

National Highways Infrastructure Development Corporation Ltd.
Ministry of Road Transport & Highways, Government of India

**Consultancy Services for
Preparation of Feasibility Study and Detailed Project Report for
Construction of 2 lane/2 lane with paved shoulder from**

Kohima to Nagaland/ Manipur border section of NH-29 (Old NH-150) in Nagaland

**From Existing km 7.880 (Design Ch. 7+880) Chedama Road/Kohima
Town to Existing km 131.894 (Design Ch. 128+970) near Jessami
Village in Manipur State under SARDP Phase-B on EPC Mode**



Environment Impact Assessment (EIA) including EMP

Volume-IV

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(Environmental Impact Assessment)

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ABBREVIATIONS

AAQ	Ambient Air Quality	MC	Monitoring Consultant
AAQMS	Ambient Air Quality Monitoring Station	MDR	Major District Roads
AIDS	Acquired Immuno Deficiency Syndrome	MPN	Most Probable Number
BGL	Below Ground Level	MoEF	Ministry of Environment and Forests
BOD	Biochemical Oxygen Demand	NAAQS	National Ambient Air Quality Standards
BOQ	Bill of Quantities	NBWL	National Board of Wildlife
BPL	Below Poverty Line	NGO	Non-Governmental Organisations
CALINE	California Line Source Dispersion Model	NH	National Highway
CCTV	Closed-circuit television	NPV	Net Present Value
CF	Conservator of Forest	NOC	No-objection Certificate
CGWB	Central Ground Water Board	NO _x	Oxides of Nitrogen
CO	Carbon Monoxide	ODR	Other District Roads
COD	Chemical Oxygen Demand	PAF	Project Affected Family
CoI	Corridor of Impact	PAH	Project Affected Household
CPCB	Central Pollution Control Board	PAP	Project Affected Person
CPR	Community Property Resource	PD	Project Director
DFO	Divisional Forest Officer	PF	Protected Forest
DO	Dissolved Oxygen	PIU	Project Implementation Unit
EIA	Environmental Impact Assessment	PM	Particulate Matter
EMP	Environmental Management Plan	PPP	Public Private Partnership
ESMP	Environment & Social Management Plan	PUC	Pollution Under Control
FGD	Focus Group Discussions	PWD	Public Works Department
GFF	Glass Fibre Filter	R&R	Resettlement and Rehabilitation
GO	Government Order	RAP	Resettlement Action Plan
GoI	Government of India	RF	Reserved Forest
GoRJ	Government of Nagaland and Manipur	RHS	Right Hand Side
GW	Ground Water	ROW	Right of Way
HC	Hydrocarbon	SH	State Highways
IBRD	International Bank for Reconstruction and Development	SO ₂	Sulphur Dioxide
IMD	Indian Meteorological Department	SPCB	State Pollution Control Board
IRC	Indian Roads Congress	SW	Surface Water
IS	Indian Standard	TDS	Total Dissolved Solids
Leq	Equivalent Continuous Noise Level	UV	Ultra Violet
LHS	Left Hand Side	USEPA	US Environment Protection Agency
LCV	Light Commercial Vehicles		
MAV	Multi Axle Vehicles		

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0 EXECUTIVE SUMMARY

0.1 PROJECT BACKGROUND

The Ministry of Road Transport and Highway, Government of India (the “Authority”) is engaged in the development of National highways and as part of this endeavor, the Authority has decided to undertake “Consultancy services for Preparation of Feasibility Study and Detailed Project Report for Construction of 2 lane/2 lane with paved shoulder from Kohima to Nagaland/Manipur border section of NH-29 (Old NH-150) in the State of Nagaland under SARDP Phase-B on EPC Mode”. The present study focused on the Environmental Impact Assessment (EIA) from the proposed project during construction and operation phase.

0.2 NEED OF THE PROJECT

- To provide easy access to commuters from Nagaland to Manipur
- The project road links NH 39 and NH 155 and hence provides easy communication between different districts of Nagaland & Manipur

0.3 PROJECT ROAD

Existing Project Highway, NH-29 (old NH-150) starts near Teen Patti Junction (km 3.000) in Kohima (Nagaland) and terminates at its junction with NH-202 near Jessami in Manipur state. The project road is approximately 130.390 km long. The project road is located under the jurisdiction of Nagaland & Manipur State. Major part of the road is in Nagaland where as minor part is in the Manipur state. The existing length of the Project Highway is about 129.110 kms while design length along the proposed alignment of Project Highway is 130.390 kms. The Project Highway passes through districts Kohima and Phek in the state of Nagaland and Ukhrul in the state of Manipur. It connects important Town / Villages namely Kohima, Chakabama, Kiruma, Fpsutsero, Misulumi, Enhulum, Chizami, Losami, Laniye and Jessami etc.

0.4 PROJECT AREA

The project districts are Kohima, Phek in Nagaland and Ukhrul in Manipur State.

0.5 CORRIDOR OF IMPACT

In general, the existing & proposed Right of Way (RoW) varies from 6-7 m & 20-24 m respectively. The immediate CoI thus also varies from 20-24 m. However, for parameters like Noise and air pollution, the impact goes beyond the immediate CoI.

0.6 PROJECT PROPONENT

The project proponent is Ministry of Road Transport and Highways, Government of India.

0.7 PROPOSED IMPROVEMENTS

In general roadway width shall be 12.00 m which includes 7.00 m main carriageway and 1.50 m paved and 1.00 m earthen shoulders both the sides as per typical cross sections attached in Annexure 2.1

- ROW shall be 24.00 m for Rural (Non-Urban) areas and 20.00 m in Urban areas.
- The design speed shall be the minimum 40 kmph for Mountainous and Steep (Hilly) terrain except at hairpin bend locations where design speed has been restricted to 20 kmph
- 7 Typical Cross Sections (TCS I, IC, IIC, V, VIA, IX) for widening to 2 lanes with paved shoulder status has been proposed

0.8 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) STUDY IN THE PROJECT

The study methodology for the EIA employs a simplistic approach in which the important environmental issues have been identified before initiation of the baseline study. Based on the identification baseline data was generated and then analysed to predict the impacts and quantify them.

0.9 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

As part of the project execution, developer shall take the following clearances and NOCs:

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- Project Highway is neither a new national highway nor a NH expansion project with land acquisition of greater than 40m on existing alignments and 60m on re-alignments or by-passes hence environmental clearance not required.
- There is no ecological sensitive area / wildlife sanctuary falls within 5 km radius from the project site hence wild life clearance as per Wildlife (Protection) Act, 1972 is not required.
- No presence and impact on Archaeological features. Thus no archaeological clearances / permissions to be obtained
- Forest Clearance under purview of Forest (Conservation) Act, 1980 shall be required which will be finalized after joint inspection with forest department.
- Trees are needed to be felled due to road widening. Permission to be obtained from Forest/District Authorities before felling

Apart from the clearances developer shall also obtain the required clearances NOCs & licenses from the various agencies & authorities prior to his work initiation. These are:

- NOC and Consents under Air, Water, EP Acts & Noise rules of SPCB for establishing and operating noise generating equipments from Nagaland and Manipur State Pollution Control Board
- NOC under Hazardous Waste (Management and Handling) Rules, 1989 from SPCB
- PUC certificate for use of vehicles for construction from Department of Transport
- NOC for ground water extraction for construction and allied works from Ground Water Authority

Apart from the above clearances, developer also has to comply with the following:

- Clearance of monitoring consultant for location and layout of Worker's Camp, Equipment yard and Storage yard.
- Clearance of monitoring consultant for Traffic Management Plan for each section of the route after it has been handed over for construction.
- An Emergency Action Plan shall be prepared by developer and approved by the Monitoring consultant for accidents responding to involving fuel & lubricants before the construction starts.

0.10 BASELINE ENVIRONMENTAL PROFILE

0.10.1 Physical Environment

Climate

Nagaland has a monsoon climate. The state enjoys a salubrious climate. Annual rainfall ranges around 70–100 inches (1,800–2,500 mm), concentrated in the months of May to September. Temperatures range from 70 °F (21 °C) to 104 °F (40 °C). In winter, temperatures do not generally drop below 39 °F (4 °C), but frost is common at high elevations. Summer is the shortest season in the state that lasts only for a few months. The temperature during the summer season remains between 16 °C (61 °F) to 31 °C (88 °F). Winter makes an early arrival and bitter cold and dry weather strikes certain regions of the state. The maximum average temperature recorded in the winter season is 24 °C (75 °F). Strong north-west winds blow across the state during the months of February and March.

Geology

Facing the Himalayan ranges across the Brahmaputra valley and stretching NE- SW along the eastern margin of Northeast India, bordering Myanmar, lies the Naga Hills. It represents the northern extension of the Indo- Burma Ranges (IBR) linking the Arunachal Himalaya to the north and Andaman-Nicobar Islands to the south. The N-S trending Patkai, Barail and associated ranges with their varied structural styles impart youthful geomorphology to the Naga Hills. The Cenozoic sedimentary cover in Nagaland accounts for nearly 95 percent of the area whereas the rest is being occupied by igneous and crystalline rocks of Mesozoic- Cenozoic age. These exhibit a general trend of NNE-SSW with moderate to steep dips towards NW and SE. Based on the morphotectonic elements, the Naga Hills has been longitudinally divided, from west to east, into three distinct units, namely- the Schuppen Belt, the Inner Fold Belt and the Ophiolite Belt. The Schuppen Belt has been defined as a narrow linear belt of imbricate thrust slices which follows the boundary of Assam valley alluvium for a distance of 350 Km. along the flank of Naga- Patkai hill ranges. It is postulated that this belt comprises of eight or possibly more overthrusts along which the Naga Hills have moved northwestwards relative to the Foreland spur. The total horizontal movement of all the thrusts together is estimated to be over 200 km. The Schuppen belt is delineated on the east by Halflong- Disang thrust and on the west by the Naga thrust which has an end-echelon disposition. Sediments ranging in age between Eocene-Oligocene and Plio-Pleistocene along with total absence of Disang rocks together characterize the Schuppen Belt.

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Soil

Based on the report of the Soil Survey Wing of Soil and Water Conservation, Nagaland, the soil of Nagaland belongs to 4 orders, 7 sub-orders, 10 great groups, 14 sub groups and 72 soil families. The 4 orders of soil found in Nagaland are (i) Alfisols (ii) Entisols (iii) Inceptisols and (iv) Ultisols. Inceptisols dominate the soils of the State with 66% followed by Ultisols 23.8%, Entisols 7.3% and Alfisols 2.9% of the total 16.6 million Ha. of the State geographical area.

Seismicity

According to GSHAP data, the state of Nagaland falls in a region of high to very high seismic hazard. As per the 2002 Bureau of Indian Standards (BIS) map, this state also falls in Zone V. Historically, parts of this state have experienced seismic activity greater than M6.0. Approximate locations of selected towns and basic political state boundaries are displayed. Nagaland has been hit by many disasters in the past. The most notable ones are the Great Shillong Earthquake on 12th June 1897 which measured 8.7 in the richter scale and the Assam. Tibet earthquake on 15th August 1950 which measured 8.5 in the Richter scale. However, since those days there were no facilities to record and to document, there is no local data supporting the disasters. However interviews with the older generation people reveals that the 1950 earthquake was very much felt by Nagaland, and it even resulted in the destruction of many houses in certain areas. It was even said the earth opened up and buffalos were buried alive

Ambient Air Quality

The air quality in the project area is less polluted. The result from the ambient air quality monitoring at 4 locations it is clear that concentrations of all pollutants are well within the prescribed limits of the National Ambient Air Quality Standards. The 98th percentile value of PM 10 varies between 55.31 µg/m³ at Rusoma, 54.55 µg/m³ at Kikrumba, 53.18 µg/m³ at Pfutsero, 50.95 µg/m³ at Chizami (Near Baptist Church). The 98th percentile value of PM 2.5 varies between 23.32 µg/m³ at Rusoma, 22.51 µg/m³ at Kikrumba, 20.21 µg/m³ at Pfutsero, 21.25 µg/m³ at Chizami (Near Baptist Church). The 98th percentile value of SO₂ varies between 8.03 µg/m³ at Rusoma, 7.17 µg/m³ at Kikrumba, 7.52 µg/m³ at Pfutsero, 7.72 µg/m³ at Chizami (Near Baptist Church). The 98th percentile value of NO₂ varies between 12.31 µg/m³ at Rusoma, 10.45 µg/m³ at Kikrumba, 11.23 µg/m³ at Pfutsero, 8.84 µg/m³ at Chizami (Near Baptist Church). The 98th percentile value of CO varies between 0.58 mg/m³ at Rusoma, 0.54 mg/m³ at Kikrumba, 0.51 mg/m³ at Pfutsero, 0.51 mg/m³ at Chizami (Near Baptist Church).

Noise Quality

Noise monitoring has been carried out once during the entire study period (over a period of twenty-four hours to obtain L_{eq} values at uniform time intervals of 1 hour. For each location, day and night time L_{eq} values have then been computed from the hourly L_{eq} values such that comparison could be made with the national ambient noise standards. Day & night time L_{eq} has been computed from the hourly L_{eq} values as per standards L_{eq} is varies from 40 dB(A) to 49.9 dB(A).

Surface Water

There are many perennial River and stream found along the project road which may be used for the drinking as well as construction purpose. People along the road use the stream water for drinking purpose after conventional treatment. Two surface water sample was collected in the month of April 2016. Samples were analysed for the parameters as desired for assessment of surface water quality. The results were compared against the Class C water (Water for fish culture and wild life propagation) quality standards as per IS 2296.

Ground Water

The project area falls in hilly area. The sources of ground water are limited. Some of the hand pumps found at the bend of the road at the lower terrain. 2 ground water/Drinking Water samples were collected to assess the ground water quality along the project corridor. The samples were collected in the month of April 2016. Ground water samples were analysed in lines with IS 3025 and APHA 22nd edition 2012. Water quality as analysed is presented in Table below. The water quality was found well within the permissible limits but some of the parameters are crossing desirable limit as per IS: 10500 drinking water quality standards.

0.10.2 Biological Environment

Protected Areas / Eco-sensitive Zones/ Animal Corridor

(Environmental Impact Assessment)

There is no wildlife sanctuary found along 5 km radius of the project road. Puliebadze is the nearest wildlife sanctuary from the project road, which is approx. 5.6 km from the project road

Flora & Fauna

Nagaland is very rich in bio-diversity, both flora and fauna. Even today some pockets of forests are covered with gigantic trees, where sun-rays can not penetrate. Due to reckless and uncontrolled cutting of trees for timber, firewood. Continued Jhum cultivation and annual fire in vast tracts of land, forest got degraded and barren, which accelerated demining of the most of the original characteristics of the forests.

At least 106 species of mammals are likely to occur in Nagaland, these includes nine insectivores, 34 bats, seven primates, one pangolin, 34 carnivores, one elephant, seven ungulates, one hare and at least 12 rodents. Data from the secondary source shows that about 43 species of Birds found in the Nagaland state.

Forest

Through geographically being a small state. Nagaland has several types of forests, mainly because the state is mostly tropical, and the altitudes range from a few hundred meters to about fournthousnd meters. The major types of forests fond in the state, as pe the classification of champion and Seth, are as follow,

1. Northern Tropical Wet Evergreen Forest.
2. Nor tropical Semi-Evergreen Forest.
3. Northern Sub-Tropical Broad Leave Wet Hill Forests
4. Northern Sub-Tropical Pine Forests
5. Northern Montana Wet Temperate Forests and
6. Temperate Forests.

0.10.3 Social Environment

Census Profile

The project highway passes through Kohima & Phek District of Nagaland State and Ukhrul District of Manipur.. As per the 2011 census, Nagaland has a total population of 1,978,502 and the total male and female population of the state is 1,024,649 and 953,853 respectively. The population density per sq km is 119. The total number of literates of the state is 1,342,434 while the sex ratio is 931.

Whereas, in Manipur the total population is 2,855,794 and the total male and female population of the state is 1,438,586 and 1,417,208 respectively. The population density per sq km is 128. The total number of literates of the state is 1,908,476 while the sex ratio is 985.

Workforce in Project area

The people in the villages are mostly engaged in the agricultural work and economy is largely based on agricultural activities. Some people are also working as a labourer in nearby area.

Settlement

There are a total of 11 settlements varying in size and populations along the project corridor.

Educational Institutes

There are various Schools located along the project road. All structures are outside of proposed Corridor of Impact. Hence no physical impact has been envisaged.

Cultural Properties

Some of the cultural properties found along the project raod. Which is out of CoI.

0.11 PUBLIC INTERACTIONS & CONSULTATION

Public Interactions & consultations were conducted during the project preparations. The main purpose of these consultations was to know the community's reaction to the perceived impact of proposed project on the people at individual and settlement level. Drinking water scarcity was the major environmental issue reported during consultation. Sighting of various wildlife species and occurrence of accidental road kill was also confirmed by community as well as

(Environmental Impact Assessment)

institutional stakeholders. However, some people were concerned about other environmental issues, mainly air and noise pollution. The issues raised by the public have been duly incorporated in project design.

0.12 POTENTIAL ENVIRONMENTAL IMPACTS

The environmental components are mainly impacted during the construction and operational stages of the project and have to be mitigated for and incorporated in the engineering design. Environmental mitigation measures represent the project's endeavour to reduce its environmental footprint to the minimum possible. These are conscious efforts from the project to reduce undesirable environmental impacts of the proposed activities and offset these to the degree practicable. Enhancement measures are project's efforts to gain acceptability in its area of influence. They reflect the pro-active approach of the project towards environmental management.

0.12.1 Impacts on Climate

Slight change in the micro-climate of the area is expected due to Heat Island Effect as unpaved area will be converted into the paved road. However, Impact on the climate conditions from the proposed road project widening will not be significant in long run as deforestation and / or removal of vegetation will be compensated by compensatory plantation to the tune of double the area denuded.

0.12.2 Impact on Air Quality

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

0.12.3 Impact on Noise Levels

The area is likely to experience an increment in noise level due to increase in vehicle density after road strengthening. Locations of sensitive receptors were identified and noise barriers in the form of compound wall are proposed at these locations to mitigate the noise level up to acceptable levels.

0.12.4 Impact on Water Resources and Quality

The construction and operation of the proposed project roads will not have any major impacts on the surface water and the ground water quality in the area. Retaining wall will be provided along the bridge to avoid natural flow of the water body.

Contamination to water bodies may result due to spilling of construction materials, oil, grease, fuel and paint in the equipment yards and asphalt plants. This will be more prominent in case of locations where the project road crosses rivers, nallahs, etc. Oil interceptor will be provide at the construction camp nr. Workshop area. Mitigation measures have been planned to avoid contamination of these water bodies.

0.12.5 Impact on Ecological Resources

Roadside trees are likely to be affected due to the proposed development leading temporally loss of micro ecosystem. However, on the long run the impacts will be compensated in terms of compensatory afforestation and avenue plantation.

Need for diversion of forest land will be finalized after joint inspection with forest department. Hence Forest Clearance under the purview of Forest (Conservation) Act, 1980 may be applicable. The actual extent of forest land to be diverted shall be furnished after completion of Land Acquisition Plan.

0.12.6 Impact on Land

The complete road stretch found in the hilly region. Hence cutting of rocks/hills will be envisaged. Breast wall and retention wall will be provided to avoid land slide. During the construction of the proposed project, the topography will change due to cuts & fills for project road and construction of project related structures etc. Provision of construction yard for material handling will also alter the existing topography. The change in topography will also be due to the probable induced developments of the project. Land acquisition is proposed at realignment and bypass locations.

Sl. No	Potential impact	Mitigation / Enhancement
1.	Change in Geology	Blasting to be done as per requirement and with proper safegaurds is envisaged. Quarry Development Plan need to be enforced.

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Sl. No	Potential impact	Mitigation / Enhancement
2.	Change in Seismology	All structures to be checked and complied with the seismological settings of the region (Zone)
3.	Loss of land	Land acquisition minimized Design restricted to within 24m of ROW in Rural Area and 20m in Urban Area
4.	Generation of Debris	Disposed properly to avoid contamination.
5.	Soil Erosion	Embankment protection through stone pitching, Turfing & , retaining walls Residual spoil need to be disposed properly Silt Fencing need to be provided Quarries need to be reclaimed
6.	Contamination of Soil	Hazardous Wastes (Management and Handling) Rules, 1989 to be enforced. Oil Interceptor will be provided for accidental spill of oil and diesel Rejected material will be laid as directed by engineer. Septic tank will be constructed for waste disposal.
7.	Soil quality monitoring	Measures will be revised & improved to mitigate / enhance environment due to any unforeseen impact.
8.	Scarified Bituminous Wastes	No scarification involved. In case contractor decides to scarify then the material to be reused in the GSB layer. Non re-usable Bituminous wastes to be dumped in 30cm thick clay lined pits with the top 30cm layer covered with good earth for supporting vegetation growth over a period only after obtaining permission of Independent Consultant.
9.	Scarified Non Bituminous Material	Used in the normal GSB layer (not the drainage layer)
10.	Cut material	Reused as embankment, median & shoulder fill materials Excess material to be used for filling up of borrow areas identified by the Contractor and approved by the Independent Consultant
11.	Construction debris generated from dismantling of structures	Guidelines for Identification of Debris Disposal Sites & Precautions and Guidelines for Rehabilitation of Dumpsites, Quarries and Borrow Areas shall be framed
12.	Soil Contamination due to accident spills	An emergency response team to be created. The team shall contain members of the district and police administration and also have specialist in remediation. Responsibility of Contractor to inform the team to take actions. The roles and responsibility of the members of the team shall be framed in conjunction with all the parties to address the situation arising out of the accidental spills resulting in situation like water and soil contamination, health hazards in the vicinity of the accident spot, fire and explosions etc. During construction, the contractor and the Contractor 's described previously. Fuel storage will be in proper bunded areas. All spills and collected petroleum products to be disposed off in accordance with MoEF and SPCB guidelines and as per the directions of the Emergency Response team. Fuel storage and fuelling areas will be located at least 300m from all cross drainage structures and significant water bodies.
13.	Runoff and drainage	Improvements of design shall lead to less accidents and hence less spillage of oil and grease Silt fencing to be provided Recharge well to be provided to compensate the loss of pervious surface
14.	Operation of residential facilities for labour camps, Vehicle parking areas	Vehicle parking area will be made impervious using 75 mm thick P.C.C. bed over 150 mm thick rammed brick bats. The ground will be uniformly sloped towards to adjacent edges towards the road. A drain will take all the spilled material to the oil interceptor
15.	Meteorological factors and climate	Comprehensive afforestation Avenue plantation Shrub plantation in the median / island
16.	Dust generation	Sprinkling of Water Fine materials to be completely covered, during transport and stocking. Plant to be installed in down wind direction from nearby settlement.
17.	Gaseous pollutants	Air pollution Norms will be enforced. Labourers will be provided mask. Local people will be educated on safety and precaution on access roads, newly constructed embankment etc.
18.	Air quality emissions	Compliance with future statutory regulatory requirements
19.	Air quality monitoring	Measures will be revised & improved to mitigate enhance
20.	Alteration of Cross Drainage	Widening & construction of bridges, there will be an improvement in the drainage characteristics of the project area.
21.	Water requirement for project	Contractor needs to obtain approvals for taking adequate quantities of water from surface and ground water sources.

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Sl. No	Potential impact	Mitigation / Enhancement
		This is required to avoid depletion of water sources. Water harvesting structures to be provided.
22.	Increased sedimentation	Silt fencing to be provided Guidelines for Sediment Control to be framed
23.	Contamination of Water	Hazardous wastes (Management and Handling) Rules, 1989 to be enforced. Oil Interceptor will be provided for accidental spill of oil and diesel. Rejected material will be laid as directed by IC. Septic tank will be construction for waste disposal.
24.	Water quality monitoring	Measures will be revised and improved to mitigate / enhance environment due to any unforeseen impact.
25.	Noise mitigation for Sensitive receptors	Options for Noise barriers to be analysed No Horn Zone sign Post.
26.	Noise Pollution (Pre-Construction Stage)	Machinery to be checked and complied with noise pollution regulations. Camps to be setup away from the settlements, in the down wind direction
27.	Noise Pollution (Construction Stage)	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.
28.	Noise Pollution (Operation Stage)	Will be compensated with the uninterrupted movement of vehicles
29.	Noise Pollution Monitoring	Measures will be revised and improved to mitigate / enhance environment due to any unforeseen impact.
30.	Forest area	Minimum acquisition of land Permission for acquisition from forest department as per Forest Act Plantation of trees as per Forest Department
31.	Trees Cutting	Compulsory tree plantation in the ratio of 1:2. Option of compensatory afforestation through Forest Department. Identification of incidental spaces for plantation along corridor, where ever possible
32.	Vegetation	Clearing and grubbing will be minimized Exposed surface like embankment slopes will be protected with stone pitching and turfing. Open land in and around plant will be vegetated.

0.13 ANALYSIS OF ALTERNATIVES

Detailed analyses of the alternatives have been conducted taking into account both with and without project. Comparative analysis of Bypass Locations has also been conducted. The proposed strengthening of the road is likely to have a positive impact on the economic value of the region. There is no bypass/realignment proposed for the project road. However, there are certain environment and social issue, these needs to be mitigated for sustainable development.

0.14 MITIGATION AVOIDANCE AND ENHANCEMENT MEASURES

Mitigation and enhancement measures have been planned for identified adverse environmental impacts. The construction workers camp will be located at least 500m away from nearby habitations. Construction yard, hot mix plants, etc. will also be located more than 500m away from habitations and in downwind directions. Existing cross drainage structures have been planned to maintain for proper cross drainage. In order to compensate negative impacts on flora due to cutting of trees the project plans compensatory plantation in the ratio of 1:2 i.e. for every tree to be cut, two trees will be planted. The project shall also witness the plantation of trees for providing aesthetic beauty and shade. As the space for compensatory afforestation might not be adequate along the project road, this plantation shall be taken up by the forest department, after payment of the cost for raising and maintaining the saplings for three years. The project will take an opportunity to provide environmental enhancement measures to improve aesthetics in the project area. The planned environmental enhancement measures include plantation in available clear space in ROW, enhancement of water bodies etc. In order to avoid contamination of water bodies during construction Silt fencing, oil interceptors at storage areas and at construction yard have been proposed.

0.15 INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING PLAN

The responsibility of implementing the mitigation measures lies with Environment Team duly appointed by the Contractor. The overall supervision of Environmental monitoring works during construction and operation stage shall be carried out by PWD, Nagaland and Manipur with the help of the Monitoring Consultant.

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

0.16 ENVIRONMENTAL MANAGEMENT PLAN

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

0.17 ENVIRONMENT IMPACT AND MANAGMENT MATRIX

Particulars	Stages	Potential Impacts	Mitigation Measures
Physiographic Environment			
Topography	Preconstruction & Construction	<ul style="list-style-type: none"> Slight changes are expected due to widening and improvement of the road Impacts are marginal, but permanent. 	<ul style="list-style-type: none"> Proper planning to keep the land reformation up to bare minimum No new quarry for the project
Geology	Preconstruction & Construction	<ul style="list-style-type: none"> Impacts are moderate because of extraction of sand 	<ul style="list-style-type: none"> No mitigation measure is required.
Climate			
Temperature/Rain fall/Humidity	Preconstruction & Construction	<ul style="list-style-type: none"> Tree felling will have an impact of micro-climate of the area Heat island effect due to increase in paved roads Low spatially restricted short-term impact 	<ul style="list-style-type: none"> Compensatory afforestation of double of the trees to be cut With the proposed avenue plantation scheme, the micro climate of the project corridor will be smoothening
Land			
Loss of Forest & Trees	Design, Preconstruction & Construction	<ul style="list-style-type: none"> Diversion of Forest & Conservation Reserve Land 	<ul style="list-style-type: none"> Forest & WL Clearance to be obtained Recommendation of concerned authorities must be followed Payment of NPV & Compensatory Afforestation
Loss of Other Land	Design, Preconstruction & Construction	<ul style="list-style-type: none"> Loss of Property & Livelihood 	<ul style="list-style-type: none"> Compensation as per RAP
Induced Development	Preconstruction & Construction	<ul style="list-style-type: none"> Insignificant change in the land use pattern 	<ul style="list-style-type: none"> Civil authorities to plan and guide any induced development using the prevailing regulatory framework
Soil			
Soil Erosion	Preconstruction, Construction & Operation	<ul style="list-style-type: none"> In Road slopes and spoils Erosion in excavated areas 	<ul style="list-style-type: none"> Embankment protection through pitching & turfing Regular water sprinkling in excavated areas
Contamination of Soil	Preconstruction, Construction & Operation	<ul style="list-style-type: none"> Scarified bitumen wastes Oil and diesel spills Emulsion sprayer and laying of hot mix Production of hot mix and rejected materials Residential facilities for the labour and officers 	<ul style="list-style-type: none"> Hazardous Wastes (Management and Handling) Rules, 1989 to be enforced. Oil Interceptor will be provided in storage areas for accidental spill of oil and diesel Rejected material to be laid as directed by monitoring consultant. Septic tank to be constructed for waste disposal.

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Particulars	Stages	Potential Impacts	Mitigation Measures
Water			
Impact on Water Resource	Design, Preconstruction, Construction & Operation	<ul style="list-style-type: none"> • Depletion of ground water recharge • Contamination from fuel and lubricants & waste disposal in camp area • Contamination of surface water system due to run-off from road construction area 	<ul style="list-style-type: none"> • Provision of Storage/harvesting structure of water, wherever feasible • Oil Interceptor and Septic tank in construction camp • Enforcement of Hazardous wastes (Management and Handling) Rules, 1989 • Both side drain facility to suitably divert the run-off from roads
Air			
Dust generation	Preconstruction & Construction	<ul style="list-style-type: none"> • Shifting of utilities, removal of trees & vegetation, transportation of material 	<ul style="list-style-type: none"> • Regular Sprinkling of Water • Fine materials to be completely covered, during transport and stocking. • Hot mix plant to be installed in down wind direction with at least 500m distance from nearby settlement. • Regular monitoring of particulate matter in Ambient Air
Gaseous pollutants	Preconstruction, Construction & Operation	<ul style="list-style-type: none"> • Operation of Hot mix plant and vehicle operation for material transportation 	<ul style="list-style-type: none"> • Air pollution Norms will be enforced. • Only PUC certified vehicle shall be deployed • Labourers will be provided with mask. • Regular gaseous pollution monitoring in ambient air
Ambient air quality	Operation	<ul style="list-style-type: none"> • Air pollution from traffic • CO level is likely to increase 	<ul style="list-style-type: none"> • Compliance with statutory regulatory requirements
Noise			
Pre-Construction Activity	Pre-Construction	<ul style="list-style-type: none"> • Man, material and machinery movements • Establishment of labour camps, onsite offices, stock yards and construction plants 	<ul style="list-style-type: none"> • No Horn Zone sign, Speed Barriers near sensitive receptors • Camps will be setup more than 500m away from settlements.
Construction Activity	Construction	<ul style="list-style-type: none"> • Operation of high noise equipment like hot mix plant, diesel generators etc. • Community residing near to the work zones. 	<ul style="list-style-type: none"> • Camp will be setup more than 500m away from the settlements, in down wind direction. • Noise pollution regulation to be monitored and enforced.
Operation Stage	Operation	<ul style="list-style-type: none"> • Indiscriminate blowing of horn near sensitive area 	<ul style="list-style-type: none"> • Restriction on use of horns • No Horn Zone sign.
Ecology			
Flora	Preconstruction, Construction	<ul style="list-style-type: none"> • Loss of vegetation cover • Felling of 682 nos. of trees 	<ul style="list-style-type: none"> • Felling of only unavoidable trees • Compensatory Afforestation in the ratio of 1:2
Fauna	Preconstruction, Construction & Operation	<ul style="list-style-type: none"> • Loss of insect, avian and small mammalian species due to felling of trees • Accidental run over 	<ul style="list-style-type: none"> • Compensatory Afforestation • Speed breaker, Signage and limit in sensitive areas
Social			
Socio Environment	Design, Preconstruction & Construction	<ul style="list-style-type: none"> • Loss of Property & Livelihood • Loss of CPRs, Religious Structures 	<ul style="list-style-type: none"> • Compensation as per RAP • Relocation of CPRs, Religious Structures to suitable place

(Environmental Impact Assessment)

Particulars	Stages	Potential Impacts	Mitigation Measures
Public Health and Road Safety			
Health and safety	<ul style="list-style-type: none"> • Preconstruction, Construction & Operation 	<ul style="list-style-type: none"> • Psychological impacts on project affected people • Migration of worker may lead to sanitation problem creating congenial condition for disease vectors • Discomfort arising of air and noise pollution • Hazards of accident 	<ul style="list-style-type: none"> • Continued consultation with PAPs and the competent authority for speedier settlements of appropriate compensation package and resettlement. • Ensuring sanitary measures at construction camp to prevent water borne disease and vector borne disease. • Provision for appropriate personal protective equipments like earplugs, gloves gumboot, and mask to the work force. • Safe traffic management at construction area. • Drive slow sign and speed barriers near community facilities like school, hospital and hair pin bend etc.

0.18 CONCLUSIONS

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

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1 INTRODUCTION

1.1 INTRODUCTION

The Ministry of Road Transport and Highway, Government of India (the “Authority”) is engaged in the development of National highways and as part of this endeavor, the Authority has decided to undertake “Consultancy services for Preparation of Feasibility Study and Detailed Project Report for Construction of 2 lane/2 lane with paved shoulder from Kohima to Nagaland/Manipur border section of NH-29 (Old NH-150) in the State of Nagaland under SARDP Phase-B on EPC Mode”. The present study focused on the Environmental Impact Assessment (EIA) from the proposed project during construction and operation phase.

1.2 NEED OF THE PROJECT

- To provide easy access to commuters from Kohima (Nagaland) to Jessami (Manipur). It connects important Town / Villages namely Kohima, Chakabama, Kiruma, Fpsutsero, Misulumi, Enhulum, Chizami, Losami, Laniye and Jessami etc
- The project road links between two states and hence provides easy communication between Nagaland & Manipur State.

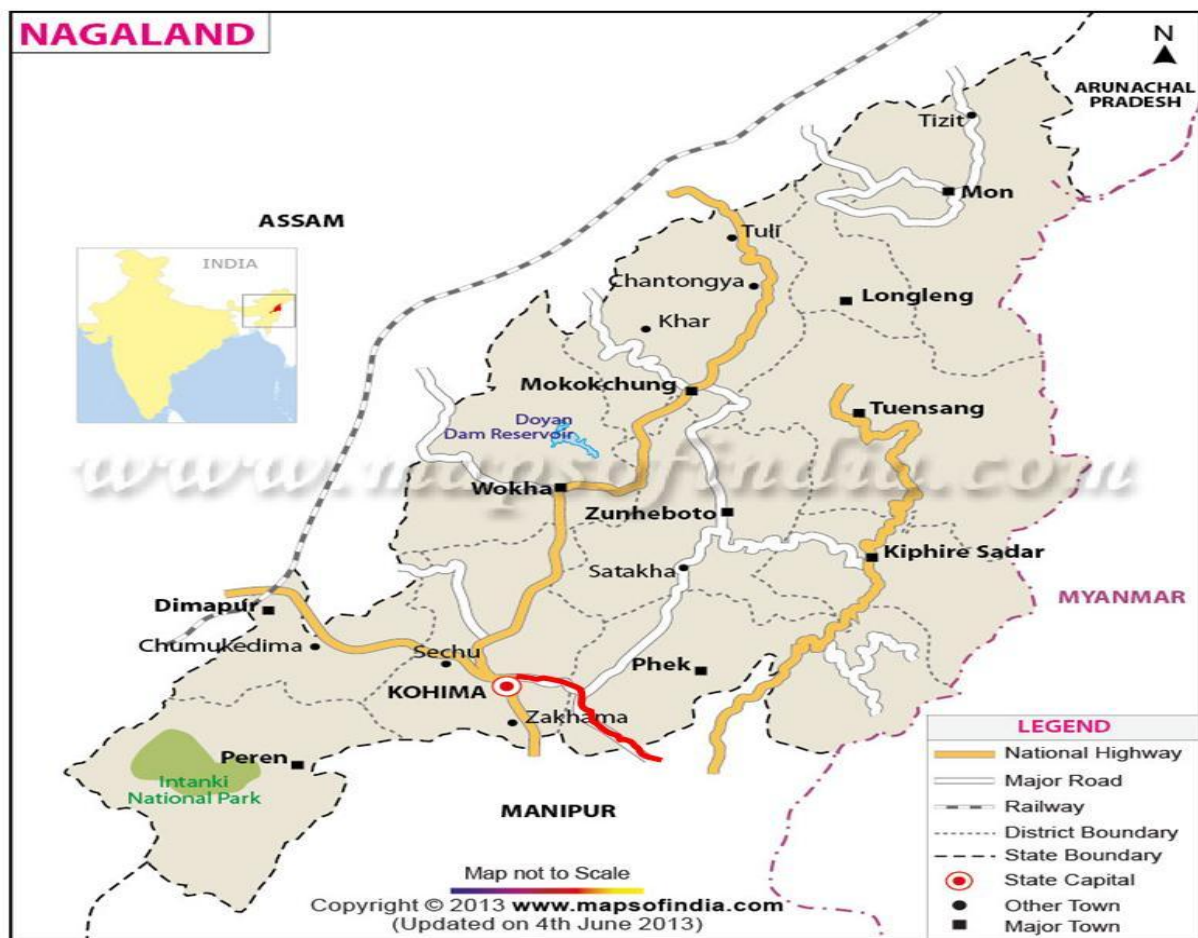
1.3 PROJECT ROAD

Existing Project Highway, NH-29 (old NH-150) starts near Teen Patti Junction (km 3.000) in Kohima (Nagaland) and terminates at its junction with NH-202 near Jessami in Manipur state. The project road is approximately 130.390 km long. The project road is located under the jurisdiction of Nagaland & Manipur State. Major part of the road is in Nagaland where as minor part is in the Manipur state. The existing length of the Project Highway is about 129.110 kms while design length along the proposed alignment of Project Highway is 130.390 kms. The Project Highway passes through districts Kohima and Phek in the state of Nagaland and Ukhrul in the state of Manipur. It connects important Town / Villages namely Kohima, Chakabama, Kiruma, Fpsutsero, Misulumi, Enhulum, Chizami, Losami, Laniye and Jessami etc.

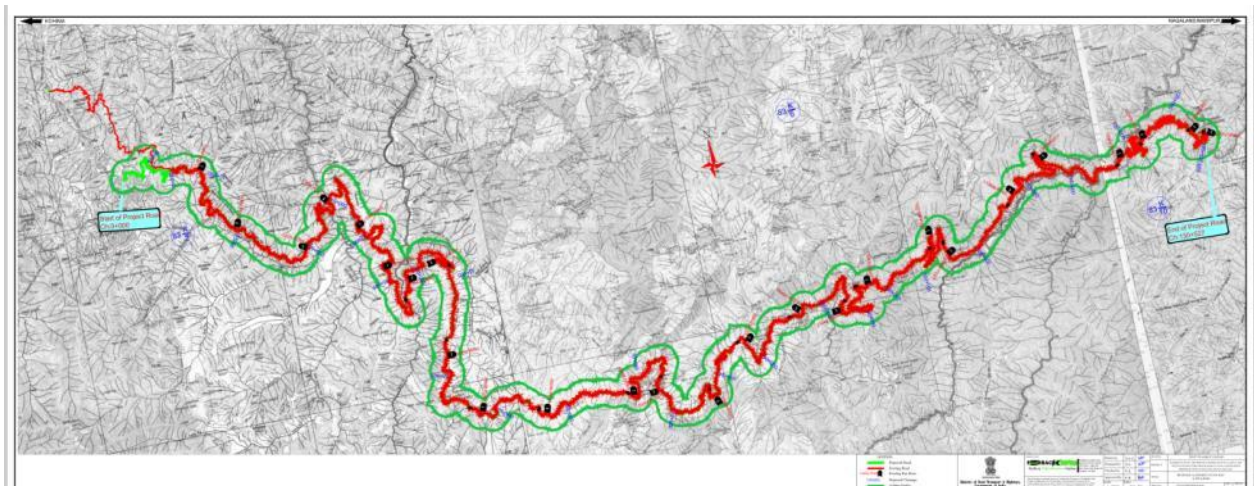
The location of the project road is presented in Figure 1.1.

Figure 1-1: Location of Project Road

(Environmental Impact Assessment)



Legend: Project Highway -



1.4 PROJECT PROPONENT

The project proponent is Ministry of Road Transport and Highways, Government of India.

1.5 PROPOSED IMPROVEMENTS

In general roadway width shall be 12.00 m which includes 7.00 m main carriageway and 1.50 m paved and 1.00 m earthen shoulders both the sides as per typical cross sections attached in Annexure 2.1

- ROW shall be 24.00 m for Rural (Non-Urban) areas and 20.00 m in Urban areas.

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- The design speed shall be the minimum 40 kmph for Mountainous and Steep (Hilly) terrain except at hairpin bend locations where design speed has been restricted to 20 kmph
- 7 Typical Cross Sections (TCS I, IC, IIC, V, VIA, IX) for widening to 2 lanes with paved shoulder status has been proposed

1.6 SCOPE OF WORK

The objectives of the EIA include:

- Collection and analysis of baseline environmental information on various components of the environment
- Identification of impacts and determination of the magnitude of environmental impacts so that due consideration is given to them during design, construction & operational phases of the road project
- Identification of areas and aspects, which are environmentally or socio-economically significant.
- Suggestion of mitigation measures and preparation of Environmental Management Plans for enhancing and mitigating the negative impacts and strengthening the beneficial impacts
- Economical assessment of project from the environmental point of view and preparation of environmental budget for implementation of mitigation measures.
- Development of the road alignment in such a way that the environment and settlements are affected the least
- Presentation of public consultation and public view on various aspects of environment and the project

1.7 APPROACH TO EIA

The study methodology for the EIA employs a simplistic approach and analyses the environmental issues identified. The sections below details out the methodology adopted for the assessment of the environment for the project.

1.7.1 Review of Applicable Environmental Regulations

Applicability of various environmental regulations and guidelines was reviewed for the project and its allied activities.

1.7.2 Assessment of Baseline Environmental Profile

The baseline conditions of the project area were studied. Data pertaining to all facets of environment which include physical, ecological, and socioeconomic environment both through primary and secondary sources were collected. Key relevant information sources has been summarised in table below. Ambient air & noise, ground and surface water samples were monitored at various locations identified along the corridor. The monitoring and analysis for each component were carried out as per MoEF and CPCB guidelines. The results of the monitoring were compared with the relevant national standards.

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

Table 1-1: Primary and Secondary Information Sources

Environmental Parameters	Information Sources
Project objectives, Technical information on existing road features	Design Report
Inventory of road features like water Bodies, Community structures, environmentally sensitive locations areas, congested locations etc.	Ground Physical surveys, Google Earth, Survey of India Maps and Bhuvan ISRO website.
Climatic Condition & Meteorological data	Indian Meteorological Department, SPCB, Envis and other Websites, District Groundwater Brochure of CGWB, Design report, primary data collection
Geology, Seismicity, Soil and Topography	State of Environment report published by SPCB, government websites, District Groundwater Brochure of CGWB & primary data collection
Land Use / Land Cover	Survey of India Toposheet, Google earth, Bhuvan ISRO website and Observation during surveys
Drainage Pattern	Survey of India Toposheet, District Groundwater Brochure of CGWB, field observation and local people

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Environmental Parameters	Information Sources
Status of forest areas, Compensatory afforestation norms etc.	Divisional Forest Office
Air quality Noise, Soil and Water	Onsite monitoring and Analysis of Field samples
Borrow Areas, Quarries and other construction material source	Material Surveys and public consultations
River geo-morphology, hydrology, drainage, flood patterns	Water resource Dept. and information from local people, field observations
Socioeconomic Environment	Official websites maintained by state Govt., Census of India 2001 & 2011 and Public Consultation during the Field survey

1.7.3 Consultations

Consultations with community members and PAPs, Focus Group Discussions & others and stakeholder meetings including institutional stakeholders' consultations were carried out. The feedback generated through these meetings has been incorporated as far as possible in the design and construction of the road. The consultation process shall continue even during the implementation stage to gauge the general opinion. The details are elaborated in chapter 5.

1.7.4 Assessment of Impacts

Assessments of potential impacts were done based on the baseline data. Assessment of the environmental impacts was carried out to ascertain that the direct and indirect impacts likely to be induced due to the project are being adequately identified and addressed. The general impacts are land acquisition and allied impacts on society, dust and air pollution due to removal of structures, trees and vegetation and other construction activities; noise pollution due to construction, loss of flora and its impacts on the ecology and impacts on water resources. The chapter on Impacts assessment details out the impacts.

1.7.5 Assessment of Alternatives

With and without project scenarios have been assessed. The assessment of alternatives included that of Bypasses, Process Technology, widening options, and assessment of alternatives with respect to environment etc. The chapter on Analysis of Alternatives elaborates the process.

1.7.6 Mitigations and Enhancement Measures

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

- **Generic measures:** To avoid or mitigate impacts on environmental components, general mitigation measures were identified based on the characteristic features.
- **Site Specific:** At representative sensitive locations, site-specific mitigation measures and enhancement designs have been formulated.

1.7.7 Environmental Management Action Plans

The EMP shall detail out the implementation of the proposed mitigation and enhancement measures. A detailed study of the following has been carried out:

- Prediction and addressal of impacts on the various environmental components;
- Site specific designs for the mitigation measures provided;
- Monitoring mechanisms and indicators during construction and operation periods.

1.8 STRUCTURE OF THE REPORT

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

- Chapter-1** **Introduction** described the introduction of the project. Introduction about the impact assessments.
- Chapter - 2** **Project Description** describes the existing features and also discusses the various proposed improvement programmes along the corridor;

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- Chapter - 3** **Policy, Legal and Administrative Framework** reviews the existing set-ups relevant to the project, at the National and the State levels;
- Chapter - 4** **Baseline Environmental Profile** describes the entire picture of the existing environmental set up of the project;
- Chapter - 5** **Public Interactions, Consultations** describes consultations carried out and people's perceptions of the project benefits and the potential impacts;
- Chapter - 6** **Analysis of Alternatives** discusses the various alternatives for the project stretch along with the criteria for analysis and evaluation;
- Chapter - 7** **Impact Assessment & Mitigation** presents the avoidance and mitigation and enhancement measures suggested on each of the environmental components;
- Chapter - 8** **Implementation Arrangements** gives a brief about the implementation arrangements for environmental components of the project
- Chapter - 9** **Environmental Management Plan & Monitoring Schedule** details both the generic and specific EMPs for the project road, compliance monitoring. This chapter also includes the Environmental Budget
- Chapter - 10** **Disclosure of the Consultant** provides the details of the consultants engaged along with their capabilities and experiences.

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2 PROJECT DESCRIPTION

This Chapter describes the project road and discusses the various improvement measures proposed as part of the project. The project description includes details of existing condition of project road, existing and proposed traffic, pavement conditions, road inventory, safety and community facilities.

The Project Highway starts at Teen Patti Junction near km 3.000 of NH-29 in Kohima and terminates at its Junction with NH-202 near Jessami in Manipur state. The Project Highway passes through districts Kohima, Phek in the state of Nagaland and Ukhurul in the state of Manipur, and passing through important towns/villages namely Kohima, Chakabama, Kiruma, Fpsutsero, Misulumi, Enhulum, Chizami, Losami, Laniye and Jessami. Location of the project road is given in figure below



Figure 2-1: Location map of the project site

District wise road details is given in table below.

Table 2-1: District wise road details

S.No.	District	State	Ch. From(km)	Ch. to(km)	Total Length(km)
1	Kohima	Nagaland	3.000	37.442	34.442
2	Phek	Nagaland	37.442	118.690	81.284
3	Ukhurul	Manipur	118.690	132.540	13.85

Source:- Design Report

The Total length of the Project Highway is about 129.000 kms. The exhibits of start and end point of the Project Highway are shown below.



Start Point of the project Highway at km 3.000 at Teen patti Nr. Kohima Town



End point of project Highway at km 132.000 of NH-29 where it meets to NH-202 nr. Jessami in Manipur State.

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Figure 2-2: Photographs of Project Road



2.1 EXISTING ROAD FEATURES

2.1.1 Alignment

- The existing carriageway of the Project Highway has predominantly single lane carriageway with earthen shoulder configuration except few locations where it has intermediate lane and 2-Lane with earthen shoulder carriageway configuration.
- The existing pavement for the Project Highway is bituminous, but bituminous layer for most length of the Project Highway is washed away or in poor to very poor condition. The general condition of the pavement varies from poor to very poor from km 3.000 to km 30.000 and fair to poor from km 30.000 to km 132.000. The width of earthen shoulder varies from 0.3m to 1.5m on both sides, and condition of the earthen shoulders is poor to very poor.
- Earthen shoulders are observed mostly the project length, the width of earthen shoulder is varies between 0-1.0m on both sides, and condition of the earthen shoulders is poor in most of the project length
- The project highway passes through hilly Terrain.
- The existing alignment comprises of many sharp horizontal and deficient vertical curves which require geometric corrections. There are about 18 hair-pin bends.
- There are 11 villages/towns along the project highway, in which most of the settlements are ribbon developed

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along the main carriageway

- Average embankment height varies from 0 to 3.0 m. The condition of the embankment is very poor.

Table 2-2: Existing Cross Section details

Carriageway Width (m)	Earthen Shoulder Width (m)	Embankment Height (m)
6-7	0-1	0.0-3.0

Source: Design Report

2.1.2 Right of way

There are no existing ROW pillars along the Project Highway, hence measured from the fixed boundaries. The observed ROW varies between 5.00m to 7.00 with an average ROW of 6.0m

Road inventory

- Only one Major bridges found across the project Road.
- There are total 49 Junctions out of which 6 nos. are major junctions and 43 nos. are minor junctions
- The abstract of Road inventory has been presented in below table. The road inventory details are given in Engineering Report

Table 2-3: Existing Road Inventory

Major Intersection	Minor intersection	Major bridges	Minor bridges	Level Crossing	Causeways	Culverts	
						slab	Pipe
49	43	0	0	3	19	2	26

Source: Primary Road Inventory Survey

2.1.3 Traffic

- The traffic was counted in 3 locations all along the project road at km 13, km 64 & km 107.000
- The average daily traffic along the project road is 347, 337 & 260 PCUs at the three locations. The traffic is mainly mixed traffic.

