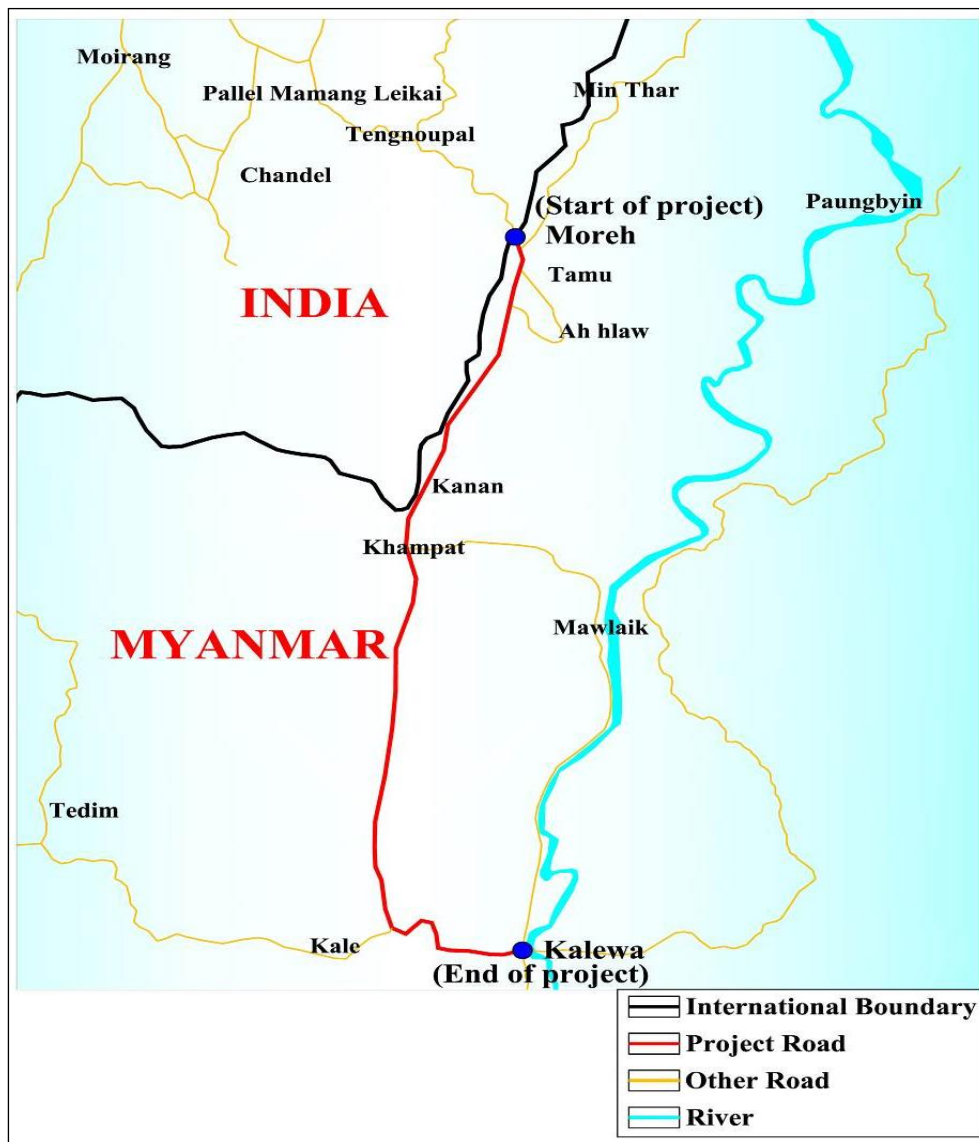




MINISTRY OF EXTERNAL AFFAIRS, NEW DELHI

**Construction of Bridges including approaches on Tamu –
Kyigone – Kalewa road section from km 0.00 to km 149.70
in Myanmar**



ENVIRONMENT MANAGEMENT PLAN

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Chapter 1

Guidelines

1. GUIDELINES

1.1 GUIDELINES FOR FINALIZATION OF ENVIRONMENT MANAGEMENT PLAN BY CONTRACTOR

The information, details, data, EMP and recommendations given in this report are for reference only.

The Contractor shall finalize the Environment Management Plan as per relevant and applicable guidelines best to the Industry practices. The finalized EMP shall assess the Environment and Social Impact of the Project and suggests mitigation measures to be implemented at Project. The Contractor shall implement the finalized EMP upon review of same by Authority's Engineer.

Chapter 2

Scope & Objectives

2. SCOPE & OBJECTIVES

2.1 ENVIRONMENTAL & SOCIAL SCREENING STUDY AND APPLICATION TO E & S IA

The Environmental & Social Screening report was prepared after thorough interaction with the engineering section of the consultants so that the negative impacts on the environment and human population could be avoided as far as possible. Some of the important findings of the study are as follows: -

1. There will be no loss of bio-diversity as no rare plant or animal species are going to be affected by the present project.
2. No Sanctuary or National Park is located within 10 km radius of the road.
3. No historical monuments are located within the ROW of highway.
4. The most important factors, which need continuous attention and assessment during the construction phase, are the ambient air quality, the water quality and the noise level. The ambient air quality of the study area is good. The quality of the ground water is good for drinking as well as other daily use purpose.
5. The proposed alignment of bridges would be such that it has minimum impact on physical and social environment. Approximately 158 numbers of trees may be cut down due to the proposed project.

2.2 SCOPE OF THE E & SIA STUDY

The scopes of the EIA/EMP study are: -

- Identification of the potential environmental & social impacts.
- Developing mitigative measures to sustain and maintain the environmental & social scenario.
- Providing compensatory developments wherever necessary, including plans for highway side tree plantation.
- Designing and monitoring the Environmental Management Plan.
- Suggesting the Environmental Enhancement Scheme and its monitoring.
- Screening, scoping and consultations with public, experts in various fields, stakeholders , etc.

2.3 OBJECTIVES

The objectives of the E & SIA include:

- Collection of baseline data on various components of the environment.
- Determination of the magnitude of environmental & social impacts so that due consideration is given to them during planning, construction and operational phases of the project implementation.
- Assessment of the socio-economic conditions of the project affected persons and suggestions for their improvement.

- Identification of areas and aspects, which are environmentally or socio-economically significant.
- Submission of environmental enhancement plan and environmental management plans for enhancing and mitigating the negative impacts.
- Development of the road alignment in such a way that the environment and settlements are least affected.
- Presentation of public view on various aspects of environment and socio-economic.

2.4 PUBLIC CONSULTATION

Public consultation at all stages of planning and implementation of a project is necessary. It helps in making the project more environment-friendly and easy to implement. Public consultation in this project is done by interaction with local people for various environmental / socio-economic parameters.

2.5 ENVIRONMENTAL & SOCIAL IMPACTS OF PROJECT

Transport facilities including roads bring development and bridges are integral part of road development. They not only facilitate transportation and movement, but, as a whole, bring significant economic growth and social benefits. It is a well-known fact that the economy and human welfare activities of an area depend on its proximity to the road. Be it health, hygiene or education, be it agriculture or business-almost all shades of human life are changed once a road is developed in an area. The road allows cultures to mix and interact.

In regions where roads already exist, they need to be strengthened at regular intervals. The bridges need strengthening in view of the growing traffic pressure, Road safety, travel time and the vehicle operating costs. It also increases the access to markets, jobs, education and health services. Obviously, with this intent the Government of India through MEA undertook the required upgrading of old bridges.

However, all is not rosy in road & bridge development. Whether a new bridge is laid or an existing bridge is strengthening through new approaches, it disturbs and destroys many more things. The widening/new construction of the bridge may result in loss of productive agricultural land, damage to sensitive ecosystems, removal of trees, dislodgment of number of people, disruption of local economic activities and accelerated urbanization. The properties and people in many cases may fall in the direct path of approach roads. The livelihood of people is often disrupted. Such a developmental project may cause soil erosion, interfere with animal and plant species, and change the level of under ground water. People may lose accustomed travel paths and community linkages and can be culturally affected. The exhaust emissions will also grow significantly leading to increase in respiratory and other health problems. Some of the negative impacts may even have far-reaching consequences. One has to be very careful and cautious in assessing these impacts and to then mitigate them.

In fact, it is easy to quantify the magnitude of physical impacts such as land clearance, trees removed and homes affected; but difficult to quantify effects on the biological and aesthetic environment such as physiological alteration on flora & fauna, reproductive and behavioral changes in organisms etc. The study therefore has been carried out with utmost care to analyze, predict and mitigate the environmental and social aspects of the region in consequence to the proposed project.

Chapter 3
Policy, Legal & Administrative
Framework

3. POLICY, LEGAL & ADMINISTRATIVE FRAMEWORK

3.1 PROJECT'S POLICY OF ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

3.1.1 Compliance of Laws and Regulations

(1) Institutional Setting

Myanmar has 31 ministries under the Office of the President. The leading ministry in charge of environmental and social consideration are the Ministry of Environmental Conservation and Forestry (MOECAF) and the Ministry of Social Welfare, Relief and Resettlement (MSWRR).

(2) Fundamental Laws and Regulations

There are 18 legislations pertinent to natural and social environment areas in Myanmar as follows:

- a. Forestry Law (1992)
- b. Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law 1994
- c. Public Health Law (1972)
- d. Factory Act (1951)
- e. Territorial Sea and maritime Zone Law (1977)
- f. National Environment Policy (1994)
- g. Draft Environment Law (2000)
- h. Mines Law (1994)
- i. Freshwater Fisheries Law (1991)
- j. Marine Fisheries Law (1990)
- k. Law on Aquaculture (1989)
- l. Irrigation Laws and Regulations (1982)
- m. The Conservation of Water Resources and Rivers Law (October, 2006)
- n. Myanmar Special Economic Zone Law (2011)
- o. Environmental Conservation Law (2012)
- p. Draft Environmental Conservation Rules (under legislation, February 2013)
- q. Draft EIA Procedures (in process)

Major Law related to natural and social environment areas in Myanmar is summarized as follows;

Environmental Conservation Law (2012)

The updated Environmental Conservation Law was passed on 30 March 2012 prepared by MOECAF. The Environmental Conservation Law contains 14 chapters that define the rights and responsibilities of MOECAF, environmental standards, environmental conservation, Management in urban areas, conservation of natural and cultural resources, process for

Businesses to apply for permission to engage in an enterprise that has the potential to damage the environment, prohibitions, offenses and punishments.

Especially, Article 16 in the law stipulates responsibility of business owner of industrial estate or business in the Special Economic Zone on environmental conservation. Besides, Environmental Conservation Rules (ECRs) as detailed enforcement regulations for ECL was gotten through parliament in July 2013 and going to be issued. ECRs stipulate basic policy and concept on EIA application of the development of Projects (Article 55).

Environmental clearance is not applicable for bridges & their approaches project as per the existing law. However, tree cutting permission shall be required.

3.2 MORTH AND IRC SPECIFICATIONS IN INDIA

All road works in India are to be in accordance with the MoRTH specifications for Road and Bridge works and guidelines of Indian Roads Congress (IRC). The MoRTH specifications have special provisions towards protection of environment under Clause 501, Annexure A and the contractor is to satisfy the provisions. Apart from the Annexure A to clause 501, there are provisions for control of erosion, drainage, dust suppression, borrow area and haul road management under relevant sections. Provisions of clause 501 Annexure A, cover the environmental aspects as:

General	<p>The contractor shall take all necessary measures and precautions to carry out the work in conformity with the statutory and regulatory environmental requirements.</p> <p>The contractor shall take all measures and precautions to avoid nuisance or disturbance from the work. It shall be precautionary measures than abatement measures taken after generation of nuisance.</p> <p>In the event of any spoil, debris, waste or any deleterious material from site being deposited on adjacent land, the same shall be removed and affected area shall be restored to its original state.</p>
Air	<p>The contractor to devise and arrange methods to control dust, gaseous or other airborne emissions in such a way that adverse impacts on air quality are minimized.</p> <p>Dust shall be minimized from stored material and stockpiles by spraying water.</p> <p>Covering of material likely to generate dust during transportation is to be covered with tarpaulin.</p> <p>Spraying of water on haul roads, if found necessary.</p>
Water	<p>The contractor shall prevent any interference with supply/abstraction of water resources.</p> <p>Water used for dust suppression shall be reused after settlement of material in collected water. Liquid waste products to be disposed off such that it does not cause pollution. No debris is to be deposited or disposed into/adjacent to water courses.</p>
Control of wastes	<p>No uncontrolled disposal of wastes shall be permitted. The contractor shall make specific provisions for disposal of all forms of fuel and engine</p>

	oil, all types of bitumen, cement, surplus aggregate, gravels, bituminous mixtures etc. conforming to local regulations and acceptance of the engineer
Noise	The contractor shall use all necessary measures to reduce noise from construction equipment and maintain all silencing equipment in good condition.
Emergency Response	The contractor shall plan and provide for remedial measures in case of occurrence of emergencies as spillages of oil, bitumen or chemicals.

