terms of the geographical spread and time. Hence, it is clear that the

implementation of the project will be a definite advantage to Himachal Pradesh in order to achieve all-round development of its economy and progress for its people.

5.3. ALIGNMENT FINALISATION

The proposed improvement to Solan - Shimla section of NH-22 consists of 4 laning of the carriageway from existing two lanes. Elevated portion cum RoB has been proposed in the initial portion to cross the Kalka- Shimla UNESCO declared heritage rail line. The proposed improvements also include geometrics and curves, providing service road at selected built-up areas, adequate number of cross drainage structures, line drains all along hill side. There are few locations, where because of poor geometry or restricted land width a bypass or realignment is proposed. The proposed alignment with improvement measures was examined on the basis of environmental attributes such as trees, forests, topography. flood and water logging prone areas, water bodies , soil erosion, wildlife park and sanctuaries, presence of endangered species, archaeological/historical monuments and religious structures etc.

Environmental attributes /parameters have been identified within 10 km on either side of the alignment of Solan- Shimla section of NH-22 by carrying out reconnaissance survey and recording observations. Based on these inputs the alignment has been finalised at site. The pertinent attributes are as under:

Table - 5.1: Environmental Parameters and Observations

Environmental Parameters	Recording of observations
Reserved/ Protected Forests	The project road passes through protected/reserved forest at few locations.
Project road alignment near river flood zone wet land, lakes, etc.	Project Road is crossing Few Nallas. Only one Nalla named Samri is perennial. No lakes or wet land along project road alignment. .
Significant groups of trees and orchards near the RoW and density of trees.	Predominant tree species that generally occur within the proposed RoW are Deodar, pine, Kail, Chill, Khark, Quhl, Kachnar, etc. The shrubs seen in study area are *Thor (Euphorbia royleana), Phil lark (Lantana camara), Karunda (Carissa apica), Ghandela (Murraya koenigii and kuri (Nyctanthes arortristis).* The grasses seen are *Makora (Heteropogon montanus), Bubba (Cynodon dactylon), Dhaulu (Chrysopogon montanus), and Labb (Cympogon martinii)* There are no endangered species of flora in the RoW. , The alignment of does not pass through orchards. Dense plantation and giant trees in the RoW have been avoided while finalizing the widening schedule. The tunnels have been proposed to avoid forest land acquisition.
Historic structures, monuments and cultural heritage structures	The alignment avoids all cultural and heritage sites.
Settlements (towns and villages) and market places	About 16 nos. habitations of various sizes are nearby to the right of way. Bypasses are proposed to avoid the major settlements and markets of Shogi, Shimla, Dhalli and Kandaghat.
Wetlands close to RoW	The alignment does not cross any major river. No wet land is present close to the project road. The alignment crosses only three land drains.

Environmental Parameters	Recording of observations
Flora , Fauna and other endangered species	No endangered species of flora and fauna within the project right of way.
Bird sanctuary, Wild life sanctuary and endangered areas	No bird sanctuary or wild life sanctuary within 10 km of the alignment.
River , canal crossings	The alignment crosses the local streams namely Kathulu Ka nallah, Kail Ka Nalla, Samri Nalla and Kalali Ka Nalla.

The information on the above was collected during the course of reconnaissance survey and at the time of baseline data collection for EIA study. This data has been instrumental in deciding the alignment of project road section from Solan to Shimla.

Characteristics of proposed Mitigation measures for Project affected settlements are discussed in detailed in the **Table 5.2** below**.**

Table-5.2: Project Mitigation Measures for Project Affected Settlements

Stretch (Km)	LHS/ RHS	Location	Nature and extent of problem	Mitigation Measures
109.000 to 109.480	RHS	Habitated area	▪ Habitation on right side ▪ Poor Geometrics	▪ Realignment proposed from left side
110.720 to 111.000	RHS	Habitation	▪ Habitated area and IRC Non conforming geometry	▪ A realignment proposed to left side
112.430 to 112.800	LHS	Habitation	▪ Habitated area and IRC Non conforming geometry	▪ A realignment proposed to right side
115.000 to 118.700	Both	Kandagha t Town	▪ Habituated area of Kandaghat town on both sides and IRC conforming geometry.	▪ Bypass Proposed
120.220 to 120.635	RHS	Habitated area	▪ Habitated area and IRC Non conforming geometry	▪ Realignment proposed on LHS
121.060 to 121.430	RHS	Habitated area	▪ Habitated area and IRC Non conforming geometry	▪ Realignment proposed on LHS
123.075 to 123.650	RHS	Habituate d area	▪ Habitated area and IRC Non conforming geometry on RHS	▪ Realignment proposed on LHS
128.725 to 129.390	RHS	Habitated area	▪ Habitated area, Railway station and IRC Non conforming geometry on RHS	▪ Realignment proposed on LHS

5.4 Bypasses

The need for bypass around the congested towns along the project road was identified in consultation with the PD, NHAI, S.E., PWD, and other stake holders and also considering the quantum of development with in the towns. These identified towns are Kandaghat, and Shogi-Shimla- Dhalli. The existing road from Shogi to Shimla is dotted by habitations such as Tara Devi, Kacchi Ghati, Tulkand Fagi and Lalpani, Vikas nagar and Kasumpti, Pantha ghati, Malyana, Mehli, Shanan Housing Board Colony, Ranjeet nagar and Dhalli. Imrovement and widening in these localities is not possible due to massive R&R problem. Hence a combined bypass for Shogi – Shimla and Dhalli has been proposed.

5.4.1 Kandaghat Bypass

Kandaghat town is located between the chainages 115.000 to 118.700. The houses are located on both sides**.** Three options were explored. The description of the each of the option is clearly outlined in the following table**.** After comparing all the options, Option1 has been recommended.

Table-5.3: Comparison of Alignment Options – Raipur Bypass

Option No.	Description	Disadvantages
1	Starting at the km 115.200 and ending at km 118.700 on left	The left side option is not feasible due to deep valley Kalka-Shimla rail line Kandaghat Station and Habitation.
2	Widening along the existing road	The enough RoW is not available. There will be massive demolition of residential and commercial structures.
3	Starting at the km 115.200 and ending at km 118.700 on right	This option is most suited as vacant land and terrain suiting for road construction is available.

Based on considerations of all facts indicated above Option-3 has been found to be feasible.

5.4.2 Shogi- Shimla – Dhalli Bypass

The project road from Shogi Dhalli by Shimla passes through many congested habitations such as Tutikandi, Fagli, and Lalpani, Khalini, New Shimla, Vikas nagar, Kasumpti, Panthaghati, Mehli, Malyana, Shanan Housing Board colony, Jawahar Colony, Bhata kufer, Ranjeet nagar and Dhalli. The three options explored were widening along the existing alignment , a bypass from right side before Shogi town and ending after Dhalli, and a bypass on left side starting before Shogi and ending at Dhalli. After comparing the two options, **Option-1** has been recommended.

Table-5.4: Comparison of Alignment Options – Charoda Dharshiva Bypass

Option No.	Description	Disadvantages
1	Starting at Km 131.150 and ending at km 156.000. on right side	None, as terrain is suitable for road construction and appreciable Government land is available. The villages are also not much this side.
2	Starting at Km 131.150 and ending at km 156.000. on Left side	Because of habitations on left side, this option would have resulted in more length and high cost. Kalka-Shimla rail line is also on this side this would have resulted in huge cost due to RoB. The valley towards left side is deep and steep. Hence this

Option No.	Description	Disadvantages
		option was not feasible from engineering considerations.
3	Widening along the existing Road	This option is not possible due large settlements all along the project road. This will result in huge demolition of houses and structure. This option was rejected by the authorities and locals.

5.5 EIA WITHOUT EMP

The Environment Impact Assessment without Environment Management Plan (EMP) will not be complete. The coverage for project will be limited to establishment of baseline scenario and extent of impacts due to project implementation. This study will not be useful in the context of the present project as Environmental Impact Assessment Notification 2006 stipulates the requirement of EMP.

The EMP is an approach and management tool to mitigate the adverse impacts of project during construction and operation phase and hence help in reducing the inconvenience to the affected people around the proposed project. Environmental Management Plan suggests the environmental measures to monitor mitigate and manage the adverse impacts of the project on the components of valued ecosystem. If a project is implemented without EMP it will be environmentally disastrous.

5.6 EIA WITH EMP

The EIA with EMP has a better sense as it will have detailed mitigation measures, budget and monitoring plan for the project – for pre construction, construction and operation phases. The responsibilities for implementation of mitigation measures will also be spelt out in the EMP. The EMP will help to mitigate adverse impacts of project. The monitoring plan will help to check the efficacy of mitigation measures planned. Hence EIA with EMP is justified for the Solan –Shimla section of NH-22. The implementation of EMP will also reduce inconvenience to local during construction and the project will become environmentally sustainable.

5.7 CONCLUSION

The analysis of the alignment for the project road widening from Solan to Shimla along with Shogi – Shimla – Dhalli bypass and Kandaghat bypass indicates that the environmental considerations have been given due weightage in the finalisation of the alignment. The minor adverse impacts would be manageable to an acceptable level by implementing Environmental Management Plan. The EIA with EMP has been considered an acceptable and justified option. No environmental sensitive features such as Notified Wildlife Parks, Bird sanctuaries, Notified Wetlands are within 10 km of the proposed alignment. Since the project alignment passes through a number of habitations, it has been finalised by proposing either realignments or bypasses at critical areas to minimise negative social impacts on the local population due to land acquisition or demolition of structures and to avoid orchards and cluster of trees.

CHAPTER – 6
ENVIRONMENTAL MONITORING PROGRAMME

CHAPTER – 6
ENVIRONMENTAL MONITORING PROGRAMME

6.1. MONITORING PROGRAMME OBJECTIVES

Monitoring programme has the underlying objective to ensure that the intended environmental mitigations are realized and this result in desired benefits to the target population causing minimal deterioration to the environmental parameters. Such programme targets proper implementation of the EMP. The broad objectives are:

- To evaluate the performance of mitigation measures proposed in the EMP;
- To evaluate the adequacy of Environmental Assessment;
- To suggest ongoing improvements in management plan based on the monitoring and to devise fresh monitoring on the basis of the improved EMP;
- To enhance environmental quality through proper implementation of suggested mitigation measures; and
- To meet the requirements of the existing environmental regulatory framework and community obligations.

6.1.1 Performance Indicators

The significant physical, biological and social components affecting the environment at critical locations serve as wider/overall Performance Indicators. However, the following specific environmental parameters can be quantitatively measured and compared over a period and are, therefore, selected as specific Performance Indicators (PIs) for monitoring because of their regulatory importance and the availability of standardized procedures and relevant expertise.

- Air Quality with respect to PM2.5, RSPM (PM10), CO, NOx and SO_2 at selected locations.
- Water Quality as per IS 10500:1991 and Surface water Quality as Specified by Central Pollution Control Board.
- Noise levels near habitations, construction sites, and sensitive receptors close to RoW. The noise sensitive receptors include schools, hospitals and community/ religious places.
- Survival rates of trees planted as compensatory plantation to compensate for lost forestlands and compensatory plantation for removal of trees from the RoW of NH -22 in Solan- Shimla section.

Ambient Air Quality (AAQ) Monitoring Parameters

Ambient air quality parameters recommended for monitoring road development projects are PM2.5, PM10, Carbon Monoxide (CO), Oxides of Nitrogen (NOx) and Sulphur Dioxide (SO_2). These are to be monitored, right from the commencement of construction activity at construction camp sites, crushers on sites, excavation works etc. Data should be generated once in a season excluding monsoon at the monitoring locations in accordance with the National Ambient Air Quality Standards formulated by MoEF in 1981.

Water Quality Monitoring

The physical and chemical parameters recommended for analysis of water quality relevant to road development projects are pH, total solids, total dissolved solids, total suspended solids, oil and grease, COD, Chlorides, Lead, Zinc and Cadmium. The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are given in the Environmental Monitoring Programme. The monitoring of the water quality is to be carried out at locations identified along the project road during construction and operation phases.

Noise Level Monitoring

The measurements for monitoring noise levels would be carried out at sensitive receptors and

construction sites along the project road. The Ambient Noise Standards formulated by Central Pollution Control Board (CPCB) in 1989 or the standards by Himachal Pradesh Pollution Control Board if such standards are stricter than those of the CPCB are to be complied with. The CPCB standards are given in **Table – 3.6**. Sound pressure levels would be monitored on twenty-four hour basis. Noise should be recorded at "A" weighted frequency using a "slow time response mode" of the measuring instrument. The details are and the locations of noise monitoring for Project road (Section of NH-22 from Solan to Shimla) have been recommended in the **Table 6.1**.

Success of Re-vegetation

The project road section from Solan to Shimla passes through a hilly area that receives good monsoon rainfall. There is availability of moisture in almost all seasons due prevalence of lower temperatures. The construction of road will involve cutting of vegetation and trees. Compensatory plantation is required to replace lost vegetation and trees. As per guidelines of State Forest Department compensatory afforestation has to be carried out @ 1: 3 (Three trees for every one tree cut). The implementing agency with the help of the Forest Department will monitor these compensatory plantations. Such monitoring will be conducted through random samples. Such sampling should cover at least 5% of the total length. There will be monitoring every year before on set of monsoon and a 90% survival will be maintained. Any deficiency noted will be planted in the monsoon season.

Soil Quality

Soil quality monitoring has been done to establish baseline scenario in terms of soil fertility contamination with pollutants, texture etc. In order to see changes in soil quality parameters soil monitoring has been recommended during pre-construction, construction and operation phases. The parameters of soil quality monitoring are colour, texture and class, sand, silt and clay percentages, bulk density water holding capacity (%), Phosphorus, available Potassium, organic Carbon, Lead, Arsenic, Iron, Sulphate, Chloride, Calcium, Copper, Zinc, Manganese, moisture Infiltration Capacity, alkalinity, acidity, Sodium absorption ratio, Sodium Carbonate and Sodium Chloride.

6.1.2 Monitoring Plan

The monitoring plan covering various performance indicators, frequency and institutional arrangements of the project in the construction and operation stages, along with the estimated cost, is summarized in **Table 6.1**

Table 6.1: Monitoring Parameters

Environment component	Project Stage	REGULAR MONITORING PARAMETERS						Institutional Responsibilities	
		Parameters	**Standards**	**Location**	**Frequency**	**Duration**	**Action plan in case criteria exceeds**	**Implementation**	**Supervision**
Air	Construction stage	PM10, PM2.5, SO_2, NO_x, and CO	Table 3.3	At Hot mix plant (2 No)	Once in a season excluding the monsoon for 3 years	Continuous 24 hours/ or for 1 full working day when hot mix plant is in operation.	Check and modify control devices like bag filter/cyclones of hot mix plant.	Contractor through approved monitoring agency	Concessionaire
		PM10, PM2.5, SO_2, NO_x, and CO	Table 3.3	At identified 3 locations (Solan - Shogi and Dhalli).	Once in a season excluding the monsoon for 3 years	Continuous 24 hours/ or for 1 full working day	Check and modify control devices like bag filter/cyclones of hot mix plant.	Contractor through approved monitoring agency	Concessionaire
	Operation stage	PM10, PM2.5, SO_2, NO_x, and CO	Table 3.3	At identified 3 locations (Solan - Shogi and Dhalli).	Thrice in a year (winter, summer and post monsoon seasons) for 2 years	Continuous 24 hours/ or for 1 full working day	-	Concessionaire through approved monitoring agency	Concessionaire
Surface Water Quality	Construction stage	Drinking Water Parameter as defined in IS 10500: 1991 and Surface water standards of Central Pollution Control Board.	Surface Water quality standards by CPCB (Refer Chapter -3 for standards)	At Samri Nalla (1 No)	Once in a season excluding the monsoon for 3 years	Grab Sample	Check and oil interceptors, Silt fencing devices.	Contractor through approved monitoring agency	Concessionaire