Table 2-4: Annual Average Daily Traffic (AADT) of Various Study Locations

Vehicle Type	km 13.000	Km 64.500	km 107.000
	Chidema	Pfutsero	Losami
Car / Jeep / Van (Private)	173	129	106
Car / Jeep (Taxi)	0	0	0
Shared Jeep	0	0	0
Mini Bus	0	0	0
School. Bus	0	0	0
Govt. Bus	9	9	7
Pvt. Bus	0	0	0
Maxx/Pick-Up	0	0	0
LCV (4 tyre)	0	0	0
LCV	25	30	27
2 Axle trucks	31	40	26
3 Axle trucks	0	0	0
MAV (4 to 6 Axles)	0	0	0
MAV (> 6 Axles)	0	0	0
Others	0	0	0
3 Wheeler	0	0	0
2 Wheeler	33	32	28

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Vehicle Type	km 13.000	Km 64.500	km 107.000
	Chidema	Pfutsero	Losami
Agriculture Tractor	0	0	0
Agriculture Tractor with Trailer	0	0	0
Cycle	0	0	0
Cycle Rickshaw	0	0	0
Animal Drawn Cart	0	0	0
Grand Total (Nos.)	271	240	194
Grand Total (PCUs)	347	337	260

Source: Design Report

2.2 PROPOSED ROAD FEATURES

2.2.1 Alignment

- The design length of the project road is 130.390 Km
- The present traffic scenario from Teenapati Kohima(Nagaland) to Dessami(Manipur) is not to high but due to poor to very poor condition widening of road required. Hence two lane with paved shoulder proposed.
- Concentric widening is proposed to be adopted in most of the length to restrict land acquisition to the minimum

2.2.2 Cross Sections

6 Typical Cross Sections for widening has been proposed

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2.2.3 Estimated Traffic

Mode-wise total corridor traffic is summation of normal and generated/induced traffic. The total traffic in No of Vehicle in terms of Annual Average Daily Traffic for each section is presented in Table below.

Table 2-5: Section wise Projected traffic (AADT) in Nos. & PUC

Year	km 13.000_Chidema		km 64.500_Pfutsero		km 107.000_Losami	
	Vehicles	PCU	Vehicles	PCU	Vehicles	PCU
2015 - 16	271	347	240	337	194	260
2016 - 17	286	367	254	358	205	276
2017 - 18	302	389	269	381	218	293
2018 - 19	319	412	285	405	231	312
2019 - 20	416	521	382	514	324	416
2020 - 21	439	551	404	546	343	442
2021 - 22	463	583	427	580	363	469
2022 - 23	486	614	450	612	382	495
2023 - 24	510	647	473	646	402	523
2024 - 25	536	681	499	683	423	552
2025 - 26	563	718	525	722	446	584
2026 - 27	591	757	554	763	470	617
2027 - 28	619	794	581	802	493	649
2028 - 29	647	833	609	843	517	683
2029 - 30	677	874	639	887	543	719
2030 - 31	709	917	671	934	570	757
2031 - 32	743	963	705	983	599	797
2032 - 33	774	1006	736	1029	626	835
2033 - 34	807	1051	770	1077	655	875
2034 - 35	842	1099	805	1129	685	917
2035 - 36	879	1149	842	1183	716	961
2036 - 37	917	1201	881	1240	750	1009
2037 - 38	957	1257	922	1300	785	1059
2038 - 39	1000	1316	966	1364	823	1111
2039 - 40	1044	1378	1012	1431	862	1167
2040 - 41	1092	1443	1060	1503	904	1227
2041 - 42	1141	1512	1112	1578	949	1290
2042 - 43	1194	1585	1166	1659	995	1356
2043 - 44	1249	1662	1224	1743	1045	1427
2044 - 45	1307	1743	1285	1833	1098	1502
2045 - 46	1369	1830	1349	1929	1153	1582
2046 - 47	1434	1921	1418	2030	1213	1667
2047 - 48	1502	2018	1490	2137	1275	1757
2048 - 49	1575	2120	1567	2251	1342	1853
2049 - 50	1652	2229	1649	2372	1413	1955
2050 - 51	1733	2344	1736	2501	1488	2063
2051 - 52	1820	2466	1828	2638	1568	2179
2052 - 53	1911	2596	1926	2784	1653	2302

Source: Design Report

2.2.4 Right of Way

ROW shall be 24.00 m for Rural (Non-Urban) areas and 20.00 m in Urban areas as per comments received on Draft Feasibility Report.

2.2.5 Type of Shoulder

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- In open country Paved Shoulders of 1.50 m width and Un-Paved/ Earthen Shoulders of 1.00 m width covered with 150 mm thick compacted layer of granular material shall be provided.
- In built-up sections, 1.5 m wide footpaths and paved shoulder with proper drainage arrangement shall be provided.

2.2.6 Geometric Design Aspects

- Minor improvements in geometrics is proposed along with widening of the existing road to 2 lane with paved / granular shoulder status
- The design speed shall be the minimum design speed of 40 kmph for Mountainous and Steep (Hilly) terrain except at hairpin bend locations where design speed has been restricted to 20 kmph

2.2.7 Bypasses and Realignments

- There is no Bypass/realignments present for the project road.

2.2.8 Service roads

- No Service roads are proposed in the project road

2.2.9 Details of Structure and Improvement Proposals

- There are no new major or minor bridges proposed along the corridor. 1 major bridge retained with repairing and maintenance.
- The abstract of proposed structures is given below

Table 2-6: Proposed Cross Drainage Structures

S. No.	Type of Structure	Existing / New	Nos.	Development/ Improvement Proposals
1	Major Bridge	Existing	1	Existing Retained with Repairing & Maintenance.
2	Minor Bridge	Existing	2	Under Construction to be retained.
			4	Existing Retained with Repairing & Maintenance.
			1	Existing Retained with Repairing & Maintenance & also construction of a new 2L parallel bridge proposed on proposed realignment.
3	Slab Culverts	Existing	143	124 Nos. to be replaced with New Box Culverts
				18 Nos. to be widened with Box
				1 No. is under construction to be retained
4	Pipe Culverts	Existing	457	444 Nos. to be replaced with New Box Culverts
				11 Nos. to be Retained with Repairing
				2 Nos. to be retained without widening but with Repair & Maintenance in Kohima town
5	Box Culverts	Existing	1	1 No. to be Retained with Repairing

Source: Design Report

2.2.10 RoBs

As the road is in the hilly terrain hence no RoB is proposed.

2.2.11 Other Structures including Underpasses

No underpasses, overpasses & flyovers proposed

2.2.12 Drainage

- Drains have been provided on the hill sides for the entire length of the road

2.2.13 Wayside Amenities

Following Bus Shelters have been proposed

Table 2-7: Proposed Bus Shelters

S. No.	Design Chainage	
	LHS	RHS
1	9590	9736

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S. No.	Design Chainage	
	LHS	RHS
2	12700	12843
3	26675	26768
4	32050	32000
5	32940	33120
6	40846	41035
7	47948	47712
8	49975	50128
9	51450	51570
10	52100	52250
11	62464	62650
12	63300	63540
13	64865	64986
14	65631	65785
15	68011	68150
16	69700	69885
17	78562	78734
18	79553	79782
19	84037	84150
20	85810	86766
21	86015	86884
22	98550	98700
23	104044	104300
24	117800	117942
25	130060	130224

Source: Design Report

2.2.14 Toll Plaza

- Proposed project road Section shall be having the 3 Toll Plazas. Details are furnished in below table

Table 2-8: Toll Plaza

Toll plaza	Proposed Chainage	Village / location	Tollable section	Tollable length (km)	Tollable PCU in 2015-16
TP-1	km 13.000	Near Chidema	km 0.000 to km 67.000	67.000	347
TP-2	km 70.000	Near Pfutsero	km 67.000 to km 132.000	65.000	337

Source: Design Report

2.2.15 Design of Intersections

All junctions have been studied thoroughly with respect to traffic volume and geometric design. The important junctions leading to settlements have been identified and proper junction layouts (including road marking, and traffic signs) shall be applied as per IRC-SP: 41-1994.

2.2.16 Traffic Control and Road Safety Features

Traffic control devices and road safety features, including Traffic Signs, Road Markings etc are proposed and designed as per relevant IRC codes and standards.

2.2.17 Project Cost

Cost abstract has been presented in below table

Table 2-9: Cost for the Project

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Sr. No.	Particulars	Amount (INR)
1	Site clearance and Dismanteling	125,502,745
2	Earth Work	1,892,403,775
3	Grannular Sub Base Courses and Base Courses (Non- Bituminous)	3,095,341,891
4	Bituminous and Rigid Pavement Courses	2,338,101,957
5	Culverts	2,713,090,938
6	Bridges	
	a) Minor Bridges	7,053,637
	b) Major Bridges	0
6A	Repair and Rehabilitation of bridges and culverts	10,000,000
7	Drainage & Protective Works	7,900,618,519
8	Junctions	112,146,009
9	Traffic signs, Road markings and other road appurtunences	426,826,345
10	Miscellaneous Works including truck lay bye and bus lay bye	134,753,314
11	Maintenance of roads	97,483,655
	Civil Cost (2016-2017)	18,853,322,784
	Provision for Physical and Price Contingencies, IDC and other Financing Cost Etc 25% of Civil Cost	4,713,330,696
	Total Project Cost	23,566,653,480
	Cost Per Km in Crores (On Civil Cost)	15.38
	Cost Per Km in Crores (On TPC)	19.22
	Utility Shifting @0.5%	94,266,614
	Land Acquisition, Resettlement and Rehabilitation Cost	276,816,665
	Environmental Cost @0.3%	70,699,960
	1.0 % of Civil work for Plantation work and its maintenance	188,533,228
	Total Capital Cost	24,196,969,947

Source: Design Report

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3 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

This chapter reviews the existing institutional and legislative set-up pertaining to the project at the National and state levels. The chapter also elaborates on the various clearances and permissions required for the project from Government of Nagaland and Manipur, Ministry of Environment and forests, Government of India. This section elaborates on the various clearance requirements for the project from the State Government and MoEF, GoI.

3.1 ENVIRONMENTAL LEGISLATIONS AND THEIR IMPLICATIONS / APPLICATION

The Government of India has formulated various policy guidelines; acts and regulations aimed at protection and enhancement of environmental resources. The following table surmises the existing legislations pertaining to the project, the various clearances required for the project and the status as on date.

Table 3-1: Relevant Environmental Laws & Regulations

S. No.	Law / Regulation / Guidelines	Relevance	Applicability (Yes / No)	Reason for Application	Implementing / Responsible Agency
1	The Environmental (Protection) Act, 1986, and the Environmental (Protection) Rules, 1987-2002 (various amendments)	Umbrella Act. Protection and improvement of the environment. Establishes the standards for emission of noise in the atmosphere.	Yes	All environmental notifications, rules and schedules are issued under the act	MoEF, State Department of Environment & Forest, CPCB and SPCB
2	The EIA Notification, 14th September 2006 & subsequent amendments	Identifies expansion of National highways projects greater than 100 Km involving additional ROW and land acquisition greater than 40m on existing alignments on 60m on re-alignments or by-passes and All new state highway projects & SH expansion projects in hilly terrain (above 1000 MSL) and or ecological sensitive areas (item 7 (f) of schedule) as one of the projects requiring prior clearance.	No	Project Highway is neither a new national highway nor a NH expansion project with land acquisition of greater than 40m on existing alignments and 60m on re-alignments or by-passes	MoEF / SEIAA
		Opening of New Borrow Area	Yes	Prior Environmental Clearance to be taken by Contractor if there is any need for opening of new borrow area	
		Opening of new Quarry Area (Excavation of River bed)	Yes	Prior Environmental Clearance to be taken by Contractor if there is any need for opening of quarry area	
3	Notification for use of Fly ash, 3rd November 2009 and is subsequent amendments.	Reuse fly ash discharged from Thermal Power Station to minimise land use for dispersal and minimise borrow area material. The obligation shall lie with the implementing authority to use fly ash unless it is not feasible as per IRC	No	No thermal power plant within 100km from the Project Highway	MoEF, SPCB
4	The Water (Prevention and Control of Pollution) Act, 1974 and is subsequent amendments	Central and State Pollution Control Board to establish / enforce water quality and effluent standards, monitor water quality, prosecute offenders, and issue licenses for construction / operation of certain facilities.	Yes	Consent required for not polluting ground and surface water during construction	State Pollution Control Board

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S. No.	Law / Regulation / Guidelines	Relevance	Applicability (Yes / No)	Reason for Application	Implementing / Responsible Agency
5	The Air (Prevention and Control of Pollution) Act. 1981 and is subsequent amendments	Empowers SPCB to set and monitor air quality standards and to prosecute offenders, excluding vehicular air and noise emission.	Yes	Consent required for establishing and operation of batching plants and crushers	State Pollution Control Board
6	Noise Pollution (Regulation And Control) Act, 1990 and is subsequent amendments	Standards for noise emission for various land uses	Yes	Construction machineries and vehicles to conform to the standards for construction	State Pollution Control Board
7	Forest (Conservation) Act, 1980	Conservation and definition of forest areas. Diversion of forest land follows the process as laid by the Forest conservation Act.	Yes	Diversion of community forest land shall be required	State Forest Department, MoEF and Local community
8	Coastal Regulatory Zone Notification, 1991	Protect and manage coastal areas	No	The project area is not within designated coastal zone	MoEF, State Department of Environment
9	Wild Life Protection Act, 1972	Protection of wild life in sanctuaries and National Park	No (Environmental clearance is not applicable hence Wild life clearance is not applicable)	As per wildlife notification FOR-84/76 Dated 12th Jan/80 Puliebadze WLS is notified. No Eco sensitive zone of the Puliebadze WLS is notified till date. The distance of the wildlife sanctuary and proposed alignment near ch. 15.3 is approx 5.6km	NBWL, SBWL & Chief Wild Life Warden
10	Ancient Monuments and Archaeological sites & Remains Act 1958 and is subsequent amendments	To protect and conserve cultural and historical remains found.	No	No ASI notified archaeological monument near the Project Highway	Archaeological Survey of India, State Dept. of Archaeology
11	The Motor Vehicle Act. 1988 and is subsequent amendments	Empowers State Transport Authority to enforce standards for vehicular pollution. From August 1997 the "Pollution Under Control Certificate is issued to reduce vehicular emissions	Yes	All vehicles used for construction will need to comply with the provisions of this act.	State Motor Vehicles Department
12	The Explosives Act (& Rules) 1884 (1983) and is subsequent amendments	Sets out the regulations as to regards the use of explosives and precautionary measures while blasting & quarrying	No	No new quarrying operation require blasting to be started by the contractor	Chief Controller of Explosives
13	Public Liability And Insurance Act,1991 and is subsequent amendments	Protection to the general public from accidents due to hazardous materials	Yes	Hazardous materials like Bitumen shall be used for road construction	State Pollution Control Board
14	Hazardous Wastes (Management and Handling) Rules, 1989 and is subsequent amendments	Protection to the general public against improper handling and disposal of hazardous wastes	Yes	Hazardous wastes shall be generated due to activities like of maintenance and repair work on vehicles	State Pollution Control Board
15	Chemical Accidents (Emergency	Protection against chemical accident while handling any	Yes	Handling of hazardous (flammable, toxic and	District & Local Crisis Group

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S. No.	Law / Regulation / Guidelines	Relevance	Applicability (Yes / No)	Reason for Application	Implementing / Responsible Agency
	Planning, Preparedness and Response) Rules, 1996	hazardous chemicals resulting		explosive) chemicals during road construction	headed by the DM and SDM
16	Mines & Minerals (Regulation & Development) Act, 1957 as amended in 1972	Permission of Mining of aggregates and sand from river bed & aggregates	No	No mining of sand or aggregates. These materials shall be procured from approved agencies	State Department of Mining
17	The Building & Other Construction Workers (Regulation of Employment & Conditions of Service) BOCW Act, 1996	Employing Lab our / workers	Yes	Employment of labors	District labor Commissioner

* General Conditions also applied

3.2 ENVIRONMENTAL CATEGORIZATION

- The project road section is an existing National highway– ***No Need for Environmental Clearance because*** Project Highway is neither a new national highway nor a NH expansion project with land acquisition of greater than 40m on existing alignments and 60m on re-alignments or by-passes.

3.3 CONCLUSION

- The project roads is not passing through ecologically sensitive area.
- No presence and impact on Archaeological features. Thus no archaeological clearances / permissions to be obtained
- Forest Clearance under purview of Forest (Conservation) Act, 1980 shall be finalized as per direction of Forest Department.
- Trees are needed to be felled due to road widening. Permission to be obtained from Forest/District Authorities before felling
- Land acquisition is envisaged to accommodate the proposed development
- Affected households shall be compensated as per Social Impact Assessment Study / RAP
- Environmental Clearance is required for opening of New Borrow Area (if any) & shall be obtained by the Contractor

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4 BASELINE ENVIRONMENTAL PROFILE

This chapter assess the nature, type and dimensions of the study area and describes the physical, biological, cultural components along the Road. The baseline data on the environmental components was generated by primary surveys conducted during project preparation, interactions at various levels with local people and other stakeholders.

4.1 PROJECT AREA

The project districts are Kohima & Phek in Nagaland and Ukhrul in Manipur State. The complete stretch of the road is passing through the hilly terrain.

4.2 CORRIDOR OF IMPACT

In general, the existing & proposed Right of Way (RoW) varies from 6 m & 24 m respectively. The immediate CoI thus also varies from 15 - 21 m. However, for parameters like Noise and air pollution, the impact goes beyond the immediate CoI.

4.3 STUDY AREA

As per the EIA Guidance Manual for Highways (MoEF, 2010), Primary data has been collected within the right of way as well as 500 meters on both side of right of way. Secondary data for environmental sensitivity feature a study area of 15 km radius from the project road was considered. District level secondary information was also collected irrespective of any demarcated boundary.

4.4 REGIONAL SETTING

4.4.1 The State- Nagaland and Manipur

The proposed project is a linear project passing through three districts in the Nagaland and Manipur state. Most of the section of the project is found in Nagaland state and complete road is in hilly terrain.

4.4.2 District Kohima

Kohima, is a hilly district of India's North Eastern State of Nagaland, sharing its borders with Assam State and Dimapur District in the West, Phek District in the East, Manipur State and Peren District in the South and Wokha District in the North. Kohima features a more moderate version of a humid subtropical climate. Kohima has a pleasant and moderate climate - not too cold in winters and pleasant summers. December and January are the coldest months when frost occurs and in the higher altitudes, snowfall occurs occasionally. During peak summer months from July-August, temperature ranges an average of 80-90 Fahrenheit. Heavy rainfall occurs during summer. Total length of the project road in the Kohima district is 34.442 km. Terrain of the project road in the Kohima district is varies from approx. 1100 amsl to 1400amsl.

4.4.3 District Phek

Phek is a district in the South-eastern part of Nagaland, bounded by Myanmar in the East, Zunheboto and Tuensang districts in the North, Manipur state in the South and Kohima district in the West. Total length of the project road in the Phek district is 81.248 km. Longest stretch of the project road is found in the Phek district. Terrain of the project road in the Phek district is varies from approx. 700 amsl to 2200 amsl.

4.4.4 District Ukhrul (Manipur)

Ukhrul District is bounded by Myanmar in the East, Chandel District in the South, Imphal East and Senapati Districts in the West and Nagaland State in the North. The terrain of the district is hilly with varying heights of 913 m to 3114 m (MSL). The district HQ. Ukhrul is linked with Imphal, the state capital by a NH 150 about 84 Km. The climate of the district is of temperate nature with a minimum and maximum degrees of 3°C to 33°C. The average annual rainfall is 1,763.7 mm (1991).

Total length of the project road in the Ukhrul district is 13.850 km. Terrain of the project road in the Ukhrul district is varies from approx. 650 amsl to 1200 amsl.

4.5 PHYSICAL ENVIRONMENT

4.5.1 Climate and Meteorology

(Environmental Impact Assessment)

Nagaland has a monsoon climate. The state enjoys a salubrious climate. Annual rainfall ranges around 70–100 inches (1,800–2,500 mm), concentrated in the months of May to September. Temperatures range from 70 °F (21 °C) to 104 °F (40 °C). In winter, temperatures do not generally drop below 39 °F (4 °C), but frost is common at high elevations. Summer is the shortest season in the state that lasts only for a few months. The temperature during the summer season remains between 16 °C (61 °F) to 31 °C (88 °F). Winter makes an early arrival and bitter cold and dry weather strikes certain regions of the state. The maximum average temperature recorded in the winter season is 24 °C (75 °F). Strong north-west winds blow across the state during the months of February and March.

Long-term Meteorological Scenario

The nearest Indian Meteorological Department's observatory is located in Lumding at a distance for approximately 90 km in the West direction from the project road. The long-term meteorological data for the period 1970-2000 were collected to assess the prevailing climatological scenario of the area. Summary of the long term meteorological scenario is given in Table below.

Table 4-1: Long-term Meteorological Scenario

Rainfall and Temperature at kohima Center -2015				
sl.no	Month	Rain Fall in (mm)	Max Temp	Min temp
1	January	Nil	17.75	4.2
2	February	1.4	19.1	6.1
3	March	0.4	24.24	13.19
4	April	1.73	26.12	14
5	May	3.1	22.98	14.6
6	June	Nil	28.1	18
7	July	21.6	25.4	15.95
8	August	21.9	22.7	6.75
9	September	7.49	23.1	12.46
10	October	4.25	25	13
11	November	2	28.7	9.4
12	December	1	16.9	5.3

Source:- Statistical Handbook Of Nagaland (http://www.nagenvs.nic.in/Database/Climate_884.aspx)

Rainfall and Temperature at kohima Center -2014						
sl.no	Month	Rain Fall in (mm)	Max Temp	Min temp	AVERAGE	Relative humidity in %
1	January	Nil	19.6	3.7	11.65	63.5
2	February	3	18.8	5.1	11.95	70.4
3	March	0.6	21.8	8.5	15.15	72
4	April	3.3	26.7	12.8	19.75	63.3
5	May	4	27	13.4	20.2	78.7
6	June	6.6	26.2	16.4	21.3	82.5
7	July	9.5	25.1	15.4	20.25	83
8	August	10.6	25.5	14.5	20	87.1
9	September	6.35	21.9	12.3	17.1	86.1
10	October	1.8	18.6	5.1	11.85	73.9
11	November	Nil	15	4.7	9.85	73.2
12	December	0.07	26.5	1.8	14.15	59.9

Source:- Statistical Handbook Of Nagaland (http://www.nagenvs.nic.in/Database/Climate_884.aspx)

(Environmental Impact Assessment)

Rainfall and Temperature at Kohima Center -2013						
sl.no	Month	RainFall in mm	Max Temp	Min temp	Average temperature	Humidity
1	January	Nil	20.2	0.8	10.5	
2	February	Nil	25	5.4	15.2	
3	March	45.2	26.2	7.3	16.75	
4	April	115.5	29.5	9.6	19.55	
5	May	332.5	30	10.8	20.4	
6	June	298.2	30.8	14	22.4	
7	July	350.9	30	12	21	
8	August	268.5	30.8	15.2	23	81.4
9	September	226.3	29.5	13.8	21.65	78.6
10	October	112.1	31.4	8.5	19.95	74
11	November	Nil	25.2	5.5	15.35	65.9
12	December	Nil	23.8	2.1	12.95	58

Source:- Statistical Handbook Of Nagaland (http://www.nagenviis.nic.in/Database/Climate_884.aspx)

Rainfall and Temperature at Kohima Center -2012				
Sl.no	Month	RainFall in mm	Max Temp	Min temp
1	January	32.7	17.8	2.4
2	February	15.2	21.5	3.5
3	March	49.2	27.6	6.2
4	April	81.5	28	9.7
5	May	130.8	28.4	11.4
6	June	218.8	27.7	13.5
7	July	295	28.5	16.5
8	August	258.7	29.6	14.8
9	September	123.6	26.8	15.5
10	October	124.3	26	9.2
11	November	40.22	25.8	5.2
12	December	Nil	22.5	4.5

Source:- Statistical Handbook Of Nagaland (http://www.nagenviis.nic.in/Database/Climate_884.aspx)

(Environmental Impact Assessment)

CLIMATOLOGICAL TABLE																							
स्टेशन : लुमदिंग		अक्षांश		देशांतर		समुद्री तल माध्य से ऊंचाई				मीटर		प्रक्षालों पर आधारित											
STATION : Lumding		LAT. 25° 45'		LONG. 93° 11'		HEIGHT ABOVE M.S.L.				149		METRES		BASED ON OBSERVATIONS 1971-1992									
माह	स्टेशन का माह दाय	वायु तापमान						आर्द्रता		मेघ की मात्रा		मासिक चोष	वर्षा के दिनों की संख्या	वर्षावर्षित सबसे कम वर्षा का चोष	वर्षावर्षित अधिकतम वर्षा का चोष	24 घंटे की सबसे भारी वर्षा	दिनांक और वर्ष	मास वजन गति					
		माध्य			अधिकतम			दिनांक और वर्ष	दिनांक और वर्ष	मासिक आर्द्रता	मासिक मेघ												
		गुणक	नम	दैनिक	दैनिक	माह में अधिकतम	माह में न्यूनतम																
		ऊंचाई	ऊंचाई	अधिकतम	न्यूनतम	अधिकतम	न्यूनतम																
AIR TEMPERATURE																			RAINFALL				
MEAN										EXTREMES				HUMIDITY				CLOUD AMOUNTS					
DRY BULB WET BULB DAILY MAX DAILY MIN HIGHEST IN THE MONTH LOWEST IN THE MONTH										DATE AND YEAR LOWEST DATE AND YEAR				ALL CLOUDS LOW CLOUDS				MONTHLY TOTAL NO. OF RAINY DAYS TOTAL IN WETTEST MONTH WITH YEAR TOTAL IN DRIEST MONTH WITH YEAR HEAVIEST FALL IN 24 HOURS DATE AND YEAR					
MONTH	STATION LEVEL PRESSURE	DRY BULB	WET BULB	DAILY MAX	DAILY MIN	HIGHEST IN THE MONTH	LOWEST IN THE MONTH	HIGHEST	DATE AND YEAR	LOWEST	DATE AND YEAR	RELATIVE HUMIDITY	VAPOUR PRESSURE	ALL CLOUDS	LOW CLOUDS	MONTHLY TOTAL	NO. OF RAINY DAYS	TOTAL IN WETTEST MONTH WITH YEAR	TOTAL IN DRIEST MONTH WITH YEAR	HEAVIEST FALL IN 24 HOURS	DATE AND YEAR	MEAN WIND SPEED	
		°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	%	hPa	OKtas of sky		mm		mm	mm	mm		Kmph	
जनवरी	I	1000.6	13.8	12.7	23.9	8.1	27.2	5.1	33.3	23	2.1	28	87	13.9	0.7	0.2	10.0	0.8	99.3	0.0	50.0	6	
JAN	II	996.8	21.4	19.7					1922			1964	84	21.6	1.1	0.3			1929		1981		
फरवरी	I	998.6	16.9	15.3	27.5	10.4	31.2	6.4	33.9	24	2.8	13	83	16.1	1.1	0.2	23.3	2.1	105.9	0.0	55.9	27	
FEB	II	994.4	23.9	21.3					1952			1950	79	23.7	1.7	0.5			1936		1949		
मार्च	I	996.0	22.0	19.8	30.9	14.4	36.2	10.0	38.5	29	7.2	9	81	21.4	1.2	0.2	52.8	4.1	140.5	1.0	75.3	22	
MAR	II	992.5	27.3	24.0					1973			1921	77	27.7	2.3	0.6			1993	1933	1993		
अप्रैल	I	993.6	24.9	23.0	32.3	18.7	36.0	15.1	41.9	30	5.0	17	84	26.7	2.3	0.6	85.9	7.4	277.9	11.6	90.0	9	
APR	II	989.2	28.2	25.9					1960			1920	83	31.6	3.0	0.9			1929	1975	1981		
मई	I	991.2	26.5	25.0	32.6	21.0	36.6	18.1	41.9	1	10.0	1	87	30.4	2.7	0.7	120.1	8.9	328.7	25.4	166.4	29	
MAY	II	987.2	29.1	27.2					1960			1919	85	34.4	3.2	0.9			1936	1998	1936		
जून	I	986.7	28.3	26.9	33.3	23.7	37.1	21.1	42.0	6	16.5	15	89	34.3	3.3	1.1	227.8	11.5	656.8	51.6	135.6	30	
JUN	II	983.4	30.0	28.3					1979			1979	86	36.7	3.4	1.1			1934	1998	1957		
जुलाई	I	986.9	28.5	27.1	33.4	24.2	36.2	21.9	38.5	10	16.1	8	88	34.4	3.7	0.9	205.8	11.2	414.9	67.0	156.4	24	
JUL	II	983.4	30.6	28.7					1973			1920	86	37.5	3.7	1.2			1958	1992	1978		
अगस्त	I	987.6	28.2	27.0	33.5	24.2	36.4	21.2	39.0	8	15.0	4	89	34.4	3.5	0.9	203.3	11.1	595.9	39.6	410.0	3	
AUG	II	983.8	30.4	28.7					1979			1979	87	37.7	3.0	1.2			1981	1936	1981		
सितम्बर	I	991.2	27.5	26.2	32.7	23.3	36.0	21.5	37.2	10	20.0	29	89	33.0	3.3	0.9	174.3	8.9	482.3	33.8	360.0	26	
SEP	II	987.5	29.5	27.8					1951			1990	87	35.9	3.5	1.4			1976	1963	1976		
अक्टूबर	I	995.5	25.2	24.2	31.8	20.9	34.7	17.0	36.2	4	13.0	31	90	29.2	2.2	0.5	98.4	5.4	471.4	9.2	149.9	6	
OCT	II	991.2	28.3	27.1					1971			1983	89	34.5	2.2	0.7			1946	1985	1916		
नवम्बर	I	999.1	20.7	19.6	28.2	15.3	30.9	11.2	33.0	4	8.3	29	90	22.2	1.2	0.3	30.3	2.0	243.1	0.0	101.6	9	
NOV	II	993.9	25.3	24.0					1983			1937	89	29.0	1.2	0.5			1924		1955		
दिसम्बर	I	1001.0	15.5	14.6	25.9	9.9	28.4	6.3	31.0	5	4.4	31	90	16.0	0.7	0.1	6.2	0.7	61.4	0.0	53.0	10	
DEC	II	996.9	22.2	20.9					1972			1969	88	24.0	0.7	0.3			1973		1973		
वर्षावर्षित माह का माध्य	I	993.8	23.3	21.9	30.6	17.9	37.9	4.9	42.0	6	2.1	28	87	26.1	2.2	0.6	1239.2	74.0	1723.1	928.3	410.0	3	
ANNUAL TOTAL OR MEAN	II	989.9	27.3	25.4					6	1979	1	1964	85	31.3	2.5	0.8			1929	1998	8	1981	
वर्षावर्षित माह का माध्य	I																						
NUMBER OF YEARS	II	18	18	18	17	17	17	17	40	40		18	18	16	16	22	23	75	75	84			

CLIMATOLOGICAL TABLE																																							
स्टेशन : लुमदिंग STATION : Lumding				वर्षावर्षित										पवन										मेघ										दूरगता					
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
मेघ ताप गति की संख्या				पवन की गति की संख्या				पवन की दिशा की गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				मेघ ताप (गर्मी मेघ) गति की संख्या				दूरगता गति की संख्या						20 दिनों में अधिकतम													
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Site specific meteorological data

Meteorological Data were collected at Rusoma near Kohima (Road no – NH -150), meteorological data of March 2016 to May 2016 months was collected to assess the long-term meteorological scenario of the area. The data collected shows almost similar nature of atmospheric scenario due to geo-graphic equality of the stations.

Months	Temperature (°C)			Relative Humidity (%)			Average Wind Speed (kmph)	Total Rainfall (mm)
	Max	Min	Avg.	Max	Min	Avg.		
March 2016	28.0	16.0	22.0	66.0	48.0	57.0	7.8	2.5
April 2016	31.0	18.0	24.5	62.0	35.0	48.5	7.0	3.2
May 2016	35.0	20.0	27.5	80.0	47.0	63.5	5.3	6.2
Average	31.3	18.0	24.7	69.3	43.3	56.3	6.7	3.9

Interpretation of the Meteorological data

Data observed from the secondary source and primary data are approx. similar in respect to temperature and rain fall. Slightly increase in temperature observed during the study period.

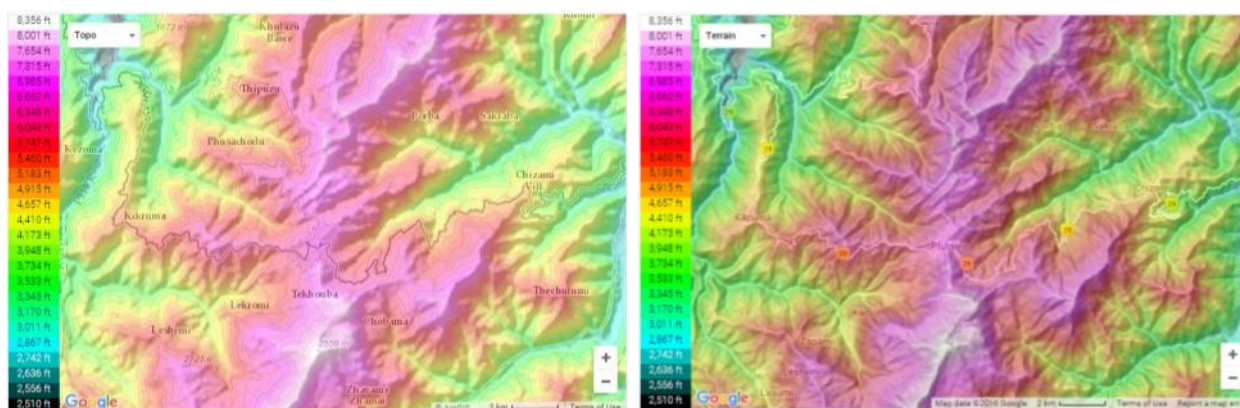
4.5.2 Land

4.5.2.1 Terrain

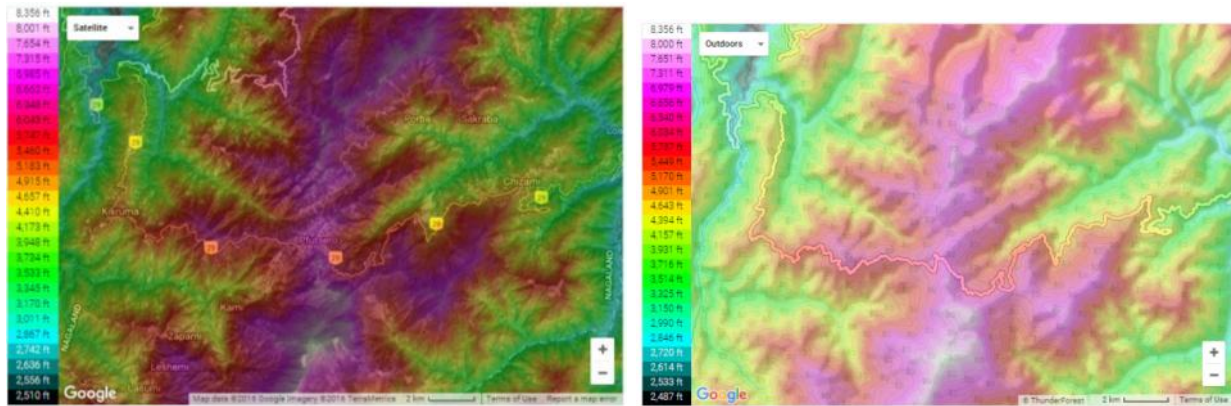
Terrain is classified by general slope of the country across the highway alignment. Based on these criteria the project highway passes through hilly terrain along the entire stretch

4.5.2.2 Topography

Nagaland consists of a narrow strip of hilly country running North-east to South-west and facing the Assam plains to its North and North-west. The Barail range enters the state at the South- west corner and runs in a North-easterly direction almost up to Kohima. Near Kohima the Barail range merges with the mountain ranges which have extended to Manipur and the main range assumes a much more northerly trend. This range is considerably higher than the Barail, with peaks like Saramati (3826.15 m) and Mataung Kien (3420 m) at its extreme east. Between Mao and Kohima, there are several very high peaks including Japvo. North of Kohima the main range declines in height, and as far north as Mokokchung district, the Japukong range attains an average elevation of 750m. In general, 94% area falls under hilly and rugged terrain and only 6% land is plain, especially those bordering Assam plains along western boundary of the state. The State has a rolling landscape with low hills covered with very dense vegetation.



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Source:- <http://en-in.topographic-map.com/places/Nagaland-4021066/>

4.5.2.3 Geology

The project road is passing through 3 districts Kohima, Phek and Ukhrul in Nagaland and Manipur state. Facing the Himalayan ranges across the Brahmaputra valley and stretching NE- SW along the eastern margin of Northeast India, bordering Myanmar, lies the Naga Hills. It represents the northern extension of the Indo- Burma Ranges (IBR) linking the Arunachal Himalaya to the north and Andaman-Nicobar Islands to the south. The N-S trending Patkai, Barail and associated ranges with their varied structural styles impart youthful geomorphology to the Naga Hills. The Cenozoic sedimentary cover in Nagaland accounts for nearly 95 percent of the area whereas the rest is being occupied by igneous and crystalline rocks of Mesozoic- Cenozoic age. These exhibit a general trend of NNE-SSW with moderate to steep dips towards NW and SE. Based on the morphotectonic elements, the Naga Hills has been longitudinally divided, from west to east, into three distinct units, namely- the Schuppen Belt, the Inner Fold Belt and the Ophiolite Belt. The Schuppen Belt has been defined as a narrow linear belt of imbricate thrust slices which follows the boundary of Assam valley alluvium for a distance of 350 Km. along the flank of Naga- Patkai hill ranges. It is postulated that this belt comprises of eight or possibly more overthrusts along which the Naga Hills have moved northwestwards relative to the Foreland spur. The total horizontal movement of all the thrusts together is estimated to be over 200 km. The Schuppen belt is delineated on the east by Halflong- Disang thrust and on the west by the Naga thrust which has an end-echelon disposition. Sediments ranging in age between Eocene-Oligocene and Plio-Pleistocene along with total absence of Disang rocks together characterize the Schuppen Belt.

Ukhrul District is bounded by Myanmar in the East, Chandel District in the South, Imphal East and Senapati Districts in the West and Nagaland State. The district HQ. Ukhrul is linked with Imphal, the state capital by a NH 150 about 84 Km



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Figure 4-1: Geological Map of Nagaland

Source:- National Disaster Risk Reduction Portal Nagaland

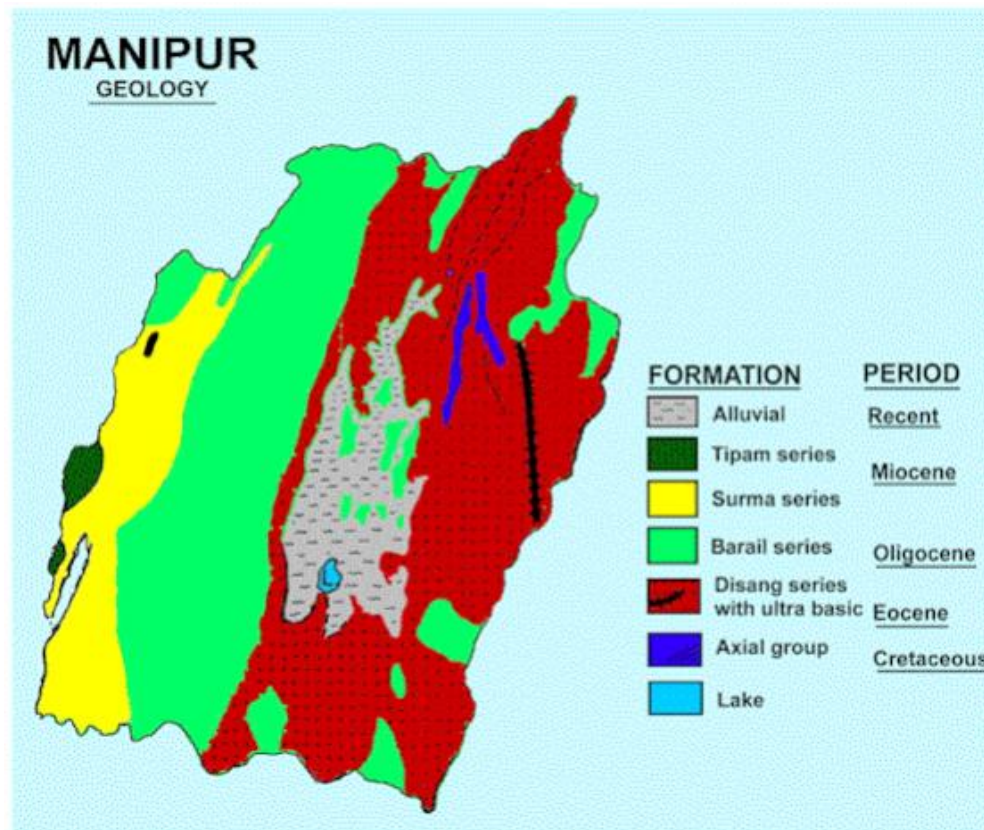


Figure 4-2: Geological map of Manipur

Source:- National Disaster Risk Reduction Portal Manipur

The Inner Fold Belt occupies the central part of Naga Hills and extends up to Pangsung Pass in Arunachal Pradesh. A large spread of Disang rocks with isolated covers of Barail as well as Disang- Barail Transition sequences characterizes the geological setting of this belt. The Palaeogene rocks have been folded into series of anticlines and synclines and are confined within two major tectonic zones viz. Haflong- Disang thrust to the west and the Ophiolite Disang thrust to the east. The Inner Fold Belt is occupied by two major synclinoria, namely the Kohima synclinorium to the south and Patkai synclinorium to the north, the Mokokchung and adjoining areas being the culmination point of the two. In Kohima synclinorium the younger Surma rocks are developed in its core.

The NE- SW trending Ophiolite belt of Naga Hills extends along the eastern margin of the Nagaland state for nearly 200 Km bordering Myanmar. It is characterized by dismembered tectonic slices of serpentinites, cumulates and volcanics. The associated pelagic sediments include mainly chert and limestones that are often interbedded with the volcanics. Cherts are usually bedded and contain radiolarians. The fossil assemblages from the limestone interbeds have suggested an Upper Cretaceous to Lower Eocene age for the Ophiolites. These Ophiolite suit of rocks are unconformably overlain by an ophiolite derived volcanoclastic and open marine to paralic sedimentary cover which have been designated as Phokphur Formation. In the entire district, the hard rocks are overlain by thin blanket of alluvium and windblown sand.

4.5.2.4 Seismicity

According to GSHAP data, the state of Nagaland falls in a region of high to very high seismic hazard. As per the 2002 Bureau of Indian Standards (BIS) map, this state also falls in Zone V. Historically, parts of this state have experienced seismic activity greater than M6.0. Approximate locations of selected towns and basic political state boundaries are displayed. Nagaland has been hit by many disasters in the past. The most notable ones are the Great Shillong Earthquake on 12th June 1897 which measured 8.7 in the richter scale and the Assam. Tibet earthquake on 15th August 1950 which measured 8.5 in the Richter scale. However, since those days there were no facilities to record and to document, there is no local data supporting the disasters. However interviews with the older generation people reveals that the 1950 earthquake was very much felt by Nagaland, and it even resulted in the destruction of many houses in

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certain areas. It was even said the earth opened up and buffalos were buried alive.

Figure 4-3: Seismic Zones of India

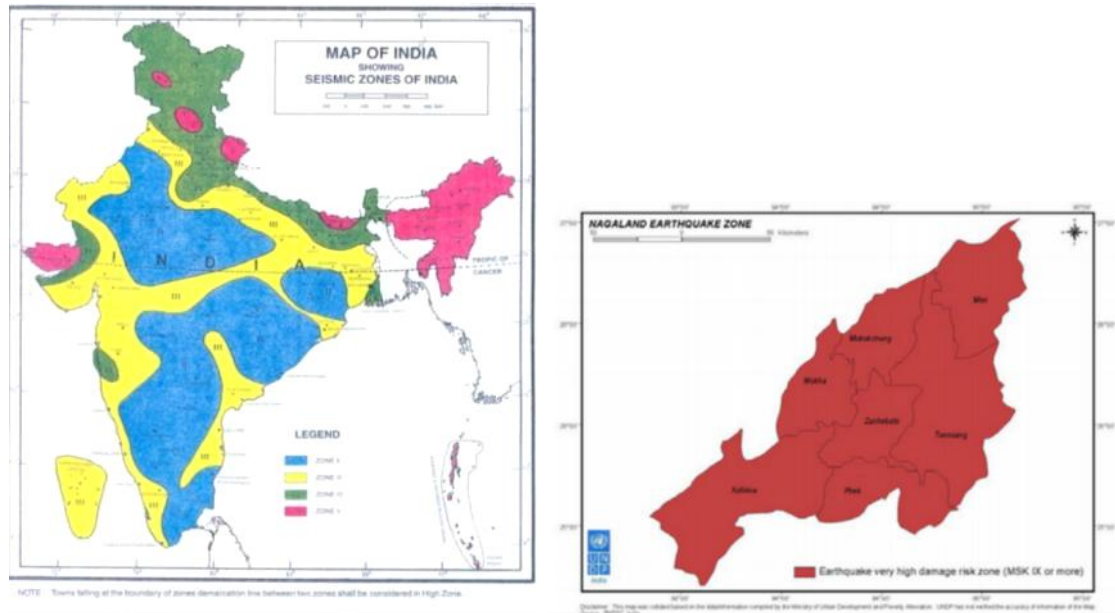


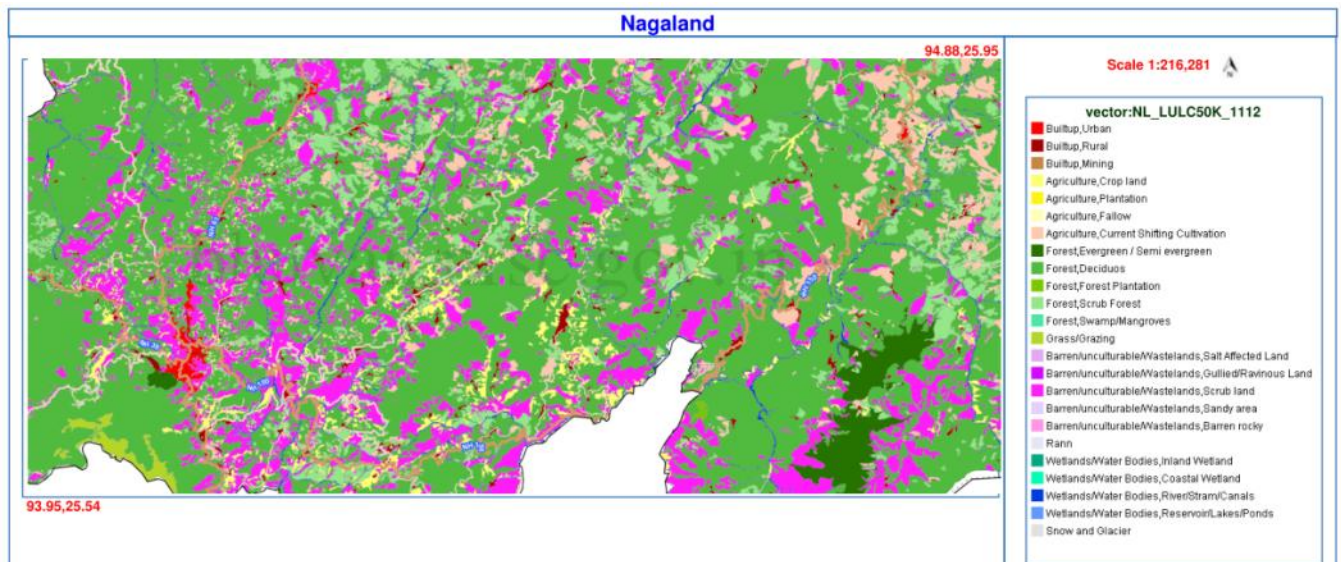
Figure 4-4: Seismic Map of India and Nagaland

Source: National Atlas Thematic Mapping Organisation, Govt. of India & envis centre Nagaland.

4.5.2.5 Land Use

The land use patterns along the Project Highway can be mentioned as Agricultural, Barren and Urban/Built-up. Few major and towns and villages have been observed along the Project Highway.

Figure 4-5: Photographs showing Land Use in Project area



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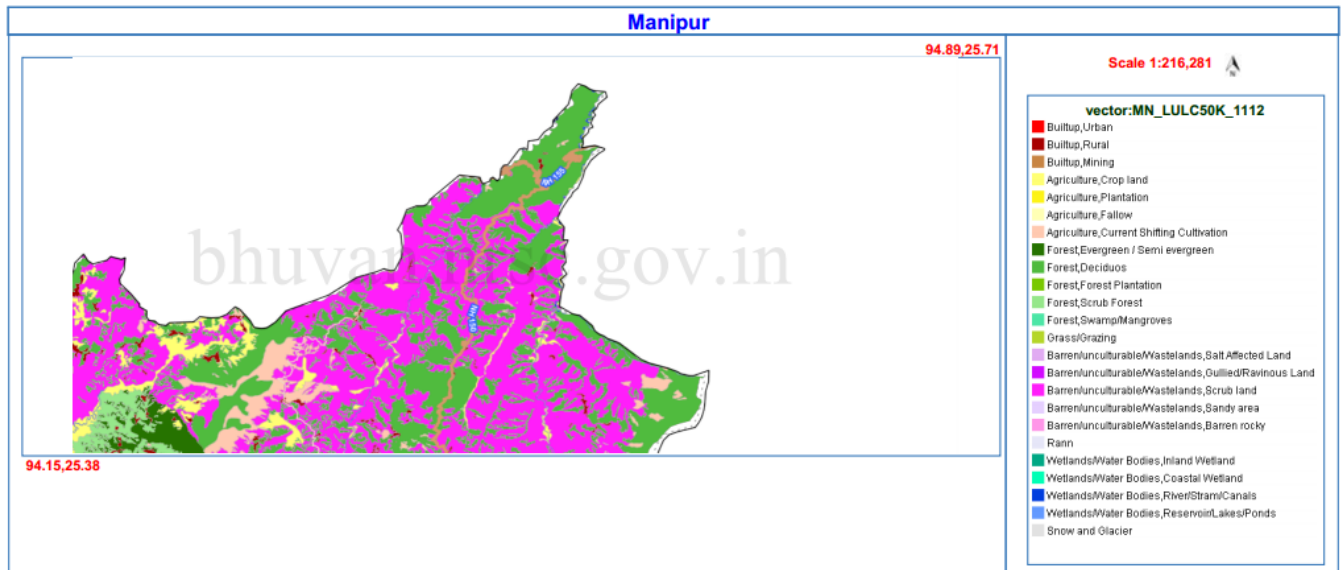


Figure 4-6:- Land Use of the Project area

Source:- <http://bhuvan.nrsc.gov.in>; <http://bhuvan.nrsc.gov.in/state/nl>



Figure 4-7: Site Photographs of Land use

Source:- Site photographs

4.5.2.6 Soil

Based on the report of the Soil Survey Wing of Soil and Water Conservation, Nagaland, the soil of Nagaland belongs to 4 orders, 7 sub-orders, 10 great groups, 14 sub groups and 72 soil families. The 4 orders of soil found in Nagaland are (i) Alfisols (ii) Entisols (iii) Inceptisols and (iv) Ultisols. Inceptisols dominate the soils of the State with 66% followed by Ultisols 23.8%, Entisols 7.3% and Alfisols 2.9% of the total 16.6 million Ha. of the State geographical area. Soil map of Nagaland is given below where as soil map of Manipur is attached as Annexure-4.2.