In addition to the above conditions, avoidance measures and control of activities having potential for generation of environmental impacts are devised. These include:

Section 111	Precautions for safeguarding the environment
Clause 201.2	Preservation of Property/Amenities during clearing and grubbing
Clause 301.3.2	Stripping and storing of topsoil for reuse during excavation for roadway and drains
Clause 302.4	Restriction on timings for blasting operations
Clause 304.3.6	Public safety near towns/villages where excavation is carried out
Clause 305.2.2.2	Locations of borrowing and relevant regulations
Clause 305.3.3	Stripping and storing of topsoil at borrow locations
Section 306	Soil erosion and sedimentation control
Clause 407.4.2	Provisions for turfing on median and islands
Section 517	Recycling of bituminous pavement and excavated material
Clause 701.2.1	Use of geo-textiles for control of soil erosion
Section 810	Use of Metal beam crash barriers for safety, relevant regulations and specifications
Clause 2501	Precautions during river training works

3.3 INSTITUTIONAL STRENGTHENING AND ARRANGEMENT

Though rich in legal and regulatory instruments, the implementing agencies are unable to regulate and monitor a sound environmental management plan due to lack of enforcement capacity. Therefore, violations or missed mitigation commitments often go unreported. The gaps and deficiencies pointed out can be removed by proper arrangements. Institutional

strengthening component has accordingly been identified. As such, the overall arrangement is as follows:-

(1) Organizational Arrangements

An environmental Unit need to be established in each construction package with a manager to address the environmental issues. The Environmental Unit will have proper staff to ensure the implementation of EMP and related measures. The manager (Environment) will be familiar with the local environmental legislation, will have proper training of the environment of the region, and will be able to coordinate with NGOs, community groups, and government department.

(2) Environmental Training

Training of staff will be done at a number of levels. Some short-term training is required for the Environment Manager, other staff members of the Environment Unit and the contractor staff to raise their levels of environmental awareness. In the long-term training, the specialized training or special environmental issues will be examined and provided to the Environment Unit

(3) Environmental Monitoring

In order to ensure that the prescribed environmental norms are maintained during the constructional and the operational phases, the regular monitoring is one of the most important components of the institutional arrangement. The regular monitoring of Air pollution, Water quality, Noise pollution, and maintenance of trees, etc. will be done at regular intervals. The field reports of various environmental components will be received at quarterly basis, and any lapse has to be taken care of.

Awareness training will be provided to the contractors and their personnel to ensure that the EMP is implemented effectively. The project co-coordinator will assess the contractor practices and, if high pollution levels are suspected, will government or private sector laboratories check them.

Chapter 4

Description of Environment

4. DESCRIPTION OF ENVIRONMENT

In order to understand the baseline environmental status and impacts due to the proposed road widening, observations were made by field visits. The relevant secondary data were also collected. The methodologies adopted may be classified in the following way:

1. The preparation of questionnaire for environmental surveys.
2. Field observations of these questionnaires including public consultation.
3. Screening, testing and monitoring of environmental factors like air, water, soil and the noise level.
4. Collection of secondary data from various departments.
5. Compilation, analysis and presentation of the report.

4.1 PREPARATION OF QUESTIONNAIRES FOR ENVIRONMENTAL & SOCIAL PARAMETERS

Questionnaires were prepared after thoroughly studying the environmental guidelines. Total four sets of questionnaires were prepared for field survey/data collection. The details of these are as follows:

1. Environmental screening information like national parks, wild life sanctuary, forests, archeological, cultural, religious structures etc. within 10 Kms on both sides of the Bridges.
2. Environmental screening survey, effects on environment: views of the community.
3. The survey of features within Right of Way (ROW) on both the sides of the Bridges.
4. Public consultations along the villages

4.1.1 Field Observation on Questionnaire

A team under the leadership of a senior Environmental Engineer was constituted to undertake the field survey of the questionnaire. The young workers were apprised of the comprehension of the work emphasis on public consultation.

4.1.2 Screening, Testing & Monitoring of Physical Environmental Factors

All the 69 bridges along the entire stretch of present section was surveyed and screened. The collection of water samples, soil samples and other data pertaining to air quality and noise were done within ROW.

4.1.2.1 Ambient Air Quality

Ambient air quality was monitored along the bridges at selected sites. The locations selected were those of the city / town area, the market place and the rural areas. The details of locations and monitoring results are discussed in Chapter – 4. The air quality parameters considered for the study include Particulate Matter₁₀ (PM₁₀), Particulate Matter 2.5 (PM_{2.5}), Nitrogen Oxides (NO_x), Sulphur Di-oxide (SO₂), and Carbon monoxide (CO).

4.1.2.2 Water Quality

Samples of ground water were collected from hand pumps & wells whereas samples of surface water were collected from river. To assess the water Quality of the area samples were tested for physico-chemical parameters.

4.1.2.3 Soil Quality

The samples were collected from 60 m corridor of the road, at 5-15 cm depth. Besides studying their texture (sand/silt/clay ratio) they were monitored for physico-chemical parameters to assess the soil quality of the area.

4.1.2.4 Noise Level

The noise level (Leq) was measured using cygnet noise meter with data recording facilities at various sites along the entire stretch of road.

The noise levels is expressed as an equivalent noise level (Leq) which is the measurement duration of sound pressure level as the averaging time. It is calculated as follows:

$$Leq = 10 \text{ Log}_{10} \left[\frac{\sum^n L_i^2}{n} \right]$$

Where, L_i = Instantaneous sound intensity level dB (A)

n = No. of observations

4.1.3 Secondary Available Data

The secondary data were collected from following sources as presented in **Table-4.1**

Table-4.1: Secondary Data Sources

1.	General information	District Collector ,Tamu
2.	Meteorological data	Meteorological Department
3.	Statistical data	PWD ,Tamu & Kalewa
4.	Irrigation and hydrogeology data	PWD ,Tamu & Kalewa
5.	Forests/Wild life/Bio-diversity	Forest office ,Tamu

4.2 PREPARATION OF BRIDGES INVENTORY

All Bridges have been mapped on the–inventory.

Photography

Photographs of the important places such as villages, market places, old trees, consultation with people, plantation areas, etc. were taken to confirm the baseline data of these areas.

4.3 ANALYSES, COMPILATION AND PREPARATION OF REPORT

The data collected by survey teams were compiled. Along with the field monitoring studies and secondary data, these were used to identify the environmental problem spots or ‘Hot Spots’.

The following analyses were carried out based on compiled information:

1. The levels of environmental parameters were compared with the prescribed limits suggested by Central Pollution Control Board (CPCB) in India as no specific standards are available in Myanmar. This gave a clear idea that special attention is paid in areas where the level of pollution is higher than desirable.
2. The mitigation measures have been suggested to reduce the adverse impacts due to the proposed bridge up gradation and detailed environmental management plan have been prepared covering both the phases i.e. construction and operation.

4.4 BASELINE ENVIRONMENTAL CONDITIONS

4.4.1 Natural Environment

Baseline environmental data plays a key role in identification of environmental parameters likely to be affected due to the project. This also facilitates the decision maker to assess a particular environmental parameter which needs to be incorporated during the detailed Environmental Assessment study and for further detailed investigation. The scope of this chapter is limited to only those issues, which are of concern in the environmental assessment. With rapid strides in economic development, the need to rationalize the development is imperative. During the process of development, there has been intensive use of natural resources, very often leading to ecological imbalances. In a road project like this involving wide ranging construction activities, conservation of flora, fauna and the ecosystem forms important aspect of overall sustainable development process. The data/ features documented hereunder have been collected through field investigation, interaction with local population and desk research and published data sources.

The environmental baseline data comprise the features present within 10 km or affected area whichever is more on either side of the proposed alignment. This area is referred to as study area/ project area in the report. It includes environmental features such as forest areas, conservation areas, water bodies (rivers, lakes ponds and reservoirs), industries, wildlife and, places of historical importance, tourism etc.

4.4.2 Geographical Location of the project road

The project road runs, in the North - South direction in the Sagaing division of Myanmar. The project road takes off from Moreh, a border town of Manipur state in India and passing through Tamu Township, Kale Township and ends at Kalewa in Kalewa Township. The total length of project road is 149.7 km.

4.4.3 Climate and Micro-Meteorological Parameters

Myanmar has three main seasons, hot season, rainy season and cold season. Hot season is from March to May, rainy season is from June to October and cold season is from November to February. The tropical monsoon is usually cloudy, rainy, hot, humid summers and less cloudy, scant rainfall, mild temperatures, lower humidity during winter.

April and May are the hottest months in the project area, while the extreme temperature varies but mean maximum temperature works out to be 31° C in Mawlik Town. During the rainy season, from May to September, climate remains very humid. During winter season and particularly rainy season, thick, low lying clouds reduce visibility, impede movement and hold up work. Depending on the variation in temperatures and general weather conditions, three different types of seasons are observed in Project Influence Area (PIA):

Winter: Starts from November and lasts till February. The temperature is comparatively lower (11° C – 28° C), but not too low to make human habitation difficult. The season receives very little rainfall.

Spring: Season begins from March and lasts till first half of May and merges with rainy season. The temperature rises up to a range of 16° C to 35° C being aggravated by rainless days.

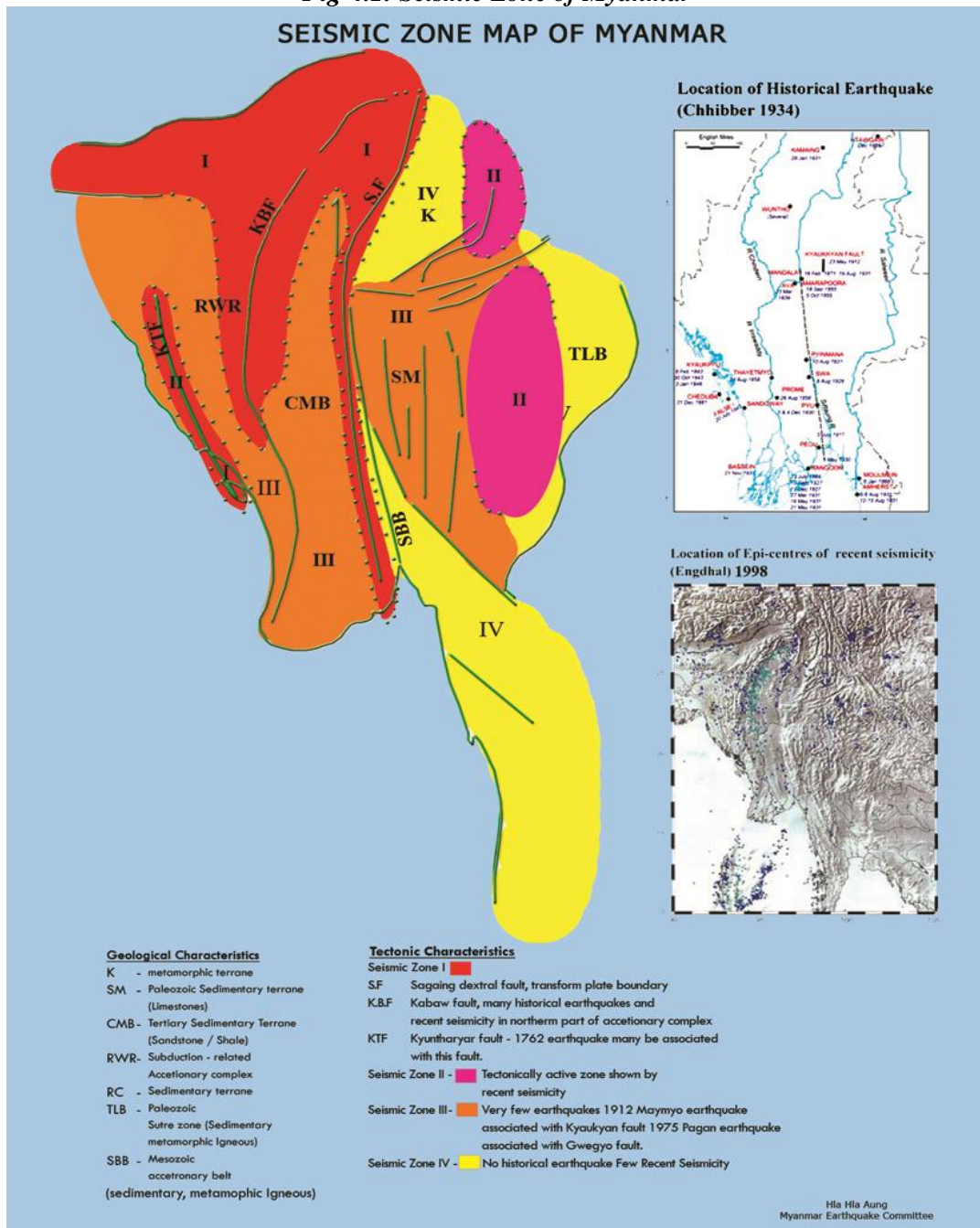
Rain: This is the longest season; hold out for nearly five months from second mid of May till late September. Rainfall is very heavy from June to September, and maximum rainfall observed in the month of September.