Environment component	Project Stage	REGULAR MONITORING PARAMETERS						Institutional Responsibilities	
		Parameters	**Standards**	**Location**	**Frequency**	**Duration**	**Action plan in case criteria exceeds**	**Implementation**	**Supervision**
	Operation stage	Drinking Water Parameter as defined in IS 10500: 1991 and Surface water standards of Central Pollution Control Board	Surface Water quality standards by CPCB (Refer Chapter – 3 for Standards)	At Samri Nalla	Once in a season excluding the monsoon for 2 years	Grab Sample	Check and modify oil interceptors, Silt fencing devices.	Concessionaire through approved monitoring agency	Concessionaire
Ground Water Quality	Construction stage	Drinking Water Parameter as defined in IS 10500: 1991	Ground Water quality standards by CPCB	At identified 3 locations (Solan - Shogi and Dhalli)	Once in a season excluding the monsoon for 3 years	Grab Sample	Check and modify oil interceptors, Silt fencing devices.	Contractor through approved monitoring agency	Concessionaire
	Operation stage	Drinking Water Parameter as defined in IS 10500: 1991	Ground Water quality standards by CPCB	At identified 3 locations (Solan - Shogi and Dhalli)	Once in a season excluding the monsoon for 2 years	Grab Sample	Check and modify oil interceptors, Silt fencing devices.	Concessionaire through approved monitoring agency	Concessionaire

Environment component	Project Stage	REGULAR MONITORING PARAMETERS						Institutional Responsibilities	
		Parameters	**Standards**	**Location**	**Frequency**	**Duration**	**Action plan in case criteria exceeds**	**Implementation**	**Supervision**
Noise levels	Construction stage	L_{eq} dB(A) (Day & Night), Average and Peak values	Noise standards by CPCB	At equipment yards / locations/ in and along NH 22 (Solan- Shimla). 05 Locations (03 location along project road) and 02 locations at construction camps)	Once in a season excluding the monsoon for 3 years	Readings to be taken at 60 seconds interval for every hour and then L_{eq} are to be obtained for Day time and Night time	Check and modify equipment and devices used to protect noise level.	Contractor through approved monitoring agency	Concessionaire
	Operation stage	L_{eq} dB(A) (Day & Night), Average and Peak values	Noise standards by CPCB	At identified 03 locations (Solan - Shogi and Shimla)	Once in a season excluding the monsoon for 2years	Readings to be taken at 60 seconds interval for every hour and then L_{eq} are to be obtained for Day time and Night time	-	Concessionaire through approved monitoring agency	Concessionaire

Environment component	Project Stage	REGULAR MONITORING PARAMETERS						Institutional Responsibilities	
		Parameters	**Standards**	**Location**	**Frequency**	**Duration**	**Action plan in case criteria exceeds**	**Implementation**	**Supervision**
Soil	Construction stage	Physical Parameters: Texture, Grain Size Distribution, Gravel, Sand, Silt, Clay; Chemical Parameters: pH (10%w/v slurry), Conductivity, Calcium, Magnesium, Sodium, Potassium, Sodium Absorption Ratio, Total Nitrogen, Phosphorous, Organic matter	Baseline	Near construction sites / along the alignment of NH 22 (Solan-Shimla Section) / Construction Camps at 03 Locations	Once in a season excluding the monsoon for 3 years	-	-	Contractor through an approved monitoring agency	Concessionaire
	Operation Stage	Physical Parameters: Texture, Grain Size Distribution, Gravel, Sand, Silt, Clay; Chemical Parameters: pH (10%w/v slurry), Conductivity, Calcium, Magnesium,	Baseline	Near NH 22 (Solan- Shimla section) at identified 03 locations	Once in a season excluding the monsoon for 2 years	-	-	Concessionaire through an approved monitoring agency	Concessionaire

Environment component	Project Stage	REGULAR MONITORING PARAMETERS						Institutional Responsibilities	
		Parameters	**Standards**	**Location**	**Frequency**	**Duration**	**Action plan in case criteria exceeds**	**Implementation**	**Supervision**
		Sodium, Potassium, Sodium Absorption Ratio, Total Nitrogen, Phosphorous, Organic matter							
Soil Erosion	Construction stage	Turbidity in Storm water	As specified by the Construction Managers of the Concessionaire	At the drains, water streams ponds and river near construction site	Pre-monsoon and post-monsoon seasons for 3 years	-	Inspection and modification of silt fencing/ any leakage of drains to these surface water bodies	Contractor	Concessionaire
	Operation stage	Turbidity in Storm water Silt load in ponds	Water quality standards	At major water bodies .	Every year before onset of monsoon	-	Check drains, culverts and its modification	Contractor	Concessionaire
Construction Sites and Construction Camps	Construction Stage	Monitoring of: 1. Storage Area 2. Drainage Arrangements 3. Sanitation in Construction Camps	As specified by the Construction Managers of the Concessionaire	At Storage area and construction camps	Quarterly in the construction stage.	-	Check sanitation/ drainage and standards of camp sites and bring up to level of satisfaction Concessionaire / IE	Contractor	Concessionaire

Environment component	Project Stage	REGULAR MONITORING PARAMETERS						Institutional Responsibilities	
		Parameters	**Standards**	**Location**	**Frequency**	**Duration**	**Action plan in case criteria exceeds**	**Implementation**	**Supervision**
Survival Plantation and Vegetation	Construction Stage	Monitor Plantation survival rate and maintain a minimum 90% survival	Minimum 90% Survival rate	At side slopes median and available place in RoW	Every Year prior to Monsoon	Every year till end of construction period.	Make up for any loss less than 90% in monsoon	Horticulture Department of Concessionaire.	Environment Cell of Concessionaire
	Operation Stage	Monitor Plantation survival rate and maintain a minimum 90% survival	Minimum 90% Survival rate	At side slopes median and available place in RoW	Every Year prior to Monsoon for 2 years	For first 3 years.	Make up for any loss less than 90% in monsoon	Horticulture Department of Concessionaire	Environment Cell Concessionaire

6.2. ENVIRONMENTAL REPORTING SYSTEM

Monitoring and Evaluation are critical activities in implementation of all projects. Monitoring involves periodic checking to ascertain whether activities are going according to the plans. It provides the necessary feedback for project management to keep the programme on schedule. In contrast, evaluation is essentially a summing up at the end of the project to assess whether those activities were actually achieved as was intended.

The reporting system will operate linearly with the contractor who is at the lowest rung of the implementation system reporting to the Concessionaire. All reporting by the contractor shall be on a quarterly basis. The Concessionaire shall be responsible for preparing targets for each of the identified EMP activities.

The compliance monitoring and the progress reports on environmental components may be clubbed together and submitted to the concessionaire quarterly during the implementation period. The operation stage monitoring reports may be annual or biennial provided the Project Environmental Completion Report show that the implementation was satisfactory. Otherwise, the operation stage monitoring reports will have to be prepared as specified in the said Project Environmental Completion Report.

Responsibilities for overseeing will rest with the Environment Management Cell of the Concessionaire. Capacity to quantitatively monitor relevant ecological parameters would be an advantage but monitoring will primarily involve ensuring that actions taken are in accordance with contract and specification clauses, and specified mitigation measures in the EMP.

During the implementation period, a compliance report may include description of the items of EMP, which were not complied with by any of the responsible agencies. It would also report to the management about actions taken to enforce compliance. It may however, be noted that certain items of the EMP might not be possibly complied with for a variety of reasons. The intention of the compliance report is not to suppress these issues but to bring out the circumstances and reasons for which compliance was not possible. This would help in reinforcing the implementation of the EMP.

Photographic records will also be established to provide useful environmental monitoring tools. A full record will be kept as part of normal contract monitoring. Reporting and Monitoring Systems for various stages of construction and related activities have been proposed to ensure timely and effective implementation of the EMP.

The reporting system has been prepared for each of the stage of road construction namely:

- Pre construction stage
- Construction Stage
- Operation Stage
- This reporting shall be done through:
- Reporting by the Contractor to the Concessionnaire
- Concessionnaire to Regional Office of Ministry of Environment and Forest.

The stage-wise reporting system is detailed out in the following **Table 6.2**.

Table – 6.2: Suggested Stage-Wise Reporting System

S. No	Item	Contractor	Supervision / Monitoring	
		Implementation and Reporting to Concessionnaire		
Construction Stage				
1	Supervision of construction site and construction camp	Before start of work	-	Quarterly
2	Target sheet for Pollution Monitoring	-	As required	After Monitoring
3	Target sheet for roadside plantation	-	Quarterly	Annually
4	Target sheet for monitoring of cleaning water bodies	-	Monthly	Monthly
Operation Stage				
1	Target sheet for Pollution Monitoring	-	Quarterly	Annually
2	Target sheet for survival reporting of roadside plantation	-	Annually	Annually
3	Target sheet for monitoring of cleaning water bodies	-	Annually	Annually

6.3. MONITORING PLAN

An environmental monitoring budget has been allocated for construction as well as operation phase. This amount has also been included in the Environmental Budget in Chapter 9. The details of environmental monitoring budget are given in **Table 6.3**.

Table 6.3: Environmental Monitoring Budget (Construction and Operation Phase)

Component	Stage	Item	Unit	Unit Cost (Rs.)	Quantity	Total Cost (INR)
Monitoring costs						
Air	Construction	Monitoring near all hot mix plant locations approved by the Engineer	No. of Samples	10,000	At 02 location once in a season excluding monsoon for 3 years. (18 Samples)	180000.00
		Monitoring at construction sites and at sensitive locations.	No. Of Samples	10,000	At 03 locations once in a season excluding monsoon for 3 years (27 samples)	270,000.00
	Operation	Ambient Air Quality Monitoring (at three Locations where baseline Monitoring Done)	No. Of Samples	10,000	At 03 locations for 2 years and once in each season excluding monsoon (total 18 samples)	180,000.00
Water Quality	Construction	Surface Water Quality (Samri Nallah)	No. of Samples	6,000	At 01 locations once in a season excluding monsoon for 3 years (9 samples)	54,000.00
		Ground Water Quality (Along RoW)	No. of Samples	6,000	At 03 locations once in a season excluding monsoon for 3 years (27Samples)	162,000.00
	Operations	Surface Water Quality (As per suggestion in monitoring plan)	No. of Samples	6,000	At 01 location once in each season excluding the monsoon season for 2 years (06sample)	36,000.00
		Ground Water Quality (As per recommendation in monitoring plan)	No. of Samples	6000	At 03 location once in each season excluding the monsoon season for 2years (total 18sample)	108,000.00
Noise	Construction	At equipment yards/ Hot mix plants / Construction Camps	No. of Samples	2,000	At 02 location once in each season excluding the monsoon season for 3 years (18 Samples)	36000.00

Component	Stage	Item	Unit	Unit Cost (Rs.)	Quantity	Total Cost (INR)
		As directed by the Engineer	No. of Samples	2,000	At 03location once in each season excluding the monsoon season for 3 years (27 Samples)	54,000.00
	Operation	As directed by the Engineer	No. of Samples	2,000	At 03 locations Thrice in a year for 2years (18Samples)	36,000.00
Soil	Construction	At productive agricultural lands abutting traffic detours and traffic diversions, to be identified by the Engineer	No of Samples	5,000	At 03 locations once in each season excluding monsoon for 3 years (27 samples)	135,000.00
	Operation	At accident/spill locations involving bulk transport carrying hazardous material	No of Samples	5,000	At 03 Location once in each season excluding monsoon for 5years (18 Samples)	90,000.00
Plantation	0peration	All along the project corridor		Lumpsum (6.0 lakhs every year)	Once every year after monsoon for 3 years	1800000.00
Total Monitoring Costs for NH -22 Section from Solan To Shimla						**31,41,000.00**

Note: Sample Rates are based on Current Market Rates.

CHAPTER – 7

STAKEHOLDER CONSULTATIONS AND PUBLIC HEARING

CHAPTER – 7
STAKEHOLDER CONSULTATIONS AND PUBLIC HEARING

7. 1 INTRODUCTION

The project will affect the communities residing near the RoW of Solan- Shimla section of NH-22 including their activities. Moreover successful implementation of the project requires co-ordinated efforts of various stakeholders at different levels. The consultations are continuous activities during all stages of any major infrastructure developmental activity as all the stakeholders (both direct and indirect) have key roles to play in achieving the goals of the project. Not only are the outcomes dependent on the consultations but the very fact that when some community members are adversely affected, the community as a whole reaps the benefits of the project. Better the community participation better is the project planning, implementation and operation. Hence, consultations at different levels are being used as a tool to inform and educate stakeholders about the proposed action both before and after the development decisions are made. Public consultation was useful for gathering environmental data, understanding likely impacts and community's needs and preferences.

The various alternatives could be evolved and sustainable mitigation measures could be formulated through consultations. It assisted in identification of the problems associated with the project as well as the needs of the population likely to be impacted. This participatory process helped in reducing the public resistance to change and enabled the participation of the local people in the decision making process. The involvement of the various stakeholders ensured that the affected population and other stakeholders are informed, consulted and allowed to participate at various stages of project preparation.

7. 2 OBJECTIVES

The objectives of the consultation process are the following:

- To promote public awareness about the widening of Solan- Shimla section of NH-22 especially amongst the potentially impacted communities/individuals;
- To educate the potentially impacted communities/individuals about the proposed course of action and the project alternatives;
- To solicit the views of affected communities/individuals on environmental and social problems;
- To gather inputs from the affected communities/individuals in crucial decisions regarding mitigation of the identified environmental and social issues;
- To stimulate community self evaluation and analysis;
- To inform Project Affected Persons (PAPs) about the compensation and resettlement in the project; and
- To ensure lessening of public resistance to change by providing them a platform in the decision making process.

7. 3 METHODOLOGY ADOPTED FOR STAKEHOLDER CONSULTATIONS

Stages and Levels of Consultations

Stakeholder Consultations is an ongoing process till project is completely constructed. The consultations have helped in finalisation of the alignment for the project road from Solan to Shimla.

Level of Consultations

Structured consultation with important stakeholders whose involvement is very much warranted for successful and smooth implementation of the project has been done under the project. For this purpose consultation at corporate level, District level and local level are have been conducted.

(i) Consultation at State level: The consultants have been in constant touch with officials of NHAI and State Government. Several rounds of meetings at the higher level were conducted to explain about the alignment of the project. Important agenda of discussion have been alternative alignment /bypasses, improvement proposal, pavement composition, cross drainage, land acquisition and other regulatory clearances.

(ii) Consultation at the District and Tahsil level: District level consultations were held at the District Headquarter involving District Magistrate, Collector, and Executive Engineers. Important issues were land acquisition, key plan and profile of proposed improvement. The consultations were also held with the forest department officials at Solan and Shimla. Similarly Tahsil level consultations were held at Solan and Shimla by the land acquisition and social team.

(iii) Consultation at Strategic Locations:

Generally these consultations were organized on pre-decided dates and at pre-decided venues. All concerned stakeholders including potential PAPs have been invited to participate in the discussions. Issues related to project are being put on record for future project planning and for incorporation of suggestions in detailed (technical) report preparation. One of the basic features of the present consultation strategy was to involve local representatives in project planning so that implementation (particularly options of bypasses, realignments, LA, issues related to utility shifting) could be faster and focused. For this purpose, pamphlets were distributed and a letter of invitation is sent to the locally elected representatives.

7. 4 ISSUES RAISED AND ADDRESSAL IN THE PROJECT

Table 7.1 describes the issues raised and suggestions given by the people in these strategic meetings.

Table 7.1: Findings of Consultation at Strategic locations

Location and Date	**Solan on 16-05-2012**
Participants	Project Preparation Team: Project Director, Team Leader, environmental and Social expert of the consultant Stakeholders: People and their representatives
Issue Discussed	• About proposed improvements in road at Solan • Impacts of noise • Land Acquisition and compensation • Loss of livelihood of vendors and kiosks • Issues of Tree cutting • ROB and Elevated portion • Bypass for Kandaghat
Suggestion	• Construction of ROB and elevated portion to avoid damage to Kalka- Shimla rail line • Minimum damage to structures and households • NHAI will provide compensation at market rate, • Loss of livelihood will be addressed through NHA Act 1956, • Planting of trees should be done before tree cutting • Local labourers should be hired for construction, a short connectivity to Dharsiva bypass from village should be

Location and Date	**Solan on 16-05-2012**
	given • Bypass for Kandaghat should be planned to minimize demolition of private properties.
Important Finding	• Participants welcomed ROB and Elevated road construction at Solan and Kandaghat bypass

Location and Date	**Dhalli on 17-05-2012**
Participants	Project Preparation Team: Team Leader, environmental and Social expert of the consultant Stakeholders: People and their representatives
Issue Discussed	• Alignment of Shimla and Shogi-Dhalli Bypass, • Water source for construction of Shogi Shimla Dhalli bypass • Compensation for those loosing property and assets • Tree plantation and hill cutting • Loss of livelihood of vendors and kiosks • People were having divided opinion about bypass option
Suggestion	• Bypass should not provided as business establishments from Shogi to Shimla will suffer business losses • Bypass project affected person list should be provided • NHAI will provide compensation at market rate, • Loss of livelihood will be addressed through NHA Act 1956, • In order to prevent soil erosion and land slide necessary protection measures should be built in. • Local contractors should be given chance in road construction,
Important Finding	• Tunnel is necessary from km 132.920 to 134.020 to avoid forest land acquisition and cutting of 100 years old deodar trees.