(Environmental Impact Assessment)

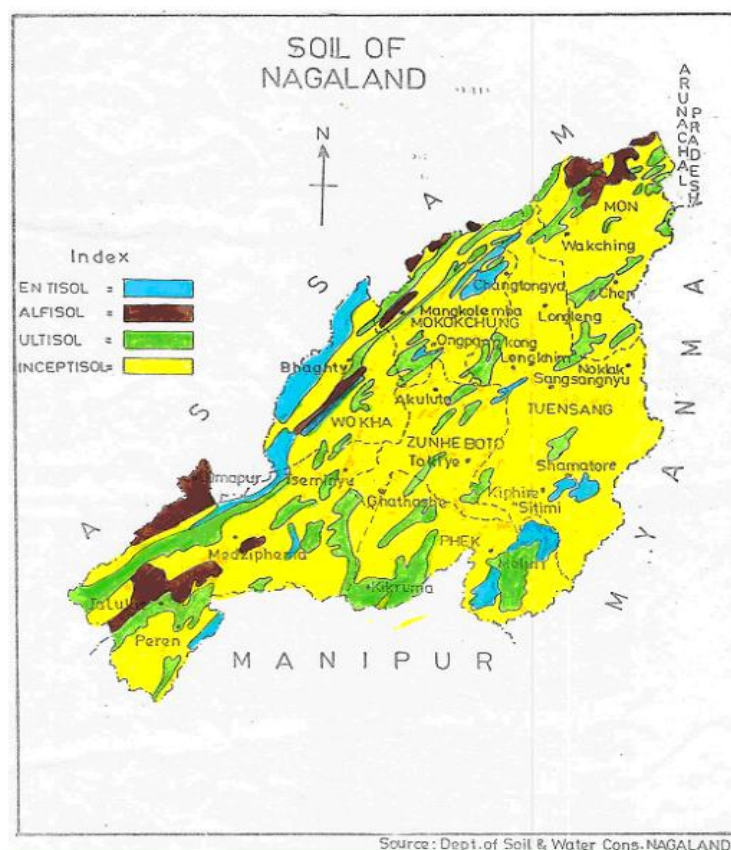


Figure 4-8: Soil of Nagaland

Sampling

All of the soil sampling locations identified along the project road are agricultural. An effort has been made to get an overall idea on existing scenario by collection of soil samples from uniform sub-section of road to the extent possible. Four locations are selected for soil sampling. The samples were collected by ramming a core-cutter into the soil up to 90-cm depth. Three locations are selected for soil sampling. At each location, soil samples were collected from three different depths viz. 30 cm, 60 cm and 90 cm below the surface and homogenized. The homogenized samples were analyzed for physical and chemical characteristics. The sealed samples were sent to laboratory for analysis. The sampling and analysis of soil along the project corridor was carried out once in the month of April 2016 by Noida Testing Laboratory, Noida on behalf of Feedback Infra Pvt. Ltd. The below table provides the details of soil sampling locations and the landuse map showing the location of sampling points have been annexed as Annexure 4.1

Table 4-2: Details of Monitoring Station for Soil

Sl. No.	Roads	Monitoring Station	Side	Chainage Existing	Location	GPS Coordinates	Sampling Date
1	NH-150	S1	RHS	6 + 800	Rusoma	N 25°40'56.84" E 94°7'43.15"	15/04/2016
2	NH-150	S2	RHS	45 + 100	Kikruma	N 25°34'46.35" E 94°13'11.87"	17/04/2016
3	NH-150	S3	LHS	61 + 400	Pfutsero	N 25°34'16.02" E 94°17'52.66"	18/04/2016
4	NH-150	S4	RHS	87 + 200	Chizami (near Baptist Church)	N 25°35'35.20" E 94°22'56.14"	20/04/2016

Source: Monitoring & Analysis done by NTL, Noida

(Environmental Impact Assessment)



Figure 4-9: Soil Sampling Locations

Source:- Google earth and Design data

Result and Analysis

Physical Parameters

The important physical characteristics of soil are bulk density, porosity and texture. Colour of soil along the proposed study area varies from light brownish to dark brownish.

Chemical Parameters

A brief summary of chemical characteristics are given below:

pH of soil in the proposed study area is found to be in the range of 6.98 to 7.83, the soil are, therefore, moderately alkaline. Conductivity of soil in the proposed study area is found to be in the range of 255 to 412 $\mu\text{S}/\text{cm}$. Available phosphorous of soil samples along the proposed study area ranges from 28.42 to 46.33 mg/kg. Potassium content as K in soil samples along the proposed study area is found in the range of 113.62 to 161.30 mg/kg. Total organic matter in soil samples along the proposed Study area is found to be fairly high (0.65 – 0.84 %), therefore the soil is fertile in terms of productivity.

Table 4-3: Physico-chemical Analysis of Soil Quality

S.NO	PARAMETER	S 1 Rusoma	S 2 Kikruma	S 3 Pfulsero	S 3 Chizami (near Baptist Church)	UNIT
1.	pH(1:5 suspension)	6.98	7.32	7.83	7.10	---
2.	Electrical Conductivity at 25°C (1:5suspension.)	345.00	312.00	412.00	255.0	$\mu\text{S}/\text{cm}$
3.	Infiltration Rate	22.80	18.25	26.35	12.32	mm/hr
4.	Organic Matter	0.78	0.81	0.84	0.65	% by mass
5.	Sulphate	73.12	65.34	87.55	51.21	mg/kg
6.	Potassium (as K)	153.70	123.47	161.30	113.62	mg/kg
7.	Moisture Retention Capacity	28.40	23.18	31.25	16.75	% by mass
8.	Porosity	33.67	31.63	35.45	38.96	% by mass
9.	Sand	31.30	36.10	31.00	24.60	% by mass
10.	Clay	45.50	38.30	41.60	46.10	% by mass

(Environmental Impact Assessment)

S.NO	PARAMETER	S 1 Rusoma	S 2 Kikruma	S 3 Pfutsero	S 3 Chizami (near Baptist Church)	UNIT
11.	Silt	23.20	25.60	27.40	29.30	% by mass
12.	Texture	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay	---
13.	Sodium Sulphate	0.035	0.028	0.036	0.025	% by mass
14.	Nitrogen	458.00	396.00	512.00	326.00	mg/kg
15.	Phosphorus	38.60	32.12	46.33	28.42	mg/kg
16.	Bulk Density	1.21	1.18	1.27	1.15	gm /cc

Source: Monitoring & Analysis done by NTL, Noida

Figure 4-10: Photographs taken during Soil Sampling



4.5.3 Ambient Air Quality

The monitoring of the ambient air quality (AAQ) for the various land uses along the project corridor was carried out at a frequency of twice in a week at each station in the months of March, April & May 2016, by Noida Testing Laboratory, Noida on behalf of Feedback Infra Pvt. Ltd. Monitoring was carried out by taking 24 hourly samples at each location as per guidelines of CPCB and the requirements of MoEF.

Monitoring Station and Methodology

Air Pollution Monitoring Stations were selected with an idea of establishing correlation between pollution levels and road geometrics, air pollution and land use along the road. 4 monitoring locations have been selected around the project corridor. Details of monitoring locations are depicted in table below the map showing the location of sampling points has been annexed as Annexure 4.1.

Table 4-4: Details of Monitoring Station for Air Quality Monitoring

S. No.	Monitoring Station Code	Chainage Existing (km)	Location	Area Categorization	Road Number	Distance from Road edge (m)	GPS Coordinates	Height from Ground Level (m)
1	AAQ1	6 + 800	Rusoma	Commercial	NH-150	20.0	N 25°40'56.84" E 94°7'43.15"	3.5
2	AAQ2	45 + 100	Kikruma	Residential	NH-150	50.0	N 25°34'46.35"	4.0

(Environmental Impact Assessment)

S. No.	Monitoring Station Code	Chainage Existing (km)	Location	Area Categorization	Road Number	Distance from Road edge (m)	GPS Coordinates	Height from Ground Level (m)
3.	AAQ3	61 + 400	Pfutsero	Residential	NH-150	30.0	E 94°13'11.87" N 25°34'16.02" E 94°17'52.66"	3.0
4.	AAQ4	87 + 200	Chizami	Silence	NH-150	15.0	N 25°35'35.20" E 94°22'56.14"	4.5

Source: Monitoring done by NTL, Noida



Figure 4-11: AAQ Sampling Location Map

It was ensured that the equipment was placed at a height of at least 3 to 6 m above the ground level at each monitoring station, for negating the effects of windblown ground dust. Also distance of the sampler to any air flow obstacle i.e. buildings, must be more than two times the height of the obstacle above the sampler has been ensured. The equipment was placed at open space free from trees and vegetation which otherwise act as a sink of pollutants resulting in lower levels in monitoring results. Monitoring has been carried out as per the latest CPCB and MoEF guidelines and notifications.

With a view to collecting the samples, Ecotech & Lata Envirotech make calibrated Respirable Dust Samplers along with Gaseous attachment and Fine Particulate Samplers have been used. The RDS was well capable of drawing air at a flow rate of 1 to 1.3 m³/min with very little pressure drop for RDS and the Impactor system of FPS is designed to operate at an air flow rate of 1 m³/hr. Filter papers were used for the collection of PM₁₀ & PM_{2.5}. SO₂ was collected by drawing air at a flow-rate of 0.5 litres per minute (lpm) through an absorbing solution i.e., Sodium tetrachloromercurate (TCM) (West and Gaek Method). NO₂ samples were collected by drawing air at a flow rate of 0.4 litres per minute (lpm) through the mixture of absorbing solutions i.e. sodium hydroxide and sodium arsenite (Jacobs and Hochheiser Method). Carbon Monoxide was collected in bladders on 8 hourly basis and analyzed by Non Dispersive Infra-Red Spectroscopy (NDIR).

Figure 4-12: Photographs of Air Quality Monitoring

(Environmental Impact Assessment)



Results & Analysis of Ambient Air Quality

The air quality in the project area is less polluted. The AAQ of the project area is given in below Table. From the table it is evident that concentrations of all pollutants are well within the prescribed limits of the National Ambient Air Quality Standards. The 98th percentile value of PM 10 varies between 55.31 $\mu\text{g}/\text{m}^3$ at Rusoma, 54.55 $\mu\text{g}/\text{m}^3$ at Kikruma, 53.18 $\mu\text{g}/\text{m}^3$ at Pfutsero, 50.95 $\mu\text{g}/\text{m}^3$ at Chizami (Near Baptist Church). The 98th percentile value of PM 2.5 varies between 23.32 $\mu\text{g}/\text{m}^3$ at Rusoma, 22.51 $\mu\text{g}/\text{m}^3$ at Kikruma, 20.21 $\mu\text{g}/\text{m}^3$ at Pfutsero, 21.25 $\mu\text{g}/\text{m}^3$ at Chizami (Near Baptist Church). The 98th percentile value of SO₂ varies between 8.03 $\mu\text{g}/\text{m}^3$ at Rusoma, 7.17 $\mu\text{g}/\text{m}^3$ at Kikruma, 7.52 $\mu\text{g}/\text{m}^3$ at Pfutsero, 7.72 $\mu\text{g}/\text{m}^3$ at Chizami (Near Baptist Church). The 98th percentile value of NO₂ varies between 12.31 $\mu\text{g}/\text{m}^3$ at Rusoma, 10.45 $\mu\text{g}/\text{m}^3$ at Kikruma, 11.23 $\mu\text{g}/\text{m}^3$ at Pfutsero, 8.84 $\mu\text{g}/\text{m}^3$ at Chizami (Near Baptist Church). The 98th percentile value of CO varies between 0.58 mg/m³ at Rusoma, 0.54 mg/m³ at Kikruma, 0.51 mg/m³ at Pfutsero, 0.51 mg/m³ at Chizami (Near Baptist Church).

Table 4-5: Ambient Air Quality within Project Corridor

S. No.	Station Name	PM 10	PM2.5	SO ₂	NO _x	CO
1	AAQ1	50.95	21.25	7.72	8.84	0.51
2	AAQ2	54.55	22.51	7.17	10.45	0.54
3	AAQ3	53.18	20.21	7.52	11.23	0.51
4	AAQ4	55.31	23.32	8.03	12.31	0.58

Source: Monitoring & Analysis done by NTL, Noida

4.5.4 Water

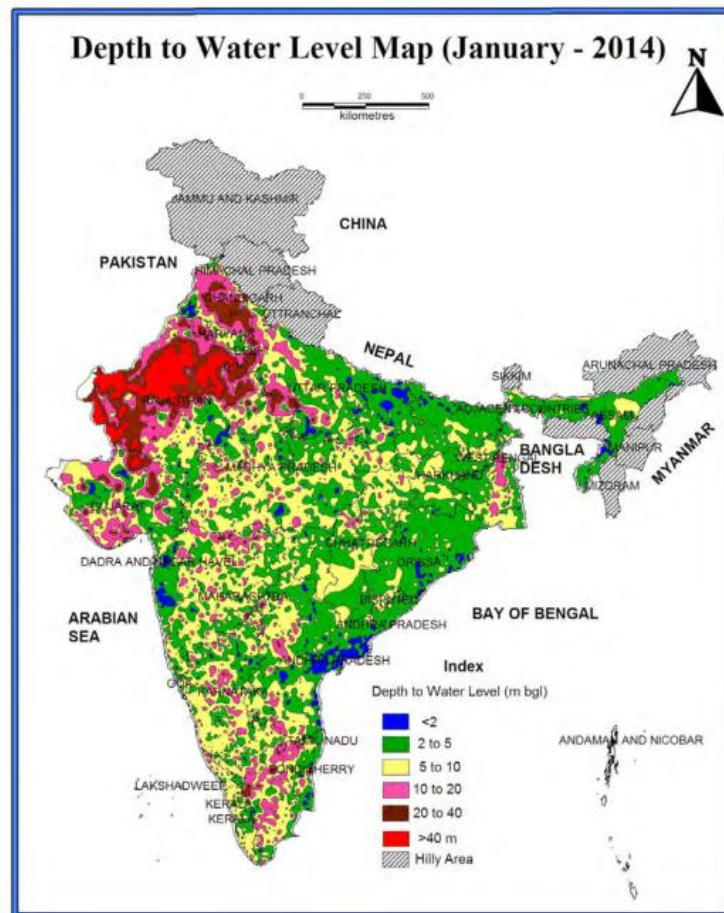
4.5.4.1 Ground Water Availability

As the complete stretch found in the hilly terrain hence ground water is not used as a source of water. In the last stretch of the project road i.e. in Manipur Ukhurul district some of the handpumps were observed but their condition is not good.

Figures depicting Groundwater Level in the hilly terrain are presented below.

Figure 4-13: Ground Water Scenario in India (Nagaland)

(Environmental Impact Assessment)



Source: Ground water Scenario in India, GGWB, 2014

Figure 4-14: Water Resources along Project Road



4.5.4.2 Ground Water Quality

This road falls under Brahmaputra & Barak Basin Organization of Central water Commission, flood estimation report. This zone is fed both by snow and rain. A good percentage of the runoff in the zone is derived from the snow and glaciers which constitute a potential reservoir. Winter precipitation which occurs in the form of snow goes on accumulating till summer. As the summer advances, the accumulations melt and release water in the streams.

2 ground water/Drinking Water samples were collected to assess the ground water quality along the project corridor. The samples were collected in the month of April 2016, by Noida Testing Laboratory, Noida for testing on behalf of Feedback Infra. All the basic precautions were taken care to avoid any contamination during the sampling. Water samples were collected from sampling locations in plastic jerry can and 500 ml sterilized clean glass bottles for complete physico-chemical and bacteriological tests respectively. Sampling bottles were kept in airtight large plastic ice-cold containers and were transported to laboratory for further processing.

(Environmental Impact Assessment)



Figure 4-15: Water Sampling Photographs

The locations selected for water sampling are presented in Table below and the map showing the location of sampling points and surrounding land use have been given below and annexed as Annexure 4.1.

Table 4-6: Details of Ground Water Quality Sampling Location

Sl. No.	Type & Source of Sample	Sampling Station (Code)	Chainage Existing	Location	GPS Coordinates	Road No.	Sampling date
1.	Ground Water	GW - 1	6 + 800	Rusoma	N 25°40'56.84" E 94°7'43.15"	NH-150	15/04/2016
2.	Ground Water	GW - 2	61 + 300	Pfutsero	N 25°34'16.02" E 94°17'52.66"	NH-150	18/04/2016

Source: Sampling done by NTL, Noida



Figure 4-16: Ground Water sampling Location

Results & Analysis of Ground Water Samples

Ground water samples were analysed in lines with IS 3025 and APHA 22nd edition 2012. Water quality as analysed is presented in Table below. The water quality was found well within the permissible limits but some of the parameters are crossing desirable limit as per IS: 10500 drinking water quality standards

Table 4-7: Physical and Chemical Results of Ground Water Samples

(Environmental Impact Assessment)

Source: Monitoring & Analysis done by NTL, Noida; BDL- Below Detection Level

Parameters	Unit	GW - 1 Rusoma Village	GW - 2 Chizami Village	Limits as per IS Standard 10500
pH	---	7.35	7.10	6.5 - 8.5
Temperature	°C	23.0	21.5	
Turbidity	NTU	<1.0	<1.0	1 - 5
Conductivity @25°C	µS	353	285	---
Sulphate (SO ₄)	mg/l	26.9	21.2	200 - 400
Nitrate (NO ₃)	mg/l	2.3	1.8	45 – No Relaxation
Total Hardness(as CaCO ₃)	mg/l	96.34	77.60	200 - 600
Chloride(as Cl)	mg/l	38.15	29.40	250 - 1000
Fluoride (as F)	mg/l	0.16	0.12	1.0 - 1.5
Iron (as Fe)	mg/l	0.09	0.06	0.3 - No Relaxation
Total Dissolved Solid	mg/l	225	182	500 -2000
Calcium (as Ca)	mg/l	28.5	21.3	30 -1000
Magnesium (as Mg)	mg/l	8.1	6.4	0.01 - No Relaxation
Arsenic (as As)	mg/l	BDL	BDL	0.01 - No Relaxation
Lead (as Pb)	mg/l	BDL	BDL	0.05 - No Relaxation
Copper (as Cu)	mg/l	BDL	BDL	5.0 - 15.0
Zinc (as Zn)	mg/l	0.63	0.50	0.1 – 0.3
Manganese (as Mn)	mg/l	BDL	BDL	0.05 - No Relaxation
Total Chromium (as Cr)	mg/l	BDL	BDL	---
Sodium (as Na)	mg/l	18.3	18.3	---
Potassium (as K)	mg/l	3.6	2.7	200 - 600
Total Alkalinity (as CaCO ₃)	mg/l	73.5	64.2	---
Phosphate (as P)	mg/l	41.5	28.4	---
Nitrite (as NO ₂)	mg/l	BDL	BDL	---
Total Suspended Solid	mg/l	<1.00	<1.00	---
Faecal Coliform	---	Absent/100ml	Absent/100ml	Absent/100ml
Total Coliform	---	Absent/100ml	Absent/100ml	Absent/100ml

4.5.4.3 Surface Water Resources

There is a perennial river along the project road starting from chainage no. 102.300 and end at ch. 118.500. Various streams are found along the project road. Few ponds are located along the project corridor. Many of these water bodies play very crucial role to the local biodiversity and community. The details of surface water bodies are presented in below Table

Table 4-8: Details of Surface Water Resources along Project Road

S. No.	Location (km)	Design Chainage (Ch.)	Development proposal
1	120.027	118+550	Existing Retained with Repairing & Maintenance

Source: Primary Survey

S. No.	Location		Details of Proposed (New) Minor Bridge	
	Existing Location (km)	Proposed Chainage (Ch.)	Type	Span Arrangement (Nos. x m)
1	92.759	94+410	RCC Box	1x8.0x 1.5

Source: Primary Survey

(Environmental Impact Assessment)

S. No.	Location (km)	Design Chainage (Ch.)	Development proposal
1	24.409	24+050	Existing Retained with Repairing & Maintenance
2	37.949	37+430	Existing Retained with Repairing & Maintenance
3	39.129	38+580	Under Construction
4	82.179	81+100	Under Construction
5	103.599	102+280	Existing Retained with Repairing & Maintenance
6	114.469	113+040	Existing Retained with Repairing & Maintenance

Source: Primary Survey

There are many perennial River and stream found along the project road which may be used for the drinking as well as construction purpose. People along the road use the stream water for drinking purpose after conventional treatment.

Figure 4-17: Photographs of Surface Water Bodies



Perennial River along the project road

4.5.4.4 Surface Water Quality

Two surface water sample was collected in the month of April 2016, by Noida Testing Laboratory, Noida for testing on behalf of Feedback Infra. All the basic precautions were taken care to avoid any contamination during the sampling. Water samples were collected from sampling locations in plastic jerry can and 500 ml sterilized clean glass bottles for complete physico-chemical and bacteriological tests respectively. Sample for DO was collected in a pre-cleaned BOD bottle. The water samples were preserved and stored in polythene bottles. Sampling bottles were kept in airtight large plastic ice-cold containers and were transported to laboratory for further processing. The locations selected for water sampling are presented in Table below and the map showing the location of sampling points have been annexed as Annexure 4.1.

Table 4-9: Details of Surface Water Quality Sampling Location

Sl. No.	Type & Source of Sample	Sampling Station (Code)	Chainage Existing	Location	GPS Coordinates	Road No.	Sampling date
1.	Surface Water	SW - 1	25 + 400	River Nr. Chainage 102.300	N 25°36'49.59" E 94°02'38.02"	NH-150	16/04/2016
2	Surface Water	SW - 2	86 + 300	Pond Water near Chizami	N 25°35'35.20" E 94°22'52.14"	NH-150	20/04/2016

Source: Sampling done by NTL, Noida



Figure 4-18: Surface water sampling location

(Environmental Impact Assessment)

Results & Analysis of Surface Water Samples

Samples were analysed for the parameters as desired for assessment of surface water quality and results are presented in Table below. The results were compared against the Class C water (Water for fish culture and wild life propagation) quality standards as per IS 2296.

Table 4-10: Physical and Chemical Results of Surface Water Sample

Parameters	Unit	SW – 1 (River Nr. Ch. 102.300)	SW – 2 (Pond Water near Chizami)	Tolerance Limit IS:2296 CLASS C
pH	-	8.32	8.61	6.5 -8.5
Temperature	°C	22.0	21.5	\$
Turbidity	NTU	9	14	\$
Conductivity @25°C	mg/l	475.5	1087	\$
Sulphate (SO ₄)	mg/l	42.8	84.3	400.0
Nitrate (NO ₃)	mg/l	5.8	6.3	50.0
Total Hardness(as CaCO ₃)	mg/l	125.6	365	\$
Chloride(as Cl)	mg/l	68.9	136	600.0
Fluoride (as F)	mg/l	0.23	0.36	1.5
COD (as O ₂)	mg/l	8	14	\$
Iron (as Fe)	mg/l	0.36	0.41	50.0
Dissolve Oxygen	mg/l	4.3	6.8	4.0
Total Dissolved Solid	mg/l	255	714	1500.0
BOD (3 days at 27°C)	mg/l	< 2.0	< 2.0	3.0
Calcium (as Ca)	mg/l	45.8	125	\$
Magnesium (as Mg)	mg/l	3.7	12.9	\$
Arsenic (as As)	mg/l	BDL	BDL	0.2
Lead (as Pb)	mg/l	BDL	BDL	0.1
Copper (as Cu)	mg/l	BDL	BDL	1.5
Zinc (as Zn)	mg/l	0.36	0.41	15.0
Manganese (as Mn)	mg/l	BDL	BDL	\$
Total Chromium (as Cr)	mg/l	BDL	BDL	0.05
Sodium (as Na)	mg/l	23.8	63	\$
Potassium (as K)	mg/l	8.5	15	\$
Total Alkalinity (as CaCO ₃)	mg/l	113.7	210	\$
Phosphate (as P)	mg/l	112.5	136.4	\$
Nitrite (as NO ₂)	mg/l	BDL	BDL	\$
Total Suspended Solid	mg/l	110	225	\$

Source: Monitoring & Analysis done by NTL, Noida; BDL- Below Detection Level, \$- Not Specified

Figure 4-19: Photographs of Water Sampling

(Environmental Impact Assessment)



4.5.5 Noise

The monitoring of the ambient noise quality for the various land uses along the project corridor was carried out with the help of hand held noise level meters (Model: Lutron Make SL – 4033SD) in the months of April 2016, by Noida Testing laboratory, Noida on behalf of Feedback Infra Pvt. Ltd.

Noise Sampling Locations

4 monitoring stations were selected on the basis of land use and density of habitation. Details of monitoring stations are given in Table below and the map showing the location of sampling points with surrounding land-use have been given below and annexed as Annexure 4.1.



Figure 4-20: Noise Monitoring Location

Table 4-11: Noise Sampling Locations

Monitoring Station Code	Chainage Existing	Location	Road Number	Date of Sampling	GPS Coordinates	Area Category	Distance Road(m)	Observed Noise Levels in dB (A)		Noise Quality Standards in dB (A)	
								Leqday	Leqnight	Leqday	Leqnight
N 1	6 + 800	Rusoma	NH-150	15/04/2016	N 25°40'56.84" E 94°7'43.15"	Commercial Zone	50.0	49.04	39.86	65	55
N 2	45 + 100	Kikuma	NH-150	17/04/2016	N 25°34'46.35" E 94°13'11.87"	Residential Zone	25.0	49.37	39.66	55	45
N 3	61 + 400	Pfutsero	NH-150	18/04/2016	N 25°34'16.02" E 94°17'52.66"	Residential Zone	20.0	47.84	38.76	50	40
N 4	87 + 200	Chizami	NH-150	20/04/2016	N 25°35'35.20" E 94°22'56.14"	Silence Zone	30.0	43.29	34.08	55	45

Source: Monitoring done by NTL, Noida;

(Environmental Impact Assessment)

Results & Analysis of Noise Monitoring

At each location, noise monitoring has been carried out once during the entire study period (over a period of twenty-four hours to obtain L_{eq} values at uniform time intervals of 1 hour. For each location, day and night time L_{eq} values have then been computed from the hourly L_{eq} values such that comparison could be made with the national ambient noise standards. Day & night time L_{eq} has been computed from the hourly L_{eq} values as per standards. The noise level as monitored for the project is shown in Table below.

Table 4-12: Noise Level of the Study Area

Monitoring Station Code	Observed Noise Levels in dB (A)								Noise Quality Standards in dB (A)	
	L10	L50	L90	L_{eq} Day	L_{eq} Night	L_{eq}	Min Value	Max Value		
NM 1	43.65	49.15	61.40	56.04	32.86	44.45	31.40	64.50	65	55
NM 2	44.25	50.20	59.15	55.37	33.66	44.51	30.10	57.50	55	45
NM 3	41.45	47.95	64.20	60.84	38.76	49.80	34.20	66.30	50	40
NM 4	45.15	42.70	53.30	48.29	31.80	40.00	31.20	55.80	55	45

Source: Monitoring & Analysis done by NTL, Noida

The noise monitoring survey (in table above) shows that noise levels are well within the stipulated limit as per CPCB Standard in all of the locations during day and night time both.

Figure 4-21: Photographs of Noise Monitoring



Noise Sensitive Receptors along the Project Alignment

There are Some school, Hospital, temple and church observed along the project road. Noise Sensitive Receptors have been identified along the project road section. Among them 8 Health Facilities & 19 Schools are there.

4.6 BIOLOGICAL ENVIRONMENT

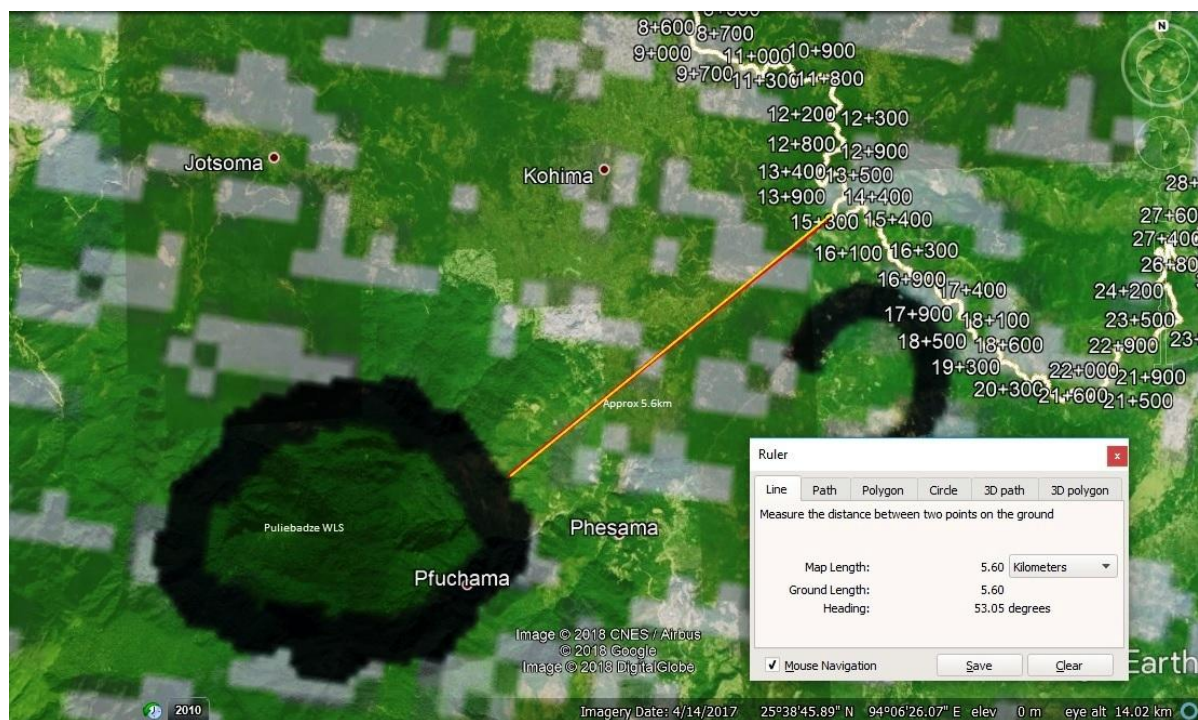
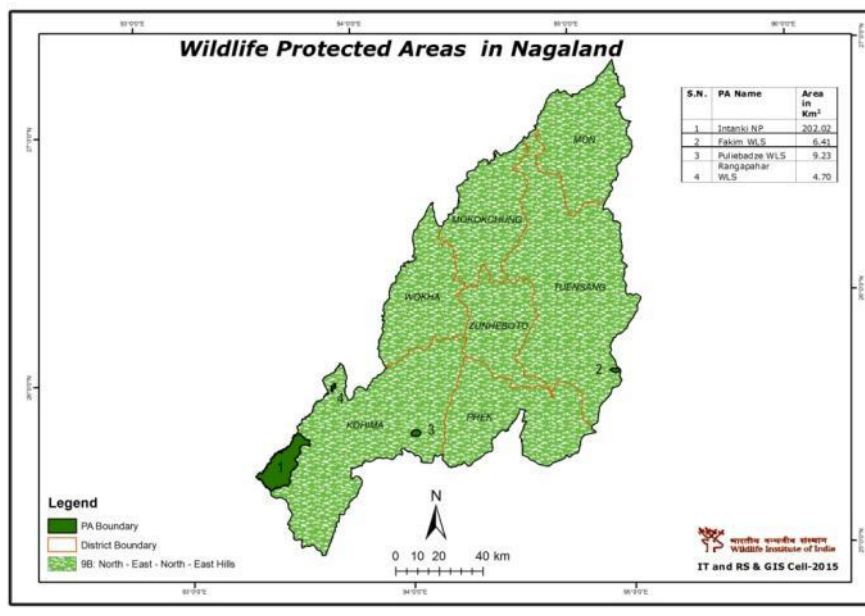
4.6.1 Protected Areas / Eco-sensitive Zones/ Animal Corridor

Puliebadze is the nearest wildlife sanctuary from the project road, which is approx. 5.6 km from the project road. Wildlife map along with project road as per coordinate given in the wildlife map is shown below.

No other Notified Protected Area like National park, Sanctuary, Biosphere Reserve, etc, Eco Sensitive Zone or Wildlife Corridor is located within 5 Km radius of the project road section.

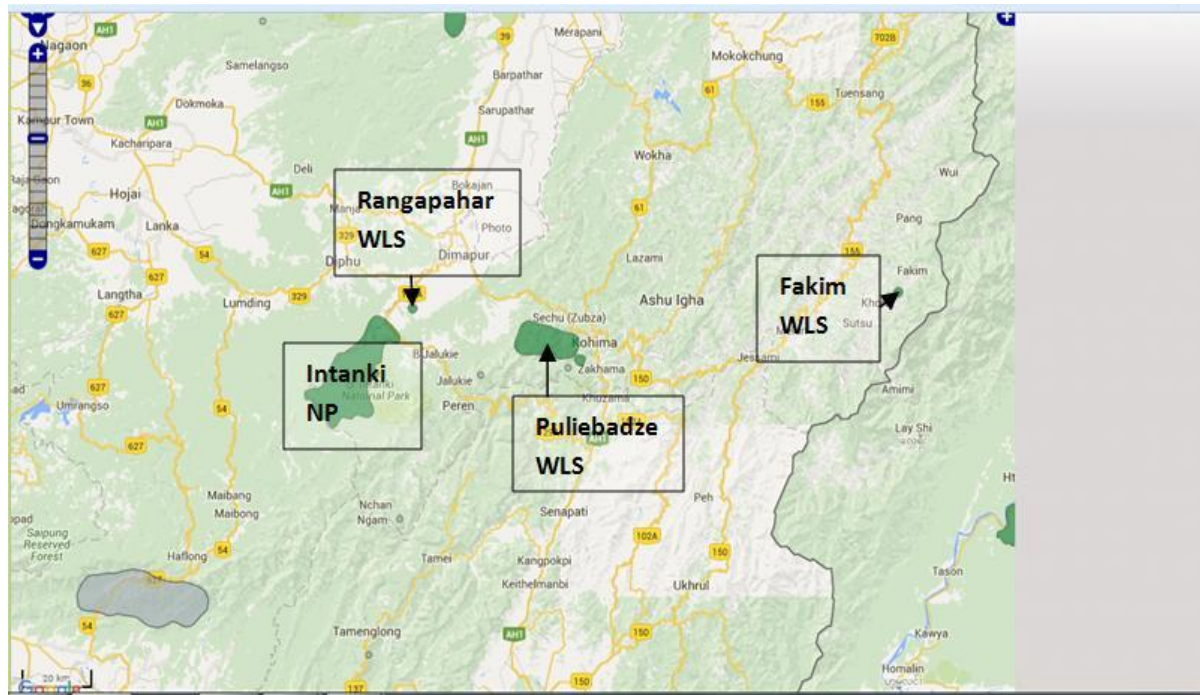
(Environmental Impact Assessment)

Wild life map of Nagaland



Source :- Envis centre of wildlife

(Environmental Impact Assessment)



Source:- National Wildlife Database cell

4.6.2 Forest Areas

Nagaland has several types of forests, mainly because the state is mostly tropical, and the altitudes range from a few hundred meters to about four thousand meters. The major types of forests found in the state, as per the classification of Champion & Seth, are as follows.

- Northern Tropical Wet Evergreen Forest

These forests once covered the Namsa-Tizit area but now only a small vestige is found in the Zankam area. It is found only in Mon District. The dominant species in this type of forest are Hollong (*Dipterocarpus macrocarpus*), Makai (*Shorea assamica*), Nahor (*Mesua ferrea*) etc.

- Northern Tropical Semi Evergreen Forest

These types of forests are found in the foothills of Assam-Nagaland border in Mokochung, Wokha and Kohima Districts. The species that make up this forest are similar to those of the Northern Tropical Wet Evergreen Forests. The only difference is that in the former case the evergreen species dominate though there are deciduous species like Bhelu (*Tetrameles nudiflora*), Paroli (*Stereospermum chelonoides*), Jutuli (*Altingia excels*) etc, whereas in the present case, the number of evergreen species decreases and the deciduous species are more in number.

- Northern Sub-Tropical Broad Leaf Wet Hill Forests

These types of forests are found in the hill areas below 1800m and above 500m in all the districts of Nagaland. The wet evergreen species are conspicuous by their absence and the dominant species are mostly semi-deciduous. Some of the important timber species in this type are Koroi, Pomas, Sopas, Gamari, Hollock, Sam, Am, Badam, Betula etc.

- Northern Sub-Tropical Pine Forest

These types of forests are found in hills with elevation of 1000m to 1500m in parts of Phek and Tuensang Districts of Nagaland. Pine is the dominant species, and is found mixed with *Quercus*, *Schima*, *Prunus*, *Betula* and *Rhododendron*.

- Northern Montana Wet Temperate Forests

These types of forests are found on the higher reaches of the tallest mountains (above 2500m) like Saramati and Dzükou area. The species that dominate are Rhododendron, Oaks, Birch and Juniperus sp.

- Alpine Forests

Alpine vegetation is found at high altitudes in ridges of Saramati range, which remains covered with snow for major part of the year from October to April. After melting of the snow during the brief summer a few annuals, herbs and shrubs along with mosses can be seen growing there. Species of Rhododendron, Abies, and Juniperus are found in sub alpine vegetation gradually merges into alpine vegetation which comprises of high altitude grasses and dwarf Rhododendrons. Many members of *Primulaceae*, *Saxifragaceae*, and *Polygonaceae* families are also found.

(Environmental Impact Assessment)

Table 4-13: Forest Cover in the Project District & Project State

District/ State	Area in Km2					Proportion of Forest Cover to State Geographic Area (%)
	Geographical Area	Very Dense Forest	Moderately Dense Forest	Open Forest	Total	
Kohima	3,283	290	1130	1443	2863	87.21
Phek	2,026	275	652	757	1684	83.12
Nagaland	16,579	1296	4695	6975	12966	78.21
Ukhrul	4544	181	980	2381	3542	77.95
Manipur	22,327	727	5,925	10,342	16,994	76.11

Source:- Envis Centre Nagaland(Source:- forest Survey of India -Indian State of Forest Report:2013)

Figure 4-22: Forest Cover in the Project State

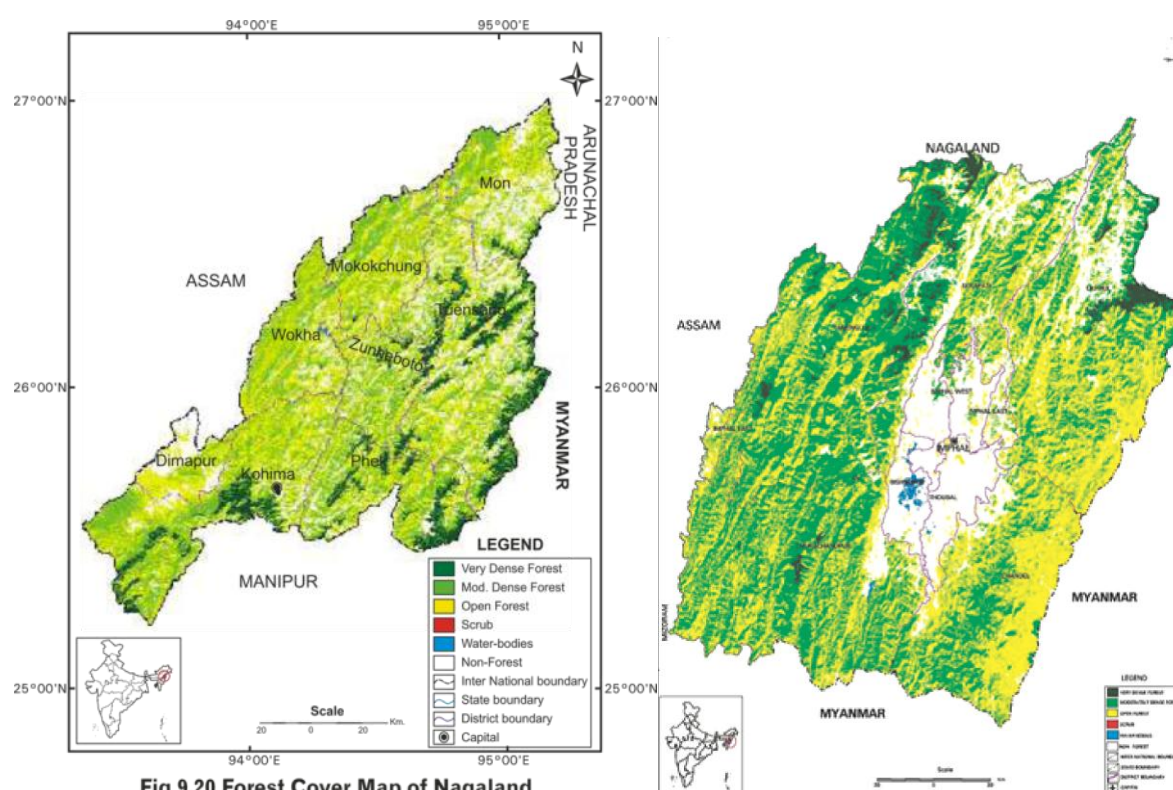


Fig 9.20 Forest Cover Map of Nagaland

Source: Envis centre Forest data Nagaland/Manipur

4.6.3 Flora & Fauna

The state of Nagaland is almost entirely hilly and is located on the Indo-Myanmarese border in north-eastern India. The total area of the state is 16,626 sq. km. Barail and Patkai are the main hill ranges. Mt Saramati (3841) is the highest peak of Nagaland, while Mt Japfü (3043) is the second highest. The forest type is mostly tropical semi-evergreen with evergreens in the valleys and gorges. Sub-tropical broadleaf and sub-tropical pine forest occurs in the higher areas. Sub-alpine vegetation is found on Mt Saramati which also remains under snow in winter.

Nagaland is very rich in bio-diversity, both flora and fauna. Even today some pockets of forests are covered with gigantic trees, where sun-rays can not penetrate. Due to reckless and uncontrolled cutting of trees for timber, firewood. Continued Jhum cultivation and annual fire in vast tracts of land, forest got degraded and barren, which accelerated diminishing of the most of the original characteristics of the forests.

(Environmental Impact Assessment)

Through geographically being a small state. Nagaland has several types of forests, mainly because the state is mostly tropical, and the altitudes range from a few hundred meters to about four thousand meters. The major types of forests found in the state, as per the classification of Champion and Seth, are as follows,

7. Northern Tropical Wet Evergreen Forest.
8. Northern Semi-Evergreen Forest.
9. Northern Sub-Tropical Broad Leaf Wet Hill Forests
10. Northern Sub-Tropical Pine Forests
11. Northern Mountain Wet Temperate Forests and
12. Temperate Forests.

Trees

Details of trees are given in Annexure 4.2.

Table 4-14: Floral Components along Project Road Section

<p>FLORA:</p> <p>CONIFEROUS:</p> <p><i>Pinus khasia</i> (Indigenous), <i>Pinus caribiae</i> (Exotic), <i>Pinus petula</i> and <i>Cryptomeria japonica</i> (Exotic)</p> <p>BROAD LEAVED:</p> <p><i>Lagerstromia speciosa</i> (Ajhar), <i>Tectona grandis</i> (Teak), <i>Mangifera indica</i> (Am), <i>Alnus nepalensis</i> (Alder), <i>Morus laevigata</i> (Bola), <i>Tetrameles nudiflora</i> (Bhelu), <i>Trewia nudiflora</i> (Bhelkar), <i>Betula alnoides</i> (Betula), <i>Canarium resiniferum</i> (Dhuna), <i>Gmelina arborea</i> (Gomari), <i>Cinnamomum cecicodaphne</i> (Gonsoroi), <i>Nyssa javanica</i> (Gahorisopa), <i>Terminalia myriocarpa</i> (Hollock), <i>Adina eligocephala</i> (Haldisopa), <i>Cedrela toona</i> (Jatipoma), <i>Podocarpus nerifolia</i> (Jinari), <i>Altingia exelsa</i> (Jutuli), <i>Duabanga grandiflora</i> (Khokon), <i>Albizia procera</i> (Koroi), <i>Anthocephalus kadamba</i> (Kadam), <i>Shorea assamica</i> (Mekai), <i>Endospermum chinensis</i> (Phulgomari), <i>Melia azadirach</i> (Ghoora-Neem), <i>Stereospermum chelonoides</i> (Paroli), <i>Magnolia spp.</i> (Sopas), <i>Cassia fistula</i> (Sonaru), <i>Bombax ceiba</i> (Semal), <i>Ficus nervosa</i> (Robar), <i>Spondias axillaris</i> (Hog plum), <i>Michelia champaca</i> (Titasopa), <i>Bischofia javanica</i> (Uriam), <i>Juglans regia</i> (Walnut), <i>Mansonia dipikai</i> (Badam), <i>Phoebe goalparensis</i> (Bonsom), <i>Dipterocarpus macrocarpus</i> (Hollang), <i>Terminalia chebula</i> (Hilika), <i>Schima wallichii</i> (Gogra), <i>Mesua ferrea</i> (Nahar), <i>Albizia lebbeck</i> (Siris), <i>Quercus Spp.</i> (Oaks), <i>Artocarpus chaplasha</i> (Sam), <i>Chukrasia tabularis</i> (Bogipoma), <i>Terminalia bellerica</i> (Bahera), <i>Hovenia dulcis</i> (Coral tree), <i>Acrocarpus fraxinifolius</i> (Mandani), <i>Bucklandia populnea</i> (Pipli), <i>Pseudostreblus indicus</i> (Tsüngkoh)</p> <p>World tallest Rhododendron tree, which is recorded in the Guinness Book, has been found in Japfu Mountain of Kohima district.</p>
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Source: Source: Annual Administrative Report 2014-15 (Department of Forests, Ecology, Environment & Wildlife, Nagaland, Kohima)

Figure 4-23: Flora along the Project Corridor

(Environmental Impact Assessment)



Source:- Site Photographs

Birds

Data from the secondary source shows that about 43 species of Birds found in the Nagaland state. All of them are of Least Concern category as per IUCN Conservation status.

Table 4-15: Birds spotted along Project Road Section

(Environmental Impact Assessment)

BIRDS	
<u>Common Name</u>	<u>Scientific Name</u>
Greyheaded fishing eagle	<i>Ichuophaga nana</i>
Crested serpent eagle	<i>pilernia cleala</i>
Bearded vulture	<i>Gypactus barbatus</i>
Forest eagle owl	<i>Bubo nipalensis</i>
Collared pigmy owl	<i>Tus bakkameena</i>
Collared scope owl	<i>Lauacidium brodei</i>
Tragopan	<i>Tragopan blythii</i>
Kaleej Pheasants	<i>Lophura leucemelona</i>
Common hill partridge	<i>Arboraphila forqueola</i>
Common pheasants	<i>Entropus simensia</i>
Red Jungle fowl	<i>Gallus gallus</i>
Peacock pheasants	<i>Polyplectron bicalcaratum</i>
Pintailed green pigeons	<i>Treron apicauda</i>
Rutous turtle dove	<i>Streptopolia orientalia</i>
Marmbacked imperial pigeon	<i>Ducula badia</i>
Emerald dove	<i>Chalcophapa indica</i>
Himalayan Jungle nightjar	<i>Caprimulgus indicus</i>
Indian roller	<i>Coracias bengalensis</i>
Chestnut threaded bee-eater	<i>Morapa leschanaulti</i>
Bluethreated barbet	<i>Megalaima lineata</i>
Great barbet	<i>Megalaima virens</i>
Great pied hornbill	<i>Buceros bicornis</i>
Rufousnecked hornbill	<i>Aceros nipalensis</i>
Goldenbacked throated woodpecker	<i>Dimopium shortii</i>
Darjeeling pied woodpecker	<i>Picoides darjellensis</i>
Redaered by woodpecker	<i>Lythipicus pyrrhotis</i>
Bluenapped pitta	<i>Pitta nepalensis</i>
Mrs. Gould's sunbird	<i>Aethopyga gapldinale</i>
Nepal Yellow backed sunbird	<i>Aethopyga nipalensis</i>
Black breasted sunbird	<i>Aethopyga saturata</i>
Firetailed yellow backed sunbird	<i>Aethopyga ignicauda</i>
Longtailed broadbill	<i>Serilophus lunatus</i>
Red drumped swallow	<i>Hirundedaurice</i>
Tyflers swallow	<i>Hirunderustice tyleri</i>
Balcknapped ariole	<i>Oriolus chinesis</i>
Himalayan tree pie	<i>Dendrocitta formosee</i>
Bronzed drongo	<i>Dicrurus aeneus</i>
Large brown thrush	<i>Zoothera menticola</i>
Lesser racket-tailed drongo	<i>Dicrurus renifer</i>
Large racket tailed drongo	<i>Dicrurus paradiseau</i>
Black drongo	<i>Dicrurus adaimilis</i>
Grey drongo	<i>Dicrurus leucephaecus</i>
Clouded Leopard	<i>Niofolis nibulosa</i>

Source: Annual Administrative Report 2014-15 (Department of Forests, Ecology, Environment & Wildlife, Nagaland, Kohima)
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Source: Source: Annual Administrative Report 2014-15 (Department of Forests, Ecology, Environment & Wildlife, Nagaland, Kohima)

Mammals

At least 106 species of mammals are likely to occur in Nagaland, these includes nine insectivores, 34 bats, seven primates, one pangolin, 34 carnivores, one elephant, seven ungulates, one hare and at least 12 rodents. Nagaland is rich in primate-diversity with the Slow loris (*Nycticebus coucang*), Pigtailed macaque (*Macaca nemestrin*), Rhesus macaque (*M. mulatto*), Assamese macaque (*M. assamensis*), Stumptailed macaque (*M. arctoides*), Capped langur (*Presbytis pileatus*) and the Hoolock gibbon (*Hylobates hoolock*). Five species of lesser cats are found of which three, i.e., Marbled cat (*Felis marmorata*), Golden cat (*F. temmincki*) and the Fishing cat (*F. viverrina*) are extremely rare. Among the big cats, the Tiger (*Panthera tigris*) has not only become extremely rare, its survival is in grave danger due to unreported poaching for its bone and loss of prey-base.