4.4.4 Natural Hazards and Vulnerability of the sub project area

4.4.4.1 Seismic Profile of the area

The present project falls under Zone-III and area have very few earthquakes. It is associated with KYAUKYAN fault. A map showing the seismic zones of Myanmar is provided as **Fig-4.1**.

Fig-4.1: Seismic Zone of Myanmar



4.5 AIR QUALITY

There is no major air pollution source along the project road & associated bridges. There is no major settlement between Tamu & Kalewa, However no. of small villages are located all along the project road. The ambient air quality was measured during May, 2014 at four locations and results are presented in *Table-4.2* and shown in *Fig-4.2* and *4.3*. The Results show that all the parameters are well below the National ambient air quality standards, 2009 of India (There is no Myanmar standards for Ambient air quality). The result are presented in *Table-4.2*

Table-4.2: Value of the AAQ along the project location

Location	PM10	PM2.5	SO2	NOx	CO
Tamu (Ch. 0.00)	55	28	07	12	455
Khampat (Ch. 56.0)	45	20	06	10	205
Nann Han Nwe (Ch. 107.9)	42	18	06	10	221
Nat Tet (Ch. 146.0)	46	16	05	09	178
Standards for 24 hours monitoring except for CO (8Hrs), as per National Ambient Air Quality Standards, 2009 in India.	100	60	80	80	2000

1. Note: All values are in $\mu\text{g}/\text{cubic meter}$.

4.6 NOISE LEVELS

The noise levels were monitored at four locations during May, 2014 along the project road to assess the baseline status of noise environment along the project road. The Results are presented in *Table-4.3*. The noise levels along the project road & bridges are very less as area is devoid of industries & only noise source are vehicular traffic & local market places.

Table-4.3 Value of the Noise along the project location

Location	Noise levels dB(A), Day (Leq)	Noise levels dB(A), Night (Leq)
Tamu (ch. 0.00)	52.10	40.20
Khampat (ch. 56.0)	49.20	38.40
Nann Han Nwe (ch. 107.9)	50.36	36.30
Nat Tet (ch. 146.0)	47.80	39.50

Table-4.4: Ambient Air Quality Standards with respect to Noise (2000) in India.

Area Code	Category of Area/Zone	Limits in dB(A) Leq	
		Day time	Night time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

4.7 RIVERS / STREAMS / WATER COURSES

The Chindwin river basin is located in North-western part of Myanmar in Sagaing region. The project road is in the vicinity of Chindwin River. As a result a number of water courses/ streams have been formed across the proposed alignment. The major streams crossing the project road are Lakchao, Nanpalong, Lalim, Nie-Ell-Kiaiz, Tuivang, Kanmagyi, Kannan and some local streams. The most of streams passing across the project road are flowing in East-west direction.

4.7.1 Water Quality

The Water samples were taken at five locations along the project bridges during May 2014, Three ground water & two surface water samples were collected along the project alignment. The results are presented in **Table-4.5**. The water quality of the study area is good and meeting the drinking water standards, except, bacteriological parameter for surface water.

Table-4.5: Water Quality of the Study Area

Sl. No.	Parameters	Unit	Khon Monn Non Km. 18.6 (Hand Pump)	Khampat River, Km. 55.617	Kanoo Km. 99.80 (Hand Pump)	Kyigon, Km. 121.7 (Open Well)	Meta River, Km. 147.950
1.	pH	-	7.26	7.21	7.29	7.23	7.30
2.	Total Suspended Solids	mg/l	<4	8	<4	<4	12
3.	Conductivity	µmhos/cm	514	242	576	884	300
4.	Alkalinity as CaCO ₃	mg/l	168	96	188	316	102
5.	Total Dissolved Solids	mg/l	334	152	374	574	195
6.	Total Hardness as CaCO ₃	mg/l	198	82	226	363	86
7.	Calcium as CaCO ₃	mg/l	126	52	182	269	56
8.	Magnesium as CaCO ₃	mg/l	72	30	44	94	30
9.	Chloride as Cl	mg/l	38	20	39	48	22
10.	Phosphate as PO ₄	mg/l	0.12	0.09	0.08	0.07	0.09
11.	Nitrate as NO ₃	mg/l	0.09	0.41	0.17	0.49	0.23
12.	Sulphate as SO ₄	mg/l	23	12	24	28	14
13.	Sodium as Na	mg/l	26	14	28	32	18
14.	Potassium as K	mg/l	2	3	2	4	4
15.	Chemical Oxygen Demand	mg/l	<4	<4	<4	<4	22
16.	Biological Oxygen Demand	mg/l	<2	<2	<2	<2	8
17.	Total Coliform	MPN/100ml	Absent	1050	Absent	Absent	1250
18.	Faecal Coliform	MPN/100ml	Absent	320	Absent	Absent	215

4.8 SOIL TYPES

4.8.1 Geology and Soil Types

The geological map of Myanmar shows that in the region of project road, most of the area under soft rock predominantly under the category of bedrock. The area around the last 15 km of alignment passing from hard and soft rock of Basalt, rhyolite, tuff and volcanic ash

Soil cover in the area comprises of weathered shale and laterite is generally present in the major parts of the area, which is sticky in nature. The thickness of the soil cover in the area ranges from 0.30 to 1.5 m. The soil samples were collected from four locations along the highway near the bridges and the results are presented in *Table-4.6*.

Table-4.6: Soil Quality of the Study Area

Sl. No.	Parameters	Unit	Man Maw, Km. 10.5 (Ag. Land)	Kanan, (Km. 53.40)	Sonelar Mying, (Km. 101.1)	Kyigone, (Km. 121.70)
1.	pH	-	7.36	7.46	7.48	7.16
2.	Bulk Density	gm/cm ³	1.57	1.61	1.61	1.61
3.	Conductivity	micro mhos/cm	306	296	319	321
4.	Moisture	%	13.46	11.21	12.61	11.62
5.	Texture	-	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
6.	Sand	%	74	78	74	76
7.	Clay	%	10	8	8	8
8.	Silt	%	16	14	18	16
9.	Sodium	mg/100gm	29.0	29.0	31.0	30.0
10.	Potassium	mg/100gm	0.7	0.5	0.3	0.6
11.	CEC	meq/100gm	1.88	1.87	2.00	1.94
12.	Nitrogen	mg/100gm	13.16	9.8	6.23	6.91
13.	Phosphorous	mg/100gm	82.62	80.16	82.16	82.16
14.	Ca	meq /100gm	6.21	7.12	5.16	4.26
15.	Mg	meq /100gm	4.96	6.21	4.42	3.96

4.9 ECOLOGICAL FEATURES

4.9.1 Flora and Fauna

There is no major forest area all along the highway except teak plantation at some stretches. The trees along the bridges stretch are Gulmoher (Delonix Regia), Teak (Tectona Grandis), Amaltash (Cassia fistula), Mango (Mangifera Indica), Pipal (Ficus religiosa) and Bamboo

(Dendrocalamus strictus). The density of the trees along the bridges & Its approaches is less and total 158 trees are going to be affected. The details of these tree locations are presented in Table 4.7 There is no rare and endangered species reported during survey. The presence of wild animals was not reported during field survey.

Table 4.7 -Locations of Affected Trees

S. No.	Chainage (km)	Bridge No.	Number of Trees Cut	Remarks
1.	0.170	1/1	22	The trees along the bridges stretch are Gulmoher (Delonix Regia), Teak (Tectona Grandis) , Amaltash (Cassia fistula), Mango (Mangifera Indica), Pipal (Ficus religiosa)and Bamboo (Dendrocalamus strictus).
2.	4.880	4/1	1	
3.	10.880	7/1	-	
4.	12.000	8/1	-	
5.	13.740	9/1	3	
6.	15.760	10/2	-	
7.	18.240	12/1	2	
8.	19.575	13/2	-	
9.	22.470	15/1	5	
10.	25.130	16/2	1	
11.	27.290	18/1	-	
12.	27.725	18/2	-	
13.	31.040	20/2	2	
14.	34.620	22/1	-	
15.	36.930	24/1	-	
16.	42.075	27/1	-	
17.	43.630	28/1	7	
18.	49.510	32/1	4	
19.	49.850	32/2	8	
20.	53.850	34/1	9	
21.	54.150	34/2	5	
22.	55.560	35/1	17	
23.	60.275	38/1	6	
24.	60.275	38/2	9	
25.	64.135	41/1	2	
26.	66.405	42/1	-	
27.	68.995	44/1	1	
28.	72.200	46/1	-	
29.	74.905	47/3	-	
30.	75.325	48/1	2	
31.	81.085	51/1	2	
32.	89.990	57/1	5	
33.	90.870	57/2	1	
34.	91.215	57/3	1	
35.	92.505	58/1	5	
36.	92.755	58/2	-	
37.	94.845	60/1	-	
38.	96.165	61/1	-	
39.	96.525	61/2	-	
40.	97.610	61/3	-	
41.	98.880	62/1	1	
42.	99.205	62/2	1	
43.	99.575	63/1	4	

S. No.	Chainage (km)	Bridge No.	Number of Trees Cut	Remarks
44.	101.425	64/1	-	
45.	106.260	67/1	2	
46.	107.290	68/1	1	
47.	107.930	68/2	2	
48.	112.320	71/1	8	
49.	116.010	73/1	-	
50.	121.900	77/1	-	
51.	122.200	77/2	-	
52.	122.385	77/3	2	
53.	126.475	80/1	1	
54.	126.990	80/2	-	
55.		82/1	Under Construction	
56.	133.390	83/2	-	
57.	133.610	84/1	-	
58.	134.460	85/1	-	
59.	136.460	86/1	4	
60.	138.110	86/2	-	
61.	138.525	87/1	1	
62.	139.380	87/2	-	
63.	140.240	88/1	3	
64.	141.390	88/2	2	
65.	142.820	89/1	1	
66.	143.270	89/2	Under Construction	
67.	145.320	90/1	3	
68.	146.340	91/1	3	
69.	146.590	91/3	-	
70.	147.490	92/1	-	
71.	147.940	92/2	-	

4.9.2 National Park / Wildlife Sanctuary / Wetlands

There is no national park / wildlife sanctuary / wetland has been identified on either side of the proposed bridges.

4.10 SOCIO-ECONOMIC ENVIRONMENT

4.10.1 Area and Population

The total area of Myanmar is 678,500 sq km where 657,740 sq km occupies the land and 20,760 sq km occupies the water. The bordering countries are Bangladesh 193 km, China 2,185 km, India 1,463 km, Laos 235 km, and Thailand 1,800 km. The central lowlands ringed by steep, rugged highlands The lowest point is the Andaman Sea (0 m) and the highest point Hkakabo Razi (5,881 m).

Myanmar is made up of 135 national races, of which the main national races are Kachin, Kayah, Kayin, Chin, Bamar, Mon, Rakhine and Shan. Population is estimated to be over 60 million. There are more than 100 ethnic groups in Myanmar. Some of the Ethnic groups are listed as Akha, Palaung, Padaung, Naga, Taron, Eng and many more near extinct tribes. The

religions are Buddhist, Christian and Muslim. The major language is Myanmar, but minority ethnic groups have their own languages. English is widely spoken and understood.

The majority of Myanmar's population is rural, with the density of settlement in each region related to agricultural production, particularly of rice. Thus, the most populous regions are the Irrawaddy delta and the dry zone, and the highest densities are found in the upper delta, between Yangon and Hinthada (Henzada). Settlement in the Sittang delta, the sedimented hinterland of Sittwe, and the regions of both sides of the lower Chindwin River is moderately dense. The Rakhine region (except the Sittwe area), the west bank of the Irrawaddy at the base of the Rakhine Mountains, Tenasserim, and the less accessible parts of the western and northern mountains and the Shan Plateau are sparsely inhabited. Although city populations have been growing, the pace of urbanization has not been as rapid in Myanmar as it has been in most other countries of Southeast Asia.