Location and Date	**Shimla on 18-05-2012**
Participants	Project Preparation Team: Team Leader, environmental and Social expert of the consultant Stakeholders: People and their representatives
Issue Discussed	• Shimla bypass end point • Tree cutting and slope stabilisation • Situation of existing road after bypass

Location and Date	Shimla on 18-05-2012
	• Land Acquisition and compensation
Suggestion	• Defiance installation should be kept in mind while finding the alignment • Distance of bypass should be minimal, from Shimla city. • Existing road will be transferred to PWD/local government and they will maintain it. • Loss of livelihood will be addressed through NHA Act 1956, • Compensation should be paid at market rate
Important Finding	• The project road implementation should be expedited to reduce traffic congestion in Shimla • Locals should be given preference in employment during project implementation.

7.5 Role and Responsibilities Identified during Consultation

The above-mentioned highlight of consultation suggests the role and responsibility of stakeholders in project planning. **Table 7.2** envisages the responsibilities of officials and expected benefits from the consultation. From the consultation, it was established that implementation of the project could be better done with the help of regular PWD engineers.

Table 7.2: Role and Responsibilities Identified after Consultation under the Project

Stakeholders	Roles and Responsibility	Expected Benefit for the Project
Potential Project Affected Persons, Project affected groups, Project Affected Communities, Host population	• Participate in formal and informal public meeting, • Raise critical issues relevant to the project, • Suggest alternative alignments, • Options of widening, • Methodologies for agreement on compensation and assistance • Suggest methodologies for continued participation in project cycle	• Easing implementation. • Incorporation of good practices (From long term memories of the people) of the past in project design. • Planning for road safety issues. • Community Capacity building and sense of ownership of the project.
Engineers supervision consultant and NHAI	• Land Acquisition • Forest Clearance • Participate in Public meetings • Participate in Block and District Level Meeting	• Ease in implementation • People oriented planning • Ensured public cooperation • Determination of market value
Forest Official	• Enumeration of trees • Identification of eco sensitive hot spots • Scrutiny of application form for forest clearance • Permission for tree cutting • Salvaging/Auctioning of trees	• Faster Forest Clearance for the project • Transfer of Forest Land is easier
Land Acquisition Officials	• Authentication of existing • land • Ensure availability of land for road improvement • Timely evacuation of Corridor	• Speedy and timely land acquisition

Stakeholders	Roles and Responsibility	Expected Benefit for the Project
Line Department Officials (Irrigation, Telephone, Municipalities, Panchayat)	• Permission to acquire land from irrigation department • Estimates for Utilities • Dovetailing Government schemes	• Eases implementation
NGOs/CBOs Self Help Group, Water User Association PRIs. ORWs	• Ensure public participation in project preparation and implementation, • Assist NHAI and contractor	• Public are informed • Opinion and preferences are known • Easy to develop community capacity development plan.

7.6 PUBLIC HEARING

The public hearing as per Environmental Impact Assessment Notification 2006 will be organised with the assistance of Himachal Pradesh Pollution Control Board assistance. The comments and suggestions of all stakeholders in the Public hearing will be incorporated in the final EIA report.

7.7 CONCLUSION

It is clear from the above discussion that project design has accounted for all issues raised during public consultations. The environmental management plan will be part of contract documents for all contractors. This will ensure implementation of all mitigation measures. The consultation is ongoing process. During implementation, all constructive suggestions of public and statutory undertakers will be taken into consideration.

CHAPTER – 8

PROJECT BENEFITS

CHAPTER - 8

PROJECT BENEFITS

8.1 GENERAL

Good roads have varied embedded connotations, like the backbone of modern economy, the philosophy of life signifying the voyage unremitting from birth till death, the history of mankind and its endeavour, the passion for speed and dart non-episodically, etc. Road projects promote access to markets, materials and opportunities by facilitating movement of people and goods and improve earning and thereby enhancing the quality of life. This in turn enhances the demand for transport. This two-way interaction works through a host of inter-sectoral forward and backward linkages effects and dynamic externalities, tend to relocate industries, services and labour and thus helps to shape the economic geography of the region.

The ultimate aim of the developmental activities, such as 4 laning of Solan- Shimla section of NH-22 is to promote societal welfare of the region and in the process contribute to the welfare of the state and in the process for the whole nation. The development of such a project plays a significant role in changing the socio-economic condition of the living of people of a region through dynamic externalities such that development often generates. Thus, the benefits of the project may be direct or indirect in nature.

All these should have a bearing on the level of well being of the households, although some of them may not themselves necessarily use more of the 4 lane project road facility created. These would in turn lead to changes in the level of well-being and human development, through their benefit on consumption level, educational attainment, health status, etc.

8.2 REDUCTIONS IN OPERATION COST

Vehicle operating cost (VOC) will be reduced when riding quality of road is good. Maintenance and Operation cost such as fuel consumption, wear and tear of tyres, will be sufficiently reduced. The vehicle operating cost shall be further reduced by improved geometrics and design. The benefits accrued to the road user are in the form of lower expenditure. VOC consist of the following components:

- Fuel Consumption;
- Lubricating oil consumption;
- Spare part consumption and repairs
- Tyre consumption; and
- Vehicle depreciation.

8.3 REDUCTIONS IN ACCIDENTS, MORBIDITY AND MORTALITY

The proposed improvements of NH-22 will reduce congestion in built-up areas along the project road such as Solan, Shimla, Dhalli, Kandaghat, wakanaghat, New Shimla, Vikas nagar, Shanan Hosing board Colony, Mehli, Panthaghati, etc. The distance between Dhalli and Solan will be reduced by about 16 km. The accidents will reduce in these habitations as well as on the existing NH - 22 portions from Solan to Shimla.

In order to make the project road accident free road signage and safety features have been planned at the design stage. Required lighting shall be provided at the locations of Toll Plaza, ROB, Tunnels, and sharp curves and other critical location to avoid accidents during night in adverse climatic conditions.

8.4 TOURISM DEVELOPMENT

The project road provides access to Shimla, Kufri and other destinations in the region. Hence project road 4 laning will further enhance tourism potential of the Shimla and surroundings.

8.5 ECONOMIC DEVELOPMENT

Road development program can contribute to economic development by encouraging attraction of businesses to sites equipped with good access and by improving the travel efficiencies of existing businesses and to start new avenues. They also help for:

- The development of new project sites,
- The development of Hotels, restaurants and Resorts,
- Infrastructure projects, and
- Development of IT parks.

8.6 EMPLOYMENT OPPORTUNITY

The project like any other road development project will serve as an important employment generator and will provide employment opportunity during construction phase. In post-construction phase industrial and infrastructure development will provide enormous direct & indirect employment opportunities.

8.7 DEVELOPMENT OF AGRICULTURE

The immediate impact area of the NH-22 (Solan- Shimla section) has good fruit and vegetables producing area.. Improvement of the road will help the farmers in getting good prices of their produce by way of quick and fast transportation of perishable goods to the market places at Kalka, Ambala, Chandigarh, Delhi, and cities of Punjab state..

8.8 INDIRECT BENEFITS

In addition to direct positive impacts, a large number of indirect benefits are also attributed to 4 laning of project road section from Solan to Shimla. Lowering transportation cost & time duration for users and improving access to goods and services enables new and increased economic and social activity. Individuals, households and firms adjust to take the advantage of those benefits, leading to several indirect impacts over a period. These indirect impacts include changes in land use and development, changes in decision to locate houses and business in areas where houses and land are less expensive or more desirable, and changes in warehouse and delivery procedure for businesses in order to take advantage of improved speed and reliability in the transportation system. These impacts further lead to increased property values, increased productivity, employment and economic growth.

8.9 ENVIRONMENTAL BENEFITS

Reductions in adverse environmental impacts of transportations i.e. reduced emissions; decrease in Respirable Suspended Particulate Matter and Suspended Particulate Matter, reduced Noise and other impacts are also the direct benefits of the proposed 4 laning of Solan – Shimla section of NH-22.. These benefits will also be felt within the major habitations as bypasses have been proposed at the congested locations.

CHAPTER – 9
ENVIRONMENTAL MANAGEMENT PLAN

CHAPTER – 9

ENVIRONMENTAL MANAGEMENT PLAN

9.1 INTRODUCTION

Environmental Management Plan (EMP) is the key to ensure that the environmental quality of the zone under impact does not deteriorate beyond the expected level due to the construction and operation of the project. The EMP comprises a set of measures to be taken in different stages like the design, construction and operation to eliminate, offset or reduce adverse environmental impacts to acceptable levels. Elimination/prevention is possible through elimination of impacts or by avoiding the action. This can also be achieved by reducing the scale of action. Remediation is repairing or restoring particular features of the environment adversely affected by the activity. Offsetting actions means compensating for impacts by providing additions to or substitutes for the affected environment. In the case of 4 laning of Solan- Shimla section of NH-22, prevention gets limited only to scaling down the magnitude of operations in environmentally sensitive stretches of the project road. Mitigation plans generally evolve around remediation and offsetting.

9.2 ENVIRONMENT MANAGEMENT PLAN MATRIX

The Environmental Management Plan is meant for mitigation/management /avoidance of the negative impacts and the enhancement of the various environmental components along the project road. For each mitigation measure to be taken its location, timeframe, implementation and overseeing/supervising responsibilities are listed in the EMP matrix. The measure adopted and /or to be adopted during the different stages of the project have been detailed in **Table 9.1,** for pre construction, construction and operation phases respectively**.**

9.2.1 Implementation Arrangements

The responsibility of implementing the mitigation measures lies with the NHAI, All construction activities being taken up by the contractor under the IE will be scrutinised by the NHAI.

9.2.2 Environmental Monitoring

Introduction

The environmental monitoring programme provides such information on which management decision may be taken during construction and operational phases. It provides basis for evaluating the efficiency of mitigation and enhancement measures and suggest further actions that need to be taken to achieve the desired effect.

The monitoring includes:

(i) Visual observations;

(ii) Selection of environmental parameters at specific locations;

(iii) Sampling and regular testing of these parameters.

Objectives

The objectives of the environmental monitoring programme are:

- Evaluation of the efficiency of mitigation and enhancement measures;
- Updating of the actions and impacts of baseline data;
- Adoption of additional mitigation measures if the present measures are insufficient;
- Generating the data, which may be incorporated in environmental management plan in future projects.

Methodology

Monitoring methodology covers the following key aspects:

- Components to be monitored;

- Parameters for monitoring of the above components;
- Monitoring frequency;
- Monitoring standards;
- Responsibilities for monitoring;
- Direct responsibility,
- Overall responsibility;
- Monitoring costs.

Environmental monitoring of the parameters involved and the threshold limits specified are given in the monitoring plan along with the environmental parameters and the time frame is presented in the **Table 9.2.**

9.3 ENVIRONMENTAL BUDGET

The environmental budget for the various environmental management measures proposed in the EMP is detailed in **Table 9.3.** The cost of Compensatory Afforestation and monitoring is also included in this budget. There are several other environmental issues that have been addressed as part of good engineering practices, the costs for which have been accounted for in the Engineering Costs.

The budget reflects this and while retaining the types of enhancement suggested, allows the selection of the locations at the discretion of the Engineer.

Table 9.1: Environmental Management Plan Matrix for Solan- Shimla Section of NH-22

Environmental Issues/Impacts	Enhancement/ Mitigation Measures	Reference to Contract Documents	Management Action	Implementation Responsibilities
PRE-CONSTRUCTION PHASE (removal of trees and encroachments; site clearances, establishments of construction camps)				
Uncertainties concerning land and other assets acquisition	Refer Resettlement Plan for Details			
Inadequate compensation and other grievances	Refer Resettlement Plan for Details			
Tree clearance (6734 Nos.)	• Compensatory plantation & additional plantation in available clear space	• Indian Forest Act (1980)	• Only marked trees to be felled. • Compensatory plantation of 20204 trees (@ 3 saplings for each tree felled). • Removal of trees only within CoI after joint verification with forest department.	• Himachal Pradesh Forest Department, IE, NHAI& Forest Department
Grubbing & levelling	• Removal of remains of trees to facilitate construction and carting away of remains	• Project Requirement	• Contractor will carry out the clearing of stumps and levelling • Carting away will be done by the forest department after the stumps are removed from the ground.	• Forest Department, IE& NHAI
Siting of construction yard	• Sitting will be finalised after approval of IE who will look into the site and planning of the contractor.	• Project Requirement	• Contractor will prepare a site plan. • The contractor will avoid site near watercourses for site fuel & lubricant storage areas. • Machinery and equipment area will be protected.	• IE & NHAI
CONSTRUCTION PHASE (earthworks; road construction; camp site operation; procurement of material from quarries, crushers and borrow areas; traffic management during construction)				
Borrow pit exploitation	• Indemnity by contractor to	• MoRTH 305.2.2.2	• Contractor will verify that	• Contractor and

Environmental Issues/Impacts	Enhancement/ Mitigation Measures	Reference to Contract Documents	Management Action	Implementation Responsibilities
causing loss of productive land	NHAI against third party claims.		enough quantity of borrow materials is available at identified borrow pits	NHAI
	• Equitable agreements for borrow pit development will be reached between land owners and contractors including measures for post-restoration.	• Contract Requirement	• NHAI will check restoration and post-restoration use.	• The NHAI and contractor
	• Contractors will submit plans to NHAI for borrow pit exploitation and post-use restoration before commencement of work and implementation of approved plans.	• MoRTH 305.2.2.2	• Inclusion of appropriate clauses in construction contracts, monitoring of compliance during construction and proper administration of contracts will be ensured.	• NHAI and IE
	• Contractors will be advised that extensive exploitation of shallow borrow areas will not be approved • Restoration and post-restoration productive use of land will be ensured by the contractor.		• Detailed programme covering restoration for other productive use shall be prepared by the contractor and overseen by the IE • Monitoring of restoration work.	• NHAI and IE
Erosion of embankments, shoulders, side slopes, and pavement leading to deterioration and affecting stability and integrity of road	• Earth works specifications will include provision for stable slope construction, compacting and laying out turf including watering until ground cover is fully established • Proper construction of Breast wall and retaining	• MoRTH 306.3, MoRTH 307 shall be applicable for mitigation measures in this impact	• Inclusion of appropriate items in specification, monitoring of compliance during construction and appropriate administration of contracts will be ensured.	• IE, NHAI contractor

Environmental Issues/Impacts	Enhancement/ Mitigation Measures	Reference to Contract Documents	Management Action	Implementation Responsibilities
	wall at the locations identified by the design team to avoid soil erosion.			
	The measures proposed for slope stabilisation are: • Discharge zones of drainage structures (culverts and minor bridges) provided with riprap. • Construction in erosion and flood prone areas will not be in monsoon /season. • Side slopes will be kept flatter wherever possible, and in case of steeper slopes it will be supported by the retaining wall.. • In order to avoid soil erosion from uphill side the drain along the breast wall will be constructed in the entire length. The breast wall will be constructed at the chainages identified by the design team.			
Safe site for construction workers' camp	• Site will be located at least at 500 m down wind from habitations	• Contract Requirement	• NHAI (PIU) will approve the site chosen by the contractor Conditions will be put in contract document for location of site at above specified dis-tances.	• NHAI IE and Contractor • NHAI
Sanitation and disposal facilities at construction	• Proper availability of drinking water and sanitation	• MoRTH 105.2	• Contractor will install temporary toilets with septic	• NHAI, IE and Contractor