Other big cats found in Nagaland are the Leopard (*P. pardus*) and the Clouded leopard (*Neofelis nebulosa*). The Elephant (*Elephas maximus*) occurs in small numbers in the foot hills forest bordering Assam. Poaching for meat and ivory as well as habitat loss are the major factors for decline of the species. Although the Sumatran rhino (*Dicerorhinus sumatrensis*) is officially extinct in India, straying of a few individuals to eastern Nagaland from Tamanthi Wildlife Reserve of Myanmar cannot be ruled out. There were unconfirmed reports of occurrence of the Pigmy hog (*Sus*

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Salvanus) from Nagaland. One animal dealer had even claimed to have obtained a few of this rare animal from some Nagas of Mon district in the eighties (Mohd. Moosa, pers.comm.). The Gaur or Indian 'bison' (*Bos gaurus*) has become extremely rare in recent years mainly due to poaching. Small populations are found in Intanki Sanctuary and near Assam-Nagaland border in Mon with some possible animals on the Indo-Myanmarese border. The Serow (*Capricornis sumatraensis*) and the Goral (*Nemorhaedus goral*) are also found but in depleted numbers.

Among other species of mammals, some notable are the Northern tree shrew (*Tupaia belangeri*), Dhole or Wild dog (*Cuon alpinus*), Sun bear (*Helarctos malayanus*), Binturong (*Arctictis binturong*), and the Malayan giant squirrel (*Ratufa bicolor*).

Table 4-16: Mammals in the Project Area

FAUNA		
a. MAMMALS		
Common Name		Scientific Name
1. Asian Elephant		<i>Elephas maximus</i>
2. Gaur (Indian Bison)		<i>Bos gaurus</i>
3. Jackal		<i>Canis auratus</i>
4. Tiger		<i>Panthera tigris</i>
5. Sambar		<i>Cervus unicolor</i>
6. Leopard		<i>Panthera pardus</i>
7. Barking Deer		<i>Muntiacus muntjak</i>
8. Wild boar		<i>Sus scrofa</i>
9. Sloth Bear		<i>Melursus ursinus</i>
10. Serow		<i>Capricornis sumatraensis</i>
11. Hoolock		<i>Hylodactylus hoolock</i>
12. Common Langur		<i>Presbytis antillus</i>
13. Macaque		<i>Macaca spp.</i>
14. Leopard Cat		<i>Felis bengalensis</i>
15. Himalayan Squirrel		<i>Callosciurus pygerythrus</i>
16. Pangolin		<i>Manis crassicaudata</i>
17. Civet		<i>Viverra Spp.</i>
18. Wolf		<i>Canis auratus</i>
19. Fruit bat		<i>Cynopterus sphinx</i>
20. Porcupine		<i>Hystrix indica</i>
21. Hispid hare		<i>Capreolus hispidus</i>
22. Slow Loris		<i>Nycticebus caucaseang</i>
23. Otter		<i>Lutra lutra</i>
24. Wild Dog		<i>Cuon alpinus</i>
25. Orange billed Himalayan Squirrel		<i>Citrus unicolor</i>
26. Mongoose		<i>Herpestes spp.</i>
27. Musk Deer		<i>Moschus moschiferus</i>
28. Binturong		<i>Arctictis binturong</i>
29. Jungle cat		<i>Felis chaus</i>
30. Mole rat		<i>Bandicota bengalensis</i>
31. Indian hare		<i>Lepus nigricollis</i>
32. Martin		<i>Martia spp.</i>
33. House Mouse		<i>Mus musculus</i>
34. Field Mouse		<i>Mus booduga</i>
35. Goral		<i>Nemorhaedus goral</i>
36. Clouded Leopard		<i>Niufelis nebulosa</i>
37. Palm Civet		<i>Paguma larvata</i>
38. Wood cat		<i>Rattus blanfordi</i>
39. House cat		<i>Rattus rattus</i>
40. Fulvous fruit bat		<i>Troxenetus lechinitas</i>
41. Indian fox		<i>Vulpes bengalensis</i>

Source: Annual Administrative Report 2014-15 (Department of Forests, Ecology, Environment & Wildlife, Nagaland, Kohima)

Accidental Kill Due to Road Accident

There is a possibility to road kills during operation phase because normal speed is proposed 40 kmph. Hence special mitigation measure should be taken to avoid road kills.

4.7 SOCIAL ENVIRONMENT

4.7.1 Settlement

There are a total of 11 settlements varying in size and populations along the Project Highway. The settlements are given

(Environmental Impact Assessment)

in the following table.

Table 4-17: Major Settlements along Project Road

Town/Village	Existing Location (km)
Kohima	From km 3.000 to km 8.500
Chikabama	30.600
RD Block, Kiruma	49.000
Kikumar	53.500
Pfutsero	66.000
Misulumi	79.800
Enhulum	85.500
Chizami	87.600
Losami	105.500
Laniye	119.400
Jessami	From km 131.000 to km 132.000

Source: Road Inventory Survey;

4.7.2 Structure Details along the project road

Total 421 no. of structures are going to be affected. Out of 421 only one religious structure observed which is directly affecting due to widening of road. The summary of observed structures along the Project Highway are given in Table below

Table 4-18: Structure details along Project Road

SI No.	Type Religious Structures	Total No. of Structure
1	Rural Temporary Structures (RTS)	262
2	Commercial	44
3	Residential	112
4	Religious	1
5	BSF camp	2
	Total	421

Source: Road Inventory Survey

4.7.3 Educational Institutes

There are 19 Schools located along the project road. All structures are outside of proposed Corridor of Impact. Hence no physical impact has been envisaged.

4.7.4 Medical & Others Facilities

There are health facilities found along the project road. All structures are outside of proposed Corridor of Impact. Hence no physical impact has been envisaged.

4.7.5 Biodiversity Park/Bird watching Point

No wildlife sanctuary found within 5km radius of the project site.

4.7.6 Census Profile

The project highway passes through Kohima & Phek District of Nagaland State and Ukhrul District of Manipur.. As per the 2011 census, Nagaland has a total population of 1,978,502 and the total male and female population of the state is 1,024,649 and 953,853 respectively. The population density per sq km is 119. The total number of literates of the state is 1,342,434 while the sex ratio is 931.

Whereas, in Manipur the total population is 2,855,794 and the total male and female population of the state is 1,438,586 and 1,417,208 respectively. The population density per sq km is 128. The total number of literates of the state is 1,908,476 while the sex ratio is 985.

The demographic profile of Project District and Project State is presented in table below.

Table 4-19: Census Details

State / District	Total Population			Sex Ratio	Population density (Km2)	No of Literate Population		
	Persons	Males	Females			Persons	Males	Females

(Environmental Impact Assessment)

State / District	Total Population			Sex Ratio	Population density (Km2)	No of Literate Population		
	Persons	Males	Females			Persons	Males	Females
Kohima	267,988	138,966	129,022	928	183	197,489	107,038	90,451
Phek	163,418	83,743	79,675	951	81	105,893	57,926	47,967
Nagaland	1,978,502	1,024,649	953,853	931	119	1,342,434	723,957	618,477
Ukhrul	183,998	94,718	89,280	943	40	129,829	70,148	59,681
Manipur	2,855,794	1,438,586	1,417,208	985	128	1,908,476	1,039,858	868,618

Source: Census of India 2011

4.7.7 Primary Census Profile

A primary census survey was carried out to identify and collect the details of the families and persons affected by the project. The details of all families who are losing their properties either part or full have been captured. The details of the primary census shall be presented in SIA & RAP Report.

4.7.8 Places of Historical Importance / Cultural Heritage

There are no Historical Importance / Cultural Heritage structures on the project road.

(Environmental Impact Assessment)

5 PUBLIC INTERACTIONS & CONSULTATIONS

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

This chapter documents the issues that are close to the community, their aspirations and their addressal by the project. The objectives of consultation sessions, the procedure adopted and the outputs of the consultation conducted have been described in the following sections.

5.1 OBJECTIVES

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

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

5.2 TYPES OF STAKEHOLDER

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

Primary Stakeholders are local people including project affected people, local residents, shopkeepers, farmers, etc.; and

Institutional Stakeholders such as concerned Govt. departments etc

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

5.3 CONSULTATION SESSIONS

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

5.3.1 Consultations with Institutional Stakeholders

The institutional level consultations were held with representatives of institutions having stakes in implementation of the project. The institutions contacted included State Forest Department, State Wildlife Department etc. Several meetings were held with PWD Officials and their inputs have been incorporated in the Reports. Details of Consultations with Institutional Stakeholders are given in below table and Figure.

5.3.2 Consultations with Community

The extent or the likely level of adverse impacts was one of the major criteria in deciding locations for public consultation sessions. A listing of the various consultation sessions conducted at different locations along the project roads is presented in table below

Table 5-1: Consultations with Community / Primary Stakeholders

(Environmental Impact Assessment)



Name of Settlements	Chainage	Issues Discussed
Kohima	From km 3.000 to km 8.500	<ul style="list-style-type: none"> • Project proposal details • Quality of the surrounding environment • Presence of places with archaeological / historical importance • Previous history of natural calamity • Local flora and fauna • Safety & occurrence of accidents • Sources of drinking water • Previous records of Epidemic/severe disease • Environmental degradation • Loss of livelihood due to proposed project • Suggestions to make the project much beneficial
Chikabama	30.600	
RD Block, Kiruma	49.000	
Kikumar	53.500	
Pfutsero	66.000	
Misulumi	79.800	
Enhulum	85.500	
Chizami	87.600	
Losami	105.500	
Laniye	119.400	
Jessami	From km 131.000 to km 132.000	

Source: Consultation conducted by Social/Env Team


Outcome of the consultation with institutional stakeholders

The suggestion / observation of the public are recorded and summarized in below table. Proposed project activities and further impact on social and environment aspects were discussed during consultation. Probable Management plan to avoid or minimize the negative impacts were also discussed during consultation. The Attendance Sheet of Attendees has been attached as Annexure-5.1.

Table 5-2: Outcome of the Consultations with Community / Primary Stakeholders

Outcome of the Discussion	
Settlement- Kohima District	
	<ul style="list-style-type: none"> • Welcomed the proposed development. • Surrounding environment is quite satisfactory in the hilly resion • Land slide is the main issue during construction phase. • No such places with archaeological / historical importance. • No previous record of natural calamity. As per their knowledge no cases of STD recorded in last 10 yrs • The occurance of some wild animals are reported in the project area. • Hair pin bend of Project Road along the project road is the accident prone zone of the area.
Settlement- Phek District	
	<ul style="list-style-type: none"> • Welcomed the proposed development. • Surrounding environment is quite satisfactory in the hilly resion • Land slide is the main issue during construction phase. • No such places with archaeological / historical importance. • No previous record of natural calamity. As per their knowledge no cases of STD recorded in last 10 yrs • The occurance of some wild animals are reported in the project area. • Hair pin bend of Project Road along the project road is the accident prone zone of the area.
Settlement- Ukhurul District	

(Environmental Impact Assessment)

Outcome of the Discussion	
	<ul style="list-style-type: none"> • Welcomed the proposed development. • Surrounding environment is quite satisfactory in the hilly region • Land slide is the main issue during construction phase. • No such places with archaeological / historical importance. • No previous record of natural calamity. As per their knowledge no cases of STD recorded in last 10 yrs • The occurrence of some wild animals are reported in the project area. • Hair pin bend of Project Road along the project road is the accident prone zone of the area.

Source: Consultation conducted by Social/Env Team

5.4 KEY FINDINGS OF THE CONSULTATION

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

- It was observed that people are not only aware of the project but also welcomed the project in general.
- The project road lies in land slide region. People request more focus on land slide point.
- Air & Noise pollution is not a big concern in the project area. However dust pollution in dry season and noise due to traffic movement sometime disturbs immediate roadside dwellers.
- Information about presence of some wild animals along the project road is observed.
- The potential PAPs in general were very much concerned about the mode of compensation.
- People suggested that adequate safety measures should be provided. In brief, it was felt during consultation that regular meeting with the local population / community could easily resolve any dispute between the community people and implementing agency settlements.
- The inhabitants requested to plant trees in the same locality where the trees will be felled.
- RAP should address the social issues brought to the fore during the public consultations.
- EMP has been designed to address environmental related issues

(Environmental Impact Assessment)

6 ANALYSIS OF ALTERNATIVES

The chapter tries to compare feasible alternative to the proposed project with respect to site, technology, design etc. The alternatives examined take into account all possible and feasible options and includes both with and without project scenarios in terms of the potential environmental impacts for the justification of the project. The chapter discusses how environmental parameters were assigned due importance and were carefully considered in the analysis of alternatives.

6.1 WITH AND WITHOUT PROJECT ALTERNATIVES

6.1.1 Without Project Scenario

The existing project road section is mostly single lane highway with varying pavement width. With present and projected high traffic volumes, the capacity of the present highway is insufficient for handling the high volume of traffic and calls in for improvements to a 2 lane carriageway with earthen shoulder. This is further compounded by the various land use conflicts, in terms of uncontrolled development along the highway. The population growth, increase in traffic volumes and the economic development along the corridor would continue to occur and will worsen the already critical situation. The existing unsafe conditions and the adverse environmental consequences in terms of the environmental quality along the highway would continue to worsen in the absence of the proposed improvements. Moreover, if it is decided not to proceed with the project, then the attendant reduced socio-economic development of this remote, relatively poorly connected area cannot be justified. Therefore, the no-action alternative is neither a reasonable nor a prudent course of action for the proposed project, as it would amount to failure to initiate any further improvements and impede economic development.

6.1.2 With Project Scenario

The 'with project scenario' is found to have a positive impact in the long run on social, environmental, economic and financial issues. This scenario includes the widening to 2 lanes with paved/granular shoulder of the existing single/two lanes stretch as envisaged in the project objectives. The scenario is economically viable and will improve the existing conditions. It, would thereby, contribute to the development goals envisaged by the Governments of Nagaland and India, and enhance the growth potential of the area.

To avoid the acquisition of land and properties, the project envisages the development within the existing ROW as much as possible. However need for land acquisition has been envisaged widening the RoW at some places. There is no Bypass, Realignment proposed along the project road.

In spite of the various development benefits likely to accrue due to the project, as is the case of every road development project, the project would be accompanied by certain impacts on the natural, social and environmental components. The potential impacts on the various environmental components can be avoided through good environmental practices. Wherever avoidance of negative impact has not been possible, appropriate mitigation and enhancement actions will be worked out to effectively offset the environmental damages inflicted due to the project. A detailed Resettlement and Rehabilitation (R&R) Action Plan has been worked out to improve the well-being and livelihood of the people to be impacted. Comparative assessments of the "with and without" project scenarios are presented in the following Table given below.

Table 6-1: "With and Without" Project Scenarios - A Comparative Assessment

Component	"With" Project Scenario	"Without" Project Scenario
Highway Geometrics	2/4-lane carriageway with paved/granular shoulder with geometric improvements	Existing intermediate/two lane carriageway with poor geometrics
Design Speed	40 Kmph 20kmph in hair pin bend.	30 Kmph in rural Sections, 20 Kmph in Urban Sections
Congestion in Settlements	Free flow of traffic due to widened carriageway.	Congestion In urban areas
Felling of road side trees	Felling of both old and young trees. Old and weak trees near the road edge shall be a road hazard and shall be felled. Double the number of new young and healthy trees to be planted in compensation.	No felling of trees. The old trees may become a safety hazard to the road users with passage of time.
Pedestrian safety	Along the settlement stretches with significant pedestrian traffic pedestrian (zebra) crossings and footpath has been provided in urban sections.	Pedestrian safety an issue of major concern especially along the settlements and congested sections.
Road Safety Measures	Provision of proper road markings, zebra crossings and improvement of geometry to reduce accidents.	Accident incidents shall rise with an increased traffic volume.
Environmental	Provision of lined drain in urban settlements	Poor due to congestion and high emission

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Component	"With" Project Scenario	'Without" Project Scenario
Quality	improves environmental and quality. Besides an aggressive tree plantation and provision of enhancement features shall not only provide aesthetics but also improve the quality of air	levels because of slow movement of traffic. A further deterioration is expected due to Increase in traffic volumes and further congestion.
Drainage	Will be improved due further widening of culverts / bridges with adequate hydraulics.	These issues remain unaddressed without the project
Road Side Amenities	Appropriate road side amenities to be provided at various locations along the corridor.	Not adequate.
Development	Higher potential for development due to improvement in access and consequent increase in connectivity	Development activities will be greatly hampered by the gross inadequacy of infrastructure.

6.2 JUSTIFICATION FOR SELECTION

The major difficulties with following an entirely new alignment is the magnitude of land acquisition and social disruption likely, lack of funds, and lack of viability for private financing. Therefore, as an alternative, the project proponent has adopted the policy of widening of single/two-lane highways to 2 lanes with paved/granular shoulder on existing alignments, with selective provision of bypasses and realignments.

The project, therefore, involves mostly concentric widening of the existing alignment to fully utilise the available ROW. The project road shall be flexible pavement throughout the stretch.

6.3 ALIGNMENT MODIFICATIONS

Most of the stretch of the project road is in the hilly terrain with very poor to poor geometry. The selection of the alignment along various sections has been worked out based on continuous interaction between the highway and environmental teams. However, existing alignment has been followed almost throughout the stretch except few curve improvement.

6.3.1 Curve Improvement Locations

Various locations have been identified along the project corridor, where the poor geometrics warrant a deviation from the existing alignment. Most of these locations are situated in curves both horizontal and vertical. Deviation from the existing alignment was followed at the following locations.

Care though has been taken to minimise the impact on sensitive, cultural and community features like water bodies, schools, hospitals etc.

6.3.2 Bypasses & Realignments

No bypasses and realignments proposed along the project road.

6.4 WIDENING / SERVICE ROAD OPTIONS

Widening Option

Concentric widening has been proposed almost throughout the project road.

Service Road

No Service road has been provided in the project stretch.

6.5 ROBs/ Underpasses/ Overpasses / Flyovers

No ROBs, Underpasses, Overpasses, Flyovers proposed along the project road.

6.6 COLD MIX & HOT MIX TECHNOLOGY ANALYSIS

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

Table 6-2: Analysis of Cold & Hot Mix Technology

Sl. No.	Parameter	Cold Mix	Hot Mix
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Sl. No.	Parameter	Cold Mix	Hot Mix
1	Description	<ul style="list-style-type: none"> Street Cold Asphalt is a relatively new product developed in 1995 through the introduction of new polymer technology and research into the manipulation of viscosity and material design, of the various components of an asphalt mix - Street Cold Asphalt is soft and sticky out of the bag, but it quickly hardens after application and the end result is a pavement patch with better strength but similar properties to hot asphalt. 	<ul style="list-style-type: none"> Hot mix asphalt is used primarily as paving material and consists of a mixture of aggregate and liquid asphalt cement, which are heated and mixed in measured quantities. Hot mix asphalt facilities can be broadly classified as either drum mix plants or batch mix plants, according to the process by which the raw materials are mixed. In a batch mix plant, the aggregate is dried first, then transferred to a mixer where it is mixed with the liquid asphalt. In a drum mix plant, a rotary dryer serves to dry the aggregate and mix it with the liquid asphalt cement.
2	Requirements	<ul style="list-style-type: none"> Cold patch, also known as cold mix or cold asphalt, was first recognized as a way to make road repairs quickly because it can be applied right from the container without heating. Cold asphalt also doesn't require any special heavy rolling machines or special applicators as it can be shovelled or poured into a pothole or utility cut and tamped down with a hand tool. 	<ul style="list-style-type: none"> Hot mix asphalt concrete (commonly abbreviated as HMAC or HMA) is produced by heating the asphalt binder to decrease its viscosity, and drying the aggregate to remove moisture from it prior to mixing. Mixing is generally performed with the aggregate at about 300 °F (roughly 150 °C) for virgin asphalt and 330 °F (166 °C) for polymer modified asphalt, and the asphalt cement at 302 °F (150 °C). Paving and compaction must be performed while the asphalt is sufficiently hot
3	Use	<ul style="list-style-type: none"> Cold mix asphalt concrete is produced by emulsifying the asphalt in water with (essentially) soap prior to mixing with the aggregate. While in its emulsified state the asphalt is less viscous and the mixture is easy to work and compact The emulsion will break after enough water evaporates and the cold mix will, ideally, take on the properties of cold HMAC Cold mix is commonly used as a patching material and on lesser trafficked service roads 	<ul style="list-style-type: none"> HMAC is the form of asphalt concrete most commonly used on high traffic pavements such as those on major highways, racetracks and airfields Asphalt concrete has different performance characteristics in terms of surface durability, tire wear, braking efficiency and roadway noise.
4	Merits	<ul style="list-style-type: none"> Actually less expensive to use over the life of a road repair Completely seals and patches potholes, utility cuts, edge repairs, and even overlays. 	<ul style="list-style-type: none"> Less expensive for new road construction
5	Demerits	<ul style="list-style-type: none"> Less resilient and more vulnerable to cracking 	<ul style="list-style-type: none"> Expensive

Benefits over Cold Mix and Hot-mix Asphalt Concrete

- Durability and strength equivalent to using hot mix
- Permanent repair compared to traditional cold-mix which is only a temporary fix
- No Priming required
- Works even when water is present
- Works at low ambient temperatures (hot-mix cannot be used in cold weather as the asphalt will cool too much prior to compacting)
- Instantly ready for traffic – and in fact product cures and hardens more quickly with compaction forces. Rapid

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access over the surface reduces down time where there are time-critical schedules

- Limited mess than other brands – product will not stick to or stain hands or shoes even when bucket is freshly opened
- No bleeding
- No drift of bitumen to the surface requiring surface preparation prior to any further overlay
- Reduced labour time and therefore cost
- No requirement for special equipment
- Environmentally beneficial as its noxious fumes are reduced & wastage avoided

Cold Mix technology is more suitable for repair of potholes and cracks on roads, bridges, overlays, parking lots and other asphalt and concrete surfaces. Cold Mix is fast, permanent, easy to use and environmentally preferable cold asphalt product. However for constructing of new roads hot mix technology is better suited. Contractor shall utilise the same where ever suitable.

6.7 ENVIRONMENTAL CONSIDERATIONS

The various avoidance measures for minimising the extent of environmental impacts and avoiding of sensitive environmental features have been worked out. The table below provides the measures that have been adopted for offsetting the impacts. A description of the measures has been presented in the following sections.

Table 6-3: Minimization of Environmental Impacts

Criteria	Means
Maintenance of Design Speed for through traffic	Improved geometrics
Improvement of Road Safety	Intersection Improvements; Geometric improvements at curves Provide breast wall and Retention wall through out the road in the hilly region. Sign board for speed limit and hair pin bend.
Adequate drainage	Provision of drains
Reduction of Air and Noise Pollution	Intersection improvements; aggressive tree plantations; good EMP
Displacement of Local Population	Limiting of development within available ROW, SIA & RAP
Minimisation of Direct Impact on Sensitive Receptors, cultural and religious properties	Public consultations, Good EMP measures
Minimisation of Property acquisition	Concentric widening, SIA & RAP
Avoidance of contamination due to Siltation / spillage	Oil Interceptor
Displacement of Commercial Properties	Concentric widening, SIA & RAP
Minimisation of Loss of Utility Lines	Centre line alterations
Minimisation of Tree Loss	Maximum effort shall be given to avoid avoidable tree felling
Stabilisation of Slope	Turfing / Pitching
Accidental Road Kill of Fauna	Proper Signage, Speed Control

6.7.1 Improvement of air and noise quality

- By improving intersections;
- By removing traffic bottlenecks;
- Provision of Noise barrier
- By maintaining a steady stream flow of traffic and by segregating slow and fast modes (also by segregation of through traffic by reducing median in small urban areas to accommodate service roads)

6.7.2 Avoidance of Impact of Sensitive, Cultural and Community Properties

- By lateral shifting of the alignment;
- By providing zebra crossing for smooth and safe travel of local populace
- Providing noise attenuation measures mainly along schools and hospitals
- Avoiding direct impact on sensitive receptors

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7 IMPACT ASSESSMENT & MITIGATION

This chapter assesses the nature, type and magnitude of the potential impacts likely on the various relevant physical, biological and cultural environmental components along the project corridor. For the assessment of impacts, the baseline information based on the field visits and the primary surveys of the various environmental components carried out. The description of the impacts on the individual components has been structured as per the discussion in Chapter 4: Baseline Environmental profile of this report. The impacts on the various environmental components were assessed considering following stages of the project planning and implementation:

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

The negative impacts of road projects can be reduced or minimised only if proper safeguards are put in place during the design and construction stage itself. These can include reducing pollutant discharge from the harmful activities at source or protecting the sensitive receptor. An effective mitigation strategy will utilise a combination of both options to arrive at practically implementable measures. Conscious efforts have been worked out to minimise any adverse impacts on the various environmental and social components. Where the impacts on various environmental components have been unavoidable, mitigation designs have been worked out.

The description and magnitude of impacts for the various environmental components as visualised for the project are presented in the following sections along with proposed mitigation.

7.1 PHYSICAL ENVIRONMENT

7.1.1 Meteorological Parameters

☉ Impact

The Project Highway is located in a subtropical region with marked monsoon effects. Though no change in the macro-climatic setting (precipitation, temperature and wind) is envisaged due to the project, the microclimate is likely to be temporarily modified by vegetation removal and the addition of increased pavement surface. There will be an increase in daytime temperature on the road surface and soil due to loss of shade and big trees, which in turn might lead to formation of heat islands especially along the inhabited sections. In addition, at green tunnel locations, the removal of trees will increase the amount of direct sunlight resulting in higher temperatures along the highway.

This increase in the daytime temperature assumes significance especially to the slow moving traffic, the pedestrians and the first row of residences / receptors along the corridor, as the entire project stretch experiences high temperatures during summers. Although the impact shall be significant and long term in nature, it is reversible in nature and shall be compensated for by additional plantation of trees. It must be noted that the impact is unavoidable.

☉ Mitigation

Although the impact shall be significant and long term in nature, it is reversible in nature and shall be compensated for by additional plantation of trees. It must be noted that the impact is unavoidable. However, it may be pointed out that the project has taken care to minimise tree felling as no tree felling shall be done beyond corridor of impact.

7.1.2 Land

Land Acquisition, soil erosion and contamination of soil have emerged as major sources of land impact especially in urban areas and nearby watercourses. Due to the proposed road improvements aimed at enhancing the efficiency of road transport system, which will result in economic growth in the region over time.

Table 7-1: Summary of Impacts and Mitigation on Land

Sl. No	Particular	Impact	Reason	Mitigation / Enhancement
1.	Change in Geology	Direct, long term, negative Impact	Extraction of materials (borrow earth, coarse and fine aggregates)	<ul style="list-style-type: none"> • No blasting is envisaged. • Quarry Development Plan need to be enforced.
2.	Change in Seismology	No Negative Impact		<ul style="list-style-type: none"> • Cross drainage structures are checked and complied with the seismological settings of the region (Zone)
3.	Loss of land	Direct, long-term negative impact	Land Acquisition, Change in land use pattern	<ul style="list-style-type: none"> • Land acquisition minimised. LA only at locations which require geometric correction • Design restricted to within 30m of ROW

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Sl. No	Particular	Impact	Reason	Mitigation / Enhancement
4.	Generation of Debris	Negative Impact	May contaminate air, water and land, if not disposed properly	<ul style="list-style-type: none"> • Disposed properly to avoid contamination.
5.	Soil Erosion	Moderate, direct, long-term negative impact	Road slopes and spoils	<ul style="list-style-type: none"> • Embankment protection through: • Stone pitching • Turfing
6.			Construction of new bridges and culverts Quarry and Borrow areas	<ul style="list-style-type: none"> • Residual spoil need to be disposed properly • Silt Fencing need to be provided • Quarries need to be reclaimed
7.	Contamination of Soil	Direct, long term negative impact	<ul style="list-style-type: none"> • Scarified bitumen wastes • Oil and diesel spills • Emulsion sprayer and laying of hot mix • Production of hot mix and rejected materials • Residential facilities for the labour and officers • Routine and periodical maintenance 	<ul style="list-style-type: none"> • Hazardous Wastes (Management and Handling) Rules, 1989 to be enforced. • Oil Interceptor will be provided for accidental spill of oil and diesel • Rejected material will be laid as directed by engineer. • Septic tank will be constructed for waste disposal.
8.	Soil quality monitoring		Effectiveness / shortfall (if any) Any unforeseen impact	<ul style="list-style-type: none"> • Measures will be revised & improved to mitigate / enhance environment due to any unforeseen impact.

7.2.1.1 Soil Quality Monitoring

The quality of the soil shall be monitored to find out the effectiveness of the mitigation measures and further improvement in designs if required. The monitoring plan shall be functional in construction as well as in operation stages. The frequency, duration and responsibility will be as per the Annexure 9-1: Environmental Monitoring Plan.

7.2.1.2 Physiography and Loss of Top soil

⊙ Impact

Road construction activities involve alterations in the local physiography and drainage patterns. The impacts on physiography may include destabilisation of slopes due to cut and fill operations. Cut-and-fills will be designed for improvement to the road geometry, and parallel cross drainage structures will be added to improve drainage. There would be no grading of the roadside area and the work would consist of raising the pavement embankments. In some stretches, some amount of cuts and fills would be necessary to accommodate the new pavement. There may be an impact on the topography as a result of accelerated erosion on the cut-profiles. No impacts envisaged during the operation stage.

⊙ Mitigation

Efforts have been made to minimise the intake of productive lands. As the existing ROW is not sufficient at various locations to accommodate the proposed cross sections and the need for the provision of several bypasses along the corridor, the project calls in for a land acquisition of agricultural, barren, agricultural and private land. To conserve the productive top soil the following measures have been proposed:

- The topsoil from all areas of cutting and all areas to be permanently covered shall be stripped to a specified depth of 150mm and stored in stockpiles. At least 10% the temporarily acquired area shall be earmarked for storing top soil.
- The stockpile shall be designed such that the slope does not exceed 1:2 (vertical to horizontal), and the height of the pile be restricted to 2m. To retain soil and to allow percolation of water, silt fencing shall protect the edges of the pile.
- The stockpiles shall be covered with gunny bags or tarpaulin.
- Such stockpiled topsoil will be returned to cover the disturbed area and cut slopes. Residual topsoil will be distributed on a areas as identified by Contractor and approved by the Authority Engineer in a layer of thickness of 75mm - 150mm. Top soil shall also be utilised for redevelopment of borrow areas, landscaping along slopes, medians, incidental spaces etc,

During construction, some land will be temporarily needed to create detours, store equipment and material, site construction workers' camp and other amenities. The top 150 mm of soil from these areas will be stripped off and stored in heaps of less than 2 m height. The slope of the pile will be maintained to lesser than 1:4 to reduce removal of sediment with runoff and to enhance percolation through stored soil. The stored soil will be used for:

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- Covering all disturbed areas including for the rehabilitation of borrow areas
- Top dressing of the road embankments and fill slopes
- Distribution over barren / unproductive areas, for a depth of 75-100mm, to make these lands productive

7.2.1.3 Geology and Seismology

☉ Impact

The entire stretch of the project highway traverses through seismic zone IV as defined by the Indian Standard (IS) 1893-1994 seismic zoning classification system, i.e., a zone of stability. The project does not have any impact on the geological or seismic stability of the area.

☉ Mitigation

As part of the project all the existing structures will be checked and constructed as per the seismological requirements of the region in conformity to the IS 1893(Part 1):2002.

7.2.1.4 Quarries

☉ Impact

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

Dust, in addition to being a health concern also reduces visibility thereby increasing safety concerns. As no new quarry needs to be opened for this project (majority of the material shall be from cut operations, reuse of old materials and existing quarries), therefore, no new impacts are likely to arise due to quarrying operations. It will be ensured that quarry contractor is following environment management system to take care of the working conditions of workers in the existing quarry areas selected for the project. No impacts envisaged during the operation stage.

☉ Mitigation

Existing approved quarries which are already in operation with the required environmental clearances are recommended for this project, and no new quarries have been proposed. It needs however, to be noted that recommendation on use of quarries is a guideline only and has been done to establish the feasibility of construction. Though the quarry materials are to be transported over long distances to the construction sites, almost all the quarries identified have proper access roads, therefore, no major impacts during the hauling of materials is envisaged. The issue of dust generation etc. along the haul roads needs to be addressed through proper enforcement of dust suppression measures.

As an alternative to borrowing of sand from river bed the possibility of using stone crusher dust shall be explored. Stone dust from crusher can be used for the construction works provided the quantity and the quality produced is certified by Monitoring consultant to be satisfactory for all construction works, else river sand shall be used from the identified quarry. None of the sand quarry sites would require any additional preventive environmental measures. However, the long leads mean that care would have to be taken to prevent spillage of material and damage to the haul roads during transportation. No additional adverse environmental impact except those resulting from spillage during transportation is expected to occur. Hence proper care for transportation should be taken into account.

Guidelines for Existing Quarry Management & Guidelines for New Quarry Management has been presented in Annexure 7.1 & Annexure 7.2 respectively

7.2.1.5 Borrow Area

☉ Impact

As the borrowing is to be carried out in accordance to the guidelines laid out in IRC-9-1961, no major adverse impacts are anticipated. Also, productive agricultural areas have been avoided for borrowing. However, the borrow area pits, if not treated properly after the borrowing is complete, can form stagnant pools and pose health hazards to prevent which redevelopment of borrow areas need to be worked out. Additionally, they can also act as breeding ground for vectors like mosquitoes just after monsoon. It is expected that the implementation of the mitigation measures for borrow area redevelopment proposed as part of the project will reduce these impacts to acceptable levels.

Cartage of the borrow materials to the construction sites can be of significance, as almost all such areas are accessible through dirt tracks only and therefore, spillage and compaction of soil along these tracks will be a significant impact. Proper protections measures need to be worked out for the minimising of such impacts during the haulage of borrow materials. Rehabilitation of borrow areas from which earth has been excavated can be a major potential problem. In addition to visual blight, the other problems more down-to-earth are the safety issues. At borrow area locations where the owners are willing to create ponds for fisheries etc, proper protection measures for the drainage of the surrounding land and slope protection measures need to be worked out.

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The soils along the corridor are in general capable to produce high yielding agricultural produce and may be negatively impacted if unduly borrowed. The loss of productive topsoil due to road construction is a direct adverse long-term impact. The Contractor should ensure that in all such locations topsoil must be stacked aside and replaced after the borrowing activity is over. The soil heaps should be periodically compacted and sprinkled with water to avoid loss. Emphasis should be laid on maximum use of the stripped topsoil in medians, road junctions, redevelopment of borrow areas and additional landscaping works in the road project. The project shall take enforcement measures to prevent / minimise the use of topsoil from other locations such as borrow areas, stockyards, lands for diversions.

No impacts envisaged during the operation stage.

☉ Mitigation

The soils to be used, as sub-grade, select sub-grade and shoulder materials need to be hauled from designated borrow areas. Similar to the identification of suitable quarries, suitable borrow areas for supply of soil to the new road formation were also identified. Based on the total requirement and availability of each soil type, estimates of soil quantity to be obtained from each of the borrow areas were worked out in accordance with IRC: 9-1961: Recommended Practice for Borrow Pits for Road Embankments constructed by Manual Operation. In the selection of the borrow areas, care was taken to ensure that:

- Sufficient quantity of suitable soil is available from the borrow areas;
- The borrow areas are as close to the project road as possible;
- The loss of productive and fertile agricultural soil is minimum; and
- There is minimum loss of vegetation.

For opening new borrow areas the contractor shall follow Annexure 7.3: Guidelines for Siting, Operation & Redevelopment of Borrow Areas.

The borrowing shall not be carried out in cultivable lands, unless and until, it shall be agreed upon by the Engineer that there is no suitable uncultivable land in the vicinity for borrowing, or there are private land owners willing to allow borrowing on their fields. Borrowing of earth shall be carried out at locations recommended as follows:

- **Non-Cultivable lands:** Borrowing of earth will be carried out to a depth of 1 m. The borrowing of earth shall not be done continuously and the slope of the edges shall be maintained at not more than 1:4.
- **Productive lands:** Borrowing of earth shall not be carried out on productive lands. However, in the event of borrowing from productive lands, the contractor has to obtain the prior permission of the Engineer. At such locations, the depth of borrow pits shall not exceed 45 cm and if may be dug out to a depth of not more than 30 cm after stripping the 15 cm top soil aside and the topsoil shall be carried out and preserved.
- **Borrow Areas near Settlements:** Borrow pit location shall be located at least 0.8 km from villages and settlements. If unavoidable, they should not be dug for more than 30 cm and should be drained.

To avoid any embankment slippages, the borrow areas will not be dug continuously, and the size and shape of borrow pits will be decided by the Engineer. The borrow pits will be redeveloped by filling and providing 150 mm thick layer of preserved top-soil; by creating shallow pond for water harvesting etc. Replantation of trees along the edges of borrow areas will be carried out.

- Precautionary measures as the covering of vehicles will be taken to avoid spillage during transport of borrow materials. To ensure that the spills, which might result from the transport of borrow and quarry materials do not impact the settlements, it will be ensured that the excavation and carrying of earth will be done during day-time only, The unpaved surfaces used for the haulage of borrow materials will be maintained properly.

Use of Fly Ash as Fill Material

There are no Thermal Power Stations within the project area for supply of fly ash for the project corridor. Thus the use of fly ash hasn't been explored for filling up of embankments.

7.2.1.6 Soil Erosion

The removal of roadside vegetation will cause erosion, and increased run-off would in turn lead to erosion of productive soil. The direct impact of erosion is the loss of embankment soil and danger of stability loss for the road itself. This impact is generally restricted to the ROW.

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

No soil erosion is envisaged when the road is in operation as all the slopes and embankments of the project road shall be

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stabilised through sound engineering techniques.

☉ **Mitigation**

The project has taken care of this issue at the engineering design stage itself, as at design gradients of 1:2, the slopes of the embankments are perceived to be stable for all stretches of road. These sections of the road embankment would need stone pitching or any other suitable turfing. Slope protection is normally required only for slopes steeper than this. The side slopes gentler than this will be turfed with shrubs and grasses as per IRC: 56-1974: Recommended Practices for Treatment of Embankment Slopes for Erosion Control.

Though during construction period, drainage alteration and downstream erosion / siltation is anticipated, due to the improved design and added capacity of the cross-drainage structures, there should be an improvement in the drainage characteristics of the surrounding area. Adequate slope protection measures are proposed as part of engineering design. Removal of trees to facilitate construction will cause erosion problems until the proposed compensatory afforestation plantation is established. Silt fencing to be provided to prevent eroded material from entering watercourses. The regular cleaning of the drains by the Contractor will ensure that these structures will not be overloaded or rendered ineffective due to overload.

7.2.1.7 Compaction of Soil

☉ **Impact**

Compaction of soil will occur in the pre-construction stage (particularly during site clearance stage) due to movement of heavy machinery and vehicles. Similarly, compaction will take place during setting up of construction camps and stockyards. During construction, compaction shall occur beyond the carriageway and within the vegetated area of the ROW by the movement of vehicles and heavy machinery. Movement of vehicles during road construction is the major cause of soil compactions. This impact is direct and will be the maximum in the ROW.

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

☉ **Mitigation**

The movement of construction vehicles shall be limited to designated haulage road. So that compaction of nearby productive land may be saved. Provision of reclaiming of nearby land has also been kept to cure the soil compaction in nearby productive lands. However, this is a short duration impact. Appropriate measures should be taken to minimise the area of soil compaction.

It is necessary to ensure that there is no adverse impact of soil compaction in areas other than the ROW, where vegetation can grow and rain infiltration will take place.

7.2.1.8 Contamination of Soil

☉ **Impact**

Contamination of oil in the pre-construction stage may be considered a short-term residual negative impact. Soil contamination may take place due to waste disposal from the labour camp set up during pre-construction stage.

Contamination of soil during construction stage is primarily due to construction and allied activities. The sites where construction vehicles are parked and serviced are likely to be contaminated because of leakage or spillage of fuel and lubricants. Pollution of soil can also occur in hot-mix plants from leakage or spillage of asphalt or bitumen. Refuse and solid waste from labour camps can also contaminate the soil. Unwarranted disposal of construction spoil and debris will add to soil contamination. During the operation stage, soil pollution due to accidental vehicle spills or leaks is also having a low probability. During the operation stage, soil pollution due to accidental vehicle spills or leaks is a low probability as one of the main objective of the project is to reduce accidents, but potentially disastrous to the receiving environment should they occur. These impacts can be long term and irreversible depending upon the extent of spill

☉ **Mitigation**

Following mitigation strategies are proposed to control soil contamination.

- The fuel shall be stored in separately designated area with RCC surface to prevent any soil contamination due to spillage
- Overflow of service and washing areas shall be pass through from oil interceptors
- Septic tank with soak pit facility will be provide in labour camps to prevent any soil contamination due to sewage discharge
- Waste management system will be adopted in construction camps
- Bitumen waste shall be disposed-off at designated landfill site only

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

Table 7-2: Mitigation Measures for Soil Contamination

Potential impact	Mitigation
Scarified Bituminous Wastes	<ul style="list-style-type: none"> No scarification involved. In case Contractor decides to scarify then the material to be reused in the GSB layer. Non reusable Bituminous wastes to be dumped in 30cm thick clay lined pits with the top 30cm layer covered with good earth for supporting vegetation growth over a period only after obtaining permission of Authority Engineer.
Scarified Non Bituminous Material	<ul style="list-style-type: none"> Used in the normal GSB layer (not the drainage layer)
Cut material	<ul style="list-style-type: none"> Reused as embankment, median & shoulder fill materials Excess material to be used for filling up of borrow areas identified by the Contractor and approved by the Authority Engineer
Construction debris generated from dismantling of structures	<ul style="list-style-type: none"> Annexure 7.4 : Guidelines for Identification of Debris Disposal Sites & Precautions needed Annexure 7.5: Guideline for Rehabilitation of Dumpsites, Quarries and Borrow Areas will be applicable
Soil Contamination due to accident spills	<ul style="list-style-type: none"> An emergency response team to be created. The team shall contain members of the district and police administration and also have specialist in remediation. Responsibility of Contractor to inform the team to take actions. The roles and responsibility of the members of the team shall be framed in conjunction with all the parties to address the situation arising out of the accidental spills resulting in situation like water and soil contamination, health hazards in the vicinity of the accident spot, fire and explosions etc.
Soil contamination due to Highway run off	<ul style="list-style-type: none"> Improvements of design shall lead to less accidents and hence less spillage of oil and grease During construction, the Contractor's described previously. Fuel storage will be in proper bunded areas. All spills and collected petroleum products to be disposed off in accordance with MoEF and SPCB guidelines and as per the directions of the Emergency Response team. Fuel storage and fuelling areas will be located at least 300m from all cross drainage structures and significant water bodies.
Operation of residential facilities for labour camps, Vehicle parking areas	<ul style="list-style-type: none"> Vehicle parking area will be made impervious using 75 mm thick P.C.C. bed over 150 mm thick rammed brick bats. The ground will be uniformly sloped towards to adjacent edges towards the road. A drain will take all the spilled material to the oil interceptor (Fig 9-1)

7.2.2 Air

⊙ **Impact**

- Air quality along the project corridor will be impacted both during the construction and operation stages of the project
- Construction stage impacts will be of short term and have adverse impacts on the construction workers as well as the settlements adjacent to the road, especially those in the down wind direction
- Operation stage impacts will not be as severe as the construction stage impacts and will be confined generally to a band of width ranging from 50 to 75m from the edge of the last lane on either side of the corridor
- Both the construction and operation stage impacts can be effectively mitigated if the impacts have been assessed with reasonable accuracy in the design stage

⊙ **Mitigation**

Reduction in congestion due to better highway design being one of the objectives, an improvement in ambient air quality is expected to be one of the outcomes of the proposed improvements. However, these may be offset by the projected increase in traffic. Since the project cannot directly influence the adverse impacts of the operation stage, the efforts are concentrated in reducing air pollution during the construction phase. Several provisions can be incorporated within the contract, through the EMP, to ensure that the deterioration in air quality is limited to the maximum extent possible.

Table 7-3: Summary of Mitigations for Impacts on Air Quality

Sl. No.	Item	Impact	Reason	Mitigation / Enhancement
1.	Meteorological factors and climate	Marginal impact	Due to production and laying of hot bituminous mix	<ul style="list-style-type: none"> Comprehensive afforestation Avenue plantation Shrub plantation in the median / island

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Sl. No.	Item	Impact	Reason	Mitigation / Enhancement
2.	Dust generation	Temporary and location specific	Shifting of utilities, removal of trees & vegetation, transportation of material	<ul style="list-style-type: none"> • Sprinkling of Water • Fine materials to be completely covered, during transport and stocking. • Plant to be installed in down wind direction from nearby settlement.
3.	Gaseous pollutants	Moderate impact	Clearing and grubbing materials dumping brushing of the surface access roads to borrow area hot mix plants, Crushers paving of asphalt layers, Labour Camps	<ul style="list-style-type: none"> • Air pollution Norms will be enforced. • Labourers will be provided mask. • Local people will be educated on safety and precaution on access roads, newly constructed embankment etc.
4.	Air quality emissions	Moderate impact	Air pollutants from traffic	<ul style="list-style-type: none"> • Compliance with future statutory regulatory requirements
5.	Air quality monitoring		Effectiveness shortfall of any unforeseen impact	<ul style="list-style-type: none"> • Measures will be revised & improved to mitigate enhance

7.2.2.1 Air Quality Monitoring

Apart from provision of the mitigation measures, ambient air quality shall be monitored. The monitoring plan shall be functional in construction as well as in operation stages. The frequency, duration and responsibility will be as per the Environmental Monitoring Plan. The air quality shall be monitored at all the locations as given in Table 4.5 beside the plant sites. The maximum desirable limits as per the national ambient air quality standards are given in Annexure 9-1 and the monitored values should correspond with the table. All deviated results shall be reported to engineer, for remedial measures.

7.2.2.2 Generation of Dust

⊙ Impact

Generation of dust is the most likely impact during the pre-construction stage due to:

- Site clearance and use of heavy vehicles and machinery etc.;
- Procurement and transport of raw materials and quarries to construction sites;

As the entire project corridor has a soil type with high silt content and the construction activities to be carried out during the dry season when the moisture content would be less, dust generation, particularly due to earthworks will be significant. This is a direct adverse impact, which will last almost throughout the construction period. Dust is likely to be generated due to the various construction activities including:

- Stone crushing operations in the crushers;
- Handling and storage of aggregates in the asphalt plants;
- Concrete batching plants;
- Asphalt mix plants due to mixing of aggregates with bitumen; and
- Construction and allied activities.

During the Operation stage:

- The negative impacts on air quality during operation stage shall not be significant as that of construction stage. This is due to the reduction of dust particles.
- No dust generation is envisaged during the operation stage as the all road shoulders are proposed to be paved and all slopes and embankments shall be turfed as per best engineering practices.
- The air quality shall also improve due to the plantation activity carried out in the ROW during the end of construction phase.

⊙ Mitigation

The impacts will mostly be concentrated in the ROW. It is likely that impacts due to dust generation are felt downwind of the site rather than on the site itself. All precautions to reduce the level of dust emissions from the hot mix plants, crushers and batching plants and other transportation of materials will be taken up including:

- Vehicles delivering loose and fine materials like sand and fine aggregates shall be covered to reduce spills on existing roads

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- Water will be sprayed on earthworks, temporary haulage and detour roads on a regular basis. During and after compaction of the sub-grade, water will be sprayed at regular intervals to prevent dust generation
- The hot mix plant will be fitted with dust extraction units
- It shall be ensured that the dust emissions from the crusher and vibrating screen at the stone quarries do not exceed the emission standards set by Central Pollution Control Board by covering hoods and incorporation of cyclones
- The Environmental Action Plan prepared by the Contractor should lay emphasis on enforcement of measures such as provision of pollution masks, regular sprinkling of water to suppress dust along haul roads at quarries, crushers and borrow areas to mitigate this impact

7.2.2.3 Generation of Exhaust Gases

⊙ Impact

- Generation of exhaust gases is likely during the pre-construction stage during movement of heavy machinery, oil tankers etc. This impact is envisaged to be insignificant during the pre-construction stage
- High levels of SO₂, NO₂ and HC are likely from hot mix plant operations. Volatile toxic gases are released through the heating process during bitumen production. Although the impact is much localised, it can spread downwind depending on the wind speeds. Construction vehicles shall also be releasing exhaust gases.
- The major impact on air quality during operation stage will be due to plying of vehicles. The impacts on air quality will at any given time depend upon traffic volume / rate of vehicular emission within a given stretch and prevailing meteorological conditions. Air pollution impacts arise from two sources: (i) inadequate vehicle maintenance; and (ii) use of adulterated fuel in vehicles

⊙ Mitigation

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

- All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the SPCB norms. A vehicle maintenance schedule prepared by the contractor and approved by the Engineer shall be adhered to
- Contractors also should be asked to provide regularly Pollution under Control certificate for their equipment and machinery as per prevalent norms
- No bad quality fuel shall be used in construction vehicles and machinery
- The asphalt plants and the batching plants will be sited at least 1 km in the downwind direction from the nearest human settlement
- Also, the contractor should ensure that hot mix plants, stockyards, etc. are away from residential quarters of all workers
- An adequate cyclone / scrubber to control emissions from the stack of hot mix plants will need to be provided in the event of the emissions exceeding the SPCB norms. Other potential measures include plantation around periphery of the hot-mix plants
- To ensure the efficacy of the mitigation measures suggested, air quality monitoring shall be carried out at least once a month during the period the plant is in operation.
- Broad-leaved pollution resistant species, which can grow in high pollutant concentrations or even absorb pollutants, shall be planted as they help settle particulates with their higher surface areas along with thick foliage, which can reduce the distance for which particulates are carried from the road itself.
- *Cassia fistula* (Amaltas), *Ficus religiosa* (Peepal), *Ficus bengalensis* (Banyan), *Tamarindus indica* (Imli) and *Azadirachta indica* (Neem) are recommended.
- Other measures such as the reduction of vehicular emissions, ensuring vehicular maintenance and upkeep, educating drivers about driving behavior. However, these methods are beyond the scope of the project but will be far more effective in reducing the pollutant levels. Project developer together with the Motor vehicles Department and SPCB can arrange for provision for inspection for PUC certificates at all the major junctions
- The Environment Management Action Plan prepared by the Contractor needs to ensure adequate measures are taken especially for health safety of workers such as providing them with pollution masks during working hours

7.2.3 Water Resources

⊙ Impact

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To facilitate the cross-drainage at water crossings, new cross-drainage structures including major, minor bridges and both slab and pipe culverts are proposed. The surface water bodies along the project road might be subject to adverse impacts due to the various construction activities as well as during the operation stage of the project. The impacts on water resources have been summarised in Table 6-2. There are a number of channels & minor nallahs that criss-crosses the project corridor.