The population of Myanmar remains fairly youthful, with roughly one-fourth of the people under age 15. However, the proportion of young people has been decreasing steadily since the late 20th century, as the birth rate has dropped from notably above to significantly below the world average. Life expectancy, on the contrary, has been on the rise, with most men and women living into their 60s.

4.10.2 Economy

Myanmar's economy, based on the *kyat* (the national currency), is one of the least developed of the region and is basically agricultural. Much of the population is engaged directly in agricultural pursuits. Of those who are employed in other sectors of the economy, many are indirectly involved in agriculture through such activities as transporting, processing, marketing, and exporting agricultural goods.

Nearly half of Myanmar's economic output—notably all large industrial enterprises, the banking system, insurance, foreign trade, domestic wholesale trade, and nearly all the retail trade—was nationalized in 1962–63. Agriculture and fishing were left in the private sector. In 1975–76, however, the government reorganized nationalized corporations on a more commercial basis and instituted a bonus system for workers. The overall economic objectives of self-sufficiency and the exclusion of foreign investment also were revised. Foreign investment was permitted to resume in 1973, although only with the government. Following a military coup in 1988, both foreign and indigenous private enterprise was encouraged.

Myanmar also has an extensive informal economy. Considerable quantities of consumer goods are smuggled into the country, and teak and gems are exported both legally and illegally. In addition, northern Myanmar is one of the largest producers of opium in the world.

4.10.3 Agriculture, forestry, and fishing

Agriculture, forestry, and fishing together constitute the largest contributor to Myanmar's economy. About half of all agricultural land in Myanmar is devoted to rice, and to increase production the government has promoted multiple cropping (sequential cultivation of two or more crops on a single piece of land in a single year), a system that is easily supported by the country's climate. As a whole, the sector accounts for nearly one-half of the country's gross domestic product (GDP) and employs about two-thirds of the labour force.

Myanmar may be divided into three agricultural regions: the delta, where cultivation of rice in flooded paddies predominates; the largely irrigated dry zone, an area primarily of rice production but where a wide variety of other crops also are raised; and the hill and plateau regions, where forestry and cultivation of rice and other crops through shifting agriculture are most important.

Although the dry zone was Myanmar's most important agricultural region in the past, the rice production of the Irrawaddy River delta now provides much of the country's export earnings and the staple diet of the country's people. The delta's traditional agriculture consisted primarily of rice in normal years, with the substitution of millet in drier years when there was insufficient moisture for rice; both grains yielded good returns on the alluvial soils.

Crops raised in the dry zone, in addition to rice, include sugarcane, fruits (such as plantains), legumes, peanuts (groundnuts), corn (maize), onions, sesame, rubber, and allspice. To cultivate much of this land successfully, however, irrigation is required. The earliest known irrigation works were constructed in the 1st century and greatly improved in the 11th century; though their maintenance lapsed somewhat after the fall of the monarchy in the late 19th century, many are still in active service. As in the delta, the arrival of the British in the dry zone led to increased commercial and public-works activities. British authorities repaired and extended parts of these ancient systems during the early 20th century. Most of Myanmar's irrigated land is in the dry zone, and almost all of it is planted in rice. The portions of the dry zone that are not irrigated are utilized for the production of crops that are less sensitive to the seasonality or irregularity of rainfall than rice. In addition to the crops mentioned above, cotton and millet are cultivated, although neither is of considerable significance. Cattle also are raised there.

The third agricultural zone, the hill and plateau country, occupies perhaps two-thirds of the area of Myanmar. This land has less economic significance than the other two zones; it is the home of many of the country's non-Burman ethnic groups, most of whom are engaged in shifting cultivation. More-sedentary modes of agriculture also exist, however, and have been imposed with the advance of agricultural technology, increased population, and central planning. Outside the forest areas of these highlands, the principal crops raised are rice, yams, and millet, and large numbers of pigs and poultry are kept. Bullocks and buffalo are used as draft animals, and goats, pigs, and poultry are raised for food in all parts of the country.

The second most important element in the diet, after rice, is fish—fresh or in the form of ngapi, a sort of nutritional paste that is prepared in a variety of ways and eaten as a condiment. Much private, noncommercial fishing is provided, however, in virtually every type of permanent, seasonal, or artificial body of inland water of any size. Nonindigenous fish, including the European carp and the tilapia (originally brought from Thailand), have become the focus of a growing aquaculture industry.

Forestry has been particularly important as a source of foreign exchange. Myanmar is estimated to have the bulk of the world's exploitable teak supplies. Teak is found in the tropical-deciduous forests of the hills. Although the forests are owned and regulated by the state, concern has been raised about indiscriminate and illegal logging.

4.10.4 Resources and Power

Myanmar is rich in minerals, including metal ores, petroleum, and natural gas, and also has significant deposits of precious and semiprecious stones. Although production has been increasing from last few decades still mining sector accounts for small portion of country's GDP having small share of workforce.

Large-scale exploitation of Myanmar's mineral deposits began in the mid-1970s. Deposits of silver, lead, zinc, and gold are concentrated in the northern Shan Plateau, tin and tungsten in the Tenasserim region, and barite around the town of Maymyo in the central basin. Copper mining at the town of Monywa began in the early 1980s and has been growing, despite intermittent setbacks caused by shortages of fuel and supplies as well as by economic sanctions imposed by foreign governments.

Rubies and sapphires have been mined in the northern Shan Plateau since precolonial times. Jade is mined in the northern mountains. The country also produces smaller quantities of spinels, diamonds, and other gemstones. When Myanmar was colonized by the British in the late 19th century, the extraction of petroleum from the country's central region already was an established local practice. The industry was expanded by the British and, since the mid-20th century, by the government of independent Myanmar. Although exploration for onshore petroleum resources since independence has not proved particularly fruitful, exploration for natural gas has been especially productive. Exploitation of onshore gas fields began in the 1970s, and in the 1990s extensive gas fields were opened offshore—especially in the Gulf of Martaban—and a pipeline was constructed to serve Thailand. There are oil refineries at Chauk, Syriam, Mann, and other locations.

Myanmar also has major deposits of coal, and production rose sharply in the early 21st century. Coal is mined primarily in the upper Irrawaddy and Chindwin valleys.

The demand for electricity chronically has outstripped capacity. Although much of the country's energy is drawn from fossil fuels, hydroelectricity accounts for a significant and rapidly expanding segment of Myanmar's total power supply. The government has built several hydroelectric power plants, including those on the Balu River (a tributary of the Salween), at Taikkyi near the city of Bago (Pegu), in the northern Rakhine region, and near Mandalay.

4.10.5 Manufacturing

There was little industrialization in Myanmar until the mid-20th century, when a limited program was initiated after the country achieved independence. Yangon, Myingyan (in the dry zone), and the Rakhine area were selected to become the new industrial centers. Although the manufacturing sector has expanded, it has not grown as rapidly in Myanmar as it has in other countries of the region.

A major enterprise in Myanmar is tobacco production, consisting of government-owned factories, which manufacture cigarettes, and cottage industries, which produce cheroots (a type of small cigar). Other important industries include steel processing, the manufacture of nonelectrical machinery and transportation equipment, and cement production. Textile factories have been established in Yangon, Myingyan, and other cities, but growth of the industry has been hindered since the late 20th century by intermittent sanctions by foreign governments. Myanmar also produces lumber, paper, processed foods (mainly rice), and some pharmaceuticals. Cottage industries are encouraged by subsidies.

4.10.6 Trade

The government's decision in the early 1960s to limit foreign trade reversed the export orientation of the British colonial period. However, the subsequent relaxation of trade restrictions, notably the legalization of trade with China and Thailand in the late 20th century, allowed trade again to become a significant component of the national economy. Natural gas is Myanmar's primary export, followed by pulses (mostly dried beans), teak, and minerals and gems. Its principal imports include machinery and equipment, industrial raw materials, and consumer goods. Owing largely to the sanctions imposed by the United States and members of the European Union since the end of the 20th century, Myanmar's Asian neighbours—including Thailand, Singapore, China, Hong Kong, India, and Japan—have become its chief trading partners.

4.10.7 Transportation

The country's trade in rice is dependent on water transport. The Irrawaddy River is the backbone of Myanmar's transportation system. The Irrawaddy is navigable year-round up to Bhamo and to Myitkyina during the dry season, when there are no rapids. The Chindwin is navigable for some 500 miles (800 km) from its confluence with the Irrawaddy below Mandalay. The many streams of the Irrawaddy delta are navigable, and there is a system of connecting canals. The Sittang, in spite of its silt, is usable by smaller boats, but the Salween, because of its rapids, is navigable for less than 100 miles (160 km) from the sea. Small steamers and country boats also serve the coasts of the Rakhine and Tenasserim regions.

The first railway line, running from Yangon to Pyay (Prome) and built in 1877, followed the Irrawaddy valley. The line was not extended to Mandalay; instead, after 1886 a new railway from Yangon up the Sittang valley was constructed, meeting the Irrawaddy at Mandalay. From Mandalay it crossed the river and, avoiding the Irrawaddy valley, went up the Mu River valley to connect with the Irrawaddy again at Myitkyina. A short branchline now connects Naba to Katha on the Irrawaddy below Bhamo.

The Yangon-Mandalay-Myitkyina railway is the main artery, and from it there are branchlines connecting the northern and central Shan Plateau with the Irrawaddy. Other branches run from Pinyinana across the Bago Mountains to Kyaukpadaung and from Bago to Mawlamyine to Ye. The Pyay-Yangon railway has a branchline crossing the apex of the delta to Hinthada and Patheingyi (Bassein).

The road system, until independence, was confined to the Irrawaddy and Sittang valleys, duplicating the railway route. A road goes from Pyay along the Irrawaddy to the oil fields, and many roads extend into the rural areas. These rural roads, however, are often impassable during the wet season. There were originally three international roads in use during World War II: the Burma Road from Lashio to Kunming in China; the Stilwell, or Ledo, Road between Myitkyina and Ledo in India; and the road between Kengtung, in the southeastern Shan Plateau, and northern Thailand. These roads subsequently became neglected but more recently were rebuilt and extended.

The state-run Myanmar Airways International runs frequent domestic flights between Yangon and other cities; it also has international service from Yangon to several major Southeast Asian cities. There are also small privately owned airlines that offer domestic and very limited international service. International airports are located in Yangon and Mandalay.

Yangon, as the terminus of road, rail, and river-transport systems, is the country's major port, with up-to-date equipment and facilities. Patheingyi, Mawlamyine, and Sittwe are also important ports.

4.10.8 Sagaing Region

Sagaing Region is located in the north-west of Myanmar between 21° 30' N latitudes and 94° 97' E longitudes. It is bordered by India's Nagaland and Manipur States to the north, Kachin State, Shan State, and Mandalay Region to the east, Mandalay Region and Magway Region to the south, with the Ayeyarwady River forming a greater part of its eastern and also southern boundary, and Chin State and India to the west. The region has an area of 93,527 km². The capital is Sagaing.

4.10.9 Area & population

Sagaing Region is inhabited by different Myanmar, Kachins, Chins, Nagas, and Shans in 34 Townships and 198 Wards and Villages. It has a population of about 63, 92,000. Main

agricultural crops are paddy, wheat and maize although sesame, peanut, pulses, cotton and tobacco are also grown. The Region is the top producer of wheat in the whole country and also has the largest acreage of sunflower. Cultivable acreage has increased as the State has built irrigation works, introduced terrace cultivation, distributed pedigree seeds and insecticides and provided tractor ploughing.

4.10.10 Resources

The 12734 square miles of Forest Reserves in Sagaing region as timber extraction work is the Region's principal industry as valuable teak forests are widespread in the Region. Forestry is important in the wetter upper regions along the Chindwin River, with teak and other hardwoods extracted. A copper extracted from huge copper deposits in Sabe hill and Kyesin hill in Salingyi Township of Sagaing Region. Important minerals of the Division are gold mined at Kyaukpahto region, Kawlin Township, coal mined at Kalewa (Thitchauk) region and Monywa. A small amount of oil is found at Pantha and Inndaw regions at Chindwin River valley. Salt is produced in Wetlet and Sagaing Township.