Environmental Issues/Impacts	Enhancement/ Mitigation Measures	Reference to Contract Documents	Management Action	Implementation Responsibilities
worker's camp	facilities at workers' camp		tank/soak pits. • Contractor will provide suitable collection and disposal system for domestic refuse. For collection of domestic refuse dustbins will be provided. The collected waste may be disposed off at the nearest municipal land fill site.	• NHAI, IE and Contractor
Cooking fuel at workers' camp	• Workers' should not depend for cooking on wood.	• Contract Requirement	• Contractor will ensure availability of kerosene oil/LPG. Inclusion of the above conditions in contract document will be ensured.	• NHAI, IE and Contractor
Health facilities at workers' camp	• Availability of first aid and health facilities	• Contract Requirement	• The contractor will ensure first aid boxes in adequate numbers and make shift dispensary at camp. The above condition will be put in contract document.	• NHAI, Contractor, and IE.
HIV/ AIDs awareness campaign at workers' camp	• Workers to be made aware of HIV/AIDs and protection measures.	• Contract Requirement	• To organise awareness programme every month	• Contractor, NHAI and IE.
Damage to services running parallel or across the road during construction leading to interruption in supply	• Relocation of any potentially affected services prior to commencement of any construction works	• MoRTH 110.2	• Potentially affected services will be identified in design stage.	• IE / Contractor / NHAI
	• Contractors will be responsible for identifying and safeguarding services adjacent to works and for	• MoRTH 110.6	• Service undertakers will be notified for relocation and necessary programming to avoid construction delays	• Statutory undertakers / NHAI /IE

Environmental Issues/Impacts	Enhancement/ Mitigation Measures	Reference to Contract Documents	Management Action	Implementation Responsibilities
	compensating statutory undertakers for any accidental damage to such services.		(incl. payments).	
			• Relocation works to be completed by statutory undertakers before road construction works proceeds in accordance with an agreed programme.	• NHAI / IE/Contractor
			• Inclusion of appropriate clauses in construction contracts; monitoring of compliance during construction and proper administration of contracts will be ensured.	• NHAI
Fire Prevention	• Adopt safe work practice and have adequate fire fighting facilities	• MoRTH 111.6	• Provision of adequate fire fighting equipment will be made.	• Contractor
Presence of contractor's workforce increasing pressure on already strained local facilities including health & medical facilities	• Contractor will provide own suitably equipped and staffed site emergency medical facilities.	• MoRTH 105.2	• Inclusion of appropriate clauses in construction contracts; monitoring of compliance during construction and proper administration of contracts will be ensured.	• IE and NHAI
Incomplete post-use clearance and rein-statement of base camp, leading to loss of land productivity or additional costs for land owners to	• Contractor will prepare site restoration plans for approval of NHAI and to implement these plans fully prior to demobilization. All temporary works sites to be	• MoRTH 105.2	• Inclusion of appropriate clauses in construction contracts; monitoring of compliance during construction and proper administration of con-tracts	• IE and NHAI • IE/ NHAI

Environmental Issues/Impacts	Enhancement/ Mitigation Measures	Reference to Contract Documents	Management Action	Implementation Responsibilities
reinstate land	notified by the contractor prior to use		will be ensured. • All sites will be photo-graphed to record pre-use state. • BOQ's will include nominated lump sum for reinstatement of temporary sites to peruse status.	/Contractor • IEs/ NHAI /Contractor
Pollution of land, ground water and surface water arising from sanitary and other wastes and spillages	• During construction it will be ensured that contractor does not dispose off debris in water bodies.	• MoRTH 306.3	• Monitoring of compliance during construction and strict administration of contracts will be ensured.	• IE, NHAI, Contractor and Statutory Undertakers
	• Vehicle maintenance and refuelling will be confined to areas under construction yard to trap discarded lu-bricant and fuel spills.	• Contract Requirement	• Condition will be included in contract document	• IE, NHAI, Contractor and Statutory Undertakers
	• Sanitation waste from workers' camp will not be diverted to water bodies. The waste water will be diverted to septic tank.	• Contract Requirement	• Separate septic tanks shall be used for disposal of sanitary waste.	• IE, NHAI, Contractor and Statutory Undertakers
	• Contractor's to prepare, for NHAI''s approval detailed public health utilities plan for the workers camps and other works sites, which make adequate provision for safe disposal of all wastes and prevention of spillages, leakage of polluting materials, etc.	• MoRTH 105.2	• Monitoring of compliance during construction and strict administration of contracts will be ensured.	• IE, NHAI, Contractor and Statutory Undertakers

Environmental Issues/Impacts	Enhancement/ Mitigation Measures	Reference to Contract Documents	Management Action	Implementation Responsibilities
	• Contractor will be required to pay all costs associated with cleaning up any pollution caused by their activities and to pay full compensation to those affected	• MoRTH 306.2	• Monitoring of compliance during construction and strict administration of contracts will be ensured.	• IE, NHAI, Contractor and Statutory Undertakers
Contractor's water abstraction resulting in depletion of scarce water resources with local users and pollution of surface water bodies from construction activities	• Contractor will make suitable arrangements for own supply and protection of water bodies from pollution • Silt fencing will be provided all around the base of the stockpile of materials wherever material is stockpiled near water bodies.	• MoRTH 306.2	• Monitoring of compliance during construction and strict administration of contracts will be ensured.	• IE, NHAI
Construction traffic causing pavement and structure damage due to overloading, increasing congestion and increased road safety hazards	• Contractors will use appropriate vehicles and to comply with legal gross vehicle and axle load limits	• Contract Requirement	• Monitoring of compliance during construction and strict administration of contracts will be ensured.	• IE, NHAI
	• Contractors will repair damage at own expense	• MoRTH 119 & MoRTH 111.11	• The IE will ensure preparation and enforcement of traffic management plans.	• IE, NHAI
	• Contractors will minimise road safety hazards and inconvenience to other road users by taking appropriate measures such as proper	• MoRTH 112	• Monitoring of compliance during construction and strict administration of contracts will be ensured.	• IE, NHAI

Environmental Issues/Impacts	Enhancement/ Mitigation Measures	Reference to Contract Documents	Management Action	Implementation Responsibilities
	diversions, signages etc.			
Road safety hazards associated with temporary traffic diversions	• Contractors will take all reasonable measures to minimise interference with traffic flow and to provide safe transit at diversions. Few recommended measures are - Reduced speed signs and boards before diversion indicating such diversions. - Proper blocking of road under construction to avoid following of different paths at diversions. - Maintaining two way traffic flow to proper information to traffic police.	• MoRTH 112	• Monitoring of compliance during construction and strict administration of contracts will be ensured.	• IE and NHAI
Air pollution from asphalt and Hot mix plants, construction yard and due to movement of mechanical compactor.	• Asphalt and Hot mix plant will be located in down wind direction at a minimum distance of 500 m from urban towns and villages along project route.	• MoRTH 111.5	• Monitoring of air pollution and timely action to decrease the pollutant concentration by appropriate measures will be taken up.	• IE, NHAI, and contractor
	• Trucks carrying construction material will be covered with tarpaulin sheet to avoid spilling.	• MoRTH 111.8	• The IE will enforce the mitigation measures suggested through efficient monitoring.	• IE, NHAI, and contractor
	• Water sprinkling will be carried out in mornings and evenings on haul roads and compact surface.	• MoRTH 111.8	• The IE will enforce the mitigation measures suggested through efficient monitoring.	• IE, NHAI, and contractor

Environmental Issues/Impacts	Enhancement/ Mitigation Measures	Reference to Contract Documents	Management Action	Implementation Responsibilities
	• Vehicles and construction machinery will be maintained to conform emission standards specified by Himachal Pradesh Pollution Control Board	• MoRTH 111.1	• The IE will enforce the mitigation measures suggested through efficient monitoring.	• IE, NHAI, and contractor
	• Stock piled sand and stone will be wetted before loading. • Construction debris shall be disposed only at designated sites.	• MoRTH 111.1	• The IE will enforce the mitigation measures suggested through efficient monitoring.	• IE, NHAI, and contractor • IE, NHAI, and contractor
Noise Levels	• Construction yard will be located at 500 m away from habitations.	• MoRTH 111.5	• Condition will be included in contract document	• IE , NHAI, and contractor
	• All equipment will be maintained in good working order, properly designed engine enclosures and inbuilt silencers.	• MoRTH 111	• Condition will be included in contract document	• IE , NHAI, and contractor
	• Construction work will be prohibited between 10.0 PM – 6.00 A.M. at all habitations.	• Contract Requirement	• Condition will be included in contract document	• IE, NHAI, and contractor
Water Logging and Cross Drainage	• Need to build drains in the entire length towards hill side and in the median to avoid water accumulation on the road. The drain planned is 600 mm wide 600 mm depth in the entire length. The drains will be connected to nearest cross drainage	• Design Requirement	• The IE will ensure that contractor builds up drains as per design specifications.	• NHAI, IE and contractor.

Environmental Issues/Impacts	Enhancement/ Mitigation Measures	Reference to Contract Documents	Management Action	Implementation Responsibilities
	structure			
Accidents Hazards and Safety	• Following safety measures are designed to enhance safety: • Reduced speed signs in up and down directions at all habitations: • Proper signages at sharp curves	• Design Requirement	• –	• IE, NHAI, and Contractor
Negative Impact on Flora due to Cutting of Trees	• To compensate for 6734 numbers of trees to be cut, 20204 numbers of trees will be planted.	• Design Requirement	• The NHAI will ensure availability of budget to State Forest Department for plantation and consultation that specified numbers of trees are planted. • Ensure availability of budget to State Forest Department for plantation and those specified numbers of trees are planted.	• NHAI, IE, contractor, Forest Department. • NHAI, IE, contractor, Forest Depart-ment
Negative Impact on Fauna	• Additional plantation in RoW shall provide habitat to nesting Avifauna lost due to cutting of roadside plantation. • Construction workers shall be trained about safe handling of animals if found by chance. Cost of training built into training component cost.	• Design Requirement	–	• NHAI, Contractor IE
Occupational Safety and	• Construction workers will be provided with personal protective equipment (PPE)	• MoRTH 111.6	• The contractor will ensure adequacy and availability of	• NHAI, IE.

Environmental Issues/Impacts	Enhancement/ Mitigation Measures	Reference to Contract Documents	Management Action	Implementation Responsibilities
Health	such as earplugs, helmets, safety shoes, gloves, etc.		PPEs.	
Siltation into water Bodies	a) Slit fencing will be provided at the base of the embankment for the entire perimeter of any water body (ponds and flowing surface water bodies) b) Siltation of soil into the water bodies will be prevented as far as possible. The contractor will take all reasonable measures in this case. c) A construction material containing fine particles shall be stored in an enclosure such that sediment –laden water does not go to water body.	• MoRTH : 306	• Conditions will be included in contract document.	• NHAI, IE, Contractor
Torrent Run off	a) No tree or vegetation other than those designated for felling will be cut. The contractor shall take all necessary precautions and construct temporary/ permanent devices to prevent water pollution (due to siltation and increase of turbidity).	• MoRTH: 201.2 • MoRTH: 306.2 & 4	• Conditions will be included in contract document. • Conditions will be included in contract document	• NHAI, IE, Contractor
Alteration of Drainage	b) In selection of water body earth, stone or any construction materials or	• MoRTH: 305.3.7 • MoRTH: 306	• Conditions will be included in contract document.	• NHAI, IE, Contractor

Environmental Issues/Impacts	Enhancement/ Mitigation Measures	Reference to Contract Documents	Management Action	Implementation Responsibilities
	appendage shall be properly disposed off so as not to block the flow of water. c) All necessary measures shall be taken to prevent earthwork, stonework, materials and appendage shall be properly disposed off so far as not to block the flow of water.	• Design Requirement	• Conditions will be included in contract document.	• NHAI, IE, Contractor
Contamination of water from construction wastes	a) All measures will be taken to prevent the wastewater produce in construction from entering directly into water body as directed by IE. b) Construction works on nallahs shall be avoided during monsoon The discharge standards promulgated under the Environmental Protection Act, 1986 shall be strictly adhered to. All waste arising from the bridges is to be disposed off in the manner that is acceptable to the Himachal Pradesh Pollution Control Board and the IE.	• MoRTH 111.1	• Conditions will be included in contract document.	• NHAI, IE, Contractor
Environmental monitoring during Construction Phase	• Ambient air quality to be measure d once in a season (except monsoon) at location specified in	• Contract Requirement	• Records will be maintained for reporting and for future reference.	• NHAI, contractor and IE

Environmental Issues/Impacts	Enhancement/ Mitigation Measures	Reference to Contract Documents	Management Action	Implementation Responsibilities
	monitoring plan.			
	• Water quality (ground and surface) to be monitored once in a season at locations specified in monitoring plan	• Contract Requirement	• Records will be maintained for reporting and for future reference.	• NHAI, contractor and IE
	• Noise levels to be monitored once in a season at locations specified in monitoring plan.	• Contract Requirement	• Records will be maintained for reporting and for future reference.	• NHAI, contractor and IE
	• Soil quality along RoW to be monitored once a season at identified locations.	• Contract Requirement	• Records will be maintained for reporting and for future reference.	• NHAI, contractor and IE
	• Monitoring of construction sites for arrangements made for protection measures at storage areas, drainage arrangement, and sanitation construction camp. • Inspection of construction camps for sanitation	• Contact requirement	• Records will be maintained for reporting and for future reference.	• NHAI, IE and contractor
• **Environmental Enhancement Measures**				
Road side Landscape	• Plantation along the corridor shall be subject to the approval of from State Forest Department. Suitable design as per the land availability shall be provided.	• Design Requirement	• Necessary details of outlines enhanced measures will be included in contract document.	• NHAI,, IE, and Contractor, Himachal Pradesh State Forests Department
Kalka- Shimla UNESCO declared Heritage rail line	• Necessary permission will be obtained from the department of Archaeology to construction of road within 300 m distance of this rail	• Design and Contract requirement	• Necessary permission from department of Archaeology will be obtained in pre construction phase.	• NHAI, IE, and Contractor

Environmental Issues/Impacts	Enhancement/ Mitigation Measures	Reference to Contract Documents	Management Action	Implementation Responsibilities
	line • The contractor will ensure that no damage occurs to this rail line. The contractor will prepare construction methodology to work within 300 m distance from rail line. This methodology will be approved by the Independent engineer. • The elevated portion cum ROB design will need to be approved by the Indian railway authorities.			
Cross drainage and flooding	• Desiltation of drains to avoid water logging will be taken up. Desiltation will be come out before onset of monsoon. • There will be cleaning of culverts also.	• Design Requirement	• Maintenance of records of desiltation as given in EMP will be ensured.	• NHAI
Tunnels construction	• The ventilation and drainage system in tunnels wills provide as per IRC norms.	• Project requirement and MoEF requirement	• The Concessionnaire will design the tunnel and will ensured all safety features drainage and ventilation in tunnel	• NHAI, IE and contractor
OPERATIONAL PHASE				
Increased Air Pollution	• Ambient air quality monitoring at 3 locations specified in monitoring plan	• Project Requirement	• Monitoring frequency is thrice a year for two years (after the completion of construction works) in the operation phase.	• NHAI,
Noise Pollution	• Noise pollution monitoring at locations specified in monitoring plan	• Project Requirement	• Monitoring frequency is thrice a year for two years in the operation phase.	• NHAI,

Environmental Issues/Impacts	Enhancement/ Mitigation Measures	Reference to Contract Documents	Management Action	Implementation Responsibilities
			• Corridor management unit of NHAI will ensure maintenance and to make inspection	• NHAI,
	• Strict compliance for no horn in identified places in design.		• Information about 'No Horn Zone' on the route will be given to state traffic police for compliance.	• NHAI and State Traffic Police
Water Pollution	• Monitoring of surface and ground water quality locations specified in monitoring plan	• Project Requirement	• Monitoring frequency is thrice a year for first two years in operation phase.	• NHAI,
Soil Characteristics	• Monitoring of soil quality of agricultural field close to RoW	• Project Requirement		• NHAI,
Survival of tree plantation and shrubs plantation	• The NHAI PIU unit and State forest department will ensure that there is net survival of trees and plantation on side slopes to the extent of 90 %. Any shortage will made up before onset of monsoon.		• Proper maintenance of avenue trees and vegetation will be taken up.	• NHAI, Forest Department

Table -9.2: Environmental Monitoring Plan for NH 22 (Solan- Shimla)

Environment component	Project Stage	MONITORING						Institutional Responsibilities	
		Parameters	Special Guidance	Standards	Location	Frequency	Duration	Implementation	Supervision
Air	P:re-Construction stage	PM2.5, RSPM(PM 10), SO_2, NO_X, CO, HC	Respirable Dust sampler to be located 150 m (5-6 time of stack height of Hot Mixer Plant). Use method specified by CPCB for analysis	Air (Prevention and Control of Pollution) Rules, CPCB, 1981	1-At proposed location of construction camp	Once prior to start of construction	Continuous 24 hours/ or for 1 full working day	Contractor through approved monitoring agency	IE, NHAI
	Constructionstage	PM2.5, RSPM, SO2, NOx, CO, HC	Respirable Dust Sampler to be located m (5-6 time of stack height of Hot Mixer Plant). Use method specified by CPCB for analysis	Air (Prevention and Control of Pollution) Rules, CPCB, 1981	1- Solan (Start Point) Bypass 2- Shoghi 3- Dhalli (End point of project road)	Thrice in a year (winter, summer and post monsoon seasons) for 3years	Continuous 24 hours/ or for 1 full working day	Contractor through approved monitoring agency	IE, NHAI