Table 7-4: Likely Impacts on Water Resources during the Construction Stage

Impacts due to Construction	Indicators
Loss of water bodies	Area of water bodies affected
Loss of other water supply sources	Hand pumps, wells etc. affected
Alteration of drainage, run off, flooding	No. of cross drainage channels
Depletion of ground water recharge	Groundwater in Area rendered inaccessible & impervious
Use of water supply for construction	Quantum of water used
Contamination from fuel and lubricants	Nature and quantum of contaminants
Contamination from improper sanitation and waste disposal in construction camps	Area of camp / disposal site and proximity to water bodies / channels

- Road widening and improvement are expected to increase surface run off. Proposed widening will cause increased surface runoff along the roadsides.

Mitigation

- Widening of the cross drainage structures is proposed for the project. The cross drainage structures will be widened without compromising on the flow part
- Design made to avoid physical loss to the water bodies.
- Continuous unlined drain in rural sections and covered line drain urban sections has been proposed. Surface runoff shall be drained to the nearest cross drainage structure. The engineering design includes design of cross drainage structures, which should take care of the extra flow.

The table below presents the adverse impacts on the water resources due to the project and the mitigation measures that are proposed.

Table 7-5: Summary of Mitigations for Impacts on Water

Sl. No.	Item	Impact	Impact (Reason)	Mitigation / Enhancement
1.	Loss of water bodies	Major, direct impact	Part or complete acquisition of source of water	<ul style="list-style-type: none"> • Land acquisition to be minimized with provision of Retaining walls. • Relocation of ground / surface water sources • Compensatory water supply sources will be set up before the start of construction with location of the new point as close to the original as possible in consultation with the local community • The cost of mitigation measures and the relocation cost of the water resources impacted have been included
2.	Alteration of Cross Drainage	Very Low Impact	Major bridge constructions Widening of minor bridges and culverts.	<ul style="list-style-type: none"> • Widening & construction of bridges, there will be an improvement in the drainage characteristics of the project area.
3.	Runoff and drainage	Direct Impact	Siltation of water bodies Reduction in ground recharge Increased drainage discharge	<ul style="list-style-type: none"> • Silt fencing to be provided. • Recharge well to be provided to compensate the loss of pervious surface. • Continuous drain is provided, unlined in rural area and lined in urban area.
4.	Water requirement for project	Direct impact	Water requirement for construction activity. Water requirement for labour	<ul style="list-style-type: none"> • Contractor needs to obtain approvals for taking adequate quantities of water from surface and ground water sources. • This is required to avoid depletion of water sources. • Water harvesting structures to be provided.
5.	Increased sedimentation	Direct impact	Increased sediment laden run-off after the nature and capacity of the watercourse	<ul style="list-style-type: none"> • Silt fencing to be provided • Instructions given in Annexure 7.6 Guidelines for Sediment Control to be enforced.
6.	Contamination of Water	Direct adverse	Scarified bitumen wastes Oil and diesel spills	<ul style="list-style-type: none"> • Hazardous wastes (Management and Handling) Rules, 1989 to be enforced.

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Sl. No.	Item	Impact	Impact (Reason)	Mitigation / Enhancement
		impact	Emulsion sprayer and laying of hot mix Production facilities for the labour and officers. Routine and periodical maintenance	<ul style="list-style-type: none"> Oil Interceptor will be provided for accidental spill of oil and diesel. Rejected material will be laid as directed by IC. Septic tank will be construction for waste disposal.
7.	Water quality monitoring		Effectiveness / shortfall (if any) Any unforeseen impact	<ul style="list-style-type: none"> Measures will be revised and improved to mitigate / enhance environment due to any unforeseen impact.

7.2.3.1 Water Quality Monitoring

Apart from provision of the mitigation measures, water quality shall be monitored to understand the effectiveness and further improvement in designs in reducing the concentration of pollutants. The monitoring plan shall be functional in construction as well as in operation stages. The frequency, duration and responsibility will be as per the Environmental Monitoring Plan. The water quality shall be monitored at all the locations as given in Table 4.5 besides at 6 other locations identified by the engineer. The maximum desirable limits as per the water quality standards are given in Annexure 9-1 and the monitored values should correspond with the table. All deviated results shall be reported to engineer, for remedial measures.

It should be ensured that no construction camps or stockyards are set up near River and the ponds to prevent oil spills.

7.2.3.2 Water Resources

⊙ Impact

The impact on the local water supply sources like hand pumps, wells and tanks will be insignificant as almost all of the sources are located beyond COI. Relocations of all these water supply sources (if any) have been recommended and the cost of the relocation shall be paid as per contract provisions. No partial/complete loss of surface water resources has been envisaged.

⊙ Mitigation

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

7.2.3.3 Alteration of Drainage

⊙ Impact

No drainage modification of surface flow of rivers / streams is envisaged during pre-construction period.

Impacts of road construction, which lead to alteration of drainage, are generally widening at culvert or bridge locations. This requires river and or gully training for the period during which the bridge is to be constructed. Alteration of drainage can lead to soil erosion of adjacent areas, disturb local vegetation and impair local ecology.

Though the constructions along the watercourses are to be carried out in the lean flow periods, as the major rivers are perennial, the construction activities will necessitate the diversion of the waterway. This diversion of flow can significantly harm the aquatic habitat, if any. The waterway will be constricted, increasing velocity downstream of the bridge. This will mean increased sediment load with the flow, thereby allowing less sunlight to penetrate into the water and can reduce growth of micro flora. The impact shall be direct but short term in nature and shall last till the construction period.

Short-term increase in runoff during construction may occur due to the removal of trees, vegetative cover and compaction of the surrounding soil during pre-construction. Thus the increased sediment load will be a significant impact that needs to be addressed for all water bodies along the corridor and adequate silt fencing measures need to be provided.

The design proposes the raising of the embankments from the existing levels to ensure that the finished pavement is above the maximum flood level so as to prevent any impacts due to any water seepage in the pavement. No significant impacts in the drainage pattern due to the raising of the road profile are likely, as the road design itself takes care of the cross-pavement drainage.

One of the unavoidable aftermaths of road construction is the increased surface run off. The new lanes, which are essentially a paved impervious surface, will cause increased surface runoff along the roadsides. Increase in surface run-off is due to the creation of impervious surfaces that prevent the flow of water into the ground. The project involves the construction of four lanes with paved shoulders on either side.

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

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proposed lanes has been designed with ditches on both sides to take care of surface runoff local flooding due to the proposed increased runoff shall be taken care of effectively. Surface runoff shall be drained to the nearest cross drainage structure. The engineering design includes design of cross drainage structures, which should take care of the extra flow.

☉ **Mitigation**

Various rivers & streams at different locations have intersected the project corridor. To facilitate the cross-drainage at these water crossings, cross-drainage structures including minor bridges and slab & box culverts are proposed. The existing bridges shall be retained while new parallel bridges shall be provided. The proposed span arrangement and other particulars of the structures are provided in the Design Report of the DPR.

Mitigation measures will include contractual obligations for relocation of sources of water supply at locations desired by the host community, provision of balancing culverts of adequate capacity where the level of the formation is being raised, and provision for adequately sized drains to prevent flooding etc. All these measures form a part of the good engineering practice and should be part of the design drawings themselves.

- To ensure efficient flow of surface water and to prevent water logging along the side of the roads, adequate size and number of cross-drainage structures have been provided.
- Detailed drainage surveys and hydrological investigations have been carried out and suitable design of bridges and culverts proposed.
- Provision of lined drains at settlement areas and unlined drains at other areas

In addition to the above design requirements, the Contractor shall ensure that during construction work the following are taken care of:

- Construction work near river and other channels have to be carried out in such a way that flow of water is not blocked and even if it has to be blocked then the Contractor must ensure that the local communities are informed about the same in advance. Work near the water bodies should be carried out in dry season to avoid shortage of water
- Flooding of local drainage channels
- Measures to ensure that remnants from earthwork, stonework and other waste material do not hinder the cross-drainage of rivers, nallahs etc
- In sections of the road near to watercourses or cross-drainage channels, the construction material waste would be disposed off in a manner not to block the flow of water
- To maintain efficient storm water flow, the roadside drains will be cleaned regularly, especially before the monsoon season
- Road run-off is let off into natural drains of adequate capacity from ditches at the end of formation to prevent destabilisation of the embankment. Release of road run-off directly from the ditches can erode edges of the water body into which the run-off is let off. Scouring of banks of flowing water bodies due to high velocity run-off is also a potential danger. To ensure that run-off does not damage the water body it enters, cascading for scour protection through stepped gabion is recommended.

7.2.3.4 Water Required for the Project

☉ **Impact**

The most likely significant impact on water during construction is depletion of water table. Rigid pavements have been suggested at the toll plaza locations only. The cement concrete construction works requires a considerable quantity of potable water for the various activities including construction of the pavement, dust suppression, curing etc. The demand shall be met through availability of sufficient supply both from surface and ground sources. As the ground exploitation is not very critical in the project district, the ground water resources may not be impacted due to the project activities. More over surface water sources shall also be utilised (wherever available) for the project activities.

The groundwater recharge areas may also be reduced due to an increase in impervious layers from construction. The road operation does not make a demand on the available water resources apart from time to time requirement during works such as maintenance of road side tree plantations.

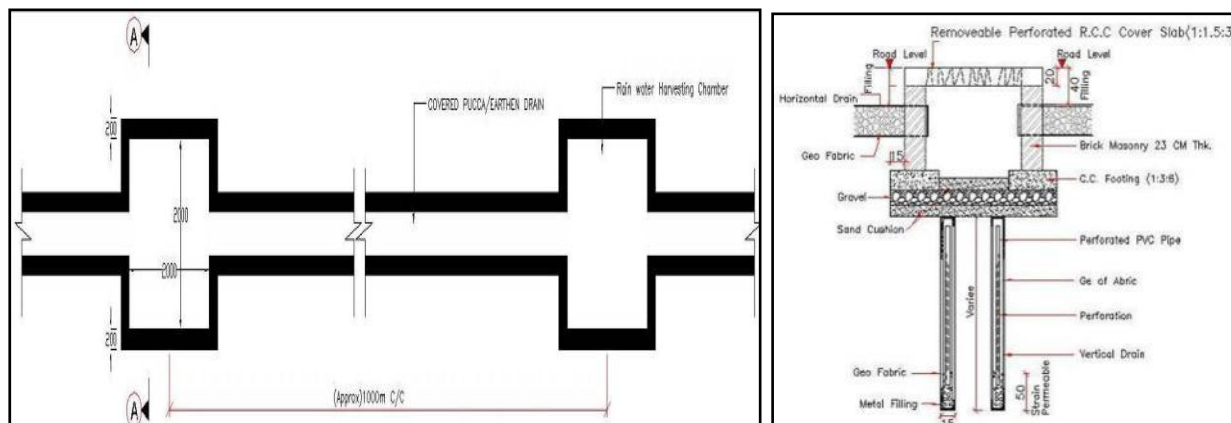
☉ **Mitigation**

Efforts will be made for the use of only surface water during construction phase. Prior approval for taking adequate quantities of water from surface and ground water sources shall be taken from respective authority before start of construction. The depletion of water is predominantly restricted to the construction phase. The road operation does not make a demand on the available water resources apart from time to time requirement during works such as maintenance of road side tree plantations. However, it is more likely that water from rivers / canals not be tapped at all for this purpose.

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Rainwater harvesting structures all along the proposed alignment where unlined drains are proposed as per MoEF guidelines and are a cost effective method for recharging of ground water level in the project area. The rainwater-harvesting chamber shall be placed at every 1000m interval c/c with dimensions of 2 x 2 x 0.75m³ all throughout the project corridor except at urban areas. A perforated RCC Slab covers the chamber. There is a 20cm filling, which also acts as sediment trap. There is another sediment trap in the bottom from where debris can be removed manually after certain period. A vertical drain (PVC pipe) is then sunk from the bottom of the chamber to a depth which varies as per the water table. Drains interconnect these chambers. The contractor along with the Engineer shall identify locations along the project route where water can be stored for the summer at least in 10 locations. Since the project area is in a water scarcity area, this shall act as good environmental practice. The measure will also reduce the cost of transportation of water. These locations should be permanent which shall be handed over to the local residents at the end of the project so that the water shortages can be reduced to a certain extent. Lump sum provision has been provided in the EMP.

Figure 7-1: Rain Water Harvesting Structure



7.2.3.5 Water Quality

☉ Impact

Due to tree felling soils around the water bodies and surface drainage channels will be exposed during the pre-construction stage, during which, the suspended sediments and the associated pollutants can be washed in to these water sources. The impacts due to the increased sediment load will be significant to some extent.

The impacts on water quality will be of greater concern during the construction stage. Increased sediment load during preparation of the site is the most likely adverse impact. The contamination by fuel and oil from construction vehicles or bitumen from hot-mix plants is less likely and in any case expected to be localised. Discharge from labour camps and vehicle parking areas will have to be treated before discharge into any watercourse. It is during the operation stage that the leakage or spillage from vehicles damaged, overturned or just badly maintained is more likely.

Also, the cutting of hillside shall mean that more surfaces are prone to erosion. However, the engineering design shall ensure protection of embankment slopes. The spoil heaps around the construction sites are also prone to erosion and contribute to the increased sediment load in the near-by water bodies. The major parameter of concern would be the sediment load from the spoils. The major pollutants of concern are suspended solids, oil and grease, lead and other heavy metals.

- Concentration of suspended solids is likely to be highest during the construction stage and immediately after the construction when vegetation has not been fully established on the embankment slopes.
- Oil and grease form a film on the water surface and hinder the transfer of oxygen into water.
- Though the compounds of lead are suspected to be carcinogenic, it is unlikely that leads pollution to have significant effects as 90-95% of lead in run-off is inert, and will be further diluted in the receiving water bodies, where the lead concentrations are minimal.

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

Water sources including flowing and stagnant water sources are likely to be contaminated due to activities such as setting up workers camp near water sources or transportation of construction material such as sand, borrow material etc. without covering it.

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Contamination of groundwater is another likely impact of road construction and allied activities. The groundwater recharge areas may be reduced due to an increase in impervious layers due to the construction. The contamination of the groundwater resources due to the project is likely at the following locations:

- Along construction sites, camps involving moving of construction equipment and machinery
- At the various community water bodies and sources of water supply such as hand pumps etc.
- Along the entire length of the corridor especially around urban areas and productive lands

The construction activities around the surface bodies can affect the water quality due to the disposal of solid and liquid wastes from labour camps, fuel and lubricant spills or leaks from construction vehicles, fuel storage and distribution sites and from bitumen or asphalt storage at hot-mix plants. The existing levels of contaminants, which can trace their origin to road run-off, indicate that water quality degradation is not a significant impact. Normally groundwater is shielded from the effects of such degradation, but if the discharges from construction camps were disposed off using soak-pits / septic-tanks that were not adequately designed, the consequences would be disastrous since restoration of groundwater quality is a much slower process.

No contamination of any water source is envisaged during the operation period. However, it is during the operation stage that the leakage or spillage from vehicles damaged, overturned or just badly maintained is more likely.

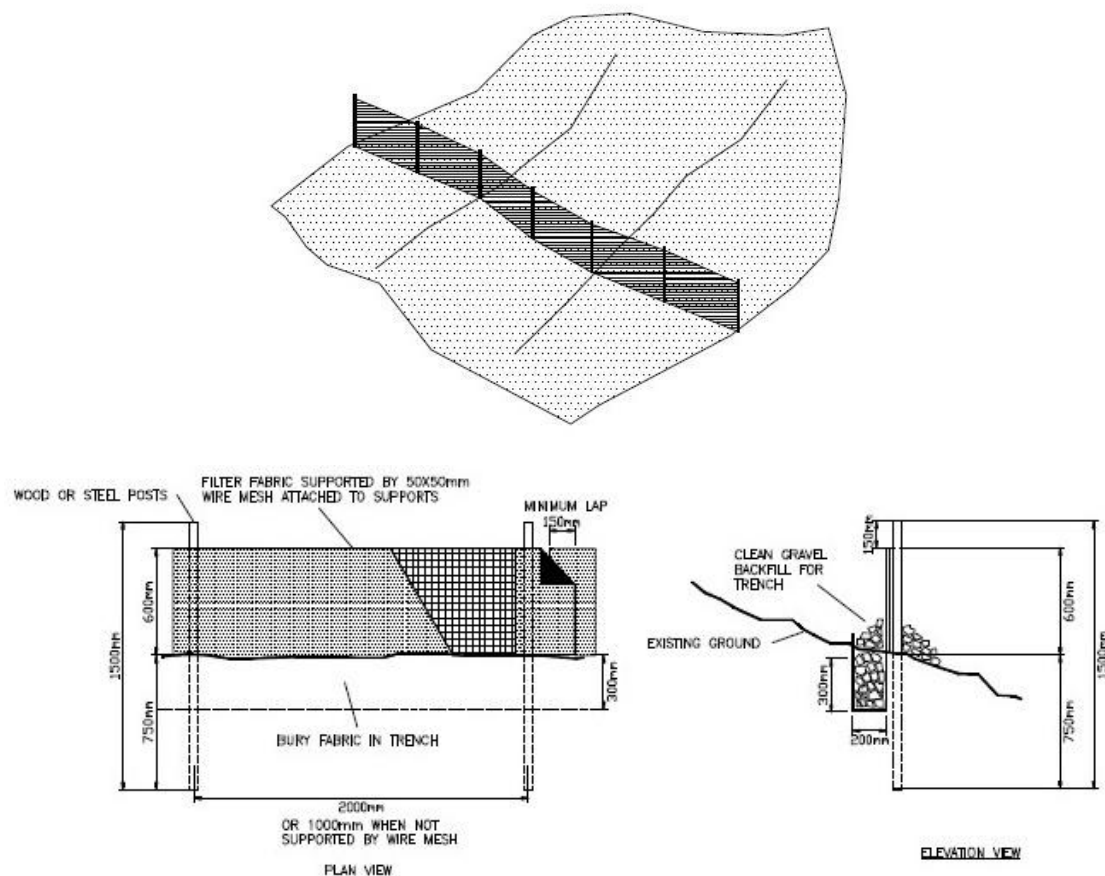
☉ **Mitigation**

To prevent any degradation of water quality of the various surface and ground water resources due to the proposed project, the Contractor shall work out the following mitigative measures during the construction period:

- Construction camps or stockyards are not to be set up near River and the ponds to prevent oil spills
- The impact of contamination of water sources such as wells can be avoided if these sources are covered while site clearance is going on at the site. The Management Plan needs to ensure that proper precautions are taken to prevent / minimise contamination of all water sources.
- Discharge from labour camps and vehicle parking areas will have to be treated before discharge into any watercourse
- Provision of necessary mitigation measures at the various locations proposed in the design to prevent contamination and degradation of water quality
- Construction work close to the streams or water bodies must be avoided during monsoon
- The discharge standards promulgated under the Environmental Protection Act, 1986 will be strictly adhered to
- Impact on the river / nallah system can be minimised if the bridge construction is taken up during the lean flow season and construction work close to the water bodies avoided during monsoon
- The fuel storage and vehicle cleaning area shall be stationed at least 500m away from the nearest drain / water body
- The slope of the embankments leading to water bodies shall be modified and re-channelled to prevent entry of contaminants into the water body.
- Provision of silt fencing and oil interceptors the details of which are given below
 - **Silt Fencing:** Silt fencing of about 500m will be provided to prevent sediments during construction period near the water bodies. This is based on the primary survey data and detailed discussions with structure engineers wherein it was found that the length shall be sufficient to cover all minor and major bridge locations and the road side water bodies. Depending on the length of the individual water body, the number of units of silt fencing to be installed is decided by the Authority Engineer. The silt fencing consists of geo textile with extremely small size supported by a wire mesh mounted on a panel made up of angle / wooden frame and post. It is expected a single person will be able to drive the angles by pressing from the top. The frame will be installed at the edge of the water body along which construction is in progress. The number of such units to be installed shall be decided depending upon the length of the water body along the side of the road construction. Guidelines for Sediment Control has been attached as Annexure 7.6

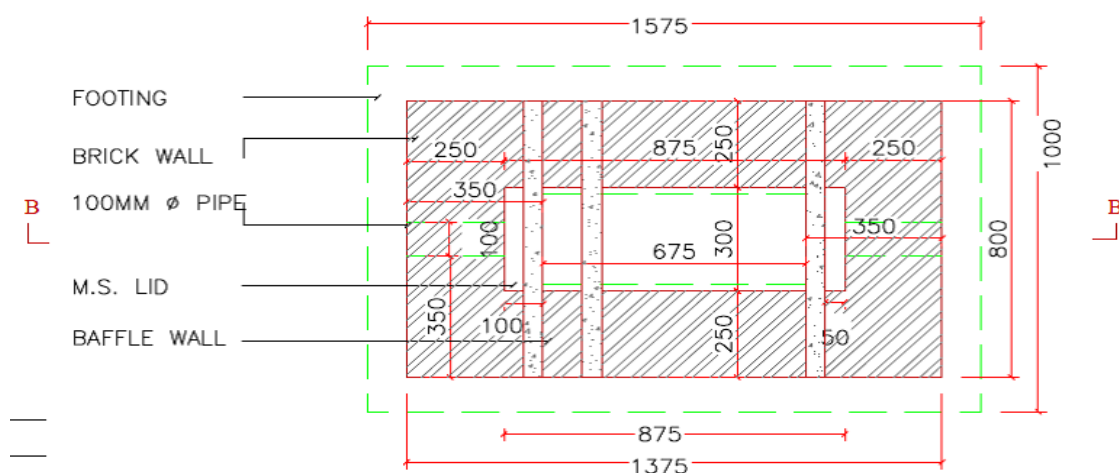
Figure 7-2: Silt Fencing

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- o **Oil interceptor:** Oil and grease from road run-off is another major concern during construction as well as operation. During construction, discharge of oil and grease is most likely from workshops, oil and waste oil storage locations, and vehicle parking areas of construction camps. Waste having hazardous properties will be stored in designated area only. A total of 10 oil interceptors shall be provided at camp sites to arrest oil and grease, as per above figure. The arrested products shall be disposed as per MoEF and SPCB guidelines. The location of all fuel storage and vehicle cleaning area will be at least 300 m from the nearest drain / water body.

Figure 7-3: Oil Interceptor



7.2.3.6 Other Water Supply Sources

Impact

The impact on the local water supply sources like hand pumps, natural and manmade water bodies will be significant as many are directly impacted. These though shall be replaced with new sources at locations near to the existing ones. As

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part of the project preparation, the alignment has been carefully routed to avoid any direct impact on these water bodies, however, at some locations; the encroachment onto these water resources has been unavoidable. In such locations the relocations of all these water supply sources has been recommended and the cost of the relocation has been included as part of the project cost.

☉ **Mitigation**

- The contractor will arrange for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected.
- If new tube-wells are to be bored, due to the non-availability of water required for construction, prior sanctions and approvals by the Ground Water Department has to be obtained by the Contractor.
- Wastage of water during the construction should be minimised.
- Construction over and close to any non-perennial streams shall be carried out in the dry season. Construction over irrigation canals should be carried out so as to minimise any disruption to the flows and to ensure that a high quality of water is maintained.

7.2.4 Noise levels

☉ **Impact**

Though the level of discomfort caused by noise is subjective, there is a definite increase in discomfort with an increase in noise levels. Road noise depends on factors such as traffic intensity, the type and condition of the vehicles plying on the road, acceleration / deceleration / gear changes by the vehicles depending on the level of congestion and smoothness of road surface (IRC: 104-1988).

The baseline noise levels monitored at various locations along the project packages indicate the baseline levels is within the permissible limits for residential and rural areas and exceeds in some commercial areas. Even the night levels recorded at the various locations are close to or higher than the noise levels allowed during daytime. Thus, noise is a major area of concern, especially since a number of sensitive receptors (schools, colleges and hospitals) have been identified to be quite close to the road. The impacts on noise due to the project will be of significance in both the construction as well as the operation stages.

Table 7-6: Noise Impacts

Sl. No.	Phase	Source	Impact
1	Pre-Construction	<ul style="list-style-type: none"> • Man, material and machinery movement • Establishment of camps, site office, stock yards, construction plants etc. 	<ul style="list-style-type: none"> • Short duration • Localised impact • Negligible
2	Construction	Plant site <ul style="list-style-type: none"> • Crushing, hot mix plants, machineries, batching plants, excavation, grading, paving activities Work zones <ul style="list-style-type: none"> • Community residing near the work zones 	<ul style="list-style-type: none"> • Plant site: significant impact within 500m • Work zones: temporary and negligible
3	Operation	<ul style="list-style-type: none"> • Increase in traffic 	<ul style="list-style-type: none"> • Negligible impact

Though the noise levels are within the stipulated standard, the noise levels are a concern due to the number of sensitive receptors located along the project road. The impacts on the receptors shall basically relate to increase in noise levels, access and physical damage to the structure. Even though complaints of noise and vibration are common, most of the receptors are quite far away from the road and hence the noise is dissipated.

☉ **Mitigation**

The contribution of project design towards mitigation of increased noise levels would be the improved riding surface and geometry, which will reduce vehicular noise generation, at least during the initial years after construction. The mitigation measures for noise are essentially aimed at protecting the receptor. Noise and vibration during construction is a significant impact especially around settlements and inhabited areas. During the construction stage, the most vulnerable population is the construction crew which is subjected to very high noise levels, albeit intermittently. Provision of Personal Protective Equipment (PPE) for the crew will be made a part of conditions of contract. Specifying construction timings will prevent disturbance to the local populations. The following mitigation measures as given in table below need to be worked out by the Contractor for the noise impacts associated with the various construction activities.

Table 7-7: Sources of Noise Pollution, Impacts and Generic Mitigation Measures

Source of Noise Pollution	Impacts	Generic Mitigation Measures
<ul style="list-style-type: none"> • Mobilisation of heavy construction machinery; • Acceleration / 	<ul style="list-style-type: none"> Increased Noise Levels 	<ul style="list-style-type: none"> • All construction equipment, plants, machinery and vehicles will follow prescribed noise standards. All construction equipment used for an 8 hour shift shall conform to a standard of less than 90 dB (A). If required, machinery producing high noise as

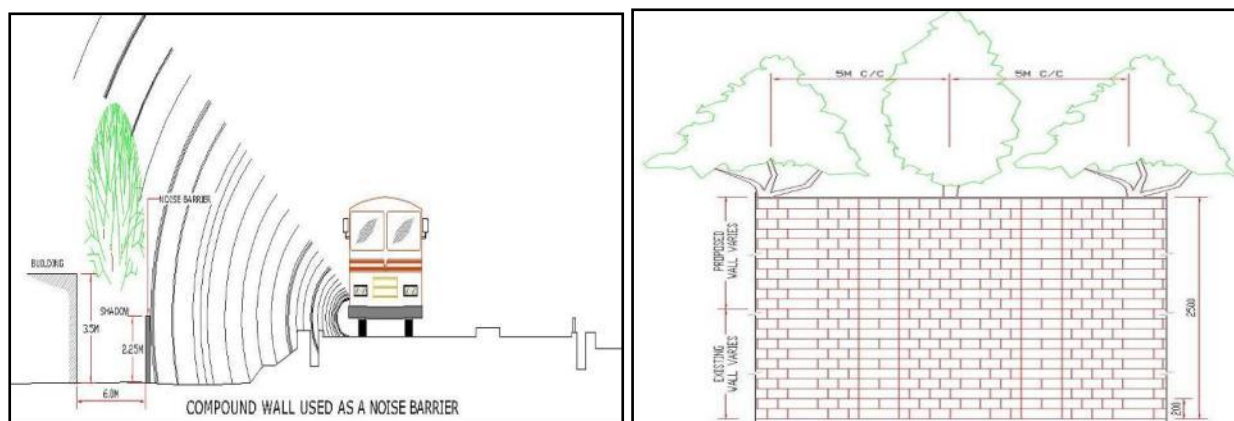
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Source of Noise Pollution	Impacts	Generic Mitigation Measures
deceleration /gear changes by the vehicles depending on the level of congestion and smoothness of road surface; <ul style="list-style-type: none"> Excavation for foundations and grading of the site; Construction of structures and facilities; Crushing plants, asphalt production plants; and Loading, transportation and unloading of construction materials. 	causing discomfort to local residents and workers	concrete mixers, generators etc, must be provided with noise shields; <ul style="list-style-type: none"> At construction sites within 500 m of human settlements, noisy construction shall be stopped between 9.00 PM and 6.00 AM; Vehicles and construction machinery shall be monitored regularly with particular attention to silencers and mufflers to maintain noise levels to minimum; Workers in the vicinity of high noise levels must wear ear plugs, helmets and should be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90 dB (A) per 8 hour shift; Hot mix plant, batching or aggregate plants shall not be located within 500 m of sensitive land use and settlements; All activities pertaining to procurement, storage, transport and handling of explosives and subsequent blasting will be carried out as per the statutory Indian Explosives Act 1984. Blasting shall be restricted only to daytime hours. Prior information of blasting operational times shall be given to people living near such blasting sites. The project road designed is a divided raised carriageway all throughout. This design shall help in reducing the impact of highway noise. Planting of trees, bushes and shrubs shall also to reduce noise levels. Provision of noise barriers. Noise barriers will be most effective if they break the line of sight between noise source and the properties being protected, and if these are thick enough or adsorb or reflect the noise received.

Table 7-8: Specific Noise Mitigation Measures

Sl. No.	Item	Impact	Reason	Mitigation / Enhancement
1.	Sensitive receptors	Direct impact	Increase in noise pollution Man, material and machinery movements.	<ul style="list-style-type: none"> Noise barrier to be provided Traffic calming devices to be used. No Horn Zone sign Post.
2a.	Noise Pollution (Pre-Construction Stage)	Direct impact, short duration	Establishment of labour camps, onsite offices, stock yards and construction plants	<ul style="list-style-type: none"> Area specific and for short duration. Machinery to be checked and 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.	<ul style="list-style-type: none"> 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 (Operation Stage)	Marginal Impact	Due to increase in traffic (due to improved facility)	Will be compensated with the uninterrupted movement of heavy and light vehicles
3.	Noise Pollution Monitoring		Effectiveness / shortfall (if any) Any unforeseen impact	Measures will be revised and improved to mitigate / enhance environment due to any unforeseen impact.

Figure 7-4: Compound Wall and Trees as Noise Barrier



To reduce noise and vibrations, noise barriers in the form of compound wall (2m height) is proposed. In case of space crunch, the use of concrete screens is suggested. As per research carried out in the developed countries, a masonry wall

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has Noise Reduction Coefficient (NRC) value of 0.2 - 0.5. Most of the sensitive receptors have their own compound wall. However, costing of the boundary wall have been calculated considering that compound wall need to be constructed afresh. The feasibility of extending the existing boundary wall will be checked by the contractor during construction phase. The noise barrier wall shall be constructed by excavation of foundation, laying of brick masonry wall up to a height of 2m above ground, plastering and coping as per the direction of the engineer and as laid in the specification. The plantation along the compound wall will act as additional facility to inhibit noise disturbance. Shade and flowering trees shall be planted within the boundary of the sensitive receptor, between the building line and the compound wall, wherever space shall be available, 5m centre to centre. Creepers and paints shall be used in consultation with the affected community to give an aesthetic look. Shade and flowering trees shall be planted within the boundary of the sensitive receptor, between the building line and the compound wall.

The measures adopted for noise attenuation for receptors (schools and hospitals for all type of land use) identified above are as below:

- Plantation within the premises if space available for plantation
- Rising of existing boundary wall / construction of new wall up to 2m height
- Planting creepers to provide aesthetic view
- In urban areas the boundary wall can be painted with posters to provide aesthetic views. The option of posters or creepers shall be agreed by the school / hospital administrator

Noise Pollution Monitoring

The effectiveness of mitigation measures and further improvement in designs to reduce the noise level due to construction and operational activity shall be monitored. The frequency, duration and monitoring plan shall be functional in construction as well as in operation stages as per the Environmental Monitoring Plan. Noise shall be monitored at all locations identified in Table 4-10 beside the plant sites. The country standards are given in National Ambient Noise Standards in Annexure 9-1. Any value / result not within acceptable limits shall be reported to engineer, for remedial measures.

7.2 BIOLOGICAL ENVIRONMENT

7.2.1 Forest Areas

☉ **Impact**

No Forest area along the project road as per forest department records. The forest department has bought some lands near the project road which are declared as forest. However it is not clear from the existing records whether these lands shall be directly affected.

☉ **Mitigation**

The mitigation of the diversion of the forest areas, if any as shall be taken up as per Forest Conservation Act

7.2.2 Roadside Plantations

☉ **Impact**

The principal impact on flora involves the removal of trees for the creation of a clear zone within the Corridor of Impact. Reason for clearing trees is threefold:

- To prevent single-vehicle collision with the roadside trees, trees very close to the road need to be cleared. Roadside trees are safety hazards, particularly those trees with strong and rigid stems. Some trees are safety hazards because they preclude clear sight distances. All trees that are safety hazards need to be cleared.
- To ease construction of the embankment for the widened road formation and, to permit construction of adequate roadside drainage structure, trees located within the area between the pavement and the daylight line needs to be removed.
- Trees need to be cleared to facilitate construction of traffic detours. As the present project road is mainly two lanes, there shall be need for diversions especially except for construction of bridges.

The project has a significant, direct and long-term impact on roadside trees in the Pre-construction stage. The cutting of trees shall have manifold impact. Most visible impact is the loss of shade. Also, there is a possibility of the local people being deprived of tree products, such as wood, fruits, leaves etc. Removal of roadside trees will reduce comfort levels for slow moving traffic and pedestrians.

A far less contentious issue, which normally takes the back seat, is the importance of the ecosystems supported by the roadside trees. Not only would the removal of trees lead to erosion, it would also mean that the micro-ecosystems developed on the roadside with the birds, animals and insects using the plantation over the years would be lost too.

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The roadside plantations will need to be cleared for the project. Though the loss of these trees is an irreversible and long-term impact, the loss of the roadside plantations shall have to be compensated in accordance to the principles of the Forest (Conservation) Act.

⊙ **Mitigation**

The felling of trees need to be compensated for by compensatory afforestation. Adequate provisions for monitoring of the same must be worked out. Activities during the construction period are likely to have adverse impact on the plant species located along the carriageway. Proper care should be taken for protection of these species too.

Table 7-9: Summary of Mitigations for Impacts on Flora

Sl. No.	Item	Impact	Reason	Mitigation / Enhancement
1.	Forest area	Direct Impact	Diversion of forest area, if any	<ul style="list-style-type: none"> • Diversion of forest land as per Forest Act • Plantation of trees as per Forest Department
2.	Wild Life	Direct Impact	Wild life as per forest records	<ul style="list-style-type: none"> • To inform forest department in sighting of wild life • Mitigations as per forest department directives
3.	Trees Cutting	Direct Impact	Increase in soil erosion, silting of water bodies Dust and noise pollution Loss of shade and loss of tree products	<ul style="list-style-type: none"> • Compulsory tree plantation in the ratio of 1:2. • Avenue plantation along corridor
4.	Vegetation	Direct Impact	Increase in soil erosion, silting of water bodies, noise pollution, dust pollution	<ul style="list-style-type: none"> • Clearing and grubbing will be minimised, and sprinkled with water to reduce dust pollution. • Exposed surface like embankment slopes will be protected with stone pitching and turfing. • Open land in and around plant will be vegetated.

Compensatory Afforestation

- Compensatory afforestation will be taken up as per the Forest (Conservation) Act, 1980.
- The directions of the Forest Department on the issue of compensatory afforestation shall be binding.

The compensatory afforestation will be carried out with native species and proper care of the saplings will be taken to ensure that the roadside plantation returns to its previous state as quickly as possible. Co-operation of locals to ensure that local cattle do not damage the saplings during the early stages of growth will be required. List of species recommended for taking up compensatory afforestation has been presented in below tables. Local authority and populace may also be consulted for selection of species types.

Avenue and Block Plantation

- Avenue plantation along corridor, where ever possible given to compensate the loss of trees due to felling.
- The plantation scheme shall involve a plantation contractor who shall supply and maintain the plantation. He shall also take necessary guidance from the Forest Schedule of Operation and maintenance and the specifications for Avenue Plantation.
- Native indigenous trees species shall be used as far as practicable, strictly avoiding any exotic (but popular) species like *Eucalyptus* sp. that can have far-reaching adverse effects on the ecology and water regime of the area.
- Endeavour to initiate plantations before the construction is complete so that the trees are at least a year or two old when the project is completed.
- The Contractor shall work out the number of trees to be planted around junctions and for enhancement purposes.
- The plantation of trees has been done subject to availability of space in the ROW

7.2.3 Fauna

⊙ **Impact**

Domesticated animals dominate fauna species. There is likelihood of slight impact to local domestic animals, which graze in the area especially after the road is constructed. Increased vehicle movement in the area might lead to accidents involving animals. Apart from this, micro-ecosystems developed on the roadside with the birds, animals and insects using the plantation over the years would be lost due to loss of their habitat. Presence of wild animals has been reported through consultation with community and Forest department. Instance of road kill in project road section is rare.

⊙ **Mitigation**

- The compensatory plantation shall act as the new habitat for these species like birds, smaller mammals, insects

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etc.

- All works are to be carried out such that minimum damage and disruption to fauna is caused
- Construction workers shall be instructed to protect natural resources and fauna, including wild animals and aquatic life
- Hunting and unauthorised fishing shall be prohibited
- During construction, at any point of time, if a rare / endangered / threatened fauna species is spotted, the contractor shall make all arrangements to intimate the wild life authorities and measures will be taken as for is conservation during the operation period also

7.2.4 Aquatic Ecology

The construction of new bridges will cause some contamination of the river water due to spillage of construction material, sediment loading & increased turbidity downstream of the bridge location. This change shall have some impact on the flora and faunal species and change the nature of the substratum resulting in decline in the number and diversity of plants and thus the food web. No negative impacts are envisaged on the aquatic ecology during the operational phase.

7.3 SOCIAL ENVIRONMENT

Entire corridor will acquire a pattern of urban and rural stretches. At certain stretches the concentration, density and level of urbanisation will be much higher due to the overlapping and amalgamation of two to three settlements over time. All along the corridor length the urban and rural stretches have been identified. Within the urban settlements the areas with highest, high, medium and low concentrations have been filtered and accordingly suggested appropriate treatment to avoid further and future ribbon development.

7.3.1 Land Acquisition & Loss Properties

⊙ Impact

The project road requires a 19m ROW which has been optimised from the standard ROW required for national highways in view of LA constraints. As a corollary to land acquisition, the project affects a number of families, and displaces some of them. These families are titleholders, and are distinct from the squatters and the encroachers. The details of the PAPs, squatters and title holders besides the categorisation of the losses are provided in the RAP report.

⊙ Mitigation

- As far as possible the land acquisition has been kept to the minimum, by restricting the geometric improvement within the existing right of way. However the land acquisition will be done at sections having width, insufficient to accommodate the approved cross-sections & geometric Improvements.
- SIA and RAP shall detail out the extent of Project Affected Family

7.3.2 Amenities and Facilities

⊙ Impact

Some of the infrastructures built to facilitate the basic needs of the communities in these areas like electricity lines, telephone lines or electric transformer shall be affected by the project, the details of which are given in the RAP and Utility Plan.

⊙ Mitigation

All impacted utilities shall be relocated as per the utility relocation plan and after obtaining approval of the department concerned. Bus Shelters and Bus Bays shall be provided.

7.3.3 Land use Change

⊙ Impact

Change In land use will be sparked off as a result of land speculation. The road, which is flanked by agricultural fields, will witness overnight selling of these lands for the prices that they will fetch. Industrialisation of fringe areas of cities is also a possible impact of a road development scheme. The availability of cheap labour and easy access to markets in the city will make roadside areas quite an incentive for the industrialist. Reduced transportation costs and availability of high-class transportation facilities for raw materials and products will be the most important advantage of the improved road.

The encroachment onto the ROW for the road to cash in on this opportunity is an almost universal occurrence, to varying degrees. Encroachment will mean that the future expansion / widening of the road scheme will be problematic and the issues related with easement and eviction will become a real challenge for the MoRT&H that is already stretched to the limit. However, the damage to encroaching structure, whatever its status, in case of an accident will be far more

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visible and potentially dangerous impact of such activity.

The development of a road scheme will lead to extension of urban areas especially at the ends of cities and towns through which the road passes. The improved transportation facility provides the linkages that will allow much better access to previously difficult to reach markets (for buyers and sellers). This would mean not only the people from congested areas in cities will want to move to the fringe, but also, people from nearby rural areas would migrate to the city. Urban services are seldom able to keep pace with the growth of a city. The growth of a city beyond the established spread network will mean piecemeal arrangements for services like water supply, wastewater treatment and disposal, and transportation. All the settlements along the project corridor will experience a sudden boom in activity and population around the start of operation of the project corridor. Thus, a ribbon development is envisaged all along the project road.

The change in land use shall also translate into change of land currently under agriculture to more commercial use. It is envisaged that due to this proposed change the crop productivity in the agricultural belt immediately adjoining the ROW shall decrease. This impact is envisaged only to be valid for the agricultural land immediate to the ROW. Although the spatial impact is likely to be insignificant the impact will be irreversible in nature.

⊙ **Mitigation**

Strict planning laws in conjunction with continuous unbiased monitoring of the development are the only proven strategies against such activities.

7.3.4 Exploitation of Resource base

⊙ **Impact**

Improvement in the road condition can have an impact on the natural resources. Easy accessibility of the area will increase the population of the region. This means more and more exploitation of the natural resources like ground water, fuel, etc. While the medium term impacts may not be large enough to be noticed, the long-term implications of such depletion are potentially disastrous.

⊙ **Mitigation**

Separate labour camp away from habitation shall be constructed. All day to day need shall be procured from nearby city markets. No tree cutting shall be permitted for the cooking and other purpose.

Strict planning laws in conjunction with continuous unbiased monitoring of the development are the only proven strategies against such activities.

7.3.5 Cultural Properties

⊙ **Impact**

There is no place of archaeological importance along the road. No heritage site of place of tourist interest was observed. However, the impact on local Cultural & Religious properties shall be elaborated in SIA & RAP.

⊙ **Mitigation**

The project proposes the relocation / replacement of all community resources likely to be impacted. Apart from replacing these community resources along the highway generic enhancement measures have been worked out for the enhancement of these resources.

7.3.6 Traffic Congestion & Loss of Access

⊙ **Impact**

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

⊙ **Mitigation**

- Detailed Traffic Control Plans will be prepared prior to commencement of works on any section of the project road by the Contractor. These plans shall be approved by the AE and or the site office of the MoRT&H prior to execution. The traffic control plans will contain details of temporary diversions details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day.
- Temporary diversion (including scheme of temporary and acquisition) will be constructed with the approval of the Engineer. Special consideration will be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night.
- The Contractor will ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. The temporary traffic detours will be kept free of dust

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by frequent application of water, if necessary.

- The Contractor will take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement. Annexure 7.8: Traffic Control and Safety during Construction gives the details of the road safety measures to be adopted during construction.
- The contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property access connecting the project road. The construction activities that shall affect the use of side roads and existing access to individual properties shall not be undertaken without providing adequate provisions. The construction works will not interfere with the convenience of the public or the access to, use and occupation of public or private roads whether public or private.

7.3.7 Public Health and Safety

☉ Impact

The improvement of the project road will entail doubling the existing carriageway to a two-lane section and improve its condition to allow vehicles at design speeds. Increased vehicular speed means that the fringe areas of the road are at increased risk from speeding vehicles. The existing facilities and amenities along the road shall be subjected to adverse impacts of road operation. The possibility of accidents is likely to increase. The possibility of this happening is a cause of concern as there are many educational, cultural and health institutes along the road.

Impacts on public health and safety may arise during the phases of pre-construction, construction and operation phases. During the pre-construction and construction phases, dismantling of the structures for ROW clearance and road construction activities may result in the following health hazards:

- Breaking and dismantling of properties during pre-construction has psychological impacts on their owners and others associated with them.
- Debris generated on account of the above-mentioned activities if not properly disposed might give rise to health problems in the area. However, the structures to be dismantled during pre-construction phase will mainly be of semi-permanent and temporary nature and much of the waste shall be salvageable.
- Dismantling of first row of structures (generally commercial) along the highway shall lead to exposure of second row of properties (generally residential) to higher dust, air and noise pollution levels. This is a long-term effect (might extend into the operation phase) and may increase the affected households' medical expenditure.
- In case of non-local labour (If so is arranged by the contractor), labour camps are set up at one or more sites adjacent to the alignment, and at some ancillary sites, like aggregate quarries. These labourers hired from outside can have clashes with the local population on account of cultural and religious differences. The influx of a large work force to an area, already hard pressed for basic services (medical services, power, water supply, etc.), can impose additional stress on these facilities.
- In and around forest areas if alternative fuels are not made available to the workforce, there is a likelihood that trees / branches will be cut down for cooking or heating purposes.
- Unsanitary conditions in the labour camps might also result in impact on health of labourers as well as the local population. Transmission of diseases is also facilitated by the migration of people. During the construction phase work, crews and their dependents may bring with them a multitude of communicable diseases including Sexually Transmitted Diseases (STDs) like AIDS. This is more so if the nature of the project requires more male-workers, who have migrated from other parts of the state or country.
- During road construction allied activities like quarrying and crushing operations, traffic diversions, etc., may cause disruption of social and economic life of the local population of the nearby areas. Dust and noise generated in crushing and blasting operations may cause nuisance to the nearby communities. Other problems perceived during construction period is inconvenience to the local people as well as the highway passengers due to traffic jams and congestion, loss of access and other road accident risks, as a result of diversion of traffic and construction work on road.
- The traffic amount and speeds are likely to increase throughout the road corridors. The accident risk would tend to increase. Although the design speeds have been kept lower in the major settlement areas, some amount of severance is expected in the rural areas.

☉ Mitigation

The Contractor is required to comply with all the precautions as required for the safety of the workmen as per the International Labour Organisation (ILO) Convention No.62 as far as those are applicable to this contract. The

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contractor will supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workers and staff. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.

- **Risk from Electrical Equipment**

Adequate precautions will be taken to prevent danger from electrical equipment. No material or any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provision and to the satisfaction of the Engineer.

- **Risk at Hazardous Activity**

All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc, will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stonebreakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals. The use of any toxic chemical, if any will be strictly in accordance with the manufacturer's instructions. The Engineer will be given at least 6 working day's notice of the proposed use of any toxic chemical. A register of all toxic chemicals delivered to the site will be kept and maintained up to date by the Contractor. The register will include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, handling and storage procedures, and emergency and first aid procedures for the product.

- **Risk of Lead Pollution**

No man below the age of 18 years and no woman will be employed on the work of painting with products containing lead in any form. No paint containing lead or lead products will be used except in the form of paste or readymade paint. Face masks will be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

- **Risk caused by Force' Majeure**

All reasonable precaution will be taken to prevent danger of the workers and the public from fire, flood, frowning, etc. All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work.

- **Risk from Explosives**

The contractor will not use explosives except as may be provided in the contract or ordered or authorized by the Engineer. Where the use of explosives is so provided or ordered or authorized, the Contractor will comply with the requirements of the following sub-clauses of this clause besides the law of the land as applicable. The Contractor will at all times take every possible precaution and will comply with appropriate laws and regulations relating to the importation, handling, transportation, storage and use of explosives and will, at all times when engaged in blasting operations, post sufficient warning flagmen, to the full satisfaction of the Engineer. The Contractor will 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.

- **Malarial Risk**

The Contractor will, at his own expense, conform to all anti-malarial instructions given to him by the Engineer; including filling up any borrow pits which may have been dug by him. Gravid, blood-laden mosquitoes cannot fly very far, so they generally bite within a kilometre or so of their breeding place. Thus borrow pits and any other water bodies created during the construction process will be situated 1 to 2km away from the human settlements. Pits dug up closer than these will be adequately drained to prevent water logging. Similarly compensatory measures for filling up part of the water bodies situated adjacent to the project corridors will be directed towards deepening of the water bodies concerned. This way the capacity of the water body remains the same, while water surface available for breeding of mosquitoes is reduced. This will have an additional advantage of decreased evaporation losses, which will be important in the water-scarce project corridor.

- **First Aid**

At every workplace, a readily available first aid unit including an adequate supply of sterilised dressing material and appliances will be provided as per the Factory Rules. Workplaces remote and far away from regular hospitals will have indoor health units with one bed for every 250 workers. Suitable transport will be provided to facilitate take injured or ill person(s) to the nearest applicable hospital. At every workplace an ambulance room containing the prescribed equipment and nursing staff will be provided as prescribed.

- **Potable Water**

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In every workplace at suitable and easily accessible places a sufficient supply of cold potable water (as per IS) will be provided and maintained. If the drinking water is obtained from an intermittent public water supply then, storage tanks will be provided. All water supply storage will be at a distance of not less than 15m from any latrine, drain or other source of pollution. Where water has to be drawn from an existing well, which is within such proximity of any latrine, drain or any other source of pollution, the well will be properly chlorinated before water is drawn from it for drinking water. All such wells will be entirely closed in and be provided with a trap door, which will be dust proof and waterproof. A reliable pump will be fitted to each covered well. The trap door will be kept locked and opened only for cleaning or inspection, which will be done at least once a month.