4.10.11 Ecotourism

In the Sagaing Region, across the Ayeyarwaddy River which is largest river in the country are the Mingun Pahtodawgyi and the Largest Ringing bell known as Mingun Bell. There is Alaung-daw Ka-tha-pa National Park which is home to large populations of wild elephants and other rare wildlife species. It is more of a religious site than a national park, drawing at least 30,000 pilgrims a year paying homage to wild pigs and tigers. The area itself is extremely isolated, elephants being the only means of transport to enter the park and forest

4.10.12 Traffic Survey

Traffic Survey was done at two locations at Km. 12.500 & Km. 122.50 & results are presented in *Table 4.8*

Table: 4.8 Average Daily Traffic (ADT) at Survey locations

Mode		Km 12.500	Km 122.500
Car/Jeep/Van		97	125
Two Wheeler		2159	1065
Auto Rickshaw		97	92
Bus	Mini Bus	102	79
	Bus	22	45
2 Axle Truck		54	86
3 Axle Truck		5	14
MAV		23	73
LCV		15	40

Mode		Km 12.500	Km 122.500
Agriculture Tractor	Tractor	9	23
	Tractor with Trolley	0	0
Cycle		116	28
Cycle Rickshaw		5	1
Hand Cart		0	0
Animal/Hand Drawn		5	0
Total		2711	1671
PCUs		1907	1742

4.10.13 Presence of sensitive receptors such as schools/colleges/health centers/ hospitals

There are no sensitive receptors such as schools/colleges/health centers/ hospitals present near the existing bridges & proposed replacement locations.

Chapter 5
Anticipated impacts &
Mitigation Measures

5. ANTICIPATED IMPACTS & MITIGATION MEASURES

The assessment of potential environmental impact consists of comparing the expected changes in the environment with or without the project. The analysis predicts the nature and significance of the expected impacts. The magnitude and duration (short-term or long-term) of impacts are also discussed.

In the following pages impacts on each biophysical environmental component (like soil, water, air, noise, flora and fauna) and socio-economic environmental component (like removal or property, land acquisition, etc.) will be discussed.

5.1 ENVIRONMENTAL ISSUES WHICH DO NOT AFFECT THE PROJECT

1. There is no loss of bio-diversity since no rare species of plants are found in along the proposed bridges & their approaches.
2. No National Park or Wildlife Sanctuary is located within a radius of 10 km from the proposed bridges & their approaches. As such, the project is free from such environmentally sensitive issue.
3. The chemical composition of the soil is not going to be affected by and large.

5.2 POTENTIAL IMPACTS ON SOIL

Soil is one of the most important components of the natural environment. For proposed bridges & their approaches the soil is primarily needed for altered road embankment. **Table-5.1** shows assessment of some of the impacts on soil.

5.2.1 Loss of Productive Soil

The potential impacts include:

- Loss of productive soil at borrow area.
- The productivity of crops in the region will not be affected
- The local economy is not going to be affected badly.

Table-5.1: The Type and Scale of Soil Impact

Location	Type of Impact		Scale of Impact	Mitigation measures suggested
	Loss of productive soil	Erosion / Contamination		
Road side approaches to bridges	Loss	Very less	May be negative impact during construction	More trees plantation to enhance environment and for soil conservation.
Market and congested areas	No Loss; Beneficial	No	May be negative impact during construction	Not needed
Borrow Pit Area	Loss of productive soil; Beneficial	No	-	Can be developed into pond for fisheries
Near Bridges	No significant Loss of productive soil	Soil erosion due to high embankment	-	By turfing, slope should be gradual

5.2.2 Erosion

The soil along the proposed bridges & their approaches is sandy loam in nature. The erosion factor of present soil is less.

The two important eroding agents are, (i) the run-off water, and (ii) the wind. The run-off dynamics are affected by the degree of slope, extent of deforestation and the amount of water stored for irrigation. Grasses and other herbaceous plant limit the surface erosion effectively.

The potential impact includes:

- The ROW of the proposed road is covered by wide range of plantation at few places. Even in areas of high embankment the slopes are stable due to vegetation and other physico-chemical features. The degree of soil erosion is noted to be less.
- Once trees are removed and the herbal cover is cleared on the proposed bridges & their approaches, the problem of soil erosion during construction is going to be there. Some mitigation measures like:
 - (i) Cutting of trees in phases,
 - (ii) Taking advantage of the period of monsoon,
 - (iii) Developing not too high and steep slopes,
 - (iv) Improving drainage,
 - (v) Re-plantation of trees, and
 - (vi) Turfing of the new embankment, should be adopted.

These steps will reduce the severity of the issue and by the time the road starts operating, the ecosystem will restore itself.

- Excavations of soil borrow areas may lead to higher degree of erosion. However, care has been taken that (i) many borrow areas are located on raised lands, earth mounds and heaps, (ii) in some cases the owner or villagers want to develop the area into pond for rearing fishes, (iii) re-plantation borrow pit areas will minimize the soil erosion.

5.2.3 Contamination of Soil

In the present project, the contamination of the soil is negligible, as there is no use of hazardous material which can contaminate the soil. However, at material storage site, interceptor / HDPE sheets will be provided to avoid any soil contamination.

5.3 IMPACTS ON WATER RESOURCES

Proposed bridges & their approaches development can lead to three types of modifications to the natural hydrological environment. These are:

5.3.1 Modification of the Surface Water Flow

The surface water flow in the existing carriageway is largely from east to west. The present project will no way alter the existing course of the surface water flow.

The widening of minor bridges, crossing over irrigation canals and culverts in the proposed design in the project will be aligned with the side of expanding roadway. As such, the surface water flow in these streams and canals will be least affected.

Modification of the Groundwater Flow

The water table along the proposed road ranges between 50 ft. to 60 ft. during summer. Since the proposed new approaches is higher or same height as compare to existing one, the groundwater flow is not going to be affected.

5.3.2 The Use of Local Water Supply

No local water supply will be used for construction purposes. Water will be taken from rivers. New bore well will be bored to take out underground water at construction sites for drinking purpose if required. As the underground water table is moderate and water requirement is during construction phase only, the crisis of water will not be there.

5.3.3 Water Quality Degradation

Some important parameters like pH, Chlorides, alkalinity etc. were compared with the acceptable standard for drinking water. No direct impact on water quality is predicted.

5.4 IMPACT ON AIR QUALITY

The ambient air quality along the proposed bridges & their approaches is good, some important observations on the project roads are:-

- The major pollution source are vehicular.
- The emissions of individual vehicles, their monitoring and regular checks are important. The fuel composition, maintenance of engines, and engine temperature must be properly regulated for improved scenario.
- As there is no structure of archaeological importance going to be affected due to proposed alignment, the impact does not need an assessment from this point of view.
- The parameters of air quality measurements, namely, PM_{2.5}, PM₁₀, NO_x, SO₂ and Carbon Monoxide at all selected sites were recorded to be within the prescribed limits.
- The mitigative measures suggested include the policies, regulation and enforcement programmes covering vehicle standards and maintenance requirement, fuel quality and technology, management of traffic efficiency and removing the high-pollution vehicles besides plantation of tall, leafy, and dense vegetation to filter and adsorb some pollutants.

5.4.1 Impacts During Construction Phase

The project site impact on ambient air quality within the project site and nearby areas may be significant during the construction phases. The particulate matter will be the main pollutant due to the excavations, handling and transport of earth and construction material etc. at site. The other pollutants will be NO_x due to the construction activities like operation of construction equipment and traffic movement.

Since the construction activities is a temporary activity and hence the increase in particulate matter and NO_x will be for short duration and its impact will be felt close to the construction site only. The construction camp shall be established at least one kilometer away from settlements. Outside the boundary of project activities, the Impacts would be marginal or insignificant

5.4.2 Impacts During Operation Phase

This replacement of existing bridges will naturally increase the traffic load on road & increase the economic activities in the area after the construction is over and as predicted the traffic load will be increased, however impact on air quality is not significant as the traffic on project road is not high.

5.5 IMPACT ON NOISE LEVELS

The assessment of potential road noise impacts helps in understanding one of the most significant pollution, the noise pollution. Some salient features related to potential noise impact of a road development include: (i) the road noise impact is greatest where busy road passes through densely populated areas, townships and markets (ii) the range of noise level should be understood in relation to the habitation type also; for example, road noise in industrial area is not likely to be problematic but at sensitive location like schools and hospitals; its impact may be significant, (iii) mitigation of noise in urban areas is rather difficult, specially at the road intersections.

Environmental noise particularly highway traffic noise, is a complex phenomenon because its intensity and characteristics vary with time depending upon the frequency as well as type of vehicles on the road.

The impacts of noise due to the project will be of temporary significance locally in the construction phase and slight increase may occur during the operation stages. Table below present the source of noise pollution and the impact categorization.

Sr. No.	Phase	Source of Noise pollution	Impact categorization
1	Pre-construction	<ul style="list-style-type: none"> • Man, material & machinery movements • establishment of labor camps onsite offices, stock yards and construction plants 	<ul style="list-style-type: none"> • all activities will last for a short duration and also shall be localized in nature
2	Construction Phase	<ul style="list-style-type: none"> • Plant Site <ul style="list-style-type: none"> - stone crushing, asphalt production plant and batching plants, diesel generators etc • Work zones <ul style="list-style-type: none"> - Community residing near to the work zones 	<ul style="list-style-type: none"> • Plant Site: Impact will be significant within 500m. • Work zones: Such impacts again will be of temporary nature as the construction site will go on changing with the progress of the works.
3	Operation Phase	<ul style="list-style-type: none"> • due to increase in traffic (due to improved facility) 	<ul style="list-style-type: none"> • will be compensated with the uninterrupted movement of heavy and light vehicles.

5.6 IMPACT ON FLORA, FAUNA AND ECOSYSTEM

Some important positive and negative impacts on flora, fauna and ecosystem of the present road-widening project are: -

- There will be no loss of bio-diversity since no rare/endangered plant or animal species is going to be eliminated due to the proposed proposed bridges & their approaches
- There will be no loss of habitat by the road itself, borrow pit areas and quarry sites.
- The proposed bridges replacement and construction of new approach will not affect migratory path of animal breeding zone, wetlands or important ecosystems. The loss of herbal cover, at least during the construction phase, is likely to produce some negative impacts.

5.6.1 Removal of Trees

Only 158 no. of trees will be cut by this project, as, the cutting of trees has been minimized due to integration of this factor exclusively in designing the proposed project. The impacts of tree cutting on the environmental quality will be as follows.

- The loss of trees will lead to higher degree of soil erosion. This has to be compensated by re-plantation of trees in the first priority, at the pre-construction stage.
- The loss of trees will reduce the ambient air quality since trees act as adsorbent of air pollutants thereby improving the air quality.
- The reduction in number of trees, especially in or near congested market places will enhance the raising of noise level.
- The other benefits of such trees such as shade, availability of fruits etc. will be worst affected till the new trees grow up and compensate.

However, a careful and proper planning of re-plantation of trees right at the commencement of construction and the phase wise removal of existing trees will mitigate the negative impacts.

5.6.2 Removal of Herbal Cover

The removal of herbaceous plants from the expanding side, will lead to soil erosion. However, the degree of erosion will be of smaller magnitude since the soil type has greater stability. Yet, the loss of soil by erosion could be mitigated by regular watering and re-plantation of herbal cover, i.e., turfing.

5.7 IMPACT ON PROTECTED MONUMENTS AND CULTURAL HERITAGE SITES

It has been observed that no archaeological site or monument and cultural heritage site exists close to proposed bridges & their approaches. Therefore there would not be any kind of significant impact on the cultural heritage sites.

5.8 IMPACTS ON SOCIAL ENVIRONMENT

The economic and social interaction of communities is going to be improved by the road projects. However, the proposed bridges & their approaches will cause disruption to local interactions. In fact, at few places over the years people have occupied the open space of the Right of Way (ROW) encroaching upon it. The encroachments are most common in market places, road crossings and in midsections. The local community activities go on the roadside, the footpath, the bus stops and even the road surface itself. These activities may take many forms, for example,

- Development of dhabas, tea shops, café and repair shops in view of catering the needs of trucks and truck drivers besides other automobiles.
- Make-shift shops in market places for catering the need of travelers and passengers besides the drivers of the vehicles.

- Uncontrolled stops by buses, taxis and informal public transport

However, in present case construction activities are limited near the bridges & approaches which are not impacted by encroachment.

5.9 IMPACTS ON ROAD SAFETY AND HUMAN HEALTH

The planning and designing of the proposed bridges & their approaches is in accordance with the improved safety measures and better health conditions. The chances of accidents could be minimized by (1) widening of existing carriageway, (2) strengthening the pavements, (3) improving upon the curves in road geometrics, (4) proposing the service lanes in market places and near schools, etc (5) providing proper median, (6) improving upon road crossings (7) putting right signals and signboards, (8) new under passes, (9) fly-over and grade separators.

The human diseases caused by the contamination of water, increase in air pollutants and noise may go up by 5-10% but proper mitigation can take care of the situation.

5.10 SUMMARY OF IMPACT ASSESSMENT

Table-5.2 presents the summary of impact assessment and mitigation.