Environment component	Project Stage	MONITORING						Institutional Responsibilities	
		Parameters	**Special Guidance**	**Standards**	**Location**	**Frequency**	**Duration**	**Implementation**	**Supervision**
	Operation stage	PM2.5, RSPM, SO_2, NO_x, CO, Pb, HC	Respirable Sampler to be located at 25 m from the edge of pavement	Air (Prevention and Control of Pollution) Rules, CPCB, 1981	1- Solan (Start Point) Bypass 2- Shoghi 3- Dhalli (End point of project road)	Once a season except monsoon for 2 years	Continuous 24 hours	PIU	NHAI
Water Quality	Constructionstage	pH, BOD, COD, TDS, TSS, DO, Oil & Grease and Pb	Grab sample collected from source and analyse as per Standard Methods for Examination of Water and Wastewater	Water quality standards by CPCB	1- Ground Water at start of project road (Solan) 2 Ground water at Shoghi (km 131.150) 3- Ground Water at Dhalli (km 156.000) 4 Samri Nallah	Once in a year before the onset of monsoon every year for 3years	-	Contractor through approved monitoring agency	IE, NHAI
	Operation stage	pH, BOD,COD, TDS,TSS, DO, Pb, Oil and	Grab sample collected from source and analyse as per Standard	Water quality standards by CPCB	1- Ground Water at start of project road (Solan) 2 Ground	Once a season except monsoon for 2 years	-	NHAI	NHAI

Environment component	Project Stage	MONITORING						Institutional Responsibilities	
		Parameters	**Special Guidance**	**Standards**	**Location**	**Frequency**	**Duration**	**Implementation**	**Supervision**
		Grease.	Methods for Examination of Water and Wastewater		water at Shoghi (km 131.150) 3- Ground Water at Dhalli (km 156.000) 4 Samri Nallah				
Noise	Constructionstage	Noise levels on dB (A) scale	Equivalent noise levels using an integrated noise level meter kept at a distance of 15 from edge of pavement	Noise standards by CPCB	Portion of section under construction as directed by the Engineer (maximum three locations) and at location of construction camp and Hot Mix plant (max 2 locations)	Thrice a year for 3 years during the construction period.	Readings to be taken at 15 seconds interval for 15 minutes every hour and then averaged. Readings are to be taken for 24 hours of the day.	NHAI through approved monitoring agency	IE, NHAI

Environment component	Project Stage	MONITORING						Institutional Responsibilities	
		Parameters	**Special Guidance**	**Standards**	**Location**	**Frequency**	**Duration**	**Implementation**	**Supervision**
	Operation stage	Noise levels on dB (A) scale	Equivalent noise levels using an integrated noise level meter kept at a distance of 25 from edge of pavement	Noise standards by CPCB	1 - Solan (km 106.000) Bypass 2- Shoghi (km 131.150) 3- Dhalli (km 156.000)	Once in s season except monsoon for 2 years	Readings to be taken at 15 seconds interval for 15 minutes every hour and then averaged. Readings are to be taken 24 hours.	Contractor through an approved monitoring agency	IE, NHAI
Soil	Constructionstage	Monitoring of Pb, Cr, Cd, CO, NOx	Sample of soil collected to be acidified and analysed using absorption spectrophotometry		1 Agriculture Field near km 108.000(RHS) 2 -Agriculture field near km 128.000(LHS) 3- Agriculture Field near km 156 (RHS),	Once a year for 3years	Grab sample	Contractor through an approved monitoring agency	IE, NHAI

Environment component	Project Stage	MONITORING						Institutional Responsibilities	
		Parameters	**Special Guidance**	**Standards**	**Location**	**Frequency**	**Duration**	**Implementation**	**Supervision**
	Operation stage	Monitoring of heavy metals, oil and grease	Sample of soil collected to acidified and analysed using absorption spectropho-tometry		1 Agriculture Field near km 108.000(RHS) 2 -Agriculture field near km 128.000(LHS) 3- Agriculture Field near km 156 (RHS),	Every non monsoon season for 2 years	Every non monsoon season in operation phase for monitoring turbidity	NHAI	NHAI
		Parameters	**Special Guidance**	**Standards**	**Location**	**Frequency**	**Duration**	**Implementation**	**Supervision**
Soil Erosion	**Construction stage**	Turbidity in Storm water Damages to Retaining wall and Breast wall	Visual observations during site visits	As specified by the engineer Water quality standards	At locations of stream crossings and at locations of retaining wall and breast wall under construction	Pre-monsoon and post-monsoon seasons for 3years		IE	NHAI

Environment component	Project Stage	MONITORING						Institutional Responsibilities	
		Parameters	**Special Guidance**	**Standards**	**Location**	**Frequency**	**Duration**	**Implementation**	**Supervision**
	Operation stage	Turbidity in Storm water Damages to Retaining wall and Breast wall	Visual observations during site visits	As specified by the engineer / Water quality standards	At major water bodies identified by the NHAI.	Every year before onset of monsoon		NHAI	NHAI
Construction Sites and Construction Camps	**Construction Stage**	Monitoring of: 1. Storage Area 2. Drainage Arrangements 3. Sanitation in Construction Camps	Visual observations	To the satisfaction of the PIU and the standards given in the reporting form.	At Storage area and construction camps	Quarterly in the construction stage.		Engineer	NHAI

Environment component	Project Stage	MONITORING						Institutional Responsibilities	
		Parameters	Special Guidance	Standards	Location	Frequency	Duration	Implementation	Supervision
Road side plantation	Pre-Construction Stage	Monitoring of felling of trees	It should be ensured that only those trees that are marked are felled.	As laid out in the Detailed Design for the project	All along the corridor	During the felling of trees	-	Forest Department	NHAI (to assist in co-ordination with the Contractor)
	Operation stage	Survival rate of trees Success of re-vegetation	The number of trees surviving during each visit should be compared with number of saplings planted. Minimum 90 % survival should be ensured	As laid by the concern department.	All along the corridor	Every year for initial 3 years during operation phase.	-	NHAI & Forest Department	NHAI& Forest Department

Table 9.3: Environmental Budget

Component	Stage	Item	Unit	Unit Cost (INR)	Quantity	Total Cost (INR)
Mitigation/Enhancement Measures						
AIR	Construction	Dust Management with sprinkling of water, covers for vehicles transporting construction material	Km	-	Covered in Engineering Costs	
WATER QUALITY		Silt Fencing around soil stockpiled near water bodies	sq. m.	-	Covered in Engineering Costs	
SOIL	Construction	Retaining Wall/ Breast wall	sq. m.		Covered in Engineering Costs	
	Operation	Redevelopment of Borrow areas	sq. m.		Covered in Engineering Costs	
FLORA	Construction	Plantation including Compensatory plantation @ 3 saplings for each tree felled (staggered to follow Civil Works) including 3 years maintenance	No.	500	20202	10101000.00
Water Pollution	Construction	Provision of oil and grease separator pit at Construction camp	No.	100,000	2	200,000.00
CONTAMINATION OF STREAMS AT BRIDGE LOCATION	Construction	Provision of Silt Fencing arrangements on either bank of stream at bridge construction location (4 streams)	No.	100,000	4	400,000
SAFETY	Construction	Demarcating Borrow Areas	m.	-	Covered in Engineering Costs	
(A) Mitigation / Enhancement Costs						10701000.00

Component	Stage	Item	Unit	Unit Cost (INR)	Quantity	Total Cost (INR)
Monitoring Costs (at prevailing market rates)						
AIR	Construction	Monitoring near all hotmix plant locations approved by the Engineer for 3 years	No. of Samples	10,000 for 1 day	18	180,000
		Monitoring at construction sites in tandem with progress in construction including haul roads	No. of Samples	10000 for 1 day	27	270,000
	Operation	At locations of baseline monitoring specified in the monitoring plan	No. of Samples	10,000 for 1 day	18	180,000
WATER QUALITY	Construction	At locations specified in the monitoring plan	No. of Samples	6,000	36	216,000
	Operation	At locations specified in the monitoring plan	No. of Samples	6,000	24	144,000
NOISE	Construction	As directed by the Engineer	No. of Samples	2,000	45	90,000
	Operation	At locations specified in the monitoring plan	No. of Samples	2,000	18	36,000
SOIL	Construction	At Agriculture land	No. of Samples	5,000	27	135,000
	Operation	Monitoring of turbidity	No. of Samples	5,000	18	90,000
Plantation Survival	Operation	Survival and make up for 3 years	Lump sum			1800000.00
(B) Monitoring Costs						**3141,000.00**
TOTAL COSTS (A) + (B)						**13842000.00**
ROUNDED-OFF TOTAL COSTS (INR)						**1,50,00000.00**

CHAPTER - 10
SUMMARY AND CONCLUSION

CHAPTER - 10

SUMMARY AND CONCLUSION

10.1 INTRODUCTION

The Ministry of Road Transport and Highways (MORTH) on behalf of Govt of India engaged in the development of National Highways through the Govt body represented by National Highways Authority to develop the National Highways under NHDP (National Highways Development Programme). As a part of Endeavour the National Highways Authority of India has decided to under take 4 -laning of section from km 106.000 to 156.000 of NH-22, from Solan to Shimla(including Shoghi- Shimla bypass), through Public Private Partnership (PPP) on Design, Build, Finance, Operate and Transfer (the "DBFOT") basis. The project, complementing the NHDP Phase III, seeks to connect high-traffic density stretches, state capitals and tourism centres to the NHDP. The study corridor is the section of NH-22 and lies in the State of Himachal Pradesh connecting to state capital Shimla to Solan (and further down cities of Kalka, Chandigarh, Ambala and Delhi), passing through various industrial and commercial places. The project road length is 50.507 km.

10.2 IMPLEMENTING AGENCY

The National Highways Authority of India (NHAI) is the implementing agency of the project.

10.3 PROJECT LOCATION

Shimla and Solan are two important cities of Himachal Pradesh. Shimla is the capital city of Himachal Pradesh. The National Highway -22 connects Solan to Shimla and this highway also provides connectivity to Kalka, Chandigarh, Panchkula and Ambala in the plain land. The project road passes through two districts namely Solan and Shimla. Project road starting point is Solan (km 106.000) and the termination point is near Dhalli (km 156.000). The project road from km 106.000 to km 132.230 runs in Solan district, from km 132.230 to 156.000 in Shimla district.

The total length of the project road is 50.507 km. Entire project road length is located in the state of Himachal Pradesh.

10.4 TYPE OF PROJECT

The Environmental Regulatory Framework in India is being controlled by “The Environment (Protection) Act, 1986. Under this Act, Environmental Impact Assessment (EIA) Notification - 2006 has been issued by the Ministry of Environment and Forest (MoEF), Government of India. According to this Notification ‘NH -22 section from Solan to Shimla ’ will fall in ‘Category-“A” project and will require Environmental Clearance from MoEF. The project is linear in nature.

10.5 PROJECT DESCRIPTION

The existing road is two-lane configuration. It is planned to widen this road to 4 lane configurations with geometric improvements for free flow of traffic.

The road passes through 16 major settlements, which do not have sufficient RoW to be widened to 4 lane facility hence 2 bypasses for Kandaghat, Shoghi- Shimla-Dhalli (for Shogi, Tara Devi, Kachhighati, Tutikandi, Fagli, Lalpani, New Shimla, Panthaghati, Mehli, Malyana, Shanan Housing board colony. Ranjeet Nagar, Jawahar colony, and Dhalli) have been proposed to avoid these congested settlements and to facilitate uninterrupted movement of traffic. At 7 locations realignment has been given for geometric improvements and also to protect/ save environmentally sensitive places. The proposed improvement will aim at improving riding quality and journey speed and reducing traffic congestion on the highway. The options of concentric widening and left or right side widening has been considered for the improvement project so as to utilize the existing right-of-way (RoW) as far as possible and minimize acquisition of additional land. However, land acquisition will be required through entire stretch as the existing RoW varies only between 12 m to 30 m. Besides the bypasses,

two ROB cum elevated road,11 major bridges 08 minor bridges and 256 culverts (27 widening and reconstruction, 89 to be retained, and 140 new), 1 ROB, 1-toll plaza, 2-truck Lay byes and 15 nos. of bus bays are proposed to be constructed. Four no tunnels have been proposed of km 117.600 to 118.060 , km130.190 to 130.880, 135.930 to 137160 and 156.350 to 156.450.

The total cost of the project has been estimated about INR 17860 millions.

10.6 RIGHT OF WAY (RoW), CARRIAGE WAY AND PAVEMENT

The existing ROW varies between 12 m to 30 m.

The existing carriageway is two-lane flexible pavement with a width of 7.0m. In built up areas width of carriageway is more than 2 lane. . The existing road has earthen shoulder of 0.5 m to 2.5 m on both sides of the road and at majority locations the shoulders width is 1.5m.

10.7 DESCRIPTION OF ENVIRONMENT

The description of the environment is given in **Table 10.1.**

10.8 IMPACTS AND MITIGATION MEASURES

The potential impacts and their mitigation measures are given in **Table 10.2.**

Table 10.1 – Description of Environment

S. No.	PARAMETER	DESCRIPTION
1. Physical Environment		
(i)	Topography	The topography of project influence area is hilly and undulating. The elevation of project road increases towards Shimla. Hence slope is from north to south.
(ii)	Geology	The project road surroundings comprise rocks of Shali formation of Shimla group . The stratigraphic setting of shali formation of rocks from top to bottom consists of the Pamalli member, Marki Member, Tattapani Member, Sorghawari member, Khatpul member, and Khaira member. **Tectonics and Seismic Hazards** All the earthquakes in Himachal Pradesh, as in all of peninsula India, are interaplate events. According to GSHAP data, the state of Himachal Pradesh falls in a region of high seismic hazard zone. It is clear from the above map that entire length of project road falls in Zone- IV of seismic hazards. Hence project road design should take into consideration this aspect.
(iii)	Physiography	The topography of the project area around the project road alignment is gently undulating which becomes medium to highly undulating in Shogi- Shimla- Dhalli bypass alignment. The area forms part of mountainous Himalayan terrain and exhibits a rugged topography. Deep strike valleys towards Dhalli and Shimla are the common physiographic features of project road alignment surroundings
(iv)	Soils	The soils in project area surroundings are generally sandy loam in valley areas and rest of the hilly and mountainous area soils are skeletal, soil depth is generally shallow except in areas having good vegetative covers. The soils are not contaminated with pollutants,
(v)	Mineral Resources	The mineral resources in project area surroundings include sand, mineral water and Stone (Building stone) in solan district and , lead-zic- silver ore, lime stone, pyrites, dolomite and Barites in Shimla District.
(vi)	Borrow Areas	Total 6 borrow areas have been identified for the project.
(viii)	Land Use Pattern	Land use pattern along the project road is of mixed type dominated by, permanent pasture and grazing land agriculture, barren and residential areas.
2. Meteorology		
(i)	Climate	The region experiences typical tropical climate. It is characterized by hot summer season and general dryness except in the southwest monsoon season.
(ii)	Temperature	The maximum temperature during summers ranges from 14ºC to 28.2ºC while minimum temperature from 1.7