- **Hygiene**

The Contractor during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour to standards and scales approved by the resident engineer. Refer Annexure 7.9: Guidelines For Sitting And Layout Of Construction Camp.

There will be provided within the precincts of every workplace, latrines and urinals in an accessible place, and the accommodation, separately for each for these, as per standards set by the Building and other Construction Workers (regulation of Employment and Conditions of service) Act, 1996. Except in workplaces provided with water-flushed latrines connected with a water borne sewage system, all latrines will be provided with dry-earth system (receptacles) which will be cleaned at least four times daily and at least twice during working hours and kept in a strict sanitary condition. Receptacles will be tarred inside and outside at least once a year. If women are employed, separate latrines and urinals, screened from those for men and marked in the vernacular will be provided. There will be adequate supply of water, close to latrines and urinals.

All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. The sewage system for the camp must be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses take place. Compliance with the relevant legislation must be strictly adhered to. Garbage bins must be provided in the camp and regularly emptied and the garbage disposed off in a hygienic manner. Construction camps are to be sited away from vulnerable people and adequate health care is to be provided for the work force.

Unless otherwise arranged for by the local sanitary authority, arrangement for proper disposal of excreta by incineration at the workplace will be made by means of a suitable incinerator approved by the local medical health or municipal authorities. Alternatively, excreta may be disposed off by putting a layer of night soils at the bottom of a permanent tank prepared for the purpose and covering it with 15 cm layer of waste or refuse and then covering it with a layer of earth for a fortnight (by then it will turn into manure).

On completion of the works, the whole of such temporary structures will be cleared away, all rubbish burnt, excreta or other disposal pits or trenches filled in and effectively scaled off and the whole of the site left clean and tidy, at the Contractor's expense, to the entire satisfaction of the Engineer.

7.4 CONCLUSION

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

- No direct physical impact will take place on Sensitive receptors like educational institute, health facilities. However, impact due to noise and dust may occur which shall be tactfully mitigated.
- No physical damage to water bodies has been envisaged
- Need for diversion of forest land

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8 INSTITUTIONAL ARRANGEMENT FOR IMPLEMENTATION

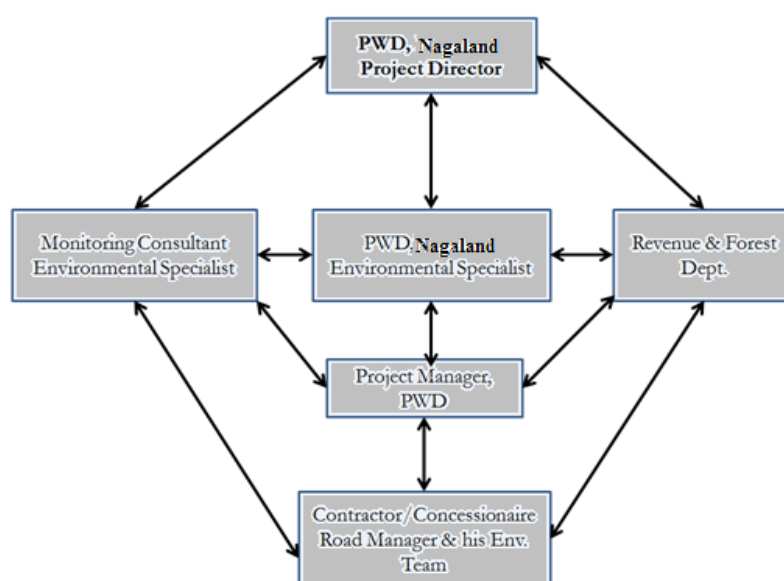
The Implementation of Environmental Management Plan during the construction phase will be carried out by Environmental team duly appointed by the Contractor. The overall supervision of Environmental monitoring works during construction and operation stage shall be carried out by PWD, Nagaland and Manipur with the help of the Monitoring Consultant.

The institutional arrangement proposed for the Project has been presented here with defined roles and responsibilities. The responsibility of implementing the mitigation measures directly lies with Contractor. The Monitoring Consultant shall monitor the effectiveness of the implementation of the work on behalf of PWD, Nagaland and Manipur. In the pre-construction phase of the project the Contractor shall study the EMP to identify environmental issues and arrive at a suitable strategy for implementation.

8.1 PROPOSED IMPLEMENTATION SETUP

The institutional arrangement proposed for the Project has been presented in Figure below.

Figure 8-1: Institutional / Implementation Arrangements



8.2 CONTRACTOR

The Contractor is responsible for the physical implementation of the mitigation measures proposed in the Environmental Management Plan (EMP). To ensure the effective implementation of the EMP, the EMP will be made as part of the Contract Document between Construction Contractor and Client (PWD, Nagaland and Manipur). It follows that the Contractor has to have environmental expert to incorporate environmentally sound construction methods.

8.2.1 Environmental Expert

For effective implementation and management of the EMP, the Contractor should depute an Environmental Expert to deal with the environmental issues of the project. This officer shall interact with the Road Manager to ensure that the mitigation and enhancement measures mentioned in the EMP are adhered. His prime responsibility shall be to apprise the Road Manager about the ground conditions. He shall also monitor that the requisite clearances and the NOCs for the project has been taken and shall also strictly supervise the adherence to the EMP. The qualifications and responsibilities of Environmental Expert are given in Box 8-1.

Box 8-1: Proposed Qualification and Responsibilities of Environmental Expert (EE)

Qualifications & Experience

- Postgraduate in Environmental Science / Environmental Management / Zoology / Botany / Ecology / Environmental Planning / degree in Civil Engineering with specialisation in environment.

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- years of total experience with a minimum of 5 years in the implementation of EMP of highway projects and an understanding of environmental, health and safety issues.
- Prior practical experience in the field of Highways would be an advantage.

Roles & Responsibilities

- He / She shall be reporting directly to the Chief Project Manager of the Contractor
- Primarily responsible for implementation of the EMP on site and ensuring that the environmental quality is meeting the standards laid down by Central Pollution Control Board and other related authority.
- The EE shall implement the EMP by assigning the necessary resources (manpower, money and machinery) and attend such meetings as are required for the effective implementation of the EMP on site.
- He shall maintain a “Complain Register” to record any grievances from public.
- He shall maintain a register of all road side trees planted and present within ROW.
- He shall maintain record of Accidental Road kill of wildlife project road section
- The EE shall be the interface of the Contractor with the client and the IE/SC.

8.3 MONITORING CONSULTANT (MC)

The Monitoring Consultant, to be procured through ICB shall assist PWD, Nagaland and Manipur in the implementation of project, once the project documents are ready. The Environmental Specialist of the MC shall be the key personnel to ensure the successful implementation of EMP provisions. Since ICB procurement is envisaged, the selected consultants are expected to have the necessary professional(s) to tackle the issues that the project is likely to bring up. The Environmental Specialist of the MC will be a key position, which can be leveraged to ensure that the Contractor complies with the various EMP requirements.

The EMP prepared for the Project road, needs to be followed during the implementation of the civil works. The EMP is integrated in the technical specification and contract documents. The key responsibility of the Environmental Specialist will be the successful implementation of the EMP. In addition, he / she will update PWD, Nagaland and Manipur on the progress of environmental protection and / or enhancement works as envisaged in the EMP. It is envisaged that the responsibilities of the Environmental specialist of the MC will include:

- Supervise and monitor the implementation of EMP by the Contractor
- Review and approve site-specific environmental mitigation / enhancement designs worked out by the Contractor based on the EMP prepared during project preparation
- Review and recommend the Contractors’ Implementation Plans for approval (with any changes that may be necessary) to ensure compliance with the environmental provisions of the Contract
- Monitor tree plantation programs and the periodic Environmental Monitoring (Air, Noise, Water, etc.) Programs to ensure compliance with the State requirements and the efficacy of EMP
- Review of records of accidental road kill of wildlife in project road section
- Hold regular meetings with Contractor and keep it updated to PWD, Nagaland and Manipur reg. the progress of environmental works
- Prepare and submit monthly and Quarterly Environmental progress report to PWD, Nagaland and Manipur
- Develop and organize environmental training programmes to upgrade the skills within the staff of the environmental cell, contractors
- Document and develop good practices during project implementation for wider dissemination

The project will require continuous environmental supervision from the IC’s/SC side. Since the Sr. Environmental Specialist for IE projects are deployed on intermittent basis, it is desirable to have the field Jr. Environmental Specialist and engineers supervising the construction works be trained on environmental aspects, who then shall apprise the Team Leader and the Sr. Environmental Specialist of any significant development on environment.

8.4 REPORTING SYSTEM

Reporting system provides necessary feedback for project management to ensure quality of the works and that the program is on schedule. The rationale for a reporting system is based on accountability to ensure that the measures proposed as part of the Environmental Management Plan get implemented in the project. Reporting system for the suggested monitoring program operates at two levels as:

- Reporting for environmental condition indicators and environmental management indicators

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- Reporting for operational performance indicators at the PWD site level.

The reporting system will operate linearly – Contractor who is at the lowest rung of the implementation system reporting to the Project Manager, PWD, who in turn shall report to Environmental Expert, PWD subsequently Project Director, PWD as per Figure 8-1. All reporting by the Contractor shall be on a monthly/Quarterly basis. The PWD Site Office will be responsible for setting the targets for the various activities anticipated during construction phase in consultation with the MC and obtaining agreement from the Contractor after mobilization but before beginning of works on site. The Contractor will report from then on regarding the status on each of these. The PWD Site Office will monitor the activities through its own staff or the Monitoring Consultant's Environmental Specialist after obtaining the Contractor's report with the Consultant's remarks during the construction phase. During the operation phase, the supervision as well as reporting responsibilities will lie with the PWD Site Office or PWD may appoint the Independent Expert for this period.

Table 8-1: Summary of Reporting of Environmental components and Responsibilities

Format No.	Item	Timing	Monitoring Consultant (MC)		PWD Office
			Supervision	Reporting	Overseeing / Compliance
PRE-CONSTRUCTION PHASE					
M1	Reporting by Contractor to MC for dumping locations & construction and labour camp site	Before start of construction	As required	Quarterly	As required
M2	Reporting by contractor to MC for construction and labour camp site	Before start of construction	As required	Quarterly	As required
M3	Target sheet for Tree cutting	Before start of work	As required	After cutting	As required
M4	Reporting for borrow areas	Before start of construction	As required	Quarterly	As required
CONSTRUCTION PHASE					
C1	Target sheet for Pollution Monitoring	As per Monitoring Plan	As required	After Monitoring	As required
C2	Top soil Conservation	Before start of work	As required	Quarterly	As required
C3	Reporting by Contractor to MC for Accidental Road kill of Wildlife. Format attached as Annexure 8.1	As required	As required	As required	As required
OPERATION PHASE					
O1	Target sheet for Pollution Monitoring	During Operation	As required	After Monitoring	As required
O2	Redevelopment of Borrow Areas	After completion of usage of Borrow Area	As required	After Monitoring	As required
O3	Survival Rate of Trees	During Operation	As required	After Monitoring	As required
O4	Reporting by Contractor to MC for Accidental Road kill of Wildlife. Format attached as Annexure 8.1	As required	As required	As required	As required

8.5 ENVIRONMENTAL CAPACITY BUILDING

Training of staff will be done at a number of levels to raise their levels of environmental awareness. The training can be conducted by either some external agency or through the help of in-house expertise. The main focus of training programmes shall be on efficacy on implementation of EMP

The basic objective of giving training to different Stakeholder is to enhance their capabilities for implementation of Environment Management and Monitoring Plan. It is recommended that training be given at least 4 times both offsite and on site

- Pre-Construction Stage
- Construction Stage
- Before de-mobilization of Contractor

The training modules have been developed for different stakeholders involved in the Project during Pre-construction, Construction and before demobilization of the Contractor.

Table 8-2: Training Module

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Sl. No.	Training Recipients	Mode of Training	Environmental Aspects to be covered in training modules	Training Conducting Agency
Module For Training Before Start Of Construction Work				
SESSION-I				
Module-I	Staff of PWD (Nodal Level), staff of MC, PWD engineers, Engineering Staff of Contractor and collaborating Government agencies	Lecture Sessions, Presentation and discussion	Overview. Need and Value of Environment Assessment	PWD / MC / Contractor's Representative
Module-II	Staff of PWD (Nodal Level), staff of MC, PWD engineers, Engineering Staff of contractor and collaborating Government agencies.	Lecture Sessions, Workshops & Presentation	Institutional Set Up Role and Responsibility of Stake Holders and Contractual obligations	Monitoring Consultant / Contractor's Representative
Module-III	Staff of PWD (Nodal Level) involved in the project, staff of MC, PWD engineers involved in construction, Contractor, and collaborating Government agencies	Lecture Sessions, Workshops & Presentation	Overall generic Environment Issues, Regulations & Statuary requirements and Mitigation Measures	Monitoring Consultant/ Contractor's Representative
SESSION –II				
Module-IV	Staff of PWD (Nodal Level), staff of MC, PWD Engineers, Engineering Staff of Contractor and other concerned agencies.	Lectures; Demonstration sessions	Project related Project related environmental issues and mitigation measures	Monitoring Consultant/ Contractor's Representative
Module-V	Staff of PWD (Nodal Level), Staff of MC, PWD engineers, Engineering Staff of Contractor.	Group Discussions and action plan for the project	Environmentally Sound Construction Management & Environmentally, Sustainable operations of Highways	Monitoring Consultant/ Contractor's Representative
Module-VI	Staff of PWD (Nodal Level), Staff of MC, PWD engineers, Engineering Staff of Contractor	Lectures; Group Discussions	Supervision and Monitoring, Reporting Formats	Monitoring Consultant/ Contractor's Representative
Module for Training during Construction				
Module-I	Staff of PWD (Nodal Level) involved in the project, staff of MC, PWD engineers involved in construction, Contractor	Lecture Sessions, Presentation & Workshops	Implementation of Environment Management Plan, Environmental Friendly Construction Methodology and Workers Safety during Construction	Monitoring Consultant/ Contractor's Representative
Module-II	Staff of PWD (Nodal Level) involved in the project, staff of MC, PWD engineers involved in construction, Contractor	Lecture Sessions, Workshops & Presentation	Interactive discussion, Monitoring and Reporting System	Monitoring Consultant/ Contractor's Representative
Module for Training during Construction at Site				
Module-I	PWD engineers, Staff of MC, All Staff of Contractor	Lecture Sessions, Workshops & Presentation	Environmental Friendly Construction Methodology and Workers Safety	Monitoring Consultant/ Contractor's Representative
Module-II	PWD engineers, Staff of MC, All Staff of Contractor	Practical on Site	Safety Practices	Monitoring Consultant/ Contractor's Representative
Module for Training before Contractor Demobilization				
Module-I	PWD Staff, PWD Engineers, Staff of MC, Engineering Staff of Contractor	Lecture, Presentation Sessions	Restoration of Site	Monitoring Consultant/ Contractor's Representative
Module-II	PWD Staff, PWD Engineers, Staff of MC, Engineering Staff of Contractor	Lecture Sessions, Presentation, Workshop and lesson learned	Reporting Formats for Restoration	Monitoring Consultant/ Contractor's Representative
Module for Training after Construction before Start of Monitoring				
Module-I	PWD Staff, PWD engineers	Lecture Sessions, Presentation and Workshop	Environment Monitoring	Monitoring Consultant/ Contractor's Representative
Module-II	PWD Staff, PWD engineers	Lecture Sessions, Presentation, Workshop	Reporting Formats	Monitoring Consultant/ Contractor's Representative

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9 ENVIRONMENTAL MANAGEMENT PLAN

9.1 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The Environmental Management Action Plan (EMP) is required to ensure sustainable development of the road during construction and operational phases. EMP is location and time specific. In general, PWD, Nagaland and Manipur (with assistance from Contractor and Monitoring Consultant) is the responsible entity for ensuring that the mitigation measures are carried out. Mitigation measures for impacts are listed in Annexure 9.1. The list provides reference (MoRT&H specification), implementing organization and responsible entity.

9.1.1 Specific Activities by PWD, Nagaland and Manipur

The role of PWD in the implementation of EMP involves the following activities:

- NOC from Nagaland and Manipur State Pollution Control Board under Air and Water Act
- Permission from Forest / District Administrative Department for felling of trees.
- Supervision of implementations of EMP through Contractor and Monitoring Consultant

9.1.2 Specific Activities by Contractor

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

- Confirm the Tree Cutting Schedule based on the final design and provide the same to PWD
- Felling of trees after PWD secures Forest Department's/ District Administrative Department's permissions
- Selection of material sources (quarry, water, sand etc).
- Selection, design and layout of construction areas, hot mix and batching plants, labour camps etc.
- Apply for and obtain all the necessary clearances from the agencies concerned after finalizing the locations of the sites.
- Planning traffic diversions and detours including arrangements for temporary land utilization on lease basis
- Plant and maintain of flowering, shade, medicinal, ornamental & fruit bearing trees in suitable area for the entire duration of the contract period
- Planting and maintenance of ornamental, medicinal & flowering plants and shrubs for the entire duration of the contract period

9.2 SITE SPECIFIC MANAGEMENT PLAN

9.2.1 Cultural Properties

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

9.2.2 Sensitive Features

- Noise barriers in the form of compound walls have been proposed.
- The educational institutes and hospitals wherein no direct impacts of the road widening shall happen, the existing compound walls shall be raised to a height of 2m.
- In case wherein direct impact, there shall be partial impacts, new boundary wall which shall also act as noise barrier shall be constructed to a height of 2 m.
- The Contractor shall provide proper cautionary/information sign board or other facilities like barricading near schools & hospitals (if found necessary during construction)

9.2.3 Water Quality

- Oil Interceptor at Camp site have been proposed

9.2.4 Wildlife Movement Sections

- No wildlife sanctuary found within 5km of the project road.
- Maintenance of accidental road kill records

9.2.5 Community properties

- The relocation / rehabilitation of affected community resources shall be as per the RAP.
- New bus bays and truck lay byes are proposed

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9.3 IMPLEMENTATION OF EMP

The Environmental Officer of the Contractor should be available for the entire duration of the project. The Environmental Officer shall be primarily responsible for compliance of EMP. The Environmental Specialist of the Monitoring Consultant who should ideally be deployed for the entire duration shall monitor the compliance of the EMP. The key issues that require special attention along with the mitigations and enhancement measures to be implemented have been detailed in Annexure 9.1.

9.4 ENVIRONMENTAL MONITORING PROGRAMME

The Environmental Monitoring Programme has been detailed out in Annexure 9.2 along with stipulated standards. Successful implementation of the Environmental Monitoring Program is contingent on the following:

- The Monitoring Consultant to request the Contractor to commence all the initial tests for monitoring of air, water quality, soil and noise levels early in the contract to establish the 'base line' i.e. to assess the existing conditions prior to effects from the Construction activities being felt.
- The Monitoring Consultant to request the Contractor to submit for approval a proposed schedule of subsequent periodic tests to be carried out.
- Monitoring by the Monitoring Consultant of all the environmental monitoring tests, and subsequent analysis of results.
- Where indicated by testing results, and any other relevant on-site conditions, Monitoring Consultant to instruct the Contractor to:
 - Modify the testing schedule (dates, frequency)
 - Modify (add to or delete) testing locations
 - Verify testing results with additional testing as/if required
 - Require recalibration of equipment, etc., as necessary
 - Request the Contractor to stop, modify or defer specific construction equipment, processes, etc., as necessary, that are deemed to have contributed significantly to monitoring readings in excess of permissible environmental "safe" levels.

9.4.1 Monitoring of Earthworks Activities

Most of the environmental problems related to the construction works are anticipated to be associated with the earthworks, particularly for the Quarries and Borrow Areas. Details regarding the guidelines and procedures adopted to minimize the environmental impacts of opening, operating and closing of Quarries and Borrow Areas are presented in Annexure 7.1, 7.2, 7.3, 7.4, 7.5 & 7.6. Other environmental effects associated with the earthworks include the development of adequate temporary drainage to minimize detrimental effects (e.g. erosion) due to run-off, and safety aspects related to Works implementation.

9.4.2 Monitoring of Contractor 's Facilities, Plant and Equipment

All issues related to negative environmental impacts of the Contractor 's facilities; Plant and equipment are to be controlled through:

- The Contractor 's self-imposed quality assurance plan
- Regular / periodic inspection of the Contractor 's plant and equipment
- Monthly appraisal of the Contractor .

Other environmental impacts are to be regularly identified and noted on the monthly appraisal inspection made to review all aspects of the Contractor's operation. The Monitoring Consultant is to review all monthly appraisal reports, and instruct through team leader to the Contractor to rectify all significant negative environmental impacts.

9.5 BUDGET

The EMP cost has been presented in below table. The budgeted cost of EMP is Rs. 10.114 Cr. Excluding forest cost which will be finalized by joint inspection with forest department. The EMP Cost including all 5 packages, Package wise EMP Cost is given in Main volume of DPR.

Table 9-1: Project Road-Wise Environmental Budget

Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Crores
1	MITIGATION / ENHANCEMENT COST						

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Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Crores
1.1	Pre-construction Stage						
1.1.1	Land acquisition		Covered in RAP Budget			0.00	0.000
1.1.2	Water	Relocation and construction of affected hand pumps, water storage tanks, open wells, water taps, OHT etc. as per directions of the Engineer.	Covered in Utility Shifting Budget			0.00	0.000
1.2	Construction Stage						
1.2.1	Horticulture	Compensatory Re-plantation to offset the loss of trees due to widening of the project corridor in accordance to the relevant forest laws (Minimum of 2 trees planted for every tree cut) including Plantation and maintenance at locations & as per directions of the forest department or administrative department	No.	0	-	-	0.000
1.2.2		Planting of flowering, shade, medicinal, ornamental & fruit bearing trees in suitable area @ 167 numbers per Km. (single row Hill side) in rural areas	No.	21710	2,000.00	4,34,20,000.00	4.342
1.2.3		circular tree guard & /other for protection of plantation	No.	21710	500.00	1,08,55,000.00	1.086
1.2.4		Landscaping and aesthetics of junctions and at other loactions as per design, drawings and direction of the Environmental Engineer /	LS	-	-	-	0.000

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Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Crores
		Environmental Specialist of the Engineer					
1.2.5	Slope / Embankment protection	Turfing of embankment with grasses and herbs.	sq. m. (Covered in Engineering Cost)			0.00	0.000
1.2.6	Soil & Ground Water	Providing Oil Interceptors as per design and drawing at vehicle areas workshop area and as per directions of the Environmental Specialist / Environmental Engineer of the Engineer.	Nos.	2	30,000.00	60,000.00	0.006
1.2.7	Surface Water	Silt Fencing for Water Bodies adjacent to the road	running m	0	-	-	0.000
1.2.8	Flora	Cost of transport & distribution of cooking fuel to construction workers to prevent indiscriminate felling of trees	Months	30	20,000.00	6,00,000.00	0.060
1.2.9	Air	Dust Management with sprinkling of water, covers for vehicles transporting construction material	Km	130.390	30,000.00	39,11,700.00	0.391
1.2.10	Noise	1) provision of and 2) Dismanteling and new construction of compound wall of noise sensitive features upto a height of total 2m above ground level complete in all respect as per Technical Specifications and as per the direction of the Engineer.	running m	200	2,500.00	5,00,000.00	0.050

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Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Crores
1.2.11	Solid Waste Disposal	Disposal of Sewage and other wastes in the construction yard and labour camps as per directions of the Environmental Specialist / Environmental Engineer of the Engineer.	Month	30	15,000.00	450000.00	0.045
1.2.12	Cultural properties	Relocation of cultural properties	Covered in RAP Budget				0.000
1.2.13	Roadside amenities	Construction of Bus Bays	Covered in Engineering Cost			0.00	0.000
1.2.14	Wildlife	Signage – Information (size 900 x 1800 mm) including lettering as per IRC code: for every Km at both Sides/ as per the direction of Environmental Specialist / Environmental Engineer of the Engineer	No	0	0	0.00	0.000
1.2.15		Signage – Information (size 1200 x 600 mm) including lettering as per IRC code for every Km at alternate Sides/ as per the direction of Environmental Specialist / Environmental Engineer of the Engineer	No	0	0	0.00	0.000
1.2.16		Cautionary/ Warning signs (900 mm Eq. triangle) as per IRC code: for every Km at both Sides/ as per the direction of Environmental Specialist / Environmental Engineer of the	No	0	0	0.00	0.000

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Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Crores
		Engineer					
1.2.17		Mandatory / Regulatory sign (60 cm circular) as per IRC code: for entire section of project road for every 2 Km at alternate side / as per the direction of Environmental Specialist / Environmental Engineer of the Engineer	No	0	0	0.00	0.000
1.3	Operation Stage						
1.3.1	Horticulture	Maintenance of flowering, shade, medicinal, ornamental & fruit bearing trees in suitable area @ 400 numbers per Km. (single row of 200 on each side) in rural areas for 3 Years	No.	0	-	-	0.000
TOTAL MITIGATION / ENHANCEMENT COST						5,97,96,700.00	5.980
2	MONITORING COST						
2.1	Construction Stage						
2.1.1	Air	Sampling and monitoring ambient Air Quality and gaseous pollutants as per CPCB Standard Procedures at 11 locations including approved hot mix plant locations, sensitive area and chainages as per direction by Environmental Specialist / Environmental Engineer of the Monitoring Consultant for three seasons a year for 2.5 years	No. of Samples	1980	2,000.00	39,60,000.00	0.396

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Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Crores
		as per the Monitoring Plan given in EMP					
2.1.2		Analysis charges of Ambient air from samples collected for parameters as per AAQ Standards Notification, 2009 in consultations and directions of the Engineer and NH-29 as per MoEF charges.	No. of Samples	1980	8,000.00	1,58,40,000.00	1.584
2.1.3	Water Quality	Collection of grab samples of water quality at 11 locations at chainages identified by the engineer for 2.5 years (twice a year) in pre & post monsoon seasons as per the Monitoring Plan given in EMP /as per direction of Environmental Specialist / Environmental Engineer of the Monitoring Consultant	No. of Samples	55	400.00	22,000.00	0.002
2.1.4		Analysis of water quality at locations in the monitoring plan for pH, Turbidity, total solids, turbidity COD, BOD, DO, Chlorides, Hardness, Oil & Grease, TSS, TDS, Total Coliform, Iron, Fluorides, Nitrates, E. coli, Total coliform and faecal	No. of Samples	55	6,000.00	3,30,000.00	0.033

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Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Crores
		coliform as specified in "Standard Methods for Examination of Water and Wastewater" published by WEF, AWWA and APHA as per direction of Environmental Specialist / Environmental Engineer of the Engineer and as per MoEF rate list.					
2.1.5	Noise	Monitoring Noise level at Equipment Yards, Sensitive area and Settlements using hand held noise meters at 11 locations at chainages identified by the Engineer as per directions of Environmental Specialist / Environmental Engineer of the Monitoring Consultant for three seasons in a year for 2.5 years as per the Monitoring Plan given in EMP	Nos.	83	2,500.00	2,06,250.00	0.021
2.1.6	Soil	Monitoring Soil at 11 locations at chainages identified by the Engineer as per directions of Environmental Specialist / Environmental Engineer of the Monitoring Consultant for twice a year for 2.5 years as per the Monitoring Plan given in EMP	Nos.	55	2,501.00	1,37,555.00	0.014

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Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Crores
2.1.7	Transportation Cost	Transportation cost for monitoring of noise, air and water during construction period	L.S.	-	1,87,500.00	1,87,500.00	0.019
2.1.8	Environmental Enhancement		LS		0.00	0.00	0.000
2.1.9		Facility for Roadside Drinking Water	10		2,00,000.00	2,00,000.00	0.020
2.2	Operation Stage						
2.2.1	Air	Sampling and monitoring ambient Air Quality and gaseous pollutants as per CPCB Standard Procedures at 6 locations including sensitive area and chainages as per direction by Environmental Specialist of Consultant for once in a month for 3 months x 3 season in every alternate year for 4 years	No. of Samples	1296	2,000.00	25,92,000.00	0.259
2.2.2		Analysis charges of Ambient air from samples collected for parameters as per AAQ Standards Notification, 2009 in consultations and directions of the Consultant and PWD as per MoEF charges.	No. of Samples	1296	8,000.00	1,03,68,000.00	1.037
2.2.3	Water Quality	Collection of grab samples of water quality at 6 locations at chainages for twice a year in pre & post monsoon seasons in every alternate year for 4 years as per direction of	No. of Samples	48	400	19,200.00	0.002

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Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Crores
		Environmental Specialist / Environmental Engineer of the Consultant					
2.2.4		Analysis of water quality at locations in the monitoring plan for pH, Turbidity, total solids, COD, BOD, DO, Chlorides, Hardness, Oil & Grease, TSS, TDS, Total Coliform, Iron, Fluorides, Nitrates, E. coli, Total coliform and faecal coliform etc. as specified in "Standard Methods for Examination of Water and Wastewater" published by WEF, AWWA and APHA as per direction of Environmental Specialist / Environmental Engineer of the Consultant and as per MoEF rate list.	No. of Samples	48	6,000.00	2,88,000.00	0.029
2.2.5	Noise	Monitoring Noise level at Sensitive area and Settlements using hand held noise meters at 6 locations for once a year for every alternate year for 4 years as per directions of Environmental Specialist / Environmental Engineer of the Monitoring Consultant	Nos.	24	2,500.00	2,25,000.00	0.023

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Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Crores
2.2.6	Soil	Monitoring Soil at 6 locations at chainages identified by the Engineer as per directions of Environmental Specialist / Environmental Engineer of the Engineer for once a year for 1 year as per the Monitoring Plan given in EMP	Nos.	12	2,501.00	30,012.00	0.003
2.2.7	Transportation Cost	Transportation cost for monitoring of noise, air and water during operation period for 4 years considering every alternate year.	L.S.	-	3,75,000.00	3,75,000.00	0.038
TOTAL MONITORING COST						3,47,80,517.00	3.478
3	MISCELLANEOUS COST						
3.1	Training	Training	L.S.	-	2,50,000.00	2,50,000.00	0.025
3.2	Advocacy and Policy Making	Holding meetings for policy planning and subsequent review meetings with Revenue Department, Forest Department, local representatives, NGOs, etc. regarding development controls.	Year	12	15,000.00	1,80,000.00	0.018
3.3	Administrative Charges including logistics	Maintenance of vehicle with the Environment Cell, Data processing, administrative support, stationery etc.	Months	30	35,000.00	10,50,000.00	0.105
3.4	Miscellaneous Items	Digital Camera for the Environment Cell	No.	1	15,000.00	15,000.00	0.002
3.5		Portable sound level meter	No.	1	2,50,000.00	2,50,000.00	0.025
TOTAL MISCELLANEOUS COST						17,45,000.00	0.175
TOTAL COST						9,63,22,217.00	9.632

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Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Crores
Contingency @ 5% on Total Environmental Cost						4816110.85	0.482
GRAND TOTAL						101138327.85	10.114
Rate per kilometer						775660.16	0.08

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10 DISCLOSURE OF CONSULTANT

10.1 CONSULTANT'S DETAILS

Feedback Infra Pvt. Ltd. (FIPL) is India's leading integrated infrastructure Services Company, with a mission of *"Making Infrastructure Happen"*. Totally focused on infrastructure development, Feedback Infra offers an integrated suite of services across the core and social sectors of infrastructure. FIPL is known for its innovative work and for operationalising challenging projects in difficult locations. No wonder, 17 of India's 50 biggest listed companies are Feedback's clients. So are the governments of 22 of the 28 Indian states and 4 of India's 7 Union Territories. FIPL is presently working on more than 35,000 MW of new power generation capacity; 20,000 km of National and State Highways; 100,000 acres of real estate development and a building area of more than 22 million square feet.

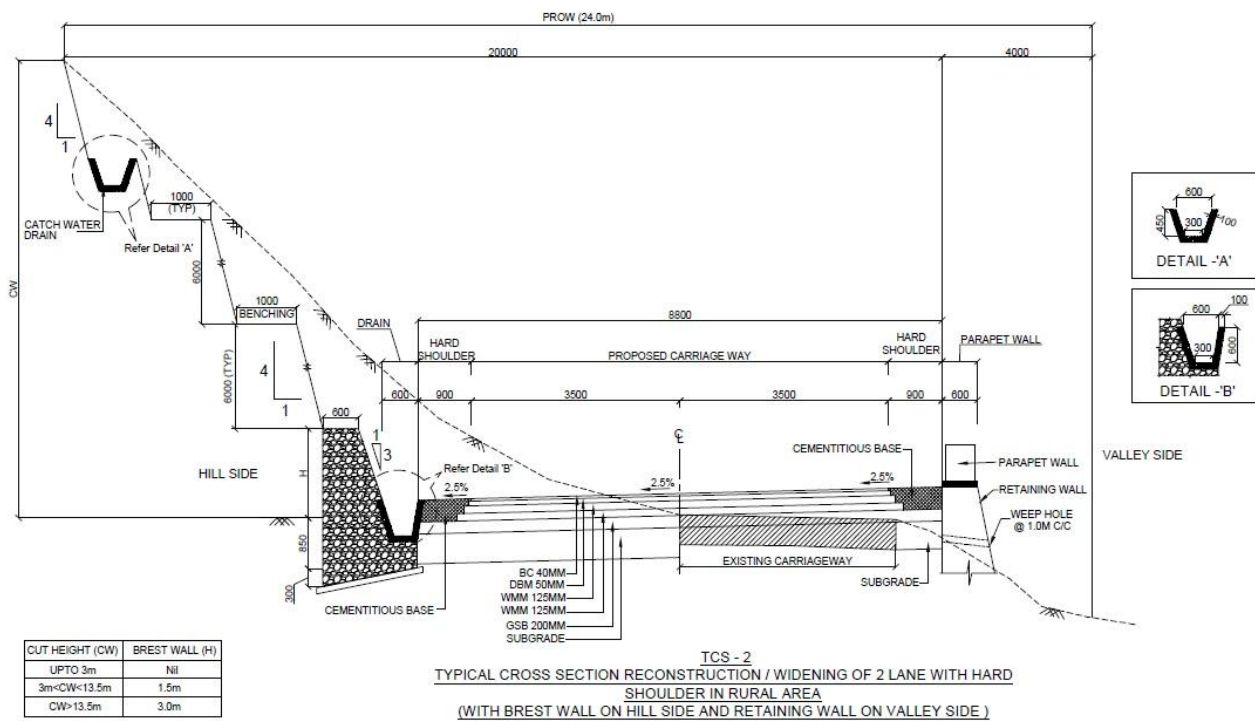
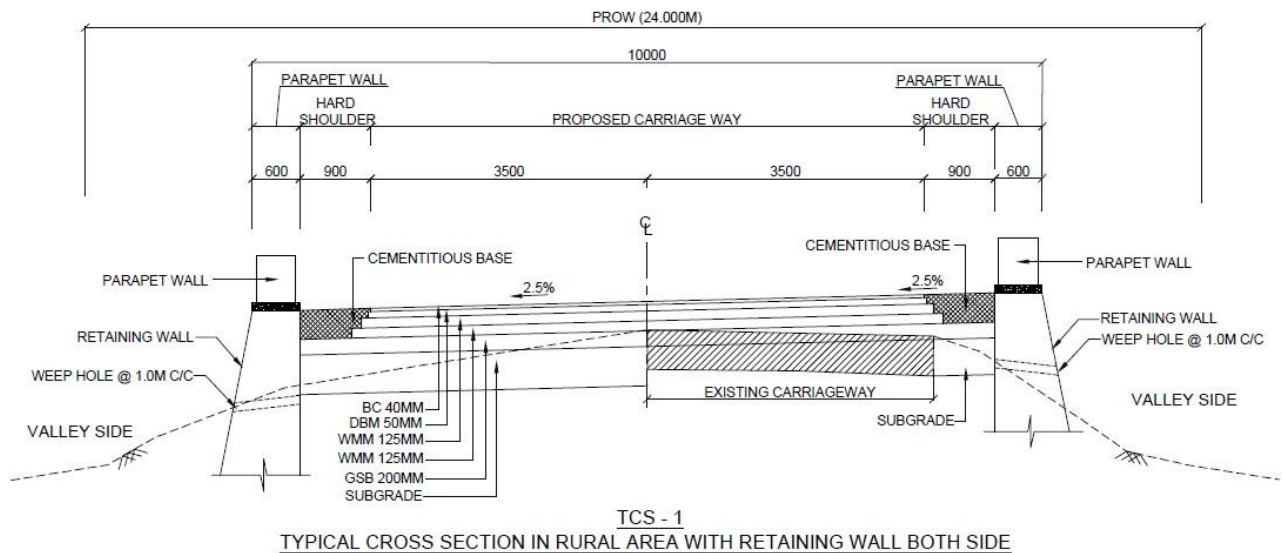
This is enabled by a large pool of multidisciplinary experts; cutting-edge functional and domain knowledge; an all-India network of offices with corporate HQ at Gurgaon and 6 Regional Offices at Mumbai, Bangalore, Gandhinagar, Chandigarh, Kolkata & Hyderabad besides a host of site & project offices; and a strong shareholding — L&T, IDFC, and HDFC. FIPL offers a range of services including EIA across eleven focused infrastructure sectors including Transportation & Logistics (including highways, railways, MRTS, ports, airports and logistics), Energy (including Power Generation, Transmission, Distribution, Coal & Mines and Oil & Gas), Housing & Townships, Commercial Infrastructure (including IT Parks, Corporate Offices & Commercial Buildings), Industrial Infrastructure, Water & Sanitation, Retail & Entertainment, Healthcare, Hospitality, Urban Development & SEZ.

FIPL has been approved by NABET for sector 34 (Highways, railways, transport terminals, mass rapid transport systems) vide MoM of 87th Accreditation Committee Meeting of QCI NABET held on September 11, 2012.

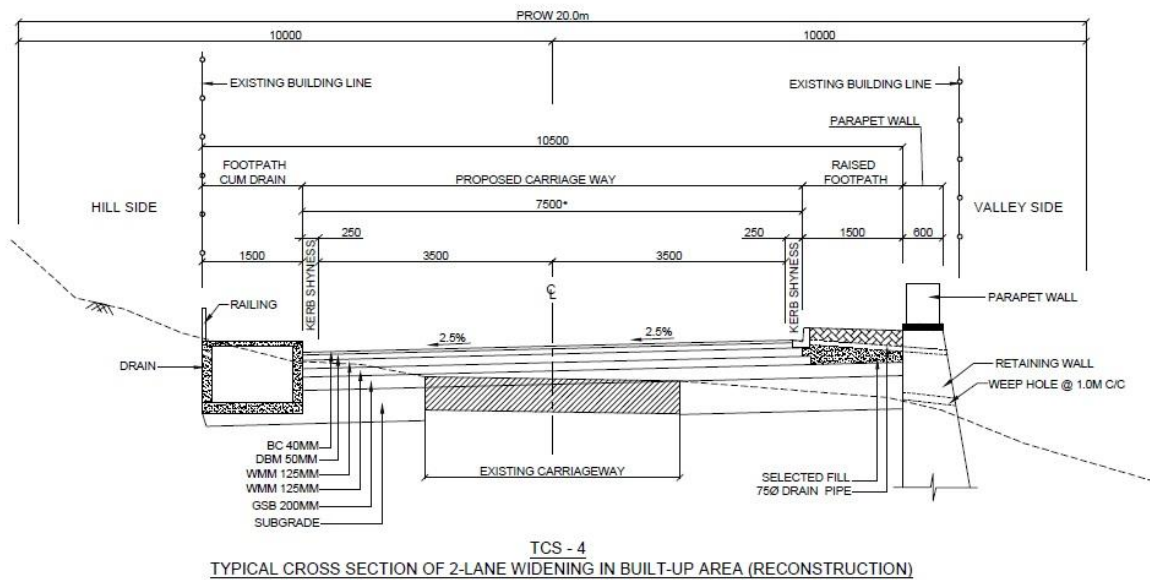
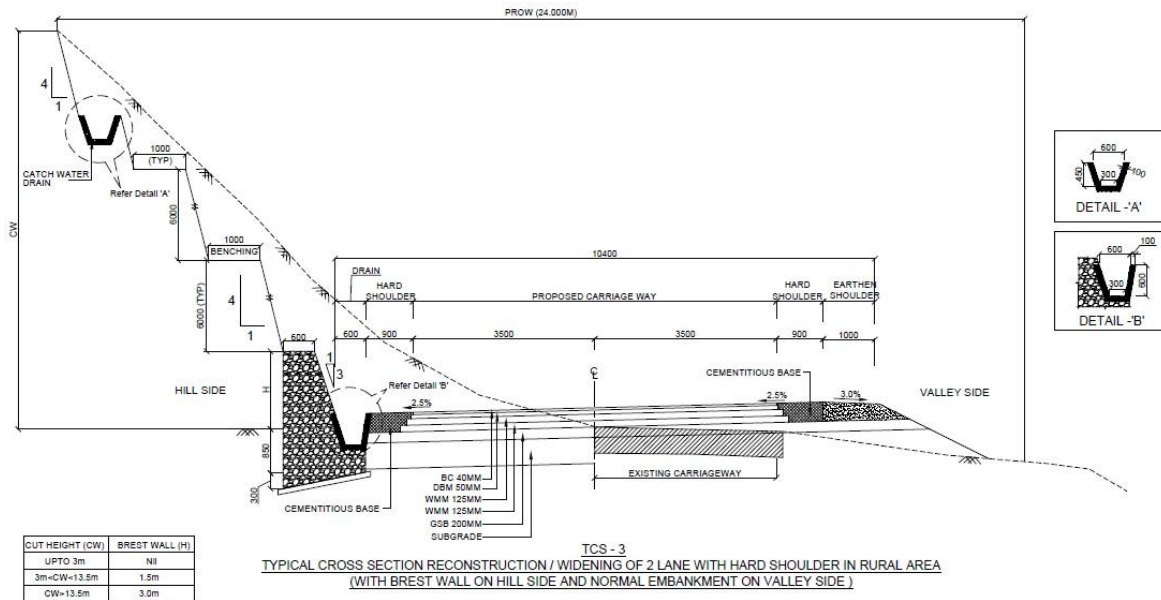
10.2 LABORATORY

Noida Testing Laboratory, Noida, has carried out the sampling and analysis for various soil, air, water, noise samples as per procedure & guidelines of Central Pollution Control Board and the requirements of MoEF on behalf of Feedback Infra Pvt. Ltd. The laboratory is a NABL accredited Laboratory.

Preparation of Feasibility Study and Detailed Project Report for Construction of 2 lane/2 lane with paved shoulder from Kohima to Nagaland/Manipur border section of NH-29 (Old NH-150) in the State of Nagaland

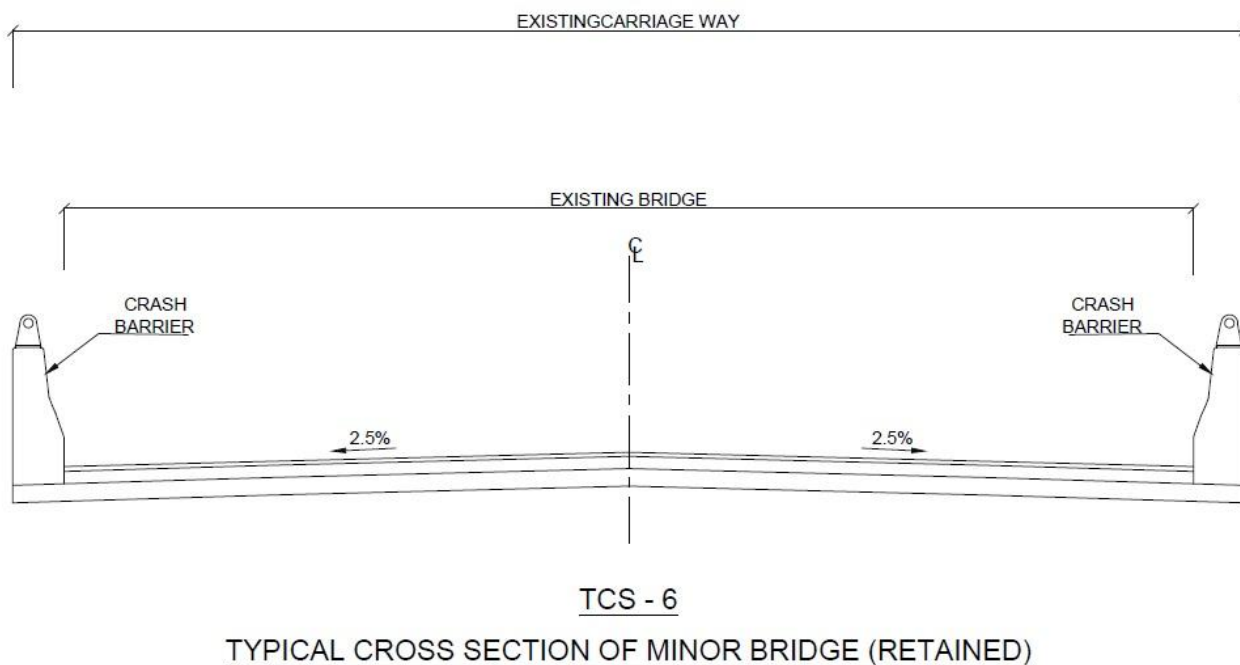
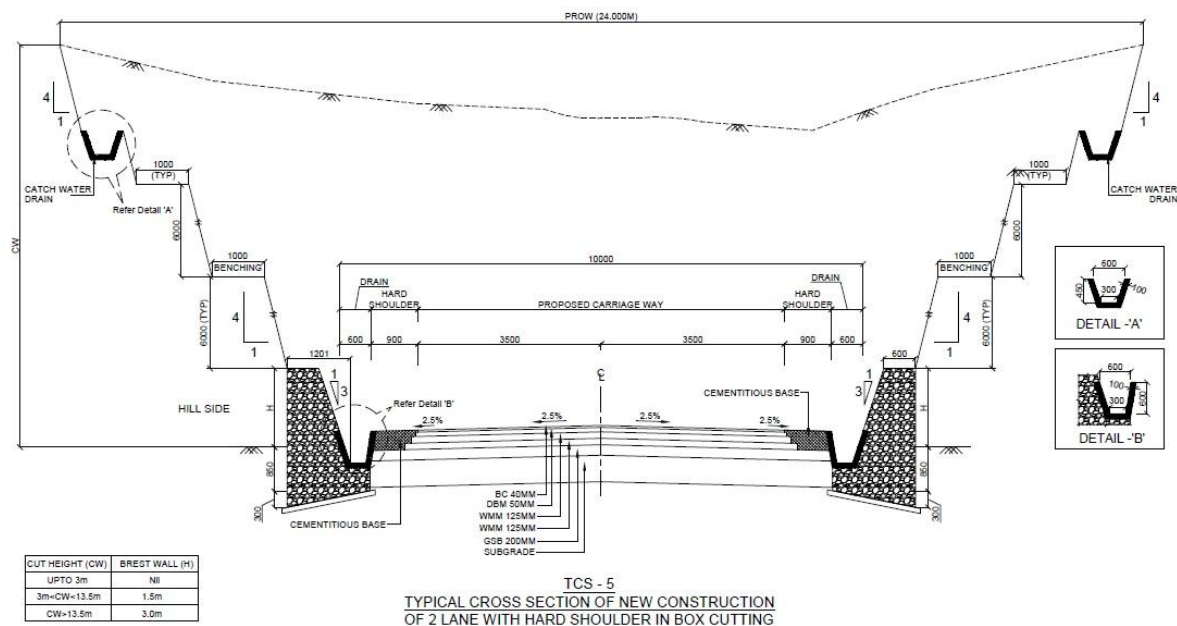


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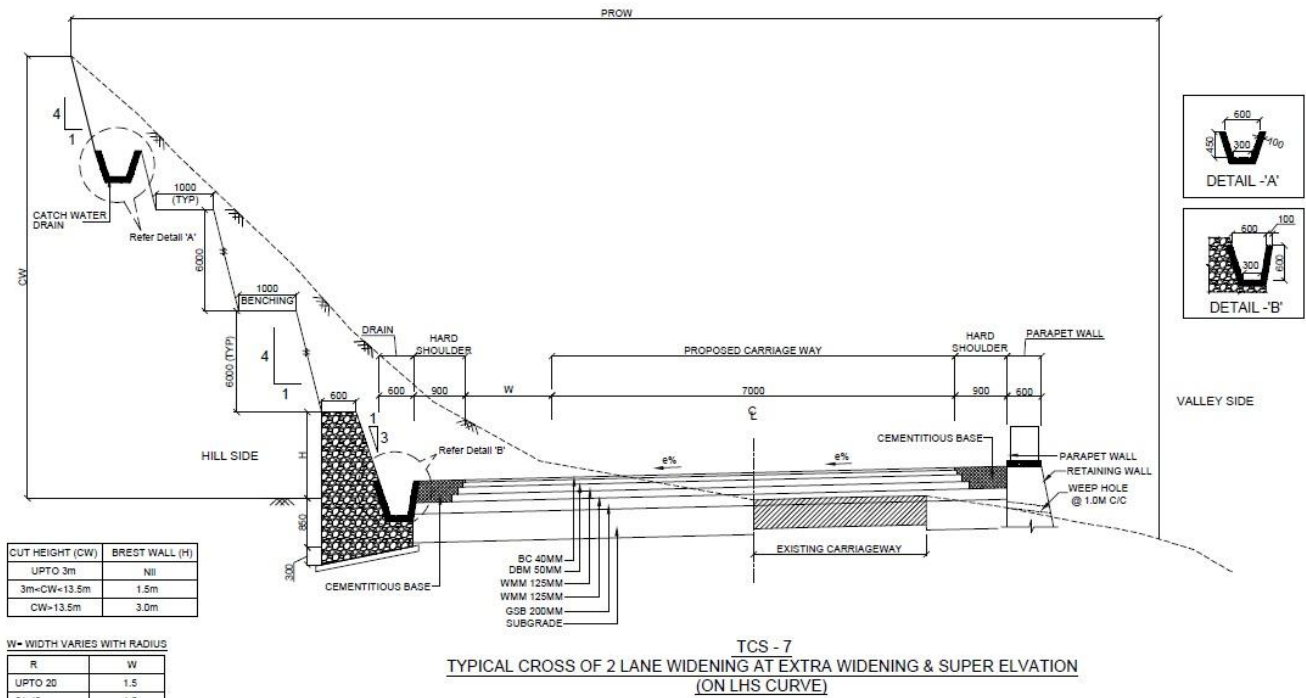


* IF WIDTH OF 7.5m IS NOT AVAILABLE INTERMEDIATE CARRIAGEWAY TO BE PROVIDED.