Table-5.2: Summary of Impact Assessment

Sl. No.	Parameters	Potential Impact	Mitigation Measures Suggested
1.	Topography and Soil	<ul style="list-style-type: none"> • Cut and fill operations during road construction 	<ul style="list-style-type: none"> • The alignment passes through plain terrain and no substantial cut and fill operations are planned
		<ul style="list-style-type: none"> • Borrow earth 	<ul style="list-style-type: none"> • Borrow soil will be procure from approved quarry. • IRC guidelines will be followed during excavation
		<ul style="list-style-type: none"> • Quarries 	<ul style="list-style-type: none"> • Operational and government licensed quarry have been identified, which will be used to procure the material
2.	Air environment	<ul style="list-style-type: none"> • Generation of Dust 	<ul style="list-style-type: none"> • Sprinkling of water <ul style="list-style-type: none"> - Earth handling site - Borrow area - Road construction site • Air pollution control at stone crusher <ul style="list-style-type: none"> - PPE for workers - Stone crushing units environment compliance • Regulation of construction timings near sensitive receptors and settlements
		<ul style="list-style-type: none"> • Gaseous Pollution 	<ul style="list-style-type: none"> • Vehicles and machineries will be regularly maintained to conform to the emission standards. • Asphalt mixing sites should be 1 km away from residential area and outside forest area. • Asphalt plant will be equipped with pollution control equipment • Use of PPE by workers engaged in construction and application of asphalt mix on road surface. • Responsibility of contractors and supervising officers that the worker use the PPE
3.	Noise environment	Noise level may likely to increase during construction phase	<ul style="list-style-type: none"> • Properly maintained equipments to be used • Noise levels of machineries used shall conform to relevant standard prescribed in Environment (Protection) Rules, 1986.

Sl. No.	Parameters	Potential Impact	Mitigation Measures Suggested
			<ul style="list-style-type: none"> • Ear plugs and muffs will be used by workers as per requirement during construction activities. • Regulation of timing of construction work generating noise pollution near the residential areas .
4.	Water environment	<ul style="list-style-type: none"> • Drainage pattern 	<ul style="list-style-type: none"> • Provision of proper drainage through culverts along the project road. • All the water bodies will be crossed by bridges and structures without affecting their original course and flow • Stabilization and turfing of slopes along the water bodies
		<ul style="list-style-type: none"> • Siltation of water bodies 	<ul style="list-style-type: none"> • Silt fencing around water bodies during construction to avoid silt laden runoff entering water body • Turfing or pitching of embankments of water bodies affected will be done where possible to prevent erosion that causes siltation. • No solid waste will be dumped in or near the water bodies or rivers.
		<ul style="list-style-type: none"> • Flooding due to siltation of drainages channel 	<ul style="list-style-type: none"> • Excavated earth and other construction materials should be stored away from water bodies
		<ul style="list-style-type: none"> • Water for construction 	<ul style="list-style-type: none"> • Water source would be selected so that local availability is not affected
		<ul style="list-style-type: none"> • Rainwater harvesting 	<ul style="list-style-type: none"> • Rainwater harvesting drains provided along the road side with oil and gas removal traps
		<ul style="list-style-type: none"> • Contamination from wastes 	<ul style="list-style-type: none"> • Provision of septic tanks to prevent any untreated sewage discharge from construction workers camps • Oil interceptors at construction machine maintenance yards
		<ul style="list-style-type: none"> • Contamination from fuel and wastes 	<ul style="list-style-type: none"> • Vehicle maintenance will be carried out in a confined area, away from water sources, and it will be ensured that used oil or lubricants are not disposed to water courses
		<ul style="list-style-type: none"> • Sanitation and water use in construction camps 	<ul style="list-style-type: none"> • Construction camp will be organized in a planned manner. • Proper sanitation facilities including toilets. • Camps will have separate water supply facilities so that

Sl. No.	Parameters	Potential Impact	Mitigation Measures Suggested
			local water sources are not affected
5.	Land environment	<ul style="list-style-type: none"> Loss of topsoil 	<ul style="list-style-type: none"> Topsoil on stripping shall be removed and stockpiled on sides to be used on the side slopes, for top cover of borrow areas and for plantation pits
		<ul style="list-style-type: none"> Loss of topsoil from borrowing 	<ul style="list-style-type: none"> Arable lands will be avoided for earth borrowing. If needed, topsoil will be separated and refilled after excavation
		<ul style="list-style-type: none"> Borrowing of fill materials 	<ul style="list-style-type: none"> Excavation from pre-selected locations. After excavation the borrow pits will be dressed to match with the surrounding.
6.	Ecological resources	<ul style="list-style-type: none"> Loss of trees Wildlife 	<ul style="list-style-type: none"> About 158 no. of trees are likely to be felled. At least, 2 times of trees for each tree to be cut will be planted. More than 316 trees (1:2 ratio) are likely to be planted as a part of compensatory afforestation.
7.	Public health and occupational safety	<ul style="list-style-type: none"> Safety to public 	<ul style="list-style-type: none"> Signs will be posted on road before construction areas informing public and travelers about the work and safety provisions.
		<ul style="list-style-type: none"> Restriction to Access 	<ul style="list-style-type: none"> Safe and convenient passage for vehicles, pedestrians and live stocks will be arranged during construction work
		<ul style="list-style-type: none"> Occupational safety for workers 	<ul style="list-style-type: none"> Contractor will arrange all safety measures for workers as per factories act.
		<ul style="list-style-type: none"> Occupational safety for asphalt plant workers 	<ul style="list-style-type: none"> All worker employed on mixing asphaltic material, cement, lime mortars, concrete etc. will be provided with protective footwear and protective goggles

5.11 MITIGATION MEASURES

The project is likely to bring some negative impacts on the environment and socio-economic structure of the region. While avoidance and analysis of the alternatives for deciding the alignment from environment point of view were the first priority, some negative potential impacts are unavoidable. In such cases, adoption of mitigation measures is the only solution. A brief description of the approach to mitigation measures on environmental issues is enumerated herewith:

5.12 SOIL

The potential impacts, their mitigation, and the phase of implementation to topographic and soil characteristics were assessed and presented below.

Potential Impacts	Mitigation	Implementation Phase
A. Altered embankment	<ul style="list-style-type: none"> Action confined within ROW Good engineering & construction practices Stabilization and turfing (revegetation) 	Pre-constructional phase & constructional phase
B. Borrow pit excavation	<ul style="list-style-type: none"> IRC standards to be followed Borrow areas identified close to road Non-productive land will be used Good engineering & construction practices 	Pre-constructional phase & constructional phase

5.13 WATER RESOURCES

The potential impacts, their mitigation and the phase of implementation regarding water sources were assessed with regard to surface water bodies, like ponds, irrigation channels and underground water tables with reference to wells, tube wells and hand pumps.

Potential Impacts	Mitigation	Implementation Phase
A. Surface water bodies	<ul style="list-style-type: none"> Provision of proper drainage Construction camps are properly located Good engineering practices to be followed 	Pre-constructional, constructional, post-constructional and operational phases
B. Underground water	<ul style="list-style-type: none"> No appreciable impacts Water to be used for construction should have separate source 	Per-construction and constructional phase

5.14 AMBIENT AIR QUALITY

Potential Impacts	Mitigation	Implementation Phase
Due to construction activities and transport of material	<ul style="list-style-type: none"> • Machinery to be fitted with pollution control device • Asphalt plant will be equipped with dust collectors • Sensitive places like schools and hospitals to be avoided (at least 1000 m away) for Asphalt plants and other generators 	Pre-construction, constructional and post-constructional phases
Due to additional traffic, specially in market places	<ul style="list-style-type: none"> • Plantation of pollutant adsorbing trees 	Operational phase & constructional phase

5.15 NOISE LEVELS

Noise particularly highway traffic noise, is a complex phenomenon because its intensity and characteristics vary with time depending upon the frequency as well as type of vehicles on the road.

Sr. No.	Item	Impact	Impact (Reason)	Mitigation/Enhancement
1	Sensitive receptors	Direct impact	Increase in noise pollution	Not applicable as no such receptors exist.
2a	Noise Pollution (Pre-Construction Stage)	Direct impact, short duration	Man, material & machinery movements Establishment of labor camps onsite offices, stock yards and construction plants	Area specific and for short duration Machinery to be checked & complied with noise pollution regulations. Camps to be setup away from the settlements, in the down wind direction.
2b	Noise Pollution (Construction Stage)	Marginal Impact	stone crushing, asphalt production plant and batching plants, diesel generators etc Community residing near to the work zones	Camps to be setup away from the settlements, in the down wind direction. Noise pollution regulation to be monitored and enforced. Temporary as the work zones will be changing with completion of construction
2c	Noise Pollution	Marginal Impact	due to increase in traffic (due to	will be compensated with the uninterrupted movement of

Sr. No.	Item	Impact	Impact (Reason)	Mitigation/Enhancement
	(Operation Stage)		improved facility)	heavy and light vehicles.
3	Noise Pollution Monitoring		Effectiveness / shortfall (if any) Any unforeseen impact	Measures will be revised & improved to mitigate/ enhance environment due to any unforeseen impact.

5.16 HUMAN HEALTH AND SAFETY

Due to inadequate width of the road, heterogeneous nature of traffic, congested market places, the accidents are not uncommon. Besides this the truck-drivers may carry contagious diseases, which might spread in the area if proper care is not taken.

Potential Impacts	Mitigation	Implementation Phase
Accidental spots can be reduced by correcting the curves, along the bridges	<ul style="list-style-type: none"> • Proper provision of service roads, junctions, fly-over, under process to be provided at appropriate places • Truck parking places to be identified • Medically facility to be provided (an ambulance fitted with all medical equipments and a doctor) 	<p>Constructional and operational phases</p> <p>Constructional and operational phases</p> <p>Operational phases</p>
Sexually transmission diseases (STDs)	<ul style="list-style-type: none"> • Detected diseased person to be carried to the nearest city hospital • Preventive measures should be taken to check the spreading of STDs 	Operational phases

5.17 MEASURES TAKEN FOR PEDESTRIAN SAFETY

Following measures are taken for pedestrian safety in built-up areas:-

- Railing is provided on both sides of the bridges.
- Pedestrian crossing is provided in built-up area and bus bays.
- Proper signage is provided at appropriate locations.

5.18 BIOLOGICAL CHARACTERISTICS

The most important negative impact that the project will cause is the loss of number of trees, leading to (a) enhanced degree of soil erosion, (b) loss of shade, fruits, timbers and other economic activities, and (c) ecology of the ecosystem. However, if re-plantation management scheme is launched vigorously, the, though slow shall restore the ecological balance.

Potential Impacts	Mitigation	Implementation Phase
Cutting of 158 No. of trees	<ul style="list-style-type: none">• Minimum two times of new trees to be planted at the loss of one tree	Pre-constructional, constructional and operational phases
No loss of bio-diversity	<ul style="list-style-type: none">• Not needed	

Chapter 6
**Information Disclosure,
Consultation, and Participation**

6. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

6.1 GENERAL

The community along the road and villages population is directly and indirectly affected by the project activity. We organize the public consultation in various patches as required and involving the persons and ethnic group and gender. The method of taking response related to the project development through question answer methods. The development will influence on their livelihood, social status, traffic volume, economic wellness and so on. They are interested and happy to this development as they respond. In few cases some persons have very small shifting of their temporary shops and they are happily agreed to shift it. We also are trying to reduce the impact to the community wherever space is less, trying to reduce the width of the road which is very nominal and secure.

Meaningful consultations were carried out during detailed design, E & SIA preparation and design and continued during project implementation. All the five principles of information dissemination, information solicitation, integration, co-ordination, and engagement into dialogue were incorporated in the consultation process. A framework of different environmental impacts likely from the project was strengthened and modified based on opinions of all those consulted, especially in the micro level by setting up dialogues with the village people from whom information on site facts and prevailing conditions were collected. The requirement of public consultation during the implementation of the project has been proposed as part of the mitigation plan.

Consultations with local community have been done during E & SIA processes and to receive comments/views on road benefits and losses. The E & SIA also incorporates extensive consultations carried by various consultations.

6.2 OBJECTIVES OF THE PUBLIC CONSULTATION

Public consultations were held early and throughout the project development stage to allow the incorporation of relevant views of the stakeholders in the final project design, mitigation measures, implementation issues, and enhance the distribution of benefits. Stakeholder's consultations were held with intent to understand their concerns, apprehensions, overall opinion and solicit recommendations to improve project design and implementation. Informal meetings, interviews were organized covering the entire project design stage. Consultations provide affected people a platform to ensure incorporation of their concerns in the decision making process and foster co-operation among officers of Govt, the community and the stakeholders to achieve a cordial working relationship for smooth implementation of the project. It inculcates the sense of belongingness in the public about the project.