S. No.	PARAMETER	DESCRIPTION
		ºC to 14.8ºC during winter monts.
(iii)	Rainfall	The monsoon season spreads from the month of June to September with average rainfall of 1361.50 mm which includes precipitation in the form of snow fall also.
(iv)	Humidity	Humidity range is between 33-91%, monsoon season experience the higher humidity as compared to summer and winter seasons.
(v)	Wind	Winds are generally calm while dust storms occur especially in May and June.
3.	**Air**	The recorded values of SO2, NOx, PM10 and PM2.5 are ND (Not Detected)-11 , 13-18, 31-43, and 8-14 ug/m3 respectively. The concentration of CO has been measured in the range of 0.4- 0.9 PPM. All parameters of air quality are well within the limits of specified standards.
4. Water		
(i)	Water resources	**River Basin** The proposed project crosses the Kathulu Ka Nalla, Kalali Ka Nalla, Samri Nall and Kair ka nalla. The project area and surroundings are part of Yamuna and Satluj river basins. **Surface Water Resources** ▪ The. Kathulu Ka Nalla, Kalali Ka Nalla, Samri Nall and Kair ka nalla **Ground Water Resources** The project area has abundant ground water resource. The base line data indicates that water quality of ground water near RoW is fit for drinking.
(ii)	Water Quality	**Surface Water Quality** Samri Nalla is the only perennial surface water source being crossed by the project road. The base line data indicates that water quality of surface water is fit for drinking. All the parameters of surface water quality are within IS 10500:1991 norms **Ground Water Quality** All the parameters of ground water quality are within IS 10500:1991 norms. The base line data indicates that water quality of ground water near RoW is fit for drinking.
5. Hydrology and Drainage		
(i)	Surface Water Hydrology	The hydrology of the project area in Solan district is governed by the Ghambar and Sirsa rivers and Satluj and tributaries in Shimla district.
(ii)	Ground Water Hydrology	Hydro geologically, the unconsolidated valley fill or alluvial formation occurring in the valley area, semi

S. No.	PARAMETER	DESCRIPTION
		unconsolidated formations belonging to Siwalik group and older consolidated hard rocks form aquifer in the project area. Intergranular pore spaces in the sedimentary formations and secondary fissured porosity in hard rocks , topographical set up coupled with precipitation in the form of rain and snow , mainly govern occurrence and movement of ground water. The ground water potential is not much because of hilly strata.
(iv)	Wetlands	There is no wet land either in the direct or indirect influence area of the project.
6.	**Noise**	The noise levels have been recorded well within the limits of respective land uses. The ranges of Day and Night Leq levels are 50-62 dB (A) and 42- 52.0 dB (A) respectively.
7.	**Biological Environment**	
(i)	Forest	The project road alignment is passing through reserved and protected forests at few locations. The forest area proposed to be acquired is around 30 ha.
(ii)	Flora	Predominant tree species that generally occur within the proposed RoW are *chhal* (*Anoegeissus latifolia*), *Jhingan (Lannea coramandalica), Siric (Albizzia lebback), Albizzia procera, Albizzia odarattissimae, simal (Bambox cieba)pula (kydia calcine), Barnasi (Forenia Limonia, Amaltes (Cassia fistula), Chamror (Ehretia leavis), Sandan (ougania oojensis), Kaim(mitragyna parviflora), kangu (Flacartia indcia), Khair (Acaciacatechu),Iaman (Syzygium cumini), Chilla (Caseria tomentosa),Amla (Emlica Officinalis), Kachnar (Bauhinia spp) Toon (cedrela toona*) in depressions, *Dhaman (Grewia spp), Shingar (Boernemeria regulosa)*, very common seen locally on the moist soils, *Kamal (Mallotus phillippines), Blojho (Sapium insigne), Ber (Zyzyphus mauritiana), Bel (Agle marmelos) and Dhak (Butea monosperma) are* seen in dry patches. *The shrubs seen in study area are Ipomea gossypiolides, capcicum friutscens cassiatora*, etc. The common grasses encountered are *Bhabar (Ishammum augustifolium), Makora (Heteropogon contortus), Dub(Cynodon Dactylon), Dhaulu (Chrysopogon montanatus), Labb (Cymbopogon martini) and Munj (Erianthus munja).* etc. There are no endangered species of flora in the RoW. The alignment of does not pass through orchards and dense tree plantation.There are no endangered species of flora in the RoW.
(iii)	Fauna	There are no endangered species of fauna reported along the existing or the proposed alignment. Most of the faunal species are domesticated like cattle, goats & dogs. Common birds like sparrow and crows are found.
(iv)	Wild Life	No Wildlife Sanctuary or National Park is located in the direct/indirect influence area of the project. No migratory route is reported in the project area.
8.	**Socio-economic environment**	
(i)	Demography	The road passes through Solan and Shimla districts. Solan and Shimla are two important cities of Himachal

S. No.	PARAMETER	DESCRIPTION
		Pradesh. Shimla is the capital city of Himachal Pradesh. About 72 nos. habitations of various sizes are nearby to the right of way. Bypasses are proposed to avoid the major settlements and markets of Shogi, Shimla, and Kandaghat and many habitations along the existing routes
(ii)	Educational Institutes	No educational institute or college are coming in RoW
(iii)	Archaeologically Protected Monuments / Historical &Cultural Structures	There are no archaeological monuments within Right of Way (RoW) of proposed project alignment. However, UNESCO World Heritage Rail Line from Solan to Shimla is running close and parallel to project road from start point to km 131.150 (start point Shogi- Shimla bypass).
(iv)	Industries	The number of factories in Shimla district are 167 employing around 60,000 workers, whereas number of factories in Solan district are 1952, employing 167716 workers. The Solan district ranks number one in industrial establishment. Baddi, Barotiwala is a major industrial hub in the state.
(v)	Agriculture	Agriculture, and fruit production is the basis of State's economy. The State being hilly, the area available or sowing the crops are 13.297% in Shimla and 0.66 % in Solan. The main cultivated areas are found in the foothills of the State.
(vii)	Quality of Life Coefficient	Planning Commission has constructed the quality of life index **(coefficients of quality of life)** for different districts of India Out of the 2 districts in the project area, district of Shimla (being the capital city) shows higher value of index of 0.743,. The quality of life coefficient for Solan district is 0.723. The Human Development Index (HDI) is another parameter used for indication of quality of life. The HDI indices for Shimla and Solan districts are 0.518 and 0.454 respectively.

Table 10.2 – Impacts and Mitigation Measures

S. No	Parameter	Potential Impact	Mitigation Measures
1. Physical Environment			
(i)	Topography	• Change in Topography as certain sections of the highway such as Shoghi- Shimla-Dhalli bypass, Kanda ghat bypass, realignments, approaches to bridges, and ROB at solan	• No mitigation measure is required.
(ii)	Geology	• Low level of impacts through removal of stones aggregate and sand from identified	• No mitigation measure is required.

S. No	Parameter	Potential Impact	Mitigation Measures
		licensed quarries.	
(iii)	Soils	• Physical & chemical contamination of soil. • Compaction and structural damage. • Soil erosion.	• Dumping of construction waste at approved locations. The surplus generated will be dumped at pre identified sites. • Construction waste will be reused in the construction only. • Storage of construction material in accordance with the IRC norms. • Avoiding work during periods of heavy rainfall. • Rehabilitation of borrow areas for productive use. • Conservation of topsoil for reuse in planting pits and rehabilitation of borrow areas, sodding /grass turfing and implementation of soil erosion control plan. • The provisions of breast wall and retaining walls at identified locations. • The construction vehicles and machineries shall move on designated routes only. • All works shall be carried out as per clause no 306 Soil Erosion and Sedimentation Control of SPECIFICATIONS FOR ROAD AND BRIDGE WORKS of Ministry of Shipping Road Transport and Highways.
2. Climate			
(i)	Temperature/ Rainfall/Humidity	• Low spatially restricted short-term impact.	• Plantation will carried out as a part of compensatory afforestation
3. Land			
(i)	Loss of Productivity	• The loss of productive land coming under the Right of way. Total land acquisition for the project is 255 Ha.	• Compensation is to be paid to the land owners as per provisions in the Resettlement Plan prepared for the project. • Benefits will be given to the persons qualifying under Resettlement and Rehabilitation as per Concession Agreements.
(ii)	Induced Development	• Development may take place along the proposed road alignment.	• The NHAI will coordinate with local civic authority to have a watch on unplanned development.
4. Water Environment			
(i)	Surface water	• Flow of Water in river local streams • Degradation of some water quality parameters like pH, COD, BOD, TDS, Turbidity etc.	• The project has a north south alignment and does not obstruct flow of run off to local drainage system • Use of sediment traps, silt fencing, sodding / grass turfing etc. for minimization of soil movement; Retaining wall and breast wall

S. No	Parameter	Potential Impact	Mitigation Measures
		• No impact on availability.	planned in soil erosion prone locations. • Stream flow only to be disturbed for construction of abutments and piers • Provision of adequate cross drainage structures. • Implementation of a protocol for storage of topsoil, construction waste away from water course. etc. • Location of onsite refueling stations away from water resource. • Use of oil/water separators to extract floating. • Monitoring of water quality during construction and operation.
(ii)	Ground water quality	• No ground water source falling in RoW. Ground water potential very poor. No usage of ground water planned in project related activities. •	• Waste water from construction camp will be disposed off properly. No disposal of waste water on open ground.
5. Environment			
(i)	Air	• Increased gaseous pollution along with fugitive dust emissions.	• Asphalt plant, Crusher, Batching Plant, will be sited 1000 m in down wind direction from nearest settlements. • Vehicles and construction equipments to be maintained properly. • Construction materials & waste will be properly covered during transportation to avoid spillage & dispersion. • Construction of bypasses/realignment as a part of project road will relieve population of congested settlements like Shogi, Shimla , Kanda ghat, Tara Devi, Dhalli, wakana Ghat, Kachhi Ghati, Ranjeet nagar, Jawahar colony, New Shimla decrease in pollutants of Ambient Air Quality. • No construction works near habitations in night time
(ii)	Noise	• Construction phase impact low to moderate, spatially restrict ted and reversible. • During operation phase noise levels will increase.	• Construction plant & machinery to be located 1 Km away from settlements. • Construction vehicles and equipments fixed or mobile to be equipped and maintained with effective muffler system. • Proper traffic management near sensitive receptors. • Putting up “no horn” signage near sensitive receptors. • Provision of earplugs to workers. • Noisy construction to be restricted during the hours by

S. No	Parameter	Potential Impact	Mitigation Measures
			10 pm- 6 AM. • Provision of portable sound screens near sensitive receptors during construction phase. • Noise barriers will be provided at sensitive educational and health institutions.
6. Ecology			
(i)	Flora	• 6734 trees impinging on work falling in Right of way will be felled.	• Only those trees which will be directly impinging on work will be felled. • 20202 no of trees will be planted as Compensatory plantation, along roadside in the ratio of 1:3 (three trees in lieu of cutting of one tree) as per state government guidelines for each tree removed.
(ii)	Fauna	• No Wild Life Protected Areas are falling near the project alignment	• No mitigation measures required.
7. Socio Environment			
(i)	Socio Environment	• Displacement of people. • Demolition of Structure. • Loss of land under agriculture. • Influx of construction workers.	• Resettlement of people as per provisions of RAP. • Compensation for loss of land, Structures private, community and public. • Employment of local labour in unskilled and semi skilled sector. • Setting up migrant workers camp at least 1 km away from settlements and providing basic facilities like potable water , ration shops etc.
(ii)	Archeological Monuments / Historical structure.	• No impact is envisaged as no protected monuments are falling in the Proposed Right of Way. • The UNESCO World heritage railway line running very close and parallel to project road at same or different elevation from Solan (km 106.000) to start Point of Shoghi- Shimla bypass (km 131.150)	• No Archaeologically Protected Structure is falling in the Right of Way of the project. • ROB cum elevated portion of about 600 m length planned at Solan. • No project related improvement works planned towards railway line side.
(iii)	Religious Structures/cultural property	• No religious structure falling in RoW	• No mitigation needed, however, during implementation if any religious structure is noticed then relocation / Compensation in consultation with communities. Relocation will be done first and at project cost.
(iv)	Quality of Life	• Positive Impact due to availability of jobs	• Quality of life will be improved due to overall economic development

S. No	Parameter	Potential Impact	Mitigation Measures
			of project implementation.
8. Public Health and Road Safety			
(i)	Public health and road safety	• Psychological impacts of project affected people. • Migration of worker may lead to sanitation problem creating congenial condition for disease vectors. • Discomfort arising of air, noise pollution. Hazards of accident.	• Continued consultation with PAPs and the competent authority for speedier settlements of required compensation package and Resettlement and Rehabilitation benefit. • Ensure sanitary measures at construction camp to prevent water borne disease and vector borne disease. • Provide appropriate personal protective equipments like earplugs, gloves, gumboot, and mask to the work force. • Safe traffic management at construction area.

10.9 ANALYSIS OF ALTERNATIVES

The analysis of alternatives for the project road was carried out for "With Project Scenario" and "Without Project Scenario", "With and Without Environment Management Plan". It is found that Project is acceptable with Environment Management Plan. The minor adverse impacts would be manageable to an acceptable level by implementing Environmental Management Plan, due this EIA with EMP has been considered an acceptable and justified option. For realignment and bypasses 3 options have been evaluated and option having minimum environmental and social problem has been opted. The widening schedule has also been finalised to minimise tree cutting in the existing RoW and to have minimum impact on properties.

10.10 PUBLIC CONSULTATIONS

The public consultations were carried out at local, district and State level as well as at Institutional levels involving the direct and indirect stakeholders of the project. The consultations involved the project affected persons, government officials including officials of the revenue department, officers of forest department, officers of PWD and senior decision makers. The following table gives the issues raised and their addressal in project design.

S. No	Issue Raised / Discussed	Addressal in Project Design
1	Requirements of Forest and Environment Department should be followed in finalisation of Alignment.	Project road alignment finalised to minimise forest land acquisition. Alignment also does not affect any ASI protected monument.
2	Nature and quantum of compensation to be paid for acquisition of land and properties	The compensation to all project affected persons whose properties and land are being acquired will be paid as per provisions in the R&R Plan.
3	No use of hazardous waste and municipal solid waste in embankment filling.	Hazardous waste and municipal waste will not be used in the construction of the embankment.
4	Hot Mix Plant, construction camps, and labour camps, should be located at safe distance form habitations.	The Hot Mix Plant will be located in accordance with guidelines of Himachal Pradesh Pollution Control Board.
5	Will habitations be avoided in RoW?	All major habitations have been avoided in the RoW by proposing bypasses and realigning the existing alignment. Only 210 ha land will be acquired that is unavoidable. Out of this 46 ha is Government land and 164 ha is private land.
6	Green Belt should be developed on either side of the road in the RoW	There will be plantation of tree on both the sides of the road within the RoW.
7	Tree cutting should be avoided and compensatory plantation should be made. Permission for tree cutting should be obtained from forest department	The compensatory plantation will be carried out in the ratio of 1:3 (i.e three trees will be planted for every tree cut.) Permission for tree cutting will be obtained from the concerned authorities.
8	Accident relief centres, truck lay byes etc. Should be provided in the design of the Project.	Two trucks lay byes and one relief centre has been provided in the design.

S. No	Issue Raised / Discussed	Addressal in Project Design
9	Pollution should be controlled during construction.	Implementation of Environment Management Plan will ensure that pollution load is not increased due to project construction.

10.11 ENVIRONMENTAL MONITORING/MANAGEMENT PLAN

Environmental management plan has been prepared for mitigation/ management/avoidance of the potential adverse impacts and enhancement of various environmental components along the project road. For each mitigation measure to be carried out its location, time frame, implementation and overseeing/ supervising responsibilities have been identified. Monitoring plan for construction and operation phase have been framed to ensure effective implementation EMP

10.12 BENEFITS OF THE PROJECT

The project will have multiple benefits. It will reduce the travel time substantially between Solan and Shimla, the two primate cities of Himachal Pradesh. In addition the improved road will provide other benefits like

- Fast and safe connectivity resulting in savings in fuel, travel time and total transportation cost to society;
- Employment opportunity to people;
- Development of local industry, agriculture and handicrafts;
- Development of tourism and pilgrimage;
- Transporting processing and marketing of agricultural products;
- Reduction in accidents;
- Reduction in pollution;
- Opening up of opportunities for new occupations;
- Better approach to Medical & Educational services and quick transportation of perishable goods like fruits , vegetables and dairy products; and
- Improved quality of life for people and so on.

10.13 CONCLUSION

The proposed project will have multiple benefits in terms of economic development and fast connectivity. All environmental impacts identified and assessed are manageable to acceptable levels by implementing environmental management plan.

CHAPTER – 11

ROAD SAFETY MANAGEMENT AND TRANSPORTATION OF HAZARDOUS CHEMICALS AND WASTES

CHAPTER – 11

ROAD SAFETY MANAGEMENT AND TRANSPORTATION OF HAZARDOUS CHEMICALS AND WASTES

11.1 PREAMBLE

The 4 laning is aimed at reduction in travel time and vehicle operation costs. Often improved roads result in fatal accidents. In order to reduce accidents design of project roads has built in safety features. In order to provide safety measures a safety audit was undertaken by the project design team including environmental specialist. The safety audit outcomes have been summarised below in the subsections.