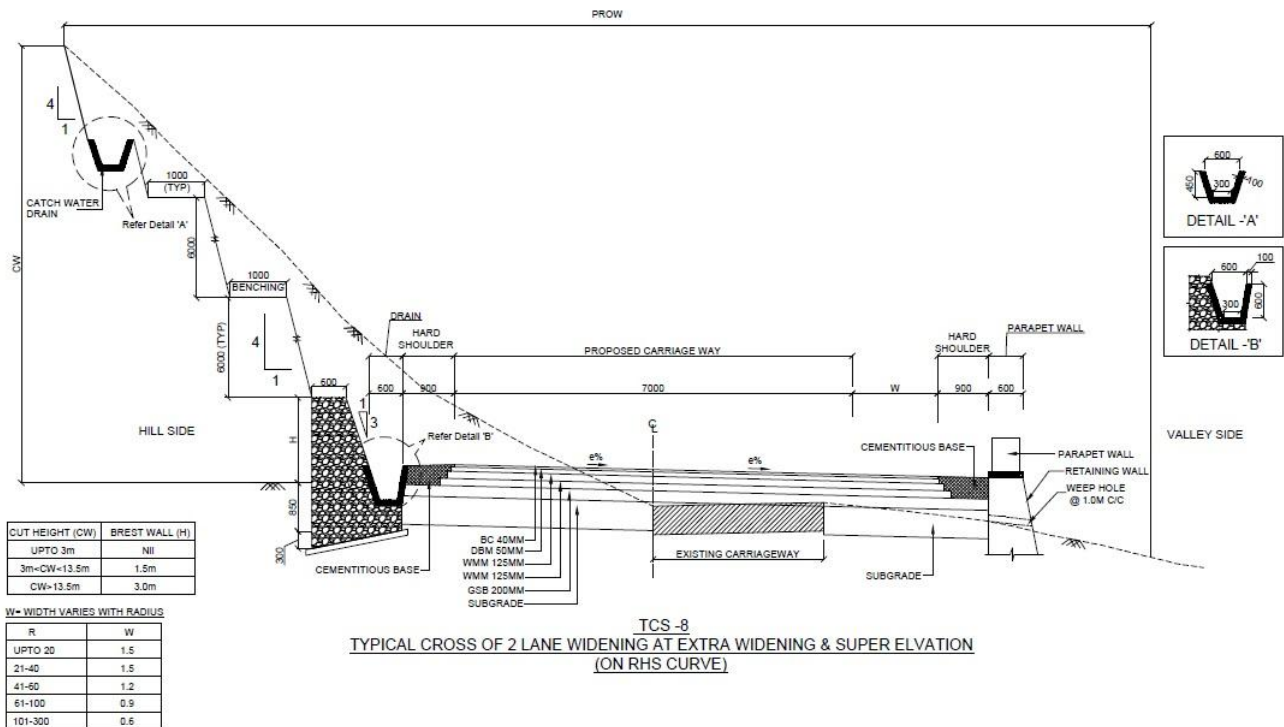
Preparation of Feasibility Study and Detailed Project Report for Construction of 2 lane/2 lane with paved shoulder from Kohima to Nagaland/Manipur border section of NH-29 (Old NH-150) in the State of Nagaland



Preparation of Feasibility Study and Detailed Project Report for Construction of 2 lane/2 lane with paved shoulder from Kohima to Nagaland/Manipur border section of NH-29 (Old NH-150) in the State of Nagaland



NOTE:- HILL SIDE / VALLEY SIDE MAY CHANGE & LOCATION OF HILLSIDE AND VALLEY SIDE IS GIVEN IN TCS SCHEDULE



NOTE:- HILL SIDE / VALLEY SIDE MAY CHANGE & LOCATION OF HILLSIDE AND VALLEY SIDE IS GIVEN IN TCS SCHEDULE

Ambient air, Noise and Soil sample collected from the same location Where as water sample collected from the different locations.

Figure 1: Common Sampling Locations for Air, Noise and Soil



Figure 2: AAQ-1 Rosama

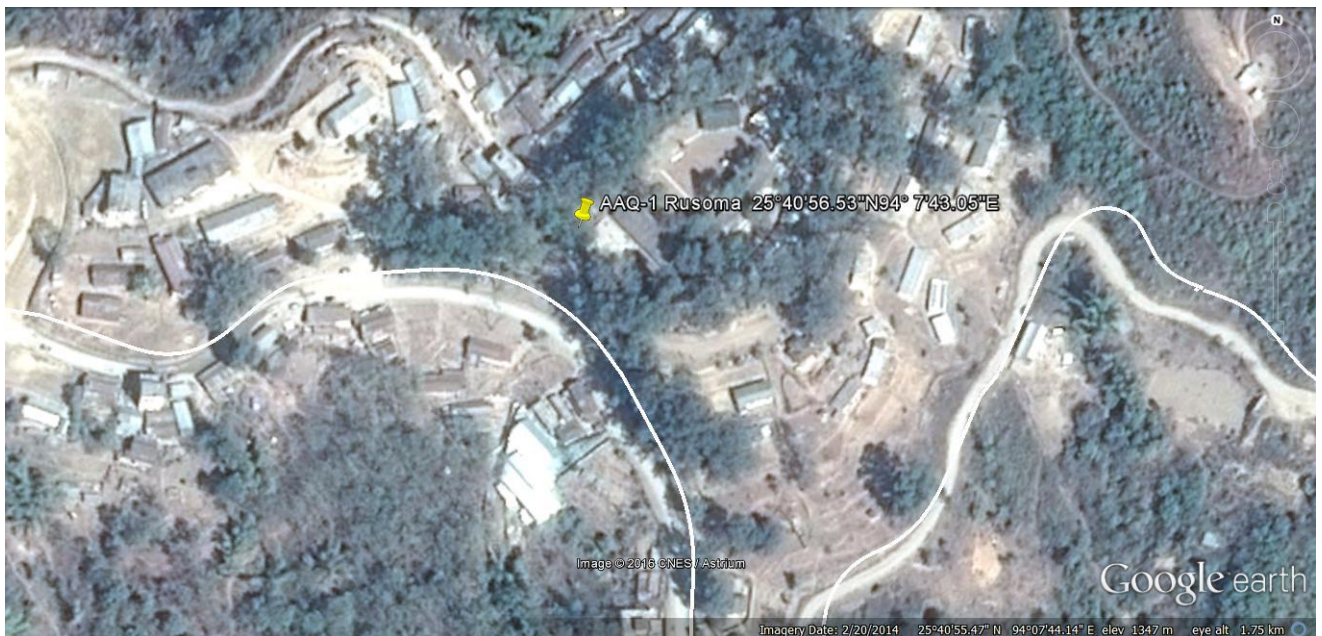


Figure 3: AAQ-2 Kikruma

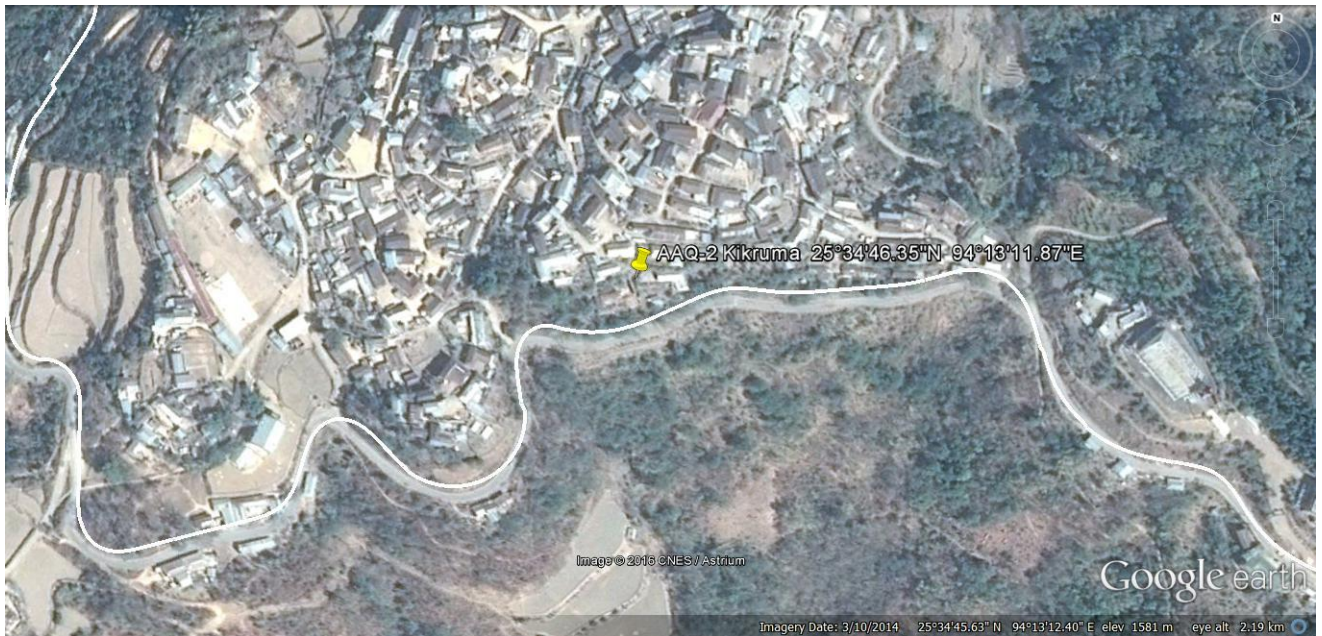


Figure 4: AAQ-3 Pfutsero

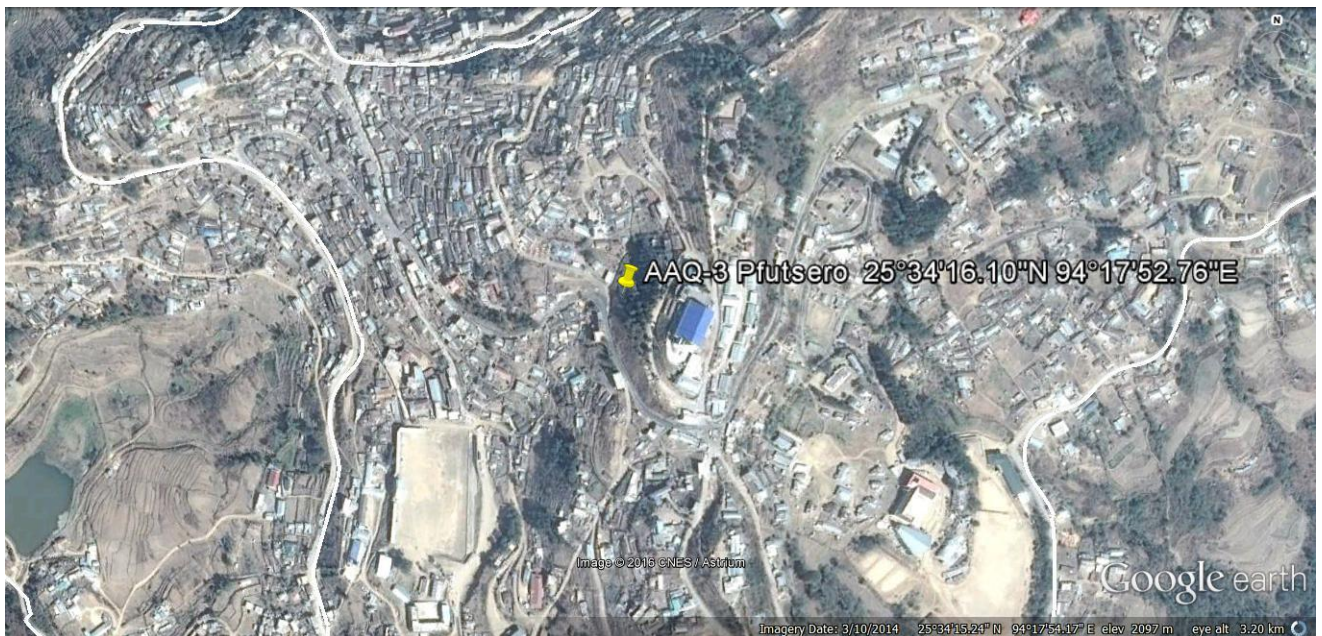


Figure 5: AAQ-4 Chizami (Nr. Baptist Church)

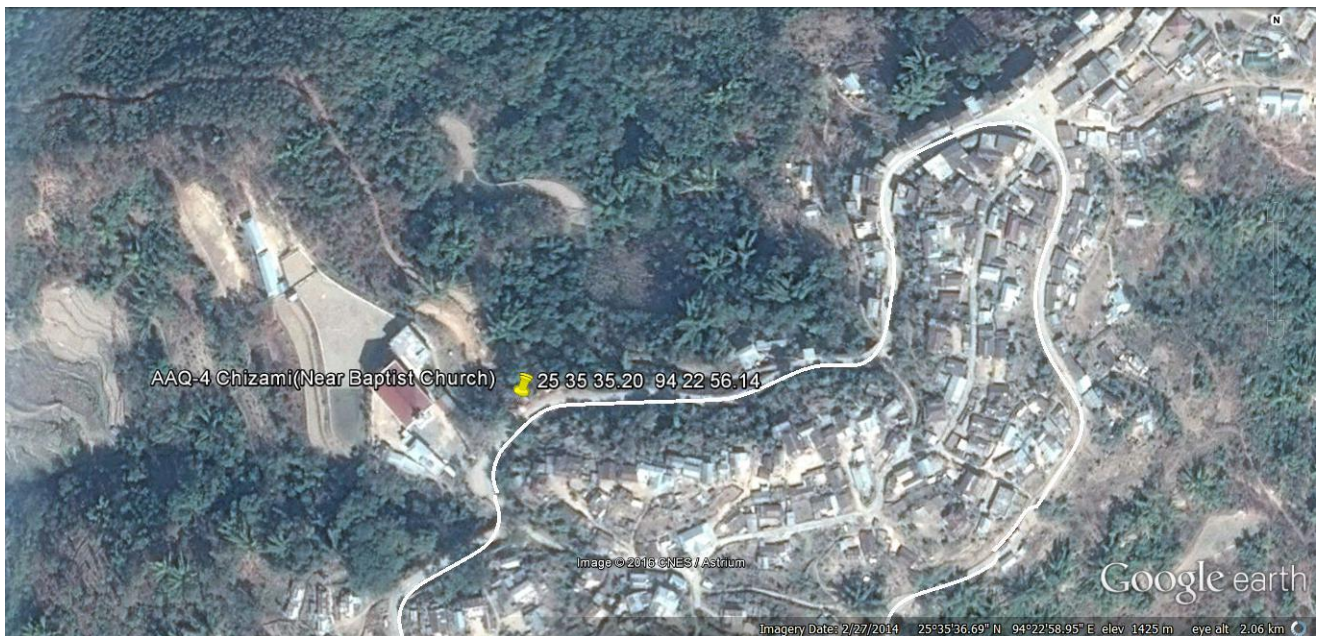


Figure 6: Ground Water -1 Rusoma

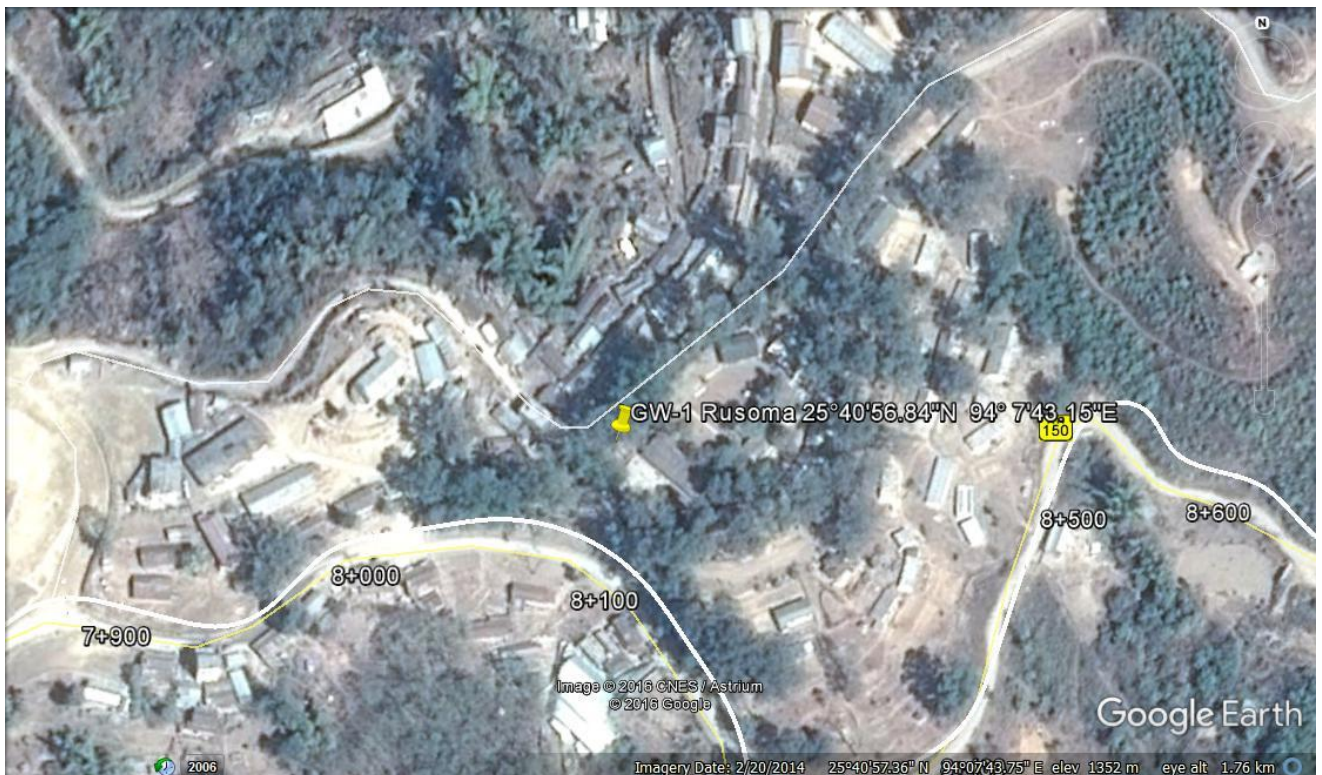


Figure 7: Ground Water-2 Psutsero

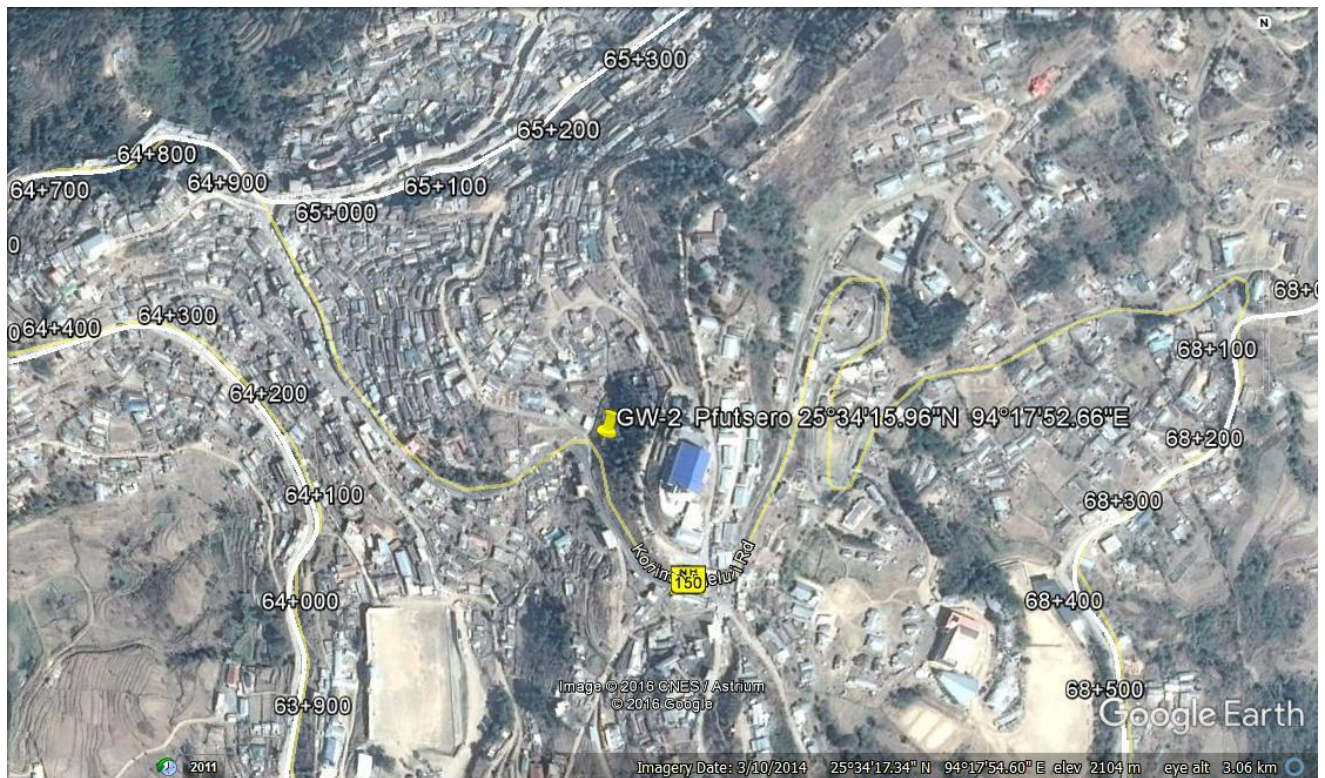


Figure 8: Surface Water Sampling Location-1(River Nr. Ch. 102+300)

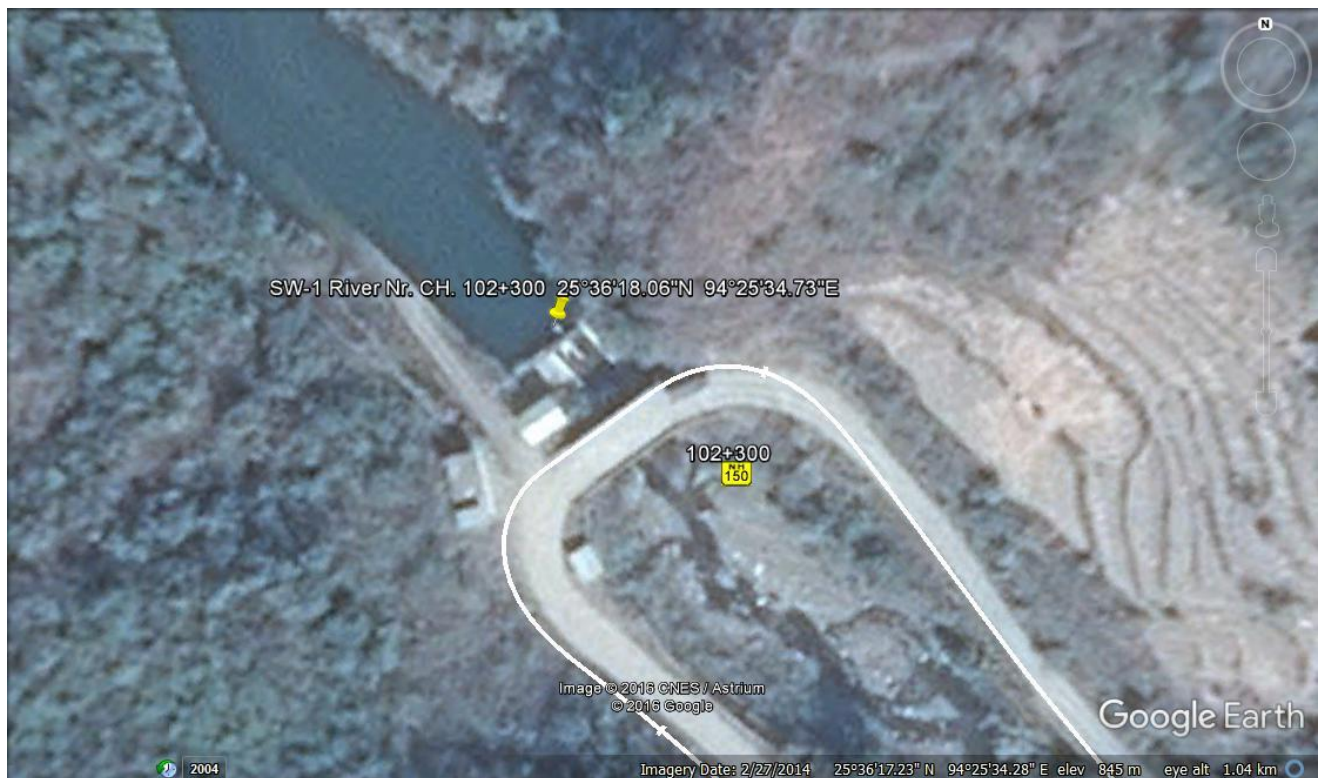
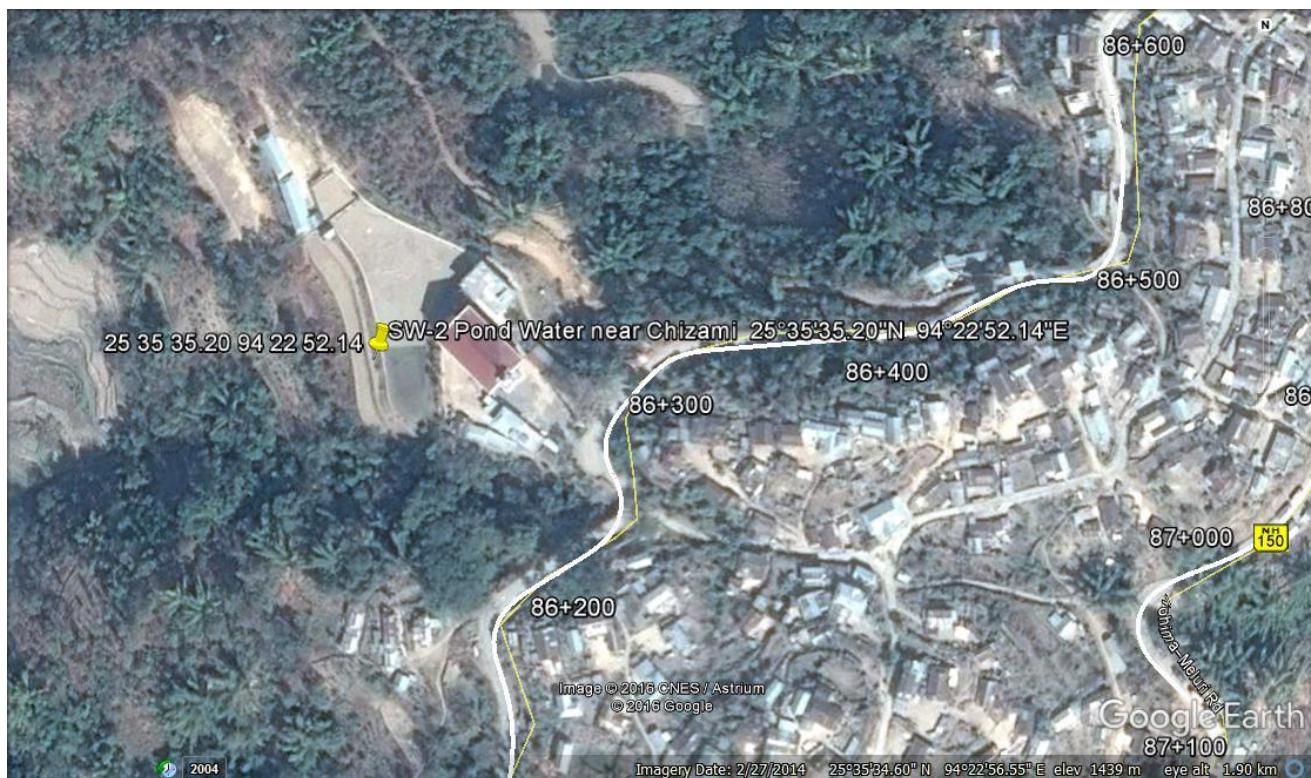


Figure 9: Surface Water Sampling Location-2; Pond Water Nr. Chizami





HOW TO READ THE SOIL MAP

The Soil Map of Manipur is published on 1:500,000 scale in one sheet. The Index Map given as first inset provides the location of districts in the state.

In order to know the soils of an area, first locate with the help of index map, in which the area of one's interest falls. After locating the area see the soil map unit numbers appearing in that area. The details of each soil map unit is given in the legend. The soil map unit is an association of soil families with dominant phases (if any).

The legend provides brief description of the dominant and associated (subdominant) soil families within a particular map unit, highlighting the soil depth, drainage, texture, slope, erosion, etc. The taxonomy of soils, as per USDA System of classification, and the extent of the area covered by each mapped unit along with its percentage of the total area of the state are given in separate columns. The dominant soils occupy 50 per cent or more, whereas the subdominant soils occupy more than 20 per cent but less than 50 per cent area of the unit.

The methodology adopted in the preparation of the soil map is given in NBSS publication 13 (Sehgal et al., 1987 2nd edition). The soil mapped units have been coloured at subgroup level to give a broad idea of major soils and their distribution pattern in the state.

The general information on annual rain fall, physiography and altitudinal zone have been presented in the inset Maps.

The soil map is accompanied by a soils bulletin [Executive Summary: NBSS Publ. 56-B] containing salient features of the mapped soils and information for land users and planners. A comprehensive account of soils has been given in the Detailed Version of Soils Bulletin (NBSS Publ. 56-A) which contains detailed descriptions of physical features, climate, physical and chemical soils properties, landform and soil relationship, interpreted information on alternative land uses, etc. The third publication on soils is database on soil-site characteristics of all the soil profiles, auger-holes and other observations, which are given in NBSS Publ. 56-C.



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REGIONAL CENTRE, JORHAT

in Co-operation with :
**DIRECTORATE OF HORTICULTURE AND
 SOIL CONSERVATION, MANIPUR**
 1996

CONTRIBUTORS

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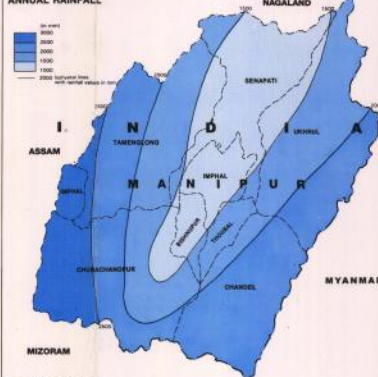
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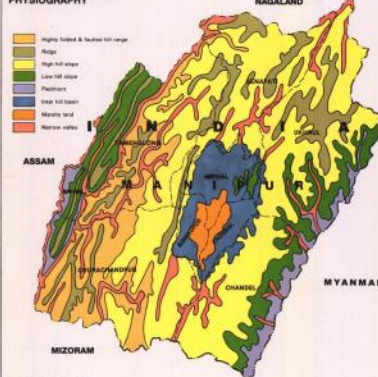
ADMINISTRATION



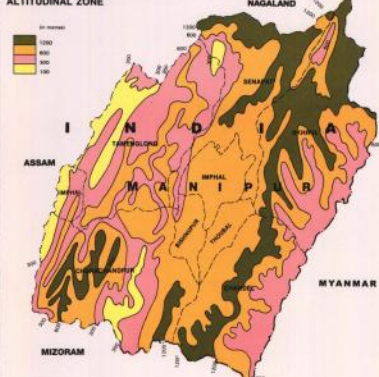
ANNUAL RAINFALL



PHYSIOGRAPHY



ALTIMETRIC ZONE



REFERENCES

- | | |
|--|----------------------------|
| | International Boundary |
| | State Boundary |
| | District Boundary |
| | State Headquarters |
| | District Headquarters |
| | Other Towns |
| | River and Stream |
| | Road |
| | National Highway Number |
| | Map Unit Boundary |
| | Marshes |
| | Sheet Rock, Rocky Slope |
| | Rock Outcrop, Boulders, |
| | Escarpment |
| | Waterlogged Area |
| | Moderate Surface Flooding |
| | Slight Surface Flooding |
| | Moderate Surface Stoniness |
| | Slight Surface Stoniness |

NOMENCLATURE

Inceptisols — Soils

- | | |
|--------------------|--|
| Inceptisols | Soils with weakly developed horizons showing definite alteration of parent material in the form of developing of soil structure or soil color. |
| Aquepts | Soils occurring in aquatic moisture regime of valley land. |
| Ochrepts | Soils with ochric, umbric or mollic epipedon. (>25 cm). |
| Umbrpts | Soils with umbric or mollic epipedon (> 25 cm). |
| Ustisols | Soils having clay-enriched B horizon with poor base status (<35% throughout). |
| Humults | Soils having 0-9 percent organic carbon in the upper 15 cm of the argillic horizon. |
| Udults | Ustisols that have a udic moisture regime. |
| Entisols | Soils without any pedogenic horizon except an epipedon, the soils retain their original (parent material) structure. |
| Orthents | Common of typical soils occurring on step to very steep hill slopes of erosional surface. |
| Alfisols | Soils having clay-enriched B horizon with medium base status (>35%). |
| FLOODING | |
| Moderate | Accumulation of water due to seasonal precipitation for <3 months and occasional overflod. |
| STONINESS | |
| Slight | Covering <15% area. |
| Moderate | Covering 15% to 40% area. |

FLOODING

- | | |
|----------|--|
| Moderate | — Accumulation of water due to precipitation for <3 m occasional overflow. |
| | STONINESS |
| Slight | — Covering <15% area. |
| Moderate | — Covering 15% to 40% area. |

LEGEND

Mapping Unit	Description	Taxonomy*	Area (1 '000 ha (%))
1	2	3	4

SOILS OF NORTH EASTERN HILL RANGES

PURVACHAL : LOW AMPLITUDINAL HILLS

Drop, wet drained, fine lumpy surface occurring on strongly sloping side slopes of hills or ridges. Moderate erosion, moderate to severe soil stress.	<ul style="list-style-type: none"> ○ Fine, Urtic. Eriogonum ○ Fine, Type: Helianthus 	27 (1)
Drop, excessively drained, the soil occurring on strongly sloping side slopes of hills or ridges. Moderate erosion, moderate to severe soil stress.	<ul style="list-style-type: none"> ○ Fine, Type: Eriogonum ○ Fine, Type: Helianthus 	280 (1)
Moderately sloping, excessively drained, clayey soil on moderate steep slopes of hills or ridges. Moderate erosion, moderate to severe soil stress.	<ul style="list-style-type: none"> ○ Clayey, Urtic. Eriogonum ○ Clayey, Urtic. Eriogonum 	172 (1)
Drop, excessively drained, fine lumpy soil on moderately sloping side slopes of hills or ridges. Moderate erosion, moderate to severe soil stress.	<ul style="list-style-type: none"> ○ Fine, Urtic. Eriogonum ○ Fine, Type: Helianthus 	109 (1)

SOILS OF NORTH EASTERN HILL RANGES

PURVACHAL : HIGH AMPLITUDINAL HILLS

	Deep, excessively drained, fine soils on moderately steep slope; sides of hills having clayey surface with moderate erosion, associated with Deep, well drained, fine soils on moderately steep slope; sides of hills with moderate erosion and slight stoniness.	0	Fine Uniform Dystrophic Fines Typic Hapludults	0.01 0.01 0.01
	Deep, well drained, fine soils on moderately steep slope; sides of hills having clayey surface with moderate erosion, associated with Deep, well drained, fine soils on moderately steep slope; sides of hills with moderate erosion and slight stoniness.	1	0	18.0
	Deep, well drained, fine soils on moderately steep slope; sides of hills having clayey surface with moderate erosion, associated with Moderately Deep, excessively drained, clayey skeletal soils on moderately sloping sides of hills with slight erosion and slight stoniness.	2	0	100.0
	Deep, well drained, fine soils on moderately steep slope; sides of hills having clayey surface with moderate erosion, associated with Moderately Deep, excessively drained, clayey skeletal soils on moderately sloping sides of hills with moderate erosion and slight stoniness.	3	0	100.0
	Deep, excessively drained, fine soils on moderately steep slope; sides of hills having clayey surface with moderate erosion, associated with Deep, well drained, fine soils on moderately steep slope; sides of hills with moderate erosion and slight stoniness.	4	0	55.0
	Deep, excessively drained, fine soils on moderately steep slope; sides of hills having clayey surface with moderate erosion, associated with Deep, well drained, fine soils on moderately steep slope; sides of hills with moderate erosion and slight stoniness.	5	0	100.0
	Deep, excessively drained, fine soils on moderately steep slope; sides of hills having clayey surface with moderate erosion, associated with Deep, well drained, fine soils on moderately steep slope; sides of hills with moderate erosion and slight stoniness.	6	0	170.0
	Deep, well drained, fine soils on gently to moderately sloping clayey surface with clayey surface with moderate erosion, associated with Moderately Deep, excessively drained, clayey skeletal soils on moderately steep slope; sides of hills with moderate erosion and slight stoniness.	7	0	167.0
	Deep, well drained, fine soils on gently to moderately sloping clayey surface with clayey surface with moderate erosion, associated with Moderately Deep, excessively drained, clayey skeletal soils on moderately steep slope; sides of hills with moderate erosion and slight stoniness.	8	0	100.0
	Deep, somewhat excessively drained, the soils on moderately steep sides slopes of hills having clayey surface with moderate erosion, associated with Deep, excessively drained, clayey skeletal soils on moderately steep slope; sides of hills with moderate erosion and slight stoniness.	9	0	100.0
	Deep, excessively drained, clayey skeletal soils on moderately steep slope; sides of hills having clayey surface with moderate erosion, associated with Deep, excessively drained, clayey skeletal soils on moderately steep slope; sides of hills with moderate erosion and slight stoniness.	10	0	100.0
	Deep, well drained, fine soils on moderately steep slope; sides of hills having clayey surface with moderate erosion, associated with Deep, well drained, fine soils on moderately steep slope; sides of hills with moderate erosion and slight stoniness.	11	0	209.0
	Deep, well drained, fine soils on moderately steep slope; sides of hills having clayey surface with moderate erosion, associated with Deep, well drained, fine soils on moderately steep slope; sides of hills with moderate erosion and slight stoniness.	12	0	58.0
	Deep, well drained, fine soils on moderately steep slope; sides of hills having clayey surface with moderate erosion, associated with Deep, well drained, fine soils on moderately steep slope; sides of hills with moderate erosion and slight stoniness.	13	0	2.0
	Deep, well drained, fine soils on moderately steep slope; sides of hills having clayey surface with moderate erosion, associated with Deep, well drained, fine soils on moderately steep slope; sides of hills with moderate erosion and slight stoniness.	14	0	2.0

SOILS OF NORTH EASTERN HILL RANGES

PURVACHAL : MANIPUR INTERHILL BASIN

	Deep, poorly drained, fine sand on level to nearly level clayey gravelly surface with very slight erosion, ground water table between 10 to two meters of the surface and moderate to severe flooding, associated with fine sand, gravelly clayey silty sand and silty clay with slight erosion	○ Fine, Typic Hypaquepts ○ Fine, Rhacic Udic Oxyaquicretes	13.6 (0.7)
	Deep, very poorly drained, fine sand, well drained, clayey silty sand, gravelly clayey silty sand and moderate to severe flooding, associated with fine sand, gravelly clayey silty sand and silty clay to moderately clayey silty sand of hills with severe erosion and strong flooding	○ Fine, Typic Hypaquepts ○ Clayey silty sand, Umbric Oxyaquicretes	11.4 (0.5)
	Deep, very poorly drained, very fine fine sand on level clayey gravelly surface with very slight erosion, ground water table below one meter of the surface and moderate to severe flooding, associated with fine sand, gravelly clayey silty sand and silty clay to moderately clayey silty sand of hills with severe erosion and strong flooding	○ Very fine, Typic Hypaquepts ○ Fine, Typic Hypaquepts	10.4 (0.7)
	Deep, extremely poorly drained, very fine sand on level clayey gravelly surface with very slight erosion, ground water table below one meter of the surface and moderate to severe flooding, associated with fine sand, gravelly clayey silty sand and silty clay to moderately clayey silty sand of hills with severe erosion and strong flooding	○ Very fine, Typic Hypaquepts ○ Very fine, Typic Hypaquepts	16.2 (0.7)
	Deep, extremely poorly drained, very fine sand on level clayey gravelly surface with very slight erosion, ground water table below one meter of the surface and moderate to severe flooding, associated with fine sand, gravelly clayey silty sand and silty clay to moderately clayey silty sand of hills with severe erosion and strong flooding	○ Very fine, Typic Hypaquepts ○ Fine, Paragelic Humaquepts	16.2 (0.7)
10	Deep, somewhat excessively drained, fine sand on level clayey gravelly surface with very slight erosion, ground water table below one meter of the surface and moderate to severe flooding, associated with fine sand, gravelly clayey silty sand and silty clay to moderately clayey silty sand of hills with severe erosion and strong flooding	○ Fine, Typic Hypaquepts ○ Fine, silty, Typic Hypaquepts	3.8 (0.2)
	Merchly land		42.9 (0.8)

* Mineralogy and temperature regime are mixed, hyperthermic for D1 to D4 and mixed, thermic for other units.

NOMENCLATURE

1. **Most Recent Soil** — No profile development suggests absence of any diagnostic horizon, except surface horizon.
2. **Sub-Recent Soils** — Initiation of profile development showing a colour B or a Cambic horizon.
3. **Developed Soils** — Appreciable profile development showing an argillic horizon.

BIODIVERSITY

Nagaland is very rich in bio-diversity, both flora and fauna. Even today some pockets of forests are covered with gigantic trees, where sun- rays can not penetrate. Due to reckless and uncontrolled cutting of trees for timber, firewood, continued Jhum cultivation and annual fire in vast tracts of land, forests got degraded and barren, which accelerated diminishing of the most of the original characteristics of the forests.

Though geographically being a small state, Nagaland has several types of forests, mainly because the state is mostly tropical, and the altitudes range from a few hundred meters to about four thousand meters. The major types of forests found in the state, as per the classification of Champion & Seth, are as follows.

1. Northern Tropical Wet Evergreen Forests.
2. Northern Tropical Semi- Evergreen Forests
3. Northern Sub- Tropical Broad Leave Wet Hill Forests
4. Northern Sub- Tropical Pine Forests
5. Northern Montana Wet Temperate Forests &
6. Temperate Forests.

FAUNA

a. MAMMALS

Common Name	Scientific Name
1. Asian Elephant	<i>Elephas maximus.</i>
2. Gaur (Indian Bison)	<i>Bos gaurus.</i>
3. Jackal	<i>Canis aurius</i>
4. Tiger	<i>Panthera tigris.</i>
5. Sambar	<i>Cervus unicolor</i>
6. Leopard	<i>Panthera pardus</i>
7. Barking Deer	<i>Muntaiqus muntjak</i>
8. Wild boar.	<i>Sus scrofa</i>
9. Sloth Bear	<i>Melursus arsinus</i>
10. Serow	<i>Capricornis sumatraensis</i>
11. Hoolock	<i>Hylobatus hoolock</i>
12. Common Langur	<i>Presbytis antillus</i>
13. Macaque	<i>Macaca spp.</i>
14. Leopard Cat.	<i>Felis bengalensis</i>
15. Himalayan Squirrel	<i>Callosciurus pygerythru</i>
16. Pangolin.	<i>Manis crasicaudata</i>
17. Civet.	<i>Viverra Spp.</i>
18. Wolf	<i>Canis auririus</i>
19. Fruit bat	<i>Cynoptirus sphinx</i>
20. Porcupine	<i>Hystrix indica</i>
21. Hispid hare	<i>Caprogus hispidus</i>
22. Slow Loris	<i>Nycticebus causeang</i>
23. Otter	<i>Lutra lutra</i>
24. Wild Dog	<i>Cuon alpinus</i>
25. Orange billed Himalyan Squirrel	<i>Cirrus unicolor</i>
26. Mongoose	<i>Herpestes spp.</i>
27. Musk Deer.	<i>Moschus moschiferous.</i>
28. Binturong	<i>Arctictis binturong</i>
29. Jungle cat	<i>Felis chaus.</i>
30. Mole rat	<i>Bandicota bengalensis</i>
31. Indian hare	<i>Lypus nigricolis.</i>
32. Martin	<i>Martia spp.</i>
33. House Mouse	<i>Mus musculus</i>
34. Field Mouse	<i>Mus booduga</i>
35. Goral	<i>Nemarahidus goral</i>
36. Clouded Leopard	<i>Niofolis nubilosa</i>
37. Palm Civet	<i>Paguna larvata</i>
38. Wood cat	<i>Rattus blaufardi</i>
39. House cat	<i>Rattus rattus</i>
40. Fulvous fruit bat	<i>Tousettus leschinuitas</i>
41. Indian fox	<i>Vulpis bengalensis</i>

BIRDS	
<u>Common Name</u>	<u>Scientific Name</u>
Greyheaded fishing eagle	<i>Ichuophaga nana</i>
Crested serpent eagle	<i>Pilearia cleala</i>
Bearded vulture	<i>Gypactus barbatus</i>
Forest eagle owl	<i>Bubo nipalensis</i>
Collared pigmy owl	<i>Tus bakkameena</i>
Collared scope owl	<i>Lauacidium brodei</i>
Tragopan	<i>Tragopan blythii</i>
Kaleej Pheasants	<i>Lophura leucemelona</i>
Common hill partridge	<i>Arboraphila forqueola</i>
Common pheasants	<i>Entropus simensia</i>
Red Jungle fowl	<i>Gallus gallus</i>
Peacock pheasants	<i>Polyplectron bicalcaratum</i>
Pintailed green pigeons	<i>Treron apicauda</i>
Rutous turtle dove	<i>Streptopelia orientalia</i>
Marmbacked imperial pigeon	<i>Ducula badia</i>
Emerald dove	<i>Chalcophaps indica</i>
Himalayan Jungle nightjar	<i>Caprimulgus indicus</i>
Indian roller	<i>Coracias bengalensis</i>
Chestnut threaded bee-eater	<i>Morapa leschanaulti</i>
Bluethreated barbet	<i>Megalaima lineata</i>
Great barbet	<i>Megalaima virens</i>
Great pied hornbill	<i>Buceros bicornis</i>
Rufousnecked hornbill	<i>Aceros nipalensis</i>
Goldenbacked throated woodpecker	<i>Dimopium shortii</i>
Darjeeling pied woodpecker	<i>Picoides darjellensis</i>
Redaered by woodpecker	<i>Lythipicus pyrrhotis</i>
Bluenapped pitta	<i>Pitta nepanlensis</i>
Mrs. Gould's sunbird	<i>Aethopyga gapldinala</i>
Nepal Yellow backed sunbird	<i>Aethopyga nipalensis</i>
Black breasted sunbird	<i>Aethopyga saturata</i>
Firetailed yellow backed sunbird	<i>Aethopyga ignicauda</i>
Longtailed broadbill	<i>Serilophus lunatus</i>
Red drumped swallow	<i>Hirundedaurice</i>
Tyflers swallow	<i>Hirunderustice tyleri</i>
Balcknapped ariole	<i>Oriolus chinensis</i>
Himalayan tree pie	<i>Dendrocitta formosee</i>
Bronzed drongo	<i>Dicrurus aeneus</i>
Large brown thrush	<i>Zoothera menticola</i>
Lesser racket-tailed drongo	<i>Dicrurus renifer</i>
Large racket-tailed drongo	<i>Dicrurus paradiseau</i>
Black drongo	<i>Dicrurus adaimilis</i>
Grey drongo	<i>Dicrurus leucephaecus</i>
Clouded Leopard	<i>Niofolis nubulosa</i>

Source: Annual Administrative Report 2014-15 (Department of Forests, Ecology, Environment & Wildlife, Nagaland, Kohima)
Go back to contents

Source: Annual Administrative Report 2014-15 (Department of Forests, Ecology, Environment & Wildlife, Nagaland, Kohima)

http://www.nagervis.nic.in/Database/fauna_852.aspx

Flora:-

FLORA:

CONIFEROUS:

Pinus khasia (Indigenous), *Pinus caribiae* (Exotic), *Pinus petula* and *Cryptomeria japonica* (Exotic)

BROAD LEAVED:

Lagerstromia speciosa (Ajhar), *Tectona grandis* (Teak), *Mangifera indica* (Am), *Alnus nepalensis* (Alder), *Morus laevigata* (Bola), *Tetrameles nudiflora* (Bhelu), *Trewia nudiflora* (Bhelkar), *Betula alnoides* (Betula), *Canarium resiniferum* (Dhuna), *Gmelina arborea* (Gomari), *Cinnamomum cecicodaphne* (Gonsoroi), *Nyssa javanica* (Gahorisopa), *Terminalia myriocarpa* (Hollock), *Adina eligocephala* (Haldisopa), *Cedrela toona* (Jatipoma), *Podocarpus nerifolia* (Jinari), *Altingia exelsa* (Jutuli), *Duabanga grandiflora* (Khokon), *Albizzia procera* (Koroi), *Anthocephalus kadamba* (Kadam), *Shorea assamica* (Mekai), *Endospermum chinensis* (Phulgomari), *Melia azadirach* (Ghoora-Neem), *Stereospermum chelonoides* (Paroli), *Magnolia spp.* (Sopas), *Cassia fistula* (Sonaru), *Bombax ceiba* (Semal), *Ficus nervosa* (Robar), *Spondias axillaris* (Hog plum), *Michelia champaca* (Titasopa), *Bischofia javanica* (Uriam), *Juglans regia* (Walnut), *Mansonia dipikai* (Badam), *Phoebe goalparensis* (Bonsom), *Dipterocarpus macrocarpus* (Hollang), *Terminalia chebula* (Hilika), *Schima wallichii* (Gogra), *Mesua ferrea* (Nahar), *Albizzia lebbeck* (Siris), *Quercus Spp.* (Oaks), *Artocarpus chaplasha* Sam), *Chukrasia tabularis* (Bogipoma), *Terminalia bellerica* (Bahera), *Hovenia dulcis* (Coral tree), *Acrocarpus fraxinifolius* (Mandani), *Bucklandia populnea* (Pipli), *Pseudostreblus indicus* (Tsüngkoh)

World tallest Rhododendron tree, which is recorded in the Guineese Book, has been found in Japfu Mountain of Kohima district.

MEDICINAL PLANTS.