The discussions were designed to receive maximum inputs from the participants regarding their acceptability and environmental concerns arising out of the sub-project. They were given the brief outline of the project to which their opinions was required particularly in identifying and mitigating any potential adverse impact.

6.3 METHODOLOGY FOR CONSULTATIONS

Consultation with the stakeholders, beneficiaries, and community leaders were carried out using standard structured questionnaires as well as unstructured questionnaires. Questionnaire survey/ discussions were designed to obtain background information and details of general environmental issues that concern people in the project area. In addition, environmental issues were discussed with relevant organizations, government officials, beneficiaries, community leaders and experts. In addition, personal discussions with officials, on site discussion with affected stakeholders, and reconnaissance visits have also been made to the project area.

6.4 PROJECT STAKEHOLDERS

All types of stakeholders were identified to ensure as wide coverage as possible.

- Residents, shopkeepers and businesspeople who live and work along the road specially the project affected persons
- All type of road users/commuters
- Executing Agency
- The beneficiary community in general

6.5 CONSULTATION WITH GOVERNMENT DEPARTMENTS

Various officials consulted during E & SIA preparation included PWD Officials Noise and Water quality information, climatic data, immigration officer for Population and demographic profile, Revenue department etc.

These departments help to provide various project related data and information which help to preparation of report and data analysis.

6.6 CONSULTATION WITH LOCAL PEOPLE AND BENEFICIARIES

The informal consultation generally started with explaining the project, followed by an explanation to potential impacts. Participant's views were gathered with regard to all aspects of the environment which may have direct or indirect impact on local people. Key Issues discussed are:

- Awareness and extent of the project and development components;
- Benefits of the project for the economic and social upliftment of community;
- Labour availability in the project area or requirement of outside labour involvement;
- Local disturbances due to project construction work;
- Necessity of tree felling etc. at project sites;
- Impact on water bodies, water logging and drainage problem if any;
- Environment and health
- Flora and fauna of the project area
- Socio-economic standing of the local people

6.7 RESULTS OF CONSULTATION WITH LOCAL PEOPLE

Most of the people interviewed strongly support the project. The people living in the entire project area expect that the proposed project will facilitate better transport, safety, employment, tourism, economic development in the region. Construction camps may, however, put stress on local resources and the infrastructure in nearby communities. In addition, local people raised construction-process related grievances with the workers. This sometimes leads to aggression between residents and migrant workers. To prevent such

problems, the contractor should provide the construction camps with facilities such as proper housing, health care clinics, proper drinking water and timely payment. The use of local labourers during the construction will, of course, increase benefits to local peoples and minimise these problems. Wherever possible, such people should be employed. It is envisaged from the interview survey that there is increased environmental awareness among the people. Majority of the persons were in the opinion that environmental conditions of the area are good. However, some of them feel that the water quality is being deteriorated.

The project road is not passing through any forest area and it is also not required any land acquisition. The project corridor have some squatters along the road and they are encroaches the road side land for their shelter and habitation. A lot of populations are migratory which comes for some particular time and then move some other places which are nominal. During the consultation with the different village areas and different communities related to bridge construction they all people are very exhausted due to bad bridges condition and happy to listen the news for new construction specially farmers and businessman. They responded that the new improve bridges reduce their labour and save time which ultimately save money. During consultation also found that the water quality of that area is satisfactory and good. As for as air is concerned, the habitants, particularly elderly people, face breathing problem sometime.

There is no wildlife area, forest area and any endangered flora and fauna along or close to the road. The road is almost clear in environment point of view. Some patches have required drainage and small bridges. There were 158 trees along the bridges and approach road which need to be cut. These tree species are social tree species and the loss of trees will compensate with the new tree plantation.

The photographs of the public consultations are presented in the end of this chapter.

6.8 CONCLUSION AND RECOMMENDATION

Most of the people interviewed strongly support the project. The people living in the entire project area expect the different project elements to facilitate transport, employment, tourism, boost economic development and thereby provide direct, or indirect, benefits to them.

Construction camps may, however, put stress on local resources and the infrastructure in nearby communities. In addition, local people raised construction-process related grievances with the workers. This sometimes leads to aggression between residents and migrant workers. To prevent such problems, the contractor should provide the construction camps with facilities such as proper housing, health care clinics, proper drinking water and timely payment. The use of local laborers during the construction will, of course, increase benefits to local peoples and minimise these problems. Wherever possible, such people should be employed.

The following are the Consultants' initial findings in regard to likely positive and negative impacts.

Positive Impacts:

- *The new improved bridges:* will reduce travel times, fuel consumption and emissions from base traffic volumes
- *Drainage conditions will be considerably improved:* this because of the provision of improved design;
- Economic development and access will be stimulated
- Health, Agricultural and Education facility will improve.

Negative Impacts

- Few tree loss which reduce the green cover but simultaneously plantation will take place to improve the green cover.
- Minor deteriorations in the present minimum levels of air, water and noise quality may be expected during construction- but this should be short-term and localised – in order to minimise the impacts, the mitigation measures recommended
- During construction the traffic will slow and messy.

On the basis of available information, field visits over the entire length of the project road, discussions with the project authorities; other discussions amongst the project team, NGOs, local people and various governmental officials, it has been concluded that overall:

- All elements of the projects will be beneficial;
- All negative impacts, during and post construction, including those deemed “significant” can be properly mitigated; and
- No comprehensive, broad, diverse or irreversible adverse impacts identified.

Chapter 7
Environmental Monitoring &
Management Plan

7. ENVIRONMENTAL MONITORING & MANAGEMENT PLAN

7.1 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. As discussed in the previous chapters, the bridge design, construction and operation activities can have various levels of environmental impacts. The Environmental Management Plan (EMP) covers all aspects of the construction and operation phases related to environment.

The Environmental Management Plan (EMP) needs to be implemented right from the conception and should continue till the end. The Plan can be divided into three phases - (a) Design phase (b) Construction phase and (c) Operational phase.

7.2 DESIGN PHASE

Design will also be based on social and environmental criteria. Important environmental components e.g. soil erosion points, water resources, drainage, trees, wild life, sensitive locations etc, and social components e.g, school, hospitals, religious places, residential areas, commercial place etc. will be preliminarily identified on existing bridges replacement plan. While finalizing alignments and deciding on corridor of impact, this data will be considered and based on same design will be incorporated to minimize the impact on environment.

Table 7.1: Design Phase Measures – General

Impacts	Mitigation Measures
Land Acquisition	Bridge shifting & approach road design to minimize the land acquisition
Major Displacement	None
Removal of Trees	Minimise and only 158 no. of trees need to cut Compensatory plantation has been planned.
Impact on public utilities.	Alignment design to have minimum impact/ alternate arrangement to be done before removal of utilities.
Impact on Cultural Sites	None
Borrow pits	Locations to be selected considering minimum loss of productive land and redevelopment
Environmental Specifications for Contractors	Environmental qualifications specification should be included in pre-qualification packages for the contractors

These mitigation measures have been considered during finalizing the bridges and approach road design. *Table 7.2* shows some special mitigation measures adopted in project design.

Table 7.2: Mitigation Measures in Project Bridges & Approach Road Design

Impacts	Mitigation Measures
Major Displacement	None
Removal of Trees	Alignment design has minimize tree cutting & only 158 no. of trees need to be cut Compensatory plantation of double the number of trees will be carried out. Besides the total

Impacts	Mitigation Measures
	road section will be planted with ten thousand trees.
Impact on public utilities e.g. community wells etc.	In case of removal alternate arrangement will be done before.
Water bodies	Wherever required retaining wall bank protection measures has been proposed.
Borrow Pits and queries	Due to environment sensitivity, the project has plan for borrow pits, far away from bridges, so that there is no direct impact on environment.
Air Quality and Noise	The compensatory plantation along the project road would reduce the impact of air and noise pollution.

7.3 CONSTRUCTION PHASE

7.3.1 Land Environment

General mitigation measures are suggested in *Table 7.3*.

Table 7.3: Mitigation Measures for Land Environment

Impacts	Mitigation Measures
Soil Erosion	Proper planning for slope stabilization, topsoil storage, plantation and turfing on slopes.
Loss of topsoil	Most of the earth work would be done from the cut volume of the project road.
Borrowing of fill materials	Excavation from pre-selected locations. After excavation, the borrow pits will be dressed to match with surroundings. In specific cases borrow pits can be excavated in consultation with local people to use those pits as water harvesting points.
Disposal of Construction waste	No haphazard dumping of construction waste. Only pre-selected location maintaining local environmental.
Disposal of human waste by construction workers.	Soak pits should be provided to manage sewage waste generated from habitation of construction workers.

7.3.2 Air Quality and Noise

Construction activities at different phases can generate significant air quality problems. So air quality and noise will be one of the major environmental issues. Mitigation measures would be taken to reduce the impact as presented in *Table 7.4*. Specific areas for air and noise pollution control have been identified and given in *Table 7.4*.

Table 7.4: General Measures for Air & Noise Pollution Control

Impact	Measures
Generation of Dust	Water will be sprayed during construction phase, in earth handling sites, asphalt mixing sites and other excavation areas for suppression of dust. Dust emission from piles of excavated material should also be controlled by spraying water on the piles.

Impact	Measures
	<p>Special care should be taken when working near schools and medical facilities.</p> <p>Dust emission is a high-risk problem in the Stone Crushing activities. Workers are exposed to high level of dust pollution. It will be responsibility of the project proponent to ensure that stone crushers supplying materials for this project implement air pollution control and workers are provided with masks.</p>
Gaseous Pollution	<p>Vehicles and machineries will be regularly maintained to conform to the emission standards stipulated under Environment (Protection), Rules 1986.</p> <p>Asphalt mixing sites should be sufficiently away from residential area and not in forest area.</p> <p>Workers working in asphalt mixing and subsequent application of asphalt mix on road surface are exposed to high level of carcinogenic emission. These workers should be provided with masks and it will be responsibility of the supervising officers that the workers use the masks.</p>
Noise	<p>Workers shall not be exposed to noise level more than permitted for industrial premises, i.e. 90 dBA (Leq) for 8 hours. Workers exposed to high noise level should use ear plugs</p> <p>Construction work generating noise pollution near residential areas should be stopped during night.</p> <p>Noise attenuation measures e.g. planting of trees, no horn zone near residential areas to be done as required.</p>

However some specific areas need to be identified for air and noise quality control.

7.3.3 Water Resources

The project work will have some impact on water environment along the roadside and also the requirement of water for construction activities may have some impact on local water resources. Mitigation measures would be taken to reduce impact as presented in *Table 7.5*

Table 7.5: General Measures for Protection of Water Resources

Impacts	Mitigation Measures
Loss or impact on water bodies	The embankments of water bodies will be raised to prevent any contamination from road run-off.
Flooding due to siltation of drainage channel	Excavated earth and other construction materials should be stored away to prevent washing away.
Water use for construction	Water sources would be selected so that local availability is not affected. Local water bodies, tube wells, wells will not be used. Borehole by contractors will be done with permission from concerned department.

Impacts	Mitigation Measures
Contamination from wastes	All practical measures will be taken to prevent any uncontrolled effluent discharge from construction workers camps and storages to water sources. The campsite will be provided with proper drainage connected with local drain.
Contamination from fuel and wastes	Vehicle maintenance will be carried out in a confined area, away from water sources, and it will be ensured that used oil or lubricants are not disposed to watercourses.
Sanitation and Water use in Construction Camps	Construction camp will be organized in a planned manner. Workers shall be provided proper sanitation facilities including toilets. Camps will have water supply facilities without affecting the local water source.

During Construction work for the bridges, it will be taken care that the river water is not polluted due to the work. Also river should not be polluted by washing of vehicles or use by the construction workers. Otherwise local users and aquatic ecology of the river may be affected

There will be impact on water bodies through sedimentation either due to tree cutting and other construction activities as discussed in **Chapter-6**. To mitigate this problem stabilize and elevate the riverbank before construction. Construction material should be keep away from Riverside.

7.3.4 Flora

About 158 trees will have to be removed during construction activities. Major mitigation measures to be taken up are given in **Table 7.6**.

Table 7.6: Mitigation Measures for Tree Loss

Impacts	Mitigation Measures
Loss of Trees	Tree felling will be restricted to requirement of construction activities. About 158 trees will have to be removed during construction activities. Two times the number of trees cut will be planted. Plantation will be done as near as the old site, most preferably just beyond the existing position within Right of Way (ROW). To compensate the felling of trees and improve environmental quality, trees will be planted in nearby areas beyond the project site.
	The species will be selected depending on site, plantation design and in consultation with local community in the plantation program and forest department. Tree plantation will continue as part of construction process and will be included in Environmental Management Plan. The trees will be planted by project authorities by the roadside within ROW. The cost for plantation has been included in Environmental Cost.