11.2 SAFETY AUDIT OUTCOMES

The location specific safety issues identified during safety audit are summarized below.

Existing Chainage		Length (m)	Design Chainage		Length (m)	Issue Identified
From	To		From	To		
106.000	106A.755	1.755	106.000	107.740	1.74	Both side habitation in Solan town and rail line parallel to Road on LHS
106A.755	108.410	1.655	107.740	108.890	1.15	Habituated area of Salogara village and IRC non conforming geometry in the existing route
108.410	109.000	0.590	108.890	109.210	0.320	Habituated area to right side and IRC non conforming geometry
109.000	109.480	0.480	109.210	109.530	0.320	Habituated area and IRC non conforming geometry to existing route
109.480	110.120	0.640	109.530	110.0520	0.520	IRC non conforming geometry
110.120	110.720	0.600	110.050	110.500	0.450	IRC Non conforming Geometry
110.720	111.000	0.280	10.750	111.600	0.850	Habituated area and IRC non conforming geometry
111.000	111.920	0.920	110.750	111.600	0.850	Constraint in widening on left side
111.920	112.430	0.510	11.600	112.100	0.500	Non Conforming IRC Geometry
112.430	112.800	0.370	112.10	112.280	0.180	Habituated area on left and IRC non conforming geometry)
112.800	113.830	1.030	112.280	112.910	0.630	Realignment to Right with geometric improvements
113.830	115.000	1.170	112.910	113.945	1.035	Constraint in widening to right side and poor road geometry
115.000	118.700	3.700	113.945	116..365	2.42	Habitated area of Kanda Ghat town on either side of road. In adequate

Existing Chainage		Length (m)	Design Chainage		Length (m)	Issue Identified
From	To		From	To		
						availability of RoW for requisite widening.
118.700	120.220	1.52	116.365	117.750	1.385	Left side space not available for widening and poor road geometry
120+220	120+635	0.415	117+750	118+020	0.27	In adequate RoW and widening not possible
120+635	121+060	0.425	118+020	118+300	0.28	Left side habitation and poor IRC Geometry
121+060	121+430	0.37	118+300	118+530	0.23	Constraint in widening to right side
121+430	123+075	1.645	118+530	119+950	1.42	Constraint in widening to left and poor IRC Geometric
123+075	123+650	0.575	119+950	120+450	0.5	In adequate Right of way for widening and poor road geometry
123+650	124+950	1.3	120+450	121+450	1	Poor road geometry
124+950	128+725	3.775	121+450	124+450	3	Poor road geometry
128+725	129+390	0.665	124+450	124+900	0.45	In adequate RoW and Poor road geometry
129+390	131+150	1.76	124+900	126+392	1.492	Poor Road Geometry
131+150 156.420	141+100 159+050	41.2	126+392	153+312	26.92	Congested settlements of Shogi (134.000 to 136.000), Tara Devi (km 140.500 to 142.000), Kachhi Ghati (142.000 to 145.000), Tutikandi, Fagli and Lalpani on Shimla Bypass (0.000 to 6.000), Khalini (km 6.000 to 7.000 on Shimla Byapss), New Shimla (km 7.000 to 8.000 on Shimla Bypass), Vikas Nagar and Kasumpti (km 8.000 to 11.000 on Shimla bypass), Pantha Ghati (km 11.000 to 13.000 on Shimla Bypass), Mehli (km 13.500 to 14.5000 on Shimla Bypass), Malyana (km 17.000 to 17.500 on Shimla Bypass), Shanan Housing Board Colony (km 18.500 to 19.500), Jawahar Colony & Ranjeet Nagar (km 20.200 to 22.500) and

Existing Chainage		Length (m)	Design Chainage		Length (m)	Issue Identified
From	To		From	To		
						Dhalli (km 153.150 to 154.700)

Based on above audit, the improvements were planned and these are as described below:

Existing chainage		Length (m)	Design chainage		Length (m)	Widening Side
From	To		From	To		
106.000	106A.755	1.755	106.000	107.740	1.74	Concentric Widening and ROB
106A.755	108.410	1.655	107.740	108.890	1.15	Salogara Byapss with IRC conforming geometry
108.410	109.000	0.590	108.890	109.210	0.320	Left Widening and geometric improvements
109.000	109.480	0.480	109.210	109.530	0.320	Realignment to left with proper geometry
109.480	110.120	0.640	109.530	110.0520	0.520	LHS widening
110.120	110.720	0.600	110.050	110.500	0.450	Concentric widening with geometric improvements
110.720	111.000	0.280	10.750	111.600	0.850	Realignment to left with proper road geometry
111.000	111.920	0.920	110.750	111.600	0.850	Widening on RHS and proper road geometry
111.920	112.430	0.510	11.600	112.100	0.500	Concentric Widening with geometric improvements
112.430	112.800	0.370	112.10	112.280	0.180	Realignment to Right
112.800	113.830	1.030	112.280	112.910	0.630	Realignment to Right with geometric improvements
113.830	115.000	1.170	112.910	113.945	1.035	Left widening with geometric improvements
115.000	118.700	3.700	113.945	116..365	2.42	Kandaghat bypass
118.700	120.220	1.52	116.365	117.750	1.385	Right widening with geometric improvements
120+220	120+635	0.415	117+750	118+020	0.27	Realignment to left
120+635	121+060	0.425	118+020	118+300	0.28	Right Widening with Geometric Improvements
121+060	121+430	0.37	118+300	118+530	0.23	Realignment to left with Geometric Improvements
121+430	123+075	1.645	118+530	119+950	1.42	Right Widening with Geometric Improvements
123+075	123+650	0.575	119+950	120+450	0.5	Realignment to left with proper road geometry
123+650	124+950	1.3	120+450	121+450	1	Left Widening with Geometric

Existing chainage		Length (m)	Design chainage		Length (m)	Widening Side
From	To		From	To		
						Improvements
124+950	128+725	3.775	121+450	124+450	3	Geometric Improvements
128+725	129+390	0.665	124+450	124+900	0.45	Realignment to left with proper road geometry
129+390	131+150	1.76	124+900	126+392	1.492	Geometric Improvements
131+150 156.420	141+100 159+050	41.2	126+392	153=312	26.92	Shogi-Shimla-Dhalli Bypass to avoid huge demolition in built up areas.

In order to avoid coverage of shoulder by the traffic for parking, 2 Truck Lay byes have been planned on the on the project road at km 118.000 and at km 138.150. One Toll Plaza has been proposed at km 112.000. There will be medical centre, ambulance facilities and emergency assistance at the Toll Plaza.

11.3 TRANSPORTATION OF HAZARDOUS CHEMICALS AND WASTES ON SOLAN-SHIMLA ROAD

The handling, transport and storage of hazardous material is governed by "Manufacture, Storage and import of Hazardous chemical Rules, 1989" and amendments till date. Similarly handling, Storage and disposal of hazardous wastes is governed by or the Hazardous wastes (Management and Handling) Rules, 1989. The Concessionaire on random basis will check compliances with statutory permits at entry points. The checks will include valid license of Chief Controller of Explosives, safety systems on Tankers, Drivers awareness about material being transported and actions to be taken by him in the event of emergency.

11.4 EMERGENCY RESPONSE PLAN

The Contractor shall prepare an Emergency Response Plan for all work sites as a part of the Contractors' Safety Health and Environment (SHE) Plan. The plan shall integrate the emergency response plans of the Contractor and all other subcontractors. The Emergency Response Plan shall detail the Contractor's 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.

The contractor shall ensure that an Emergency Response Plan is prepared to deal with emergencies arising out of:

i) Fire and explosion
ii) Collapse of lifting appliances and transport equipment
iii) Collapse of building, sheds or structure etc.
iv) Gas leakage or spillage of dangerous goods or chemicals
v) Bomb threatening, criminal or terrorist attack
vi) Drowning of workers
vii) Landslides getting workers buried floods, Earthquake, storms and other natural calamities

Arrangements shall be made for emergency medical treatment and evacuation of the victim in the event of an accident or dangerous incident occurring, the chain of command and the responsible persons of the contractor with their telephone numbers and addresses for quick communication shall be adequately publicized and conspicuously displayed in .Contractors shall require to tie-up with the hospitals and fire stations located in the neighborhood for attending to the casualties promptly and emergency vehicle kept on standby duty during the working hours for the purpose.

Contractor shall conduct an onsite emergency mock drill once in every month for all his workers and his subcontractor's workers. It shall be the responsibility of the contractor to keep

the Local Law & Order Authorities informed and seek urgent help, as the case may be, so as to mitigate the consequences of an emergency. Prompt communication to NHAI, telephonically initially and followed by a written report, shall be made by the contractor.

11.5 HEALTH OF WORKERS

Pre employment health check up

General:

A pre-employment health check up is the medical examination conducted when a potential employee applies for a job. It should be designed to assess general fitness as well as the susceptibility of the worker to any particular hazard he/she may encounter on the job.

The Contractor shall ensure that the following examinations are carried out:

A. Complete physical check-up of the worker

B. The doctor will record the medical history of the employee, including previous sickness or present conditions, medications, and therapies. The usual tests like blood tests, x-rays, urine, and stool exams

Records:

The following records shall be maintained by the Contractor:

I. Records containing details of employees, work done, hours worked, rest, wages, receipts in the prescribed form should be maintained.
II. Medical examination of every worker in hazardous jobs before assignment and records to be maintained annually.
III. Register of workers containing workers name, work, group, relay etc.
IV. Certificate of fitness of the workers that is to be granted by certifying surgeon after examination to be renewed every 12 months.
V. Notice of accidents for death and injury and enquiry status for every month.
VI. Documents containing certain dangerous occurrences of bodily injury or disability or not and notices that are sent by the Contractor and Manager to the authorities as per prescribed form and time.
VII. Notice of diseases which are to be sent by Medical Practitioner to the Chief Inspector giving name, address, disease of patient, and name and address of factory.
VIII. Safety and occupational health surveys to be undertaken by Chief Inspector, DGFAS, DGHS, or their authorized officers at their discretion

Provision of facilities

The facilities to be provided by the Contractor are:

I. Ventilation and temperature

A. Adequate ventilation by the circulation of fresh air.
B. Comfortable temperature to prevent injury to health at the construction site.

II. Overcrowding

A. No room shall be overcrowded that can cause injury to the health of workers.
B. At least 14.2m2 area has to be provided for each worker.

III. Drinking water

A. Effective arrangement and maintenance at suitable points for sufficient marked supply of wholesome drinking water.
B. All such points shall be legibly marked as “Drinking Water” and such point shall be situated at more than 6m from any source of contamination.
C. Cool drinking water during summer for sites employing more than 250 workers.

IV. Latrine and Urinals

A. Conveniently located and sufficient latrines and urinals which are accessible to workers at all times.

B. Separate enclosed accommodation for male and female workers.
C. Such accommodation should be adequately lighted and ventilated and should not be directly connected to the work room.
D. Clean and sanitary conditions at all times.
E. Sweepers are to be employed to keep the facilities clean.

Provision of medical staff:

The Contractor shall give special attention to the provision of medical staff as follows:

I. For more than 500 workers, an ambulance room in the charge of such medical and nursing staff as prescribed by the State government shall be provided and maintained.
II. A qualified Doctor, Nurse and Assistant Nurse shall be in attendance at the first aid base during all times when work is being undertaken on the site.

11.6 TRAINING

The Contractor shall organize regular safety training courses to acquaint Managers, Supervisors, workers and other personnel in the principles of work safety, implementation of mandatory safety provisions, and how to audit and improve safety performance.

Training Facility

I. The Contractor shall determine the training requirements for all the employees and initiate a training programme to demonstrate that all persons employed, including subcontractors, are suitably qualified, competent, and fit to implement safety provisions. This will include:

A. Detailed job descriptions for all personnel to include their specific safety responsibilities.
B. Specification of qualifications, competency and training requirements for all personnel.
C. Assessment and recording of training needs for all personnel, including subcontractors' employees in the workforce, vendor representatives, and site visitors.
D. A system for assessing the competence and training requirements of newly hired persons.
E. A safety protocol for evaluating and confirming that the system is effective.
F. A matrix and schedule of training requirements covering general, task–specific, and SHE-related training, showing the training frequency and the interval between refresher courses.
G. Timely, competent delivery of training courses by certified instructors.

II. The Contractor shall arrange training programmes for all executives in how to identify, recognize, and eliminate unsafe acts and unsafe conditions.
III. The refresher-training programme of all employees shall be conducted once in six months.

Tool Box Meeting

The Contractor shall ensure that:

A. Toolbox meetings and trainings are conducted on site on a daily basis by safety managers and supervisors.
B. On-the spot practical skill development training on safety including scaffold safety, crane safety, welding safety, electrical safety, and traffic safety for marshals shall also be conducted for all foremen/ workmen associated with the concerned jobs.
C. Daily Safety Oath is to be administered to every employee including all workmen to remind them about their responsibilities to themselves and fellow workers.
D. All vehicle drivers including Hydra operators shall be trained on defensive driving attaining centers. All vehicle drivers shall also undergo refresher training on defensive driving provided by the same institute once in 6 months.

11.7 SAFETY PROMOTION

Auditing

I. Objectives of the safety audit

- To find out the contractual compliance level in quantitative terms exclusively for safety aspects. The safety here covers traffic safety, construction safety, workers and work zone safety, occupational safety, temporary structures safety, mechanical, electrical, plant and

equipment and fire safety. It does not however include safety considerations during the design stage.

- To identify good practices and adopt them in future.
- To identify poor practices and eliminate them from the worksite.

II. Audit Procedure

The Contractor has to ensure that the audit team briefs the work package Team regarding the purpose of the audit, methodology of audit, and the terms of reference of the audit team B. After the briefing by the audit team, the leader of the work team makes presentation before the audit team. The presentation should cover the topics mentioned below:

A. General:

a. Project description (consisting of project start date, likely completion date, and percentage progress)
b. Major activities in progress and their location in terms of their chainage
c. Major plant and equipment deployed by the Contractor of the work package

B. Safety Management

a. Establish safety system and procedures
b. Prepare safety policy
c. Appoint safety officer
d. Set up safety committee
e. Plan for worker's/ visitor's induction
f. Provision for Personal Protective Equipment (PPE)
g. Job safety analysis
h. Training programs conducted in safety
i. Accident reporting
j. Accident investigation process
k. Safety data sheets

C. Other Aspects

a. Fire safety provisions
b. Electrical safety provisions
c. Mechanical safety provisions
d. Dust control
e. Storage, transportation, handling process
f. Road side resident safety norms
g. First aid and emergency response arrangement
h. Construction accident records at site
i. Details of environmental officers, qualification and experience
j. Details of safety officers, qualification and experience
k. Labour camp arrangement

III. Identification of work-zones

A. The audit team members are equipped with a check list covering different aspects related to safety. Against each of the checklist items, the compliance/non-compliance is recorded. While some of the activities would be audited at all locations, for some of the subgroups only sample auditing would be done. The sample audit takes place only for plant and machinery items and appliances. The sample size should be about 20% of the existing stock, subject to a minimum of two for each of the plant and machinery items and appliances
B. Besides recording the compliance/non-compliance, the audit team should also record the good and bad practices prevailing at site with reference to safety aspects
C. The audit team computes the contractual compliance of safety provisions after the completion of audit of different activities
D. The audit team conducts a closure meeting at the work package office and shares the findings of audit with the work package team in the presence of the Contractor

11.8 HAZARD IDENTIFICATION, RISK ASSESSMENT AND CONTROL MEASURES

I. General: The purpose of hazard identification and risk assessment is to identify all the significant hazards prior to the commencement of any potential high-risk operations, which may occur during the operations, and to rank them according to their severity. Having ranked the risks the Contractor shall then take measures to mitigate the effects of that risk by recording his findings on appropriate worksheets that show what measures the Contractor is going to take to remove or reduce the level of risk to acceptable levels.

II. Safety principles: The basic principles that govern the identification of and protection from hazards, in order of priority, are:

A. Remove

B. Reduce

C. Protect

Thus the Contractor, having identified the risk and ranked it according to severity, has to first take steps to remove the risk itself. If this step leaves behind some residual hazards, then the attempt has to be to reduce it to acceptable levels. Only in the last resort is the worker to be issued with personal protective equipment (PPE) so that he/she can function in an unsafe environment.

III. General precautions to be maintained by the Contractor: Ensure health, safety and welfare of all workers while at work, including:

A. Maintenance of safe systems and without risks to health
B. Safe use, handling, storage and transportation
C. Information, instruction, training and supervision for health and safety
D. Maintenance of means of safe access and egress
E. Safe working environment
F. Provision of Safe articles for use and without risks to workers
G. Necessary tests and examination for the use of articles before works
H. Adequate information for the use of articles in factory
I. Elimination/minimization of risks to health and safety wherever necessary
J. Application of suitable methods for prevention and accumulation of dust and fumes
K. Exhaust system for extracting toxic fumes and dust
L. Fencing system for every dangerous and moving part; all moving parts shall be enclosed
M. Striking gear and devices for cutting off power in an emergency .Safe working speeds not to be exceeded for any revolving machinery.

11.9 RELEVANT IRC SPECIFICATIONS

The NHAI has prepared a safety manual for construction and design. It recommends following specifications of IRC for the follow up:

- Traffic Control and safety – IRC: SP: 55 2001
- For Installation of Traffic Control Devices – IRC: SP:55 2001 (p 9)
- For Traffic management Practices – IRC: SP: 55 2001 (p 24)
- For Safety in Road Construction – IRC -58 and IRC-15

11.10 CONCLUSION

It is concluded from the above description that enough safety measures have been built in to design for safe travel of road users on Solan- Shimla section of NH-22. . The Independent Engineer (IE) will ensure compliance with Safety Manual provisions of NHAI during construction.

CHAPTER – 12
DISCLOSURE OF THE CONSULTANTS INVOLVED

CHAPTER – 12
DISCLOSURE OF THE CONSULTANTS INVOLVED

12.1 PREAMBLE

This chapter provides information about background and experience of consultancy firm and Professionals of preparation team.

12.2 ENVIRONMENTAL IMPACT ASSESSMENT STUDY - CONSULTANCY FIRM

The EIA study of Solan- Shimla section of NH-22 has been awarded to Engineering and Technological Services, Delhi as a partner of Consortium led by Meinhardt Singapore Pte Ltd.. The brief of organization is as given below:

Engineering and Technological Services (ETS) was established in 1992 to provide consultancy in the field of environmental management

M/s MEINHARDT Singapore PTE Ltd. has their office in Singapore. and regional office at NOIDA (INDIA). They have capability in the field of Highway and Structure.

Esteemed Clients

We are encouraged by increasing number of satisfied clients, which could be possible due to our dedication, on time delivery and quality of services.

- **International Funded Institutions/Organization:** ADB (Asian Development Bank), World Bank etc., United Nation Industrial Development Organization (UNIDO), etc.
- **Govt. Institutions:** MOEF (Ministry of Environment & Forests), National Highways Authority of India (NHAI), State PWD's and Delhi Tourism Department.

12.3 TEAM OF CONSULTANTS

12.3.1 Dr. B.P. Murithy

Dr. B.P. Murithy is a retired Professor from School of Environmental Sciences, Jawahar Lal Nehru University, and New Delhi. He has an experience of over 40 years in the fields of Meteorology and Air Quality Predictions through Mathematical Modelling. In the current project Dr. B.P. Murithy has contributed for Air Quality data analysis for study and Mathematical Modelling for Air Quality predictions and noise level predictions for operation phase of the project.

12.3.2 Mr. Shreeniwas Verma

Mr. Shreeniwas Verma has an experience of over 24 years in the field of environmental impact assessment, Risk Analysis and Disaster Management Plan, and Air Quality data Interpretation. Mr. Verma has completed more than 40 environmental impact assessment studies of road and urban development projects. Some of the projects he has worked are funded by multilateral funding agencies such as Asian Development Bank, World Bank, DFID and JBIC. Mr. Verma has coordinated the study of the project.

12.3.3 Mr. Arup Khan

Mr. Arup Khan is a Social expert and has an experience over 20 years in the field of Social Impact Assessment of Industrial and Infrastructure Projects. Mr. Arup Khan has collected baseline socio-economic data of project influence area and she has analyzed this data for making it in presentable form in the EIA study.

12.3.4 Dr. Seema Shrivastva

Dr. Seema Shrivastva is Doctorate in Zoology from Kanpur University and has an experience of over 20 years in the field of aquatic fauna, flora and biodiversity. Dr. Seema has provided input in Biological Environment Section of EIA report.

12.3.5 Mr. Kirti Bas

Mr. Kirti Bas has passed out M.A. in Geography from Delhi School of Economics, Delhi

Mr. Kirti Bas has passed out M.A. in Geography from Delhi School of Economics, Delhi University and has experience of over 15 years in the EIA studies of road projects. Mr. Bas has contributed in landuse data analysis of RoW and project influence area. Mr. Bas also contributed in collection of baseline information on Geology, Physiography, soils in study area for the EIA study.

12.3.6 Ms. Diksha Tewari

Ms. Diksha Tewari has passed out M.A in Geography from Delhi School of Economics. She is currently Reader in Delhi University. Ms. Diksha Tewari has contributed to Quality of Life/Human Development Index aspects in socio-economic environment.

12.3.7 Dr. S.N.A. Rizvi

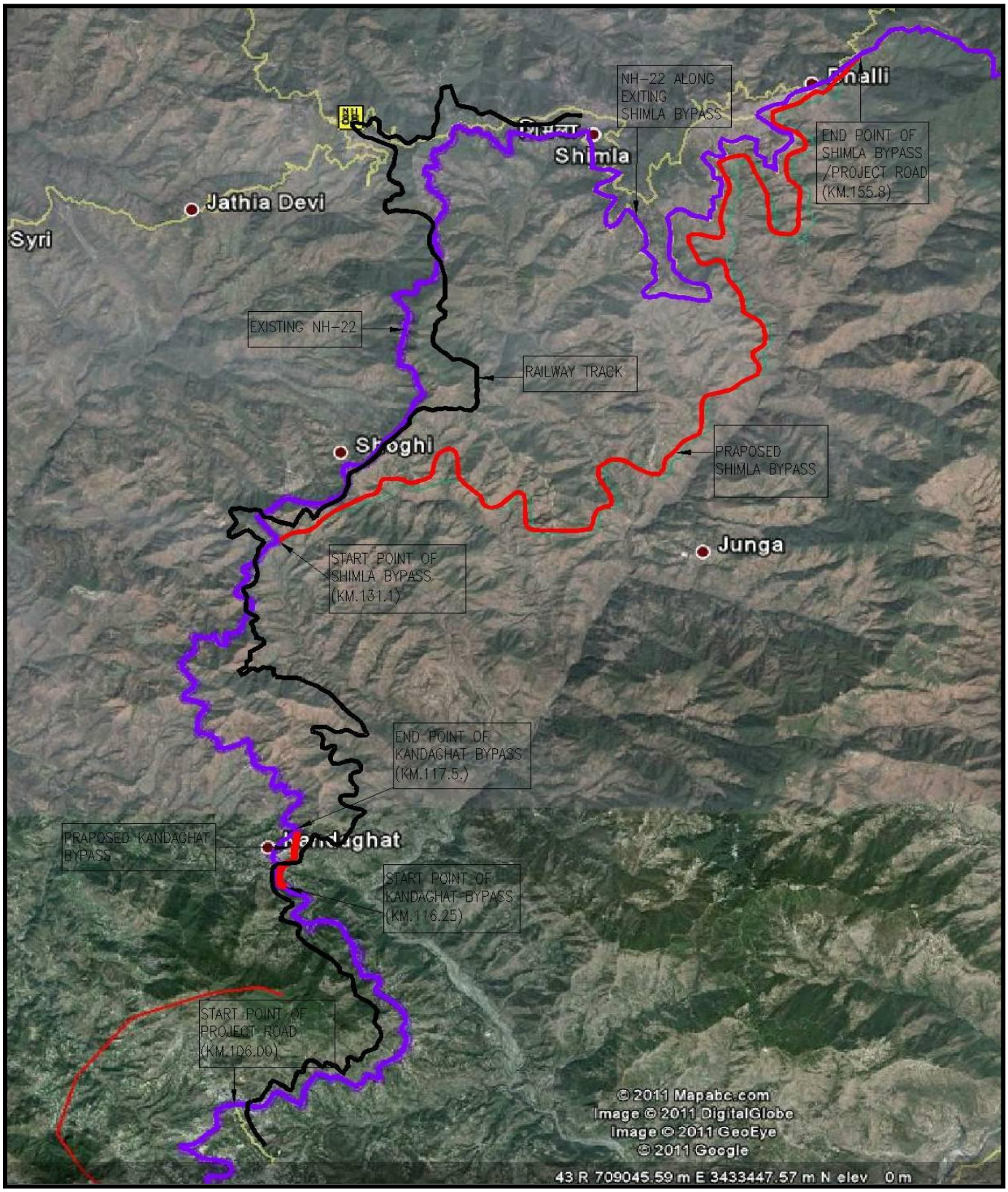
Dr. Rizvi has done his doctorate in Chemistry from Aligrah Muslim University. Dr. Rizvi has an experience of about 24 years in the field of environmental monitoring and sample testing. Dr. Rizvi has been involved in environmental monitoring of project road..

12.3.8 Ms. Bhawna Joshi

Ms. Bhawna Joshi is graduate in Business administration . She has experience of more than 3 years in data processing, report compilation and word processing. Ms. Bhawna Joshi has handled the report processing on computer.

ANNEXURE-1

Annexur-1: Project location and Alignment on Google Map



ANNEXURE 2

Finalisation of ToR for widening and improvement of the existing 4 lane alignment of Solan Shimla section of NH-22 in the State of Himchal Pradesh by M/s NHAI [F.No. 10-121/2011-IA-III]

The project road starts at Solan at km 106.000 of NH-22 and ends at Dhalli at km 156.507 (Design Chainage) of NH- 22. The project road passes through hill area. The entire length of project road falls in the State of Himachal Pradesh. Major settlements along the project road are Solan , Kandaghat, Waknaghat , Shoghi, Taradevi, Kachhighati, Shimla city and Dhalli. The project road passes through Solan and Shimla districts of Himachal Pradesh. The total revenue villages in the entire length of alignment are 72. The project road does not pass through protected areas e.g. National Park, Sanctuaries, and animal habitations. The project involves diversion of about 30 Hectares Protected forest land. The existing highway is 2 lanes. The project road is close to Kalka-Shimla rail line which UNESCO is declared heritage Rail line. The existing RoW varies from 12 to 24 m. The proposed RoW is 45 m. The existing length of the project corridor is 66.930 km and total length of the proposed project alignment is 50.507 km. The existing road there are 3 minor bridges and 185 Culverts. The proposed number of Major/Minor Bridges/Viaduct and culverts are 22 and 240 respectively. The project plans to provide tunnels at four locations. It is also proposed for 15 bus bays, one toll plaza and 2 truck lay byes. The planned improvements are 4 lane divided carriageway in the entire length of 50.507 km. Two bypasses have been proposed at major habitations of Kandaghat and Shogi-Shimla-Dhalli. These bypasses have been recommended due to environmental and social considerations. The bypasses planned and their lengths are as follows: Kanda Ghat Bypass -1.360 km, Shoghi-Shimla Bypass - 27.500 km. Realignments are proposed at few locations of existing alignment to improve the geometrics. Proposed safety measures include 2 to 5 m high breast walls at deep cut locations, 2 to 12 m high retaining walls at fill locations, junction improvements at all major junctions, blinker signals at all major intersections and road studs and hazard markers/delineators at intersections and curves. The safety features have been planned as per IRC: SP: 48-1998 - Hill Road Manual. The total land requirement for bypasses, realignments and widening of existing road has been estimated as 255 Ha. This land includes about 180 Ha private land, and balance 75 Ha government land.

About 6800 trees exist in the proposed RoW. However, bare minimum 6000 (approx) trees proposed to be felled for widening and improvement of four laning. The water requirement during construction is estimated as 600 kLD for dust suppression, domestic consumption and construction. This will be taken from local streams/small falls. About 250 structures completely and 100 structures partially to be affected. The NHAI shall compensate to the authorised owners as per NH Act 1956. There is no provision of usage of fly ash as there is no coal based power plant in 100 km radius. The avenue plantation will be carried out as per IRC SP 21: 2009 apart

from statutory requirement. Total project cost is INR 2300 Crorers (TPC). The EMP cost is INR 46 Croreres. The rehabilitation and resettlement cost is INR 115 Crores approximately.

During the discussions, the Committee finalized the following additional TOR for further study:

(i) The project required 4 tunnels of 2.84 km. examine and submit the stability of slopes, control of soil erosion from embankment, the details of the tunnel and locations of tunneling with geological structural fraction, .

(ii) Examine and submit the details of Ventilation, drainage ,Noise and vibration management measures in the tunnel area.

(iii)The proposal requires 30 ha Protected forest land . Necessary Stage-I permission for diversion of forest area shall be submitted.

(iv) It is indicated that 6800. nos. *trees are proposed to be cut, the information should be provided about their species and whether it also involved any protected or endangered species. Necessary green belt shall be provided on both side of the highway with proper central verge and cost provision should be made for regular maintenance.*

iii) The additional ToR and General Guidelines as per the annexure-I and Annexure-II respectively to this Minutes shall also be considered for preparation of EIA/EMP.

iv) Submit the details of the road safety audit and plans for meeting the IRC safety requirements.

Any further clarification on carrying out the above studies including anticipated impacts due to the project and mitigative measure, project proponent can refer to the model ToR available on Ministry website "http://moef.nic.in/Manual/ Highways*".*

Public hearing to be conducted for the project as per provisions of Environmental Impact Assessment Notification, 2006 and the issues raised by the public should be addressed in the Environmental Management Plan.

A detailed draft EIA/EMP report should be prepared as per the above additional TOR and should be submitted to the Ministry as per the Notification.

ANNEXURE-3

Annexure-3: Terms of Reference Compliance in the EIA Report

Terms of Reference Point	Compliance
The project required 4 tunnels of 2.84 km. examine and submit the stability of slopes, control of soil erosion from embankment, the details of the tunnel and locations of tunneling with geological structural fraction, .	The details of tunnel and tunnel locations are given in **Section 2.5.1.9.** In order to prevent soil erosion breast wall towards hill side and retaining wall towards valley side has been proposed at erosion prone locations. The locations and details of retaining walls have been covered in **Section- 4.2.5** of EIA report. The geological details have been provided in **Section - 3.5.2.** .
Examine and submit the details of Ventilation, drainage, Noise and vibration management measures in the tunnel area.	The details of ventilation, drainage, noise and vibration management measures in the tunnel area have been covered in **Section-4.6** of EIA report.
The proposal requires 30 ha Protected forest land. Necessary Stage-I permission for diversion of forest area shall be submitted.	The tree enumeration is in progress and forest land is being identified. The forest proposal to respective Divisional Forest Officers (DFOs) of Solan and Shimla will be submitted. Once the permission is received from Forest Department it will be submitted.
It is indicated that 6800. nos. trees are proposed to be cut, the information should be provided about their species and whether it also involved any protected or endangered species. Necessary green belt shall be provided on both side of the highway with proper central verge and cost provision should be made for regular maintenance.	There will be cutting of 6734 number of trees. The species and girth sizes have been mentioned in Section -3.9 of EIA report. The protected tree details have also been provided in this section. There will be plantation of shrubs and trees on side slopes. The shrubs will be planted in the median. The cost provision for these has been included in the EMP budget.
The additional ToR and General Guidelines as per the annexure-I and Annexure-II respectively to these Minutes shall also be considered for preparation of EIA/EMP.	These guidelines have been considered in the preparation of EIA/EMP report.
Submit the details of the road safety audit and plans for meeting the IRC safety requirements.	The road safety audit details and mitigation measures to meet the requirements of safety audit have been covered in **Chapter -11** of the EIA report.
Any further clarification on carrying out the above studies including anticipated impacts due to the project and mitigative measure, project proponent can refer to the model ToR available on Ministry website "http://moef.nic.in/Manual/ Highways".	The ToR has been referred while preparing the EIA report.
Public hearing to be conducted for the project as per provisions of Environmental Impact Assessment Notification, 2006 and the issues raised by the public should be addressed in	The draft EIA report will be submitted to State Pollution Control Board. The issues raised by the public, will be addressed in the EIA report.

the Environmental Management Plan.	
A detailed draft EIA/EMP report should be prepared as per the above additional TOR and should be submitted to the Ministry as per the Notification.	The EIA report after incorporation of comments will be submitted to Ministry of Environment and Forest for the Environmental clearance.

Figure - 3.2: Locations of Air, Water, Soil and Noise Level Monitoring