7.3.5 Fauna

Different fauna are affected due to construction activities. Mitigation measures for avifauna will be planting of more trees, which will improve the condition much better than the present. For wildlife in the remote areas, specific restrictions will be imposed. These include

restriction in timing of work; setting up of workers’ camp, use of water sources, traffic speed etc.

Table 7.7: Mitigation Measures to be adopted during construction

Impacts	Mitigation Measures
Loss of habitat for avifauna	Compensatory Plantation program will be taken up.
Impact on Wildlife	No harvesting of wild foods or hunting of animals. Speed restriction in night.

7.3.6 Safety

Safety at different stages of construction is an important issue both for local people as well as for the construction workers.

Table 7.8: Safety Measures

Impacts	Mitigation measures
Information to Public	Signs will be posted on road before construction areas informing public and travelers about the work and safety provisions.
Restriction to Access	Safe and convenient passage for vehicles, pedestrians and livestock to and from the side roads and property across the road will be arranged during construction work
Occupational Safety for Construction Workers	Contractor will arrange all safety measures for workers .
Occupational Safety for Asphalt plant workers and Crusher plant.	All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. For crusher workers, masks should be provided.
Explosive use	The Contractor shall at all times make full liaison with and inform well in advance and obtain such permission as is required from all Government Authorities, public bodies and private parties whatsoever concerned or affected or likely to be concerned or affected by blasting operations.

7.3.7 Storage Site

Storage of construction related materials, like machineries, materials etc. will not be stored near any water body, school, health facilities and residential areas. The discarded materials from the storage site will be kept in a specific place at the storage site and disposed according to environmental laws and regulations. For storage of explosives, Explosives Act should be followed. Storage site should have proper signs for safety.

7.3.8 Workers’ Camp

Construction workers are a much neglected group in the country. Unless the workers are provided proper amenities to live at the construction site, the environmental issues of road construction cannot be properly met. Following mitigation measures are suggested in

Table 7.9. For any environmental pollution from the workers’ camp, the responsibility would lie with the project authority and subsequent penal action can be taken against them.

Table 7.9: Mitigation Measures for Workers’ Camps

Issue	Measures
Location	Workers’ camps will be located away from water bodies, schools, and residential areas.
Construction	Camp will be constructed with proper accommodation facilities, should look aesthetically good as this will be a roadside feature during construction period
Water	Contractor will arrange for potable water supply for the workers so that local water sources are not disturbed. Bore well for the camp will be suitable for this region.
Sanitation	Workers’ camp will be provided with proper sanitation facilities, toilets with septic tank and soak pits.
Other amenities	Crèche, first aid etc shall be provided

Some important guidelines related to stone quarries, noise levels of machineries and vehicle standards are given in **Table 7.10.**

Table 7.10: Guidelines related to stone quarries, noise levels

Source	Regulations
Stone Crusher	i) Implementation of following pollution control measures: a) Dust containment cum suppression system for the equipment. b) Construction of wind breaking walls. c) Construction of metalled roads within the premises. d) Regular cleaning and wetting of the ground within premises e) Growing of a green belt within the periphery ii) Quantitative standard for SPM: The SPM contribution value at a distance of 50 meters from a controlled isolated as well as from a unit located in a cluster should be less than 600 mg/m ³ . The measurements are to be conducted at least twice a month for all the 12 months a year.
Vehicles	Petrol driven: 4 wheelers: Idling CO not to exceed 3 % by volume. 3 & 2 Wheelers: Idling CO not to exceed 5.5 % by volume Diesel driven: Smoke Density a) At full load and 70% maximum speed: 3.2 Light Absorption Co-eff b) At free acceleration: 2.3 Light Absorption Co-eff
General Emission	Particulate matters: 150 mg/Nm ³
Automobiles	2 and 3 wheeler : 80 dB (A) Passenger car : 82 dB(A) Passenger or commercial vehicles upto 5T : 85 dB(A) Passenger or commercial vehicles 5-12 T : 89 dB(A) Passenger or commercial vehicles 5-12 T : 91 dB(A)
Machineries	Compactors, Front loaders, Concrete mixtures, Cranes, Vibrators, Saws : 75 dB(A)

7.4 OPERATION PHASE

Environmental issues change during operation phase and its mitigation plan also has to look towards a longer period of time. Operation phase environmental aspects are thus more related to vehicular emission. The mitigation measures for different environmental aspects are discussed below in *Table 7.11*.

Table 7.11: Operation Phase Mitigation Measures

Impacts	Mitigation measures
Dust	Bad road maintenance of road gives rise to dust pollution. Road surface will be maintained properly.
Gaseous Pollution	All vehicles should be checked for “Pollution Under Control” certificates and occasional spot testing of emission from vehicles will be carried out.
Surface runoff	Surface runoff from the road will not be disposed directly in the water bodies used by people for bathing etc. It should also not be disposed directly in to any watercourse with good water quality.
Wild Life	There should be speed restrictions through specific area in the night to prevent accident with wild animals. There will be proper sign for the drivers to inform about this.
Flora	Tree plantations will be monitored continuously.
Safety	Safety signs should be kept always clean and updated
Public amenities	Bus Stops, Underpasses etc. should be kept in order.

7.5 ENVIRONMENTAL ENHANCEMENT

Environmental enhancement considers additional provisions, which can be included in the execution of present project to enhance better road service facilities

7.5.1 Water bodies

As discussed before, a number of water bodies will be affected by proposed alignment. There will be mitigation measures as also discussed earlier. However there will be further effort to enhance the aesthetics of these water bodies as well as public utility.

Landscaping: The slopes of the River and its tributaries particularly near bridges will be vegetated and landscaping will be done to improve the aesthetics of the place. The slope will rise slowly from the roadside and there will be plantation of trees, which will reduce soil erosion.

7.5.2 Workers’ Camps

As said before workers’ camps are most neglected. One of the important tasks of environmental enhancement will be to build model workers’ camps, which then can be replicated in all road construction projects. The workers’ camps will be clean, the camp houses will be properly painted, the housing area nicely separated from the surroundings. There may be flower plants etc to make the place beautiful. There should be sign stating it as workers’ camp so that people traveling along the road can learn about the model camps.

7.6 ENVIRONMENTAL MONITORING

The Environmental Monitoring Programme provides such information on which management decisions may be taken during construction and operational phase. It provides basis for evaluating the efficiency of mitigation and enhancement measures, and suggested actions that need to be taken to achieve the desired effect. The monitoring includes:

- (i) Visual observation,
- (ii) Selection of environmental parameters at specific locations, and
- (iii) Sampling and regular testing of these parameters.

The objectives 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 the environmental management plan in future projects

The **Table 7.12** provides details of how the monitoring of various components will be undertaken.

Table 7.12: Environmental Monitoring Programme

Components	Action to be Taken
AIR	<p>Parameters:</p> <ul style="list-style-type: none"> • PM10 ,PM2.5, SO₂,NO_x, CO <p>Monitoring Frequency</p> <p>Construction Phase: Residential areas near bridges, and HM / crusher plant site.</p> <ul style="list-style-type: none"> • once in a season during the construction period, except monsoon
NOISE	<p>Parameters:</p> <ul style="list-style-type: none"> • Noise measurement in dB(A) for day & night <p>Monitoring Frequency</p> <ul style="list-style-type: none"> • Construction Phase : Twice a year for 24 hours period at residential area near bridges and HM / crusher plant site • Operational Phase: Adhoc only if complaint is lodged <p>Monitoring Standard</p>
WATER QUALITY	<p>Parameters:</p> <ul style="list-style-type: none"> • pH, BOD, COD, DO, Oil & Grease, ,TDS ,Turbidity ,TSS ,Chloride & Sulfhate <p>Monitoring Frequency</p> <ul style="list-style-type: none"> • Construction Phase: One time per season in a year Ground water quality where construction camps are located. • At water crossings where bridges are to be constructed <p>Monitoring Standard</p>
SOIL	<ul style="list-style-type: none"> • Construction Phase: Twice a year during construction period at four locations near construction camp, agriculture field, near BT disposal site and borrow area. • Parameters: pH, Conductivity, NPK, texture and organic matter

Components	Action to be Taken
FLORA	Parameters: <ul style="list-style-type: none">• No of trees surviving after 1.5 yr. And 2 yrs. in relation to total number of trees planted• Re-vegetation success, in terms of survival of plantings Monitoring Points: <p>Throughout the bridge & its approach stretch</p> Monitoring Standards: 100% newly planted trees, shrubs and brushes

Chapter 8
Conclusion and
Recommendation

8. CONCLUSION AND RECOMMENDATION

The assessment of environment impacts for the sub-project shows that there are no significant, long term impacts. Most impacts are short term and limited to the construction stage. Key conclusions on the Environmental & Social implications of the project are given in the paras below.

8.1. ENVIRONMENTAL GAINS DUE TO PROPOSED WORK JUSTIFYING IMPLEMENTATION

The project entails various impacts on the project setting. There are many impacts bearing benefits to the area against the limited number and magnitude of negative impacts. These include the following: (i) the project will substantially improve the transport efficiency on the roads. (ii) the project once implemented will improve the overall environmental conditions with better roads, fuel efficiency and environmental protection measures (iii) will reduce traffic congestion particularly at bridges hence, air pollution due to idling of the vehicles.

8.2 POTENTIAL IMPACTS AND MITIGATION

The finding of E & SIA indicates that project is unlikely to cause any significant adverse environmental impacts. While some of the impacts are negative, there are many bearing benefits to the area. Most of the impacts are likely to occur during construction stage and are temporary in nature. Anticipated minor impacts will be mitigated through the implementation of mitigation measures summarized in the Environmental Management Plan.

Factors contributing to minimal impacts include, widening of the project road confined within the available ROW, presence of no sensitive environmental issue like wildlife sanctuary, national park, bio reserve, with 10 km from the project road and most of water body crossed by the road are non-perennial in nature. However, some of the impacts are unavoidable. These impacts with mitigation measures are indicated below:

- About 158 trees need be cut with prior permission of district or forest authorities. Compensatory Tree plantation on the basis of 1:5 will be made to compensate this loss. Preventive measures shall be taken into consideration during construction phase especially in rainy months, to prevent soil erosion because of tree cutting and alteration of ground flora.
- Air Pollution due to construction activities and operation of hot mix plant will be controlled through adoption of dust suppression measures and provision of high stack for good dispersion of gaseous emission from hot mix plant.
- Noise levels may increase during the construction phase due to operation of construction machineries. All the construction equipment and DG set will be well maintained and fitted with silencers.
- Waste materials generated during construction phase may contaminate soil, surface and ground water resources. Waste shall be segregated and reused or disposed off in environmentally acceptable manner.
- Along the project stretch, few religious structures are located. Appropriate design options are exercised to minimize the loss of such structures.
- The social issues are addressed through public participation during design and construction stages.

8.3 IRREPLACEABLE RESOURCES

The project does not pass through any protected areas, or eco sensitive areas. The construction material will also be sourced from identified and approved sources. As such, there are no environmental sensitive resources found in the project area, which is likely to be affected due to the project.

8.4 POST E & SIA SURVEILLANCE AND MONITORING

While an E & SIA is meant to provide a comprehensive understanding of the environment status of the area under the study, post E & SIA surveillance is the means to ensure that the significant impacts identified are adequately mitigated as per the proposed mitigation plan. A detailed monitoring plan has been provided as part of the Environmental Management Plan. Air, water quality, noise, soil erosion, and tree survival rate monitoring and reporting along with the follow up actions in case of deviation from the norms have been detailed out. The frequency has been set in consideration of the likely impacts.

8.5 PUBLIC CONSULTATIONS

The project received support and consent from most of local people. The local people did not perceive any adverse impact due to the proposed project. Environmental awareness and likewise concern were found generally low. People, however expressed the desire of minimising the tree cutting.

8.6 RECOMMENDATIONS

Adequate mitigations shall be taken up both during construction and operation stage of the project to avoid/minimise adverse environmental impacts due to this event and any such event in future as suggested in E & SIA.

Effective EMP implementation is essential for elimination or minimization of the identified impacts. The Project proponent shall ensure that EMP and forms part of bid document and civil works contract. The same shall be revised if necessary during project implementation or if there is any change in the project design.

Project Proponent needs capacity building and practical exposure. Adequate training shall be imparted as proposed under environmental management plan to enhance the capability of concerned officials.