Panax pseudo-ginseng (Gensing), *Taxus baccata* (Yew), *Aquilaria agallocha* (Agar), *Solanum khasianum*, *Ocimum sanctum* (Tulsi), *Aegle marmelos* (Bel), *Rauvolfia serpentina* (Sarpgandha), *Elaeocarpus ganitrus* (Rudraksha), *Dioscorea deltoidea* (Kath Aloo), *Emblica officinalis* (Amla), *Swertia chirata* (Chirata), *Rubia cordifolia*, *Oroxylum indicum*, *Clerodendrum colebrookianum*, *Passiflora edulis*

BAMBOO :

There are 22 species of Bamboos available in the state. The important spp. of bamboo are:

1. *Sinarundinaria griffithiana* (Munro) Chao & Renv. (*Arundinaria griffithiana* Munro) Saramati.
2. *Sinarundinaria elegans* (Kurz) Chao & Renv. (*Arundinaria elegans* Kurz) Puliebadze, near Kohima.
3. *Sinarundinaria rolloana* (Gamble) Chao & Renv. (*Arundinaria rolloana* Gamble) Japfü Range, Kohima.
4. *Sinarundinaria nagalandiana* Naithani Niriyo Peak, Wokha.
5. *Chimonobambusa callosa* (Munro) Nakai (*Arundinaria callosa*) (Munro) Puliebadze above Kohima and Mao.
6. *Neomicrocalamus prainii* (Gamble) Keng f. (*Arundinaria prainii* Gamble) Puliebadze, Japfü Range
7. *Bambusa balcooa* Roxb. Wokha.
8. *Bambusa tulda* Roxb. Kohima, Jalukie.
9. *Bambusa palliada* Munro Wokha, Kohima and Zeliang village.
10. *Dendrocalamus hookeri* Munro Kohima, Wokha
11. *Dendrocalamus hamiltonii* Nees et Arn ex Munro Dimapur-Kohima Road, and Wokha.
12. *Dendrocalamus giganteus* Munro Kohima, Mao.
13. *Dendrocalamus calostachys* (Kurz) Kurz Phikrokezema, Dimapur and Kohima.
14. *Schizostachyum polymorphum* (Munro) Majumdar (*Pseudostachyum polymorphum*) (Munro) Longsachu near Wokha
15. *Schizostachyum dullooa* (Gamble) Majumdar (*Teinostachyum dullooa* Gamble) Yikum near Wokha
16. *Schizostachyum fuchsianum* (Gamble) Majumdar (*Cephalostachyum fuchsianum* Gamble) Kohima, Zulhama-Melocanna *baccifera* (Roxb.) Kurz. (*M. bambusoides* Trin.) Jaluki

S.NO	NAME		
1	<i>Acampa papillosa</i>	42	<i>Bulbophyllum leopardinum</i>
2	<i>Acampa rigida</i>	43	<i>Bulbophyllum leptanthum</i>
3	<i>Acampa wightiana</i>	44	<i>Bulbophyllum odoratissimum</i>
4	<i>Acanthephippium striatum</i>	45	<i>Bulbophyllum ornatissimum</i>
5	<i>Acanthephippium sylhetense</i>	46	<i>Bulbophyllum penicillium</i>
6	<i>Aerides crassifolium</i>	47	<i>Bulbophyllum piluliferum</i>
7	<i>Aerides fieldingii</i>	48	<i>Bulbophyllum polychizum</i>
8	<i>Aerides multiflorum</i>	49	<i>Bulbophyllum reptans</i>
9	<i>Aerides odoratum</i>	50	<i>Bulbophyllum rigidum</i>
10	<i>Anoectochilus crispus</i>	51	<i>Bulbophyllum rothschildianum</i>
11	<i>Anoectochilus ehwesii</i>	52	<i>Bulbophyllum roxburghii</i>
12	<i>Anoectochilus grandiflorus</i>	53	<i>Bulbophyllum secundum</i>
13	<i>Anoectochilus griffithii</i>	54	<i>Bulbophyllum striatum</i>
14	<i>Anoectochilus roxburghii</i>	55	<i>Bulbophyllum umbellatum</i>
15	<i>Anthogonium gracile</i>	56	<i>Bulbophyllum uniflorum</i>
16	<i>Aphyllorchis montana</i>	57	<i>Bulbophyllum viridiflorum</i>
17	<i>Aphyllorchis prainii</i>	58	<i>Bulbophyllum wallichi</i>
18	<i>Appendicula cornuata</i>	59	<i>Calanthe alismifolia</i>
19	<i>Arachis bilinguis</i>	60	<i>Calanthe alpina</i>
20	<i>Arachis cathecartii</i>	61	<i>Calanthe angusta</i>
21	<i>Arundina graminifolia</i>	62	<i>Calanthe biloba</i>
22	<i>Ascocentrum ampullaceum</i>	63	<i>Calanthe brevicornu</i>
23	<i>Ascocentrum curvifolium</i>	64	<i>Calanthe chloroleuca</i>
24	<i>Ascocentrum micranthum</i>	65	<i>Calanthe clavate</i>
25	<i>Ascocentrum miniatum</i>	66	<i>Calanthe densiflora</i>
26	<i>Brachycorythis obcordata</i>	67	<i>Calanthe foestermanni</i>
27	<i>Bulbophyllum aculiflorum</i>	68	<i>Calanthe gracilis</i>
28	<i>Bulbophyllum affine</i>	69	<i>Calanthe herbacea</i>
29	<i>Bulbophyllum andersonii</i>	70	<i>Calanthe manni</i>
30	<i>Bulbophyllum careyanum</i>	71	<i>Calanthe musuca</i>
31	<i>Bulbophyllum caudatum</i>	72	<i>Calanthe plantaginea</i>
32	<i>Bulbophyllum cylindraceum</i>	73	<i>Calanthe puberula</i>
33	<i>Bulbophyllum dyerianum</i>	74	<i>Calanthe tricatnata</i>
34	<i>Bulbophyllum elatum</i>	75	<i>Calanthe triplicata</i>
35	<i>Bulbophyllum eulepharum</i>	76	<i>Calanthe vaginata</i>
36	<i>Bulbophyllum gambelii</i>	77	<i>Calanthe vestita</i>
37	<i>Bulbophyllum guttulatum</i>	78	<i>Calanthe whiteana</i>
38	<i>Bulbophyllum gymnopus</i>	79	<i>Cephalanthera ongifolia</i>
39	<i>Bulbophyllum helenae</i>	80	<i>Ceratostylis himalaica</i>
40	<i>Bulbophyllum hirtum</i>	81	<i>Ceratostylis teres</i>
41	<i>Bulbophyllum hymenanthum</i>	82	<i>Cheirostylis griffithii</i>
		83	<i>Cheirostylis pusilla</i>

84	<i>Cleisocentron trichromum</i>	126	<i>Cymbidium pendulum</i>
85	<i>Cleisostoma aspersum</i>	127	<i>Cymbidium tigrinum</i>
86	<i>Cleisostoma filliforme</i>	128	<i>Cymbidium tracyanum</i>
87	<i>Cleisostoma simondii</i>	129	<i>Dendrobium acinaciforme</i>
88	<i>Cleisostoma striatum</i>	130	<i>Dendrobium anceps</i>
89	<i>Cleisostoma subulatum</i>	131	<i>Dendrobium aphyllum</i>
90	<i>Cleisostoma racemiferum</i>	132	<i>Dendrobium bensoniae</i>
91	<i>Coelogyne barbata</i>	133	<i>Dendrobium bicameratum</i>
92	<i>Coelogyne corymbosa</i>	134	<i>Dendrobium candidum</i>
93	<i>Coelogyne cristata</i>	135	<i>Dendrobium chrysanthum</i>
94	<i>Coelogyne flaccida</i>	136	<i>Dendrobium chrysoxum</i>
95	<i>Coelogyne fuscescens</i>	137	<i>Dendrobium crepidatum</i>
96	<i>Coelogyne griffithi</i>	138	<i>Dendrobium densiflorum</i>
97	<i>Coelogyne hitendrae</i>	139	<i>Dendrobium denudans</i>
98	<i>Coelogyne longipes</i>	140	<i>Dendrobium devonianum</i>
99	<i>Coelogyne micrantha</i>	141	<i>Dendrobium eriaeflorum</i>
100	<i>Coelogyne nitida</i>	142	<i>Dendrobium falconeri</i>
101	<i>Coelogyne occultata</i>	143	<i>Dendrobium farmeri</i>
102	<i>Coelogyne ovalis</i>	144	<i>Dendrobium fimbriatum</i>
103	<i>Coelogyne prolifera</i>	145	<i>Dendrobium formosum</i>
104	<i>Coelogyne punctulata</i>	146	<i>Dendrobium gibsonii</i>
105	<i>Coelogyne raizada</i>	147	<i>Dendrobium heterocarpum</i>
106	<i>Coelogyne rigida</i>	148	<i>Dendrobium hookerianum</i>
107	<i>Coelogyne schultesii</i>	149	<i>Dendrobium infundibulum</i>
108	<i>Coelogyne stricta</i>	150	<i>Dendrobium jenkinsii</i>
109	<i>Coelogyne viscosa</i>	151	<i>Dendrobium lindleyi</i>
110	<i>Corymborkis veratrifolia</i>	152	<i>Dendrobium longicornu</i>
111	<i>Cremastra wallichiana</i>	153	<i>Dendrobium moschatum</i>
112	<i>Cryptochilus lutea</i>	154	<i>Dendrobium nobile</i>
113	<i>Cryptochilus sanguineus</i>	155	<i>Dendrobium ochreatum</i>
114	<i>Cymbidium aloifolium</i>	156	<i>Dendrobium porphyrochilum</i>
115	<i>Cymbidium cochleare</i>	157	<i>Dendrobium primulinum</i>
116	<i>Cymbidium devonianum</i>	158	<i>Dendrobium pulchellum</i>
117	<i>Cymbidium elegans</i>	159	<i>Dendrobium stuposum</i>
118	<i>Cymbidium ensifolium</i>	160	<i>Dendrobium terminata</i>
119	<i>Cymbidium eburneum</i>	161	<i>Dendrobium thysiflorum</i>
120	<i>Cymbidium iridioidea</i>	162	<i>Dendrobium transparens</i>
121	<i>Cymbidium lancifolium</i>	163	<i>Dendrobium wardianum</i>
122	<i>Cymbidium longifolium</i>	164	<i>Dendrobium williamsii</i>
123	<i>Cymbidium lowianum</i>	165	<i>Diplomeria hirsuta</i>
124	<i>Cymbidium macrorhizon</i>	166	<i>Diplomeria pulchella</i>
125	<i>Cymbidium mastersii</i>	167	<i>Diplomeria championi</i>

168	<i>Epigeneium amplum</i>	210	<i>Habennaria ensifolia</i>
169	<i>Epigeneium fuscescens</i>	211	<i>Habennaria furcifera</i>
170	<i>Epigeneium rotundatum</i>	212	<i>Habennaria intermedia</i>
171	<i>Eria acevata</i>	213	<i>Habennaria malleifera</i>
172	<i>Eria alba</i>	214	<i>Habennaria pactinata</i>
173	<i>Eria amica</i>	215	<i>Habennaria stenopetala</i>
174	<i>Eria bambusifolia</i>	216	<i>Herminium lanceum</i>
175	<i>Eria biflora</i>	217	<i>Herminium macrophyllum</i>
176	<i>Eria bractescens</i>	218	<i>Herminium monorchis</i>
177	<i>Eria coronaria</i>	219	<i>Hetaeria rubens</i>
178	<i>Eria dasyphylla</i>	220	<i>Hygrochilus parishii</i>
179	<i>Eria excavata</i>	221	<i>Kingidium deliciosum</i>
180	<i>Eria graminifolia</i>	212	<i>Kingidium taenialis</i>
181	<i>Eria muscicola</i>	213	<i>Liparis assamica</i>
182	<i>Eria paniculata</i>	214	<i>Liparis bistrigate</i>
183	<i>Eria pannea</i>	215	<i>Liparis biturberculata</i>
184	<i>Eria spicata</i>	216	<i>Liparis bootanensis</i>
185	<i>Eria stricta</i>	217	<i>Liparis caespitosa</i>
186	<i>Eria vittata</i>	218	<i>Liparis cordifolia</i>
187	<i>Eulophia bicallosa</i>	219	<i>Liparis delicatula</i>
188	<i>Eulophia graminea</i>	220	<i>Liparis distans</i>
189	<i>Eulophia nuda</i>	221	<i>Liparis longipes</i>
190	<i>Flickingeria fimbriata</i>	222	<i>Liparis nervosa</i>
191	<i>Flickingeria fugax</i>	223	<i>Liparis odorata</i>
192	<i>Galeola falconeri</i>	224	<i>Liparis paradoxa</i>
193	<i>Galeola lindleyana</i>	225	<i>Liparis petiolata</i>
194	<i>Gastrochilus acutifolium</i>	226	<i>Liparis plantaginea</i>
195	<i>Gastrochilus calceolaris</i>	227	<i>Liparis platyrachis</i>
196	<i>Gastrochilus distichus</i>	228	<i>Liparis pulchella</i>
197	<i>Gastrochilus inconspicuus</i>	229	<i>Liparis resupina</i>
198	<i>Gastrochilus pseudodisticus</i>	230	<i>Liparis viridiflora</i>
199	<i>Geodorum densiflorum</i>	231	<i>Luisia inconspicua</i>
200	<i>Goodyera foliosa</i>	232	<i>Luisia prachystachys</i>
201	<i>Goodyera fusca</i>	233	<i>Luisia prachystachys</i>
202	<i>Goodyera hispida</i>	234	<i>Luisia teritifolia</i>
203	<i>Goodyera procera</i>	235	<i>Luisia trichorhiza</i>
204	<i>Goodyera repens</i>	236	<i>Luisia zeylanica</i>
205	<i>Goodyera schiechtendaliana</i>	237	<i>Malaxis acuminata</i>
206	<i>Goodyera secundiflora</i>	238	<i>Malaxis baurita</i>
207	<i>Goodyera viridiflora</i>	239	<i>Malaxis cylindroatachya</i>
208	<i>Habennaria acutifera</i>	240	<i>Malaxis josephiana</i>
209	<i>Habennaria dentata</i>	241	<i>Malaxis khasiana</i>

242	<i>Malaxis latifolia</i>	284	<i>Perisrtylus goodveroides</i>
243	<i>Micropera mannii</i>	285	<i>Perisrtylus mannii</i>
244	<i>Micropera rostrata</i>	286	<i>Perisrtylus prainii</i>
245	<i>Monomera barbata</i>	287	<i>Phalus flabius</i>
246	<i>Neogyne gardneriana</i>	288	<i>Phalus longipes</i>
247	<i>Neottianthe secundiflora</i>	289	<i>Phalus mishmensis</i>
248	<i>Neottia listeroides</i>	290	<i>Phalus tankervilleae</i>
249	<i>Nephelaphyllum cordifolium</i>	291	<i>Pholidota articulata</i>
250	<i>Nervilia aragoana</i>	292	<i>Pholidota calceolata</i>
251	<i>Nervilia prainiana</i>	293	<i>Pholidota convallariae</i>
252	<i>Oberonia acaulis</i>	294	<i>Pholidota griffithii</i>
253	<i>Oberonia clarkel</i>	295	<i>Pholidota imbricata</i>
254	<i>Oberonia ensiformis</i>	296	<i>Pholidota imbricata</i>
255	<i>Oberonia griffithiana</i>	297	<i>Pholidota imbricata</i>
256	<i>Oberonia iridifolia</i>	298	<i>Pholidota protacta</i>
257	<i>Oberonia longilabris</i>	299	<i>Pholidota rubra</i>
258	<i>Oberonia mannii</i>	300	<i>Phreatia elegans</i>
259	<i>Oberonia micrantha</i>	301	<i>Platanthera arcuata</i>
260	<i>Oberonia obcordata</i>	302	<i>Platanthera stenantha</i>
261	<i>Oberonia orbicularis</i>	303	<i>Pleione hookeriana</i>
262	<i>Oberonia pachyrachis</i>	304	<i>Pleione humilis</i>
263	<i>Oberonia pyrulifera</i>	305	<i>Pleione maculata</i>
264	<i>Oberonia recurva</i>	306	<i>Pleione praecox</i>
265	<i>Oreochis foliosa</i>	307	<i>Poneoorchis chusua</i>
266	<i>Ornithochilus difformis</i>	308	<i>Pteroceras suaveolens</i>
267	<i>Otochilus alba</i>	309	<i>Renanthera imschootiana</i>
268	<i>Otochilus fusca</i>	310	<i>Rhynchostylis retusata</i>
269	<i>Otochilus lancilabius</i>	311	<i>Robiquetia succisa</i>
270	<i>Pachystoma senile</i>	312	<i>Satyrium napalense</i>
271	<i>Panasia uniflora</i>	313	<i>Schoenorchis gemmata</i>
272	<i>Paphiopedilum hirsutissimum</i>	314	<i>Smitinandia micrantha</i>
273	<i>Paphiopedilum insigne</i>	315	<i>Spathoglottis ixoides</i>
274	<i>Papilionanthe longicornu</i>	316	<i>Spathoglottis plicata</i>
275	<i>Papilionanthe teres</i>	317	<i>Spathoglottis pubescens</i>
276	<i>Pecteilis gigantea</i>	318	<i>Spiranthes sinense</i>
277	<i>Pecteilis susannae</i>	319	<i>Sunipia bicolor</i>
278	<i>Pelanthanthera insectifera</i>	320	<i>Sunipia candida</i>
279	<i>Perisrtylus affinis</i>	321	<i>Thelasis longilifolia</i>
280	<i>Perisrtylus chloranthus</i>	322	<i>Taeniophyllum khasianum</i>
281	<i>Perisrtylus constictus</i>	323	<i>Thunia alba</i>
282	<i>Perisrtylus densus</i>	324	<i>Thunia marshiana</i>
283	<i>Perisrtylus fallia</i>	325	<i>Tropidia curculigoides</i>

Source: Annual Administrative Report 2014-15 (Department of Forests, Ecology, Environment & Wildlife, Nagland, Kohima)

Preparation of Feasibility Study and Detailed Project Report for Construction of 2 lane/2 lane with paved shoulder from Kohima to Nagaland/Manipur border section of NH-29 (Old NH-150) in the State of Nagaland

Annexure 7.1: Guidelines for Existing Quarry Management

The Monitoring Consultant will finalize the locations from the list given by Contractor's/Concessionaire's for procuring materials. The Contractor/Concessionaire shall establish a new quarry only with the prior consent of the Consultant only in cases when: (i) Lead from existing quarries is uneconomical and (ii) Alternative material sources are not available. The Contractor/Concessionaire shall prepare a Redevelopment Plan for the quarry site and get it approved by the consultant.

The construction schedule and operations plans to be submitted to the consultant prior to commencement of work shall contain a detailed work plan for procuring materials that includes procurement, transportation and storage of quarry materials.

CONSTRUCTION STAGE

Development of site: To minimize the adverse impact during excavation of material following measures are need to be undertaken:

- i) Adequate drainage system shall be provided to prevent the flooding of the excavated area
- ii) If the stockpiling locations, the Contractor/Concessionaire shall construct sediment barriers to prevent the erosion of excavated material due to runoff
- iii) Construction of offices, laboratory, workshop and rest places shall be done in the up-wind of the plant to minimize the adverse impact due to dust and noise.
- i) The access road to the plant shall be constructed taking into consideration location of units and also slope of the ground to regulate the vehicle movement within the plant.
- iv) In case of storage of blasting material, all precautions shall be taken as per The Explosive Rules, 1983.

QUARRY OPERATIONS INCLUDING SAFETY

- i) Overburden shall be removed and disposed in line with Guidelines for Debris Disposal Site and management given in Annexure-7.4 & 7.5
- ii) During excavation, slopes shall be flatter than 20 degrees to prevent their sliding. In cases where quarry strata are good and where chances of sliding are less this restriction can be ignored.
- iii) In case of blasting, procedure and safety measures shall be taken as per The Explosive Rules, 1983
- iv) The Contractor/Concessionaire shall ensure that all workers related safety measures shall be done as per guidelines for Workers and Safety.
- v) The Contractor/Concessionaire shall ensure maintenance of crushers regularly as per manufacturer's recommendation.

Topsoil will be excavated and preserved during transportation of the material measures shall be taken to minimize the generation of dust and prevent accidents.

The consultant shall review the quarry site for the management measures during quarry operation, including the compliance to pollution norms.

POST CONSTRUCTION STAGE

- The Contractor/Concessionaire shall restore all haul roads constructed for transporting the material from the quarries to construction site to their original state.
- The Contractor/Concessionaire shall be entrusted the responsibility of reviewing the quarry site for the progress of implementation of Redevelopment Plan.
- The redevelopment of exhaust quarry shall be the responsibility of the agency providing the permit to ensure the implementation of Redevelopment Plan.

For existing quarry managed directly by a third party / Contractor/Concessionaire from whom the contractor is sourcing the materials, the plan should contain the following:

SI. No.	Item	Unit	Details	Remarks by consultant, if any
1.	Name / identity of the location			
2.	Nearest project road Chainage.			
3.	Name of the owner			
4.	Area involved			
5.	Arrangement with the owner (agreement with the third party / contractor should be attached as an Annexure and should necessarily require the adaptation of good quarry management practices - a description of the requirements should be included)	Cum		
6.	Quantity of material to be withdrawn vis-a-vis the material available			
8.	Machinery & equipment to be used	Cum		
9.	Drainage plans			
10.	Top soil management			
11.	Description of the operating practices			
12.	Health facilities			
13.	Safety provisions made including fire protection systems and the availability of different personal			

Preparation of Feasibility Study and Detailed Project Report for Construction of 2 lane/2 lane with paved shoulder from Kohima to Nagaland/Manipur border section of NH-29 (Old NH-150) in the State of Nagaland

SI. No.	Item	Unit	Details	Remarks by consultant, if any
	protective equipment			
14.	Copy of the consents to operate from PCB, licences from Mining & Geology, Police & Fire dept should be attached as an Annexure.			
15.	Conditions laid down in the clearances / licenses and plans to ensure compliance			
16.	Monitoring plans for air quality			
17.	Information on whether or not the quarry will be closed under this project. If yes, the proposed closure & restoration plan.			
18.	Photograph of the quarry prior to commencing operations.			
19.	Sketch of the layout of the quarry			

Attach Photograph of Proposed Site, Location Map, consents, licenses and Agreement with land owner

REMARKS

Submitted

Signature

Name

Designation

Contractor/Concessionaire

Checked & Approved

Signature

Name

Designation

Monitoring Consultant

Annexure 7.2: Guidelines for New Quarry Management

0 Management Plan for New Quarry

The Contractor/Concessionaire shall prepare a quarry management plan for operation of new quarries and submit it to the Monitoring Consultant for approval and necessary actions. The plan shall consist of the following:

3.11 Selection Details

1.1.1 Location and Layout

Sketch plans and photographs to be provided along with adequate details:

- A map and sketch plan of the area showing the location of the proposed quarry site with respect to the project road, nearby villages, crusher plants and worker accommodation locations along with indicative distances of the different sites from each other and from the road.
- A detailed sketch plan of the quarry area showing approach and haulage roads, location of the rocky outcrops to be quarried, indicating which sites will be quarried in which year or phase, location of stock piles, location of guard house, perimeter fence, location of water sources, amenities, and any further details.
- Photographs of the site

1.1.2 Selection Criteria

- A brief statement as to how the site was chosen.
- Alternative sites that were considered to be mentioned.
- Record any public consultations involved while choosing and what the public concerns were, if any.

1.1.3 Agreement with landowners

- Statement of ownership of the land along with lease / purchase agreements.

1.1.4 Licenses and permits

- Contractor/Concessionaire to state the licences and permits that are necessary for operation, and attach them as appropriate.

3.12 Operation

Method of extraction

- A brief method statement of extraction indicating the techniques to be used, use of explosives if any, if so how are the charges laid, how often the blasting shall be done, etc.
- Appropriate reference should be made to the contractor's safety manual.
- A copy of the operator's licence to handle explosives should be submitted to the Consultant.

Loading and haulage

- Contractor/Concessionaire to describe the process in a few sentences of loading of rocks fragments; means of transportation to the crusher, and from the crusher to the site.

Crusher Plant

- Type, manufacturer, date of manufacture and principal specifications of the plant, details on testing and commissioning (by whom, to what standard, and when).

Storage of explosives

- Contractor/Concessionaire to state where these are to be procured from, where they will be stored and how the supply of explosives will be kept secure (if they are to be kept off site, state what precautions will be given for transportation).

Products

- A list of aggregate sizes and any other products from the quarry. Make sure the sketch map states where these will be stock piled.

Testing and quality assurance

- Refer quality assurance plan of Contractor/Concessionaire if any.
- If not, Contractor/Concessionaire to provide details of sampling frequency, who takes the does the testing, which standards are to be complied with, and any further pertinent details.

Water sourcing

- Contractor/Concessionaire must indicate the operations that shall need water, and its source (an indication on the sketch map will suffice).

Safety

- Contactor to divulge safety measures to the Consultant.
- Ensure that workers at the quarry sites are aware of the appropriate sections of the safety plan.

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Workers Accommodation

- Contractor/Concessionaire to provide details of how many workers will be accommodated on site and what the accommodation arrangements and standard will be.

1 Environmental Management

3.11 Environmental Management during Operation

Removal of trees and plants

- Contractor/Concessionaire to describe briefly the floral species that have had to be removed (it will be helpful give local names if English or scientific names are not known), and roughly how many.

Overburden

- Contractor/Concessionaire to state where this will be deposited (indicate on the sketch map), and what methods will be taken to contain it, if any.

Silt management

- Contractor/Concessionaire to state how silt arising from quarry operations will be managed, e.g. provision of a silt retention pond, and show where this is on the sketch map. Say how the silt retention pond will be managed (i.e. how often it will be dredged).

Surface water drainage

- If it will be necessary to provide drainage channels, contractor to show on the sketch map where these are and confirm that they will be kept free of blockages.

Soil and water contamination

- Contractor to list sources of possible contaminants to the soil (fuel stores, etc) and what will be done to control it (minimise spillages, control leaks from plant, etc).

Air pollution

- What are the sources of air pollution?
- Details of air pollution control measures in each case.
- Details of worker protection equipment along with appropriate reference to the safety plan.

Noise

- Sources of noise distance from settlement, labour camp and proposed mitigation to the population / workers exposed.

Traffic

- Impact of quarry operations on traffic and how this may be controlled.

Approach road

- Contractor/Concessionaire to state whether this will be maintained, and if so in what condition.

3.12 Environmental Management at Closure of the site

Dismantling and removal of machinery

- Contractor/Concessionaire to state whether and when this shall be done.

Slope stabilisation and / or protection

- Measures taken to protect the slope and to guard against any possible serious rock fall or any measures to safeguard against hazards like this.

Rehabilitation

- Rehabilitation plan of the quarry.
- The Contractor/Concessionaire shall be responsible for the Redevelopment Plan prior to completion. The Consultant and the PWD shall be responsible for reviewing this case of redevelopment prior to the issuing the defect liability certificate.

Hand-over

- Terms of hand-over of the quarry site to the owner/authority at the end of its use.

Removal of debris and solid waste

- Confirmation of Contractor/Concessionaire in removal of debris and solid wastes and disposal at a suitable site.

For each aggregate-cum-quarry sand source, the plan should be the same. The table below gives the format:

Sl. No.	Item	Unit	Details	Remarks by IC, if any
1.	Name / identity of the location			
2.	Nearest project road Chainage.			

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Sl. No.	Item	Unit	Details	Remarks by IC, if any
3.	Name of the owner			
4.	Area involved	m ²		
5.	Existing land use (verification from land records with revenue department)			
6.	Land use of the area surrounding the proposed site including a map			
7.	Access roads – existing conditions, proposed development and maintenance			
8.	Tree cutting and vegetation clearance if any, along with compensation measures	Nos.		
9.	Arrangement with the owner (agreement with land owner should be attached as an Annexure)			
10.	Quantity of material to be withdrawn vis-a-vis the material available	Cum		
11.	Particular areas to be quarried should be clearly identified			
12.	Machinery & equipment to be used			
13.	Drainage plans			
14.	Top soil management			
15.	Description of the operating practices to be adopted.			
16.	Health facilities			
17.	Safety provisions made including fire protection systems and the availability of different personal protective equipment			
18.	Monitoring plans for air, noise and water quality			
19.	Copy of the consents to establish and operate should be attached as an Annexure.			
20.	Copy of the license from Mining & Geology, Police & Fire dept.			
21.	Conditions laid down in the clearances / licenses and plans to ensure compliance			
22.	Information on whether or not the quarry will be closed under this project. If yes, the proposed closure & restoration plan.			
23.	Concerns of the local people living in the immediate / near vicinity should be identified and appropriate measures should be reflected			
24.	Photograph of the quarry prior to commencing operations.			
25.	Sketch of the layout of the quarry			

Attach Photograph of Proposed Site, Location Map, Consents, licenses, safety plan, tree compensation plan, restoration plan, drainage plan, monitoring plan, Agreement with land owner etc. as annexure

Submitted

Signature
Name
Designation
Contractor/Concessionaire

Checked & Approved

Signature
Name
Designation
Monitoring Consultant

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Annexure 7.3: Plan for Borrow Area Management

SITING

Specific locations of borrow areas to be used (if any) will be identified by Contractor/ Concessionaire. In case the Contractor/ Concessionaire wants to open any new borrow areas and then the selection and recommendations for borrow areas will be based on environmental as well as civil engineering considerations. Location of source of supply of material for embankment or sub-grade and the procedure for excavation or transport of material shall be in compliance with the environmental requirements of the MoEF, State Govt. and as specified in IRC:10-1961.

The Contractor/ Concessionaire shall establish a new borrow areas only with the prior consent of the Monitoring Consultant only in cases when:

- Lead from existing borrow area & quarries is uneconomical and
- Alternative material sources are not available.

The Contractor/ Concessionaire shall prepare a Redevelopment Plan for the borrow area and get it approved by the Monitoring Consultant.

Certain precautions have to be taken to restrict unauthorized borrowing by the Contractor/ Concessionaire. No borrow area shall be opened without permission of the Monitoring Consultant. The borrowing shall not be carried out in cultivable lands, unless and until, it shall be agreed upon by the Monitoring Consultant that there is no suitable uncultivable land in the vicinity for borrowing or private landowners are willing to allow borrowing on their fields.

The construction schedule and operations plans to be submitted to the Consultant prior to commencement of work shall contain a detailed work plan for procuring materials that includes procurement; transportation and storage of borrow earth material. The Contractor/ Concessionaire shall provide the following:

- Selection Criteria for Evaluation of Potential Borrow Areas
- A brief statement as to how the site was chosen
- Alternative sites that were considered to be mentioned
- Record any public consultations involved while choosing and what the public concerns were, if any
- Existing land use (Agricultural / Barren / Scrub / grazing / any other type)
- Vegetation / trees to be removed
- Erosion/degradation potential
- Distance and name of the nearest settlement
- Distance from the nearest surface water body
- Drainage pattern of the area
- Distance of the nearest Reserve Forest (if any) or any other ecologically fragile area
- Distance of the nearest Sacred Tree (if any)
- Distance from the nearest school / hospital / primary health center
- Daily / Occasional use of borrow area by the community
- Any schemes or avenues for generation of income for adjoining community
- Location and Layout
- Sketch plans and photographs to be provided along with adequate details:

A map and sketch plan of the area showing the location of the proposed site with respect to the project road, nearby villages and worker accommodation locations along with indicative distances of the different sites from each other and from the road.

Probable Borrow Areas data (to be filled by Contractor/Concessionaire)

Sample no.	Name of	Material	Site identification	Approximate Quantity (Cum)	Available	Surrounding	Remarks
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	Village	type	Nearest Chainage (Km.)	Left / Right	Offset from nearest Chainage (m)	Length (m)	Breadth (m)	Depth (m)	Total (Cum)	Land / Terrain	Land/ Terrain	

REMOVAL OF TREES AND PLANTS

Contractor/Concessionaire to describe briefly the floral species that have had to be removed (it will be helpful give local names if English or scientific names are not known), and roughly how many.

MITIGATIONS & REHABILITATION OF BORROW AREAS

The soils to be used, as sub-grade, select sub-grade and shoulder materials need to be hauled from designated borrow areas. Similar to the identification of suitable quarries, suitable borrow areas for supply of soil to the new road formation were also identified. Based on the total requirement and availability of each soil type, estimates of soil quantity to be obtained from each of the borrow areas were worked out in accordance with IRC: 10-1961: Recommended Practice for Borrow Pits for Road Embankments constructed by Manual Operation. In the selection of the borrow areas, care was taken to ensure that:

- Sufficient quantity of suitable soil is available from the borrow areas;
- The borrow areas are as close to the project road as possible;
- The loss of productive and fertile agricultural soil is minimum; and
- There is minimum loss of vegetation.

For opening new borrow areas other than those identified the consultant shall follow above section. The borrowing shall not be carried out in cultivable lands, unless and until, it shall be agreed upon by the Consultant that there is no suitable uncultivable land in the vicinity for borrowing, or there are private land owners willing to allow borrowing on their fields.

REHABILITATION

The objective of the rehabilitation programme is to return the borrow pit sites to a safe and secure area, which the general public should be able to safely enter and enjoy. Securing borrow pits sites in a stable condition should be a fundamental requirement of the rehabilitation process. This could be achieved by filling the borrow pit floor to approximately the access road level.

It is important to plan restoration from the outset and coordinate restoration activities. In addition to the bio-diversity issues, land planning considerations are also taken into account when defining a rehabilitation project in order both to preserve the environment and to generate income for the local communities. In this framework rehabilitation often leads to the creation of wetlands and or recreation areas.

Special borrow pit rehabilitation plan shall be specified according to the location and shaping of the mining slopes after exploitation and overburdened dump, with different subsequent uses e.g. forest, meadow, water body etc., the re-greening and replanting methods..

Other criteria which shall be followed for rehabilitation of quarry/ borrow pits are as given below:

- Borrow pits can be backfilled with rejected construction wastes and will be given a vegetative cover. If this is not possible, then slopes will be smoothed and depression will be filled in such a way that it looks more or less like the original ground surface.
- During works execution, the Contractor/Concessionaire shall ensure preservation of trees during piling of materials; spreading of stripping material to facilitate water percolation and allow natural vegetation growth; re-establishment of previous natural drainage flows; improvement of site appearance; digging of ditches to collect runoff; and maintenance of roadways where a pit or quarry is declared useable water source for livestock or people nearby. Once the works are completed, and at own expense the Contractor/Concessionaire shall restore the environment around the work site to its original splits.
- Appropriate plant species for the planting programme have to be selected in consultation with ecological consultant and local state forest department. Depending on the limitations on the availability of appropriate plant material, harsh growing conditions (lack of irrigation and hot summer) and ongoing quarry rehabilitation operations there may be substantial loss of plantation and the planting programme may have to be continued for over 3–5 years. As plantings

are progressively established they should be monitored before undertaking the next stage to ensure maximum plant survival rates.

- The borrow pit immediate surroundings shall be developed as a low maintenance reserve, with significant areas of native trees and shrubs and areas of longer grass and tussocks forming the open spaces. Walkways around the borrow site may be constructed. Provision for a future drive-in picnic area and car parking area may be developed.

Annexure 7.4: Guidelines for Identification of Debris Disposal Sites & Precautions

Guidelines for identification

The locations of dumping sites have to be selected such that:

- No residential areas are located downwind side of these locations,
- Dumping sites are located at least 1000 m away from forest areas and water bodies
- Dumping sites do not contaminate any water sources, rivers etc.
- Dumping sites have adequate capacity equal to the amount of debris generated.
- Public perception about the location of debris disposal site has to be obtained before finalizing the location.

Precautions to be adopted during Dumping of Debris / Waste Material

The Contractor/Concessionaire shall take the following precautions while disposing off the waste material

- During the site clearance and disposal of debris, the Contractor/Concessionaire will take full care to ensure that public or private properties are not damaged / affected and that the traffic is not interrupted.
- The Contractor/Concessionaire will dispose of debris only to the identified places only with prior permission of the Environmental Specialist and the Consultant.
- Contractor can also dispose of the debris for the improvements in public utilities after the proper consent of villagers and approval of Environmental Specialist and the Consultant.
- In the event of any spoil or debris from the sites being deposited on any adjacent land, the Contractor/Concessionaire will immediately remove all such spoil debris and restore the affected area to its original state to the satisfaction of the Environmental Specialist and the Consultant.
- The Contractor/Concessionaire will at all times ensure that the entire existing stream courses and drains within and adjacent to the site are kept safe and free from any debris.
- The Contractor/Concessionaire will utilise effective water sprays during the delivery and handling of materials when dust is likely to be created and to dampen stored materials during dry and windy weather.
- Materials having the potential to produce dust will not be loaded to a level higher than the side and tail boards and will be covered with a tarpaulin in good condition.
- During disposal of debris, proper warning signs to be installed to the satisfaction of Environmental Specialist and the Consultant.
- Any diversion required for traffic during disposal of debris shall be provided with traffic control signals and barriers after the discussion with local people and with the permission of Environmental Specialist and the Consultant.
- During the debris disposal, contractor will take care of surrounding features and avoid any damage to it.
- While disposing debris / waste material, the Contractor/Concessionaire will take into account the wind direction and location of settlements to ensure against any dust problems.
- Adequate arrangements will be made to ensure that the debris / waste material is disposed off nearest to the designated dumping site. The report on this activity shall be prepared regularly by Environmental Specialist and the Consultant.

Annexure 7.5: Guideline for Rehabilitation of Dumpsites & Quarries

Dumpsites

The dumpsites filled only up to the ground level could be rehabilitated as per guidelines below and to be decided by the consultant

- The dump sites have to be suitably rehabilitated by planting local species of shrubs and other plants so that the landscape is coherent and is in harmony with its various components.
- In cases where a dumpsite is near to the local village community settlements, it could be converted into a play field by spreading the dump material evenly on the ground. Such playground could be made coherent with the landscape by planting trees all along the periphery of the playground.
- Some of the dumpsites could be used either for plantation or for growing agricultural produce.
- Care should always be taken to maintain the hydrological flow in the area.

Quarries

The Contactor/Concessionaire shall use materials from the existing and licensed quarry areas only. In case any new quarries are opened by the Contactor/Concessionaire, he shall secure permissions for the same and shall follow the rehabilitation plan.

- The objective of the rehabilitation programme is to return the quarry sites to a safe and secure area, which the general public should be able to safely enter and enjoy. Securing quarry sites in a stable condition should be a fundamental requirement of the rehabilitation process. This could be achieved by filling the quarry / quarry floor to approximately the access road level.
- It is important to plan restoration from the outset and coordinate restoration with quarrying activities. In addition to the bio-diversity issues, land planning considerations are also taken into account when defining a rehabilitation project in order both to preserve the environment and to generate income for the local communities. In this framework quarry rehabilitation often leads to the creation of wetlands and natural reserves or recreation areas.
- Special quarry / quarry rehabilitation plan should be specified according to the location and shaping of the mining slopes after exploitation and overburdened dump, with different subsequent uses e.g. forest, meadow, water body etc., and the re-greening and replanting methods.

Other criteria which should be followed for rehabilitation of quarry sites are as given below:

- Quarries will be backfilled with rejected construction wastes and will be given a vegetative cover. If this is not possible, then slopes will be smoothed and depression will be filled in such a way that it looks more or less like the original ground surface.
- During works execution, the Contactor/Concessionaire shall ensure preservation of trees during piling of materials; spreading of stripping material to facilitate water percolation and allow natural vegetation growth; reestablishment of previous natural drainage flows; improvement of site appearance; digging of ditches to collect runoff; and maintenance of roadways where a pit or quarry is declared useable water source for livestock or people nearby. Once the works are completed, and at own expense the Contactor/Concessionaire shall restore the environment around the work site to its original splits.
- To create a safe environment under the terms of The Mines and Quarries Act the faces have to be reduced to a naturally stable slope or be adequately fenced to prevent access to the top and bottom of the faces. Such a fence must be of a height as prescribed under The Mines Act with a barbed wire top strand designed to exclude the public from the quarry area. Depending on the location of the site presence of a permanent lake is considered to be a satisfactory alternative to a fence.
- Appropriate plant species for the planting programme have to be selected in consultation with ecological consultant and local forest department. Depending on the limitations on the availability of appropriate plant material, harsh growing conditions (lack of irrigation and hot summer) and ongoing quarry rehabilitation operations there may be substantial loss of plantation and the planting programme may have to be continued for over 3–5 years. As plantings are progressively established they should be monitored before undertaking the next stage to ensure maximum plant survival rates.

The quarry or quarry immediate surroundings should be developed as a low maintenance reserve, with significant areas of native trees and shrubs and areas of longer grass and tussocks forming the open spaces. Walkways around the quarries may be constructed. Provision for a future drive-in picnic area and car parking area may be developed.

Annexure 7.6: Guidelines for Sediment Control

All materials shall meet commercial grade standards and shall be approved by the Engineer before being used in the work.

CONSTRUCTION STAGE

Prior to the start of the relevant construction, the Contractor/Concessionaire shall submit to the Consultant for approval, his schedules for carrying out temporary and permanent erosion / sedimentation control works as are applicable for the items of clearing and grubbing, roadway and drainage excavation, embankment / sub-grade construction, bridges and other structures across water courses, pavement courses and shoulders. The Contractor/Concessionaire shall also submit for approval his proposed method of erosion / sedimentation control on service road and quarries and his plan for disposal of waste materials. Work shall not be started until the erosion / sedimentation control schedules and methods of operations for the applicable construction have been approved by the Consultant.

The surface area of erodible earth material exposed by clearing and grubbing, excavation, quarry and fill operations shall be limited to the extent practicable. The Contractor/Concessionaire may be directed to provide immediate control measures to prevent soil erosion and sedimentation that will adversely affect construction operations, damage adjacent properties, or cause contamination of nearby streams or other watercourses. Such work may involve the construction of temporary berms, dikes, sediment basins, slope drains and use of temporary mulches, fabrics, mats, seeding, or other control devices or methods as necessary to control erosion and sedimentation.

The Contractor/Concessionaire shall be required to incorporate all permanent erosion and sedimentation control features into the project at the earliest practicable time as outlined in his accepted schedule to minimize the need for temporary erosion and sedimentation control measures.

Temporary erosion, sedimentation and pollution control measures will be used to control the phenomenon of erosion, sedimentation and pollution that may develop during normal construction practices, but may neither be foreseen during design stage nor associated with permanent control features on the Project.

Where erosion or sedimentation is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion or sedimentation control features can follow immediately thereafter if the project conditions permit; otherwise temporary erosion or sedimentation control measures may be required between successive construction stages. Under no conditions shall a large surface area of erodible earth material be exposed at one time by clearing and grubbing or excavation without prior approval of the Environmental Specialist.

The Consultant may limit the area of excavation, quarry and embankment operations in progress, commensurate with the Contractor's/Concessionaire's capability and progress in keeping the finish grading, mulching, seeding and other such permanent erosion, sedimentation and pollution control measures, in accordance with the accepted schedule.

Temporary erosion is sometimes caused due to the Contractor's/Concessionaire's negligence, carelessness or failure to install permanent controls. Sedimentation and pollution control measures then become necessary as a part of the work as scheduled or ordered by the monitoring consultant, and these shall be carried out at the Contractor's/Concessionaire's own expense. Temporary erosion, sedimentation and pollution control work required, which is not attributed to the Contractor's/Concessionaire's negligence, carelessness or failure to install permanent control, will be performed as per the need.

Temporary erosion, sedimentation and pollution control may include construction work outside the right of way where such work is necessary as a result of road construction such as quarry operations, service roads and equipment storage sites.

The temporary erosion, sedimentation and pollution control features installed by the Contractor's/Concessionaire's shall be maintained by him till these are needed, unless otherwise agreed by the Consultant.

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Annexure 7.7: Tree Plantation strategy

1. INTRODUCTION

Due to the proposed development, some of the existing trees are to be felled. To offset this impact, compensatory afforestation programme through tree plantation, median plantation, horticulture and landscaping strategy has been prepared, based upon the experiences of successful implementation of a number of ongoing and completed projects.

2. OBJECTIVE

The main objectives are as follows:

- Reducing the impacts of air pollution
- Natural noise barrier
- Arrest of land erosion
- Providing much needed shade during the day time
- Prevention of vehicle glare from vehicles coming from opposite direction
- Enhancement of aesthetic view of the corridors
- Climatic amelioration
- Defining of ROW especially at sharp curves during night

3. SPECIES SELECTION

Grasses, shrubs and trees are the main species that are readily available in India. Where possible, the use of non-native species should be avoided since they can out compete and displace native plants leading to loss of native biodiversity. To maximise the chances of success, one should try to select species whose growing conditions roughly match the environmental conditions of the project site. Care should also be taken to select species with root systems that match the nature of the soil movement at the project site. Homogenous avenues of trees should be selected for long stretches as it provides aesthetic qualities in the landscaping. One should also take into account the economic and other social benefits while selecting the species for plantation. During the selection of species preference should be given towards rapid growing and pest and disease resistant species. Shrub species, which are dwarf and pollution hardy, are to be planted in the median to prevent the glare of traffic moving in opposite direction. Flowering, ornamentals plants and climbers can also be planted in urban areas to provide beauty. For this purpose the species may be decided by interaction with local authority and local populace. Few species has also been recommended in the report under section 7.2.2.

4. TASKS OF THE CONTRACTOR/CONCESSIONAIRE

As part of this project implementation, the contractor/concessionaire shall plant and maintain flowering, shade, medicinal, ornamental & fruit bearing trees in suitable area for which cost has been budgeted besides planting and maintenance of ornamental, medicinal & flowering plants and shrubs in the median for which cost has also been budgeted. The specific roles and responsibilities of the Contractor/Concessionaire include:

- Identification of the plantation stretches with PWD and or Consultant.
- Identification of nursery area and preparation of nurseries
- Planting of saplings in the nurseries during the construction period so that the saplings are a minimum 24 months old
- Replantation of the 2 year old saplings to the plantation stretches and
- Maintenance for three years including watering, removal of weed, litter and debris from the vicinity of the plantation.
- Ensure the protection of the tree guards provided to the saplings from trampling and browsing by the cattle.

5. GUIDELINES FOR HORTICULTURE PLANTATION AND LANDSCAPING

General

Scope

Contractor/Consultant to furnish all materials, labour and related items necessary to complete the work indicated on drawing and specified herein.

Materials

Plant Materials

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- Plant Materials shall be well formed and shaped true to type, and free from disease, insects and defects such as knots, sun-scaled, windburn, injuries, abrasion or disfigurement.
- All plant materials shall be healthy, sound, vigorous, free from plant diseases, insect's pests, of their eggs, and shall have healthy, well-developed root systems. All plants shall be hardy under climatic conditions similar to those in the locality of the project. Plants supplied shall conform to the names listed on the plant list given in section 7.2.2. Besides these plant species, the Contractor/Concessionaire shall supply other species as desired by the landscaping specialist and or the environmental specialist of the consultant. Under no circumstances non native species which might have a negative impact on the ecology of the area shall be permitted. No plant material will be accepted if branches are damaged or broken. All material must be protected from the sun and weather until planted.
- Any nursery stock shall have been inspected and approved by the Environmental Specialist of the Consultant.
- All plants shall conform to the requirements specified in the plant list. Except that plants larger than specified may be used if approved, but use of such plants shall not increase the contract price if the use of the larger plant is approved, the spread of roots or ball of earth shall be increased in proportion to the size of plant. Deliver plants with legible identification labels.

Top Soil (Good Earth)

- Topsoil or good earth shall be a friable loam, typical of cultivated topsoil of the locality containing at least 2% of decayed organic matter (humus). It shall be taken from a well-drained arable site. It shall be free of subsoil, stones, earth skids, sticks, roots or any other objectionable extraneous matter or debris. It shall contain no toxic material. No topsoil shall be delivered in a muddy condition. It shall have pH value ranging in between 6 to 8.5.

Fertiliser

- Measurement of sludge shall be in stacks, with 8% reduction for payment. It shall be free from extraneous matter, harmful bacteria insects or chemicals (Subjected to safety norms).

Root System

- The root system shall be conducive to successful transplantation. While necessary, the root-ball shall be preserved by support with Hessian or other suitable material. On soils where retention of a good ball is not possible, the roots should be suitably protected in such a way that the roots are not damaged.

Condition

Trees and shrubs shall be substantially free from pests and diseases, and shall and shall be materially undamaged. Torn or lacerated roots shall be pruned before dispatch. No roots shall be subjected to adverse conditions such as prolonged exposure to drying winds or subjection to water logging between lifting and delivery.

Supply and Substitution

Upon submission of evidence that certain materials excluding the plant Species prescribed are not available at time of contract, the Contractor/Concessionaire shall be permitted to substitute with an equitable adjustment of price. All substitutions shall be of the nearest equivalent species and variety to the original specified and shall be subjected to the approval of the Environmental Specialist of the Consultant.

Packaging

Packaging shall be adequate for the protection of the plants and such as to avoid heating or drying out.

Marking

Each specimen of tree and shrub, or each bundle, shall be legibly labelled with the following particulars:

- Its name
- The name of the supplier, unless otherwise agreed.
- The date of dispatch from the nursery.

Plantation Pattern

The type of plantation would be based upon the requirements and the feasibility of the sites along the project corridor. The availability of the space in the RoW is a major guiding factor for landscaping. The plantation pattern to be followed is:

- The first row of plants along the highways will be of small to medium height plants planted at a spacing of 3m c/c and the distance from the second row should be 3m. The second row should be in staggered. The distance from the toe of the embankment should be 1m minimum and the height should be between 1.5m to 2m.
- Flowering shrubs shall be planted in the median in rows as per width availability. Where the width is less than 1.5m grass turfing is to be done. One row of plantation to be done at a spacing of 1.5m c/c.

For special landscaping, embankment slopes and ground cover, herbaceous species to be used. Turfing to be done by grass.

Tree Planting

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Plants and Shrubs

Trees should be supplied with adequate protection as approved. After delivery, if planting is not to be carried out immediately, balled plants should be placed back to back and the ball covered with sand to prevent drying out. Bare rooted plants can be heeled in by placing the roots in prepared trench and covering them with earth, which should be watered into, avoid air pockets round the roots and shrubs shall be planted with the approval of Environmental Specialist of Consultant.

Digging of Pits

Tree pits shall be dug a minimum of three weeks prior to backfilling. The pits shall be 120cms in diameter and 120cms deep. While digging the pits, the topsoil up to a depth of 30cms may be kept aside, if found good (depending upon site conditions), and mixed with the rest of the soil.

If the side of the below, it shall be replaced with the soil mixture as specified further herein. If the soil is normal it shall be mixed with manure; river sand shall be added to the soil if it is heavy. The bottom of the pit shall be forked to break up the subsoil.

Back Filling

The soil back filled watered through end gently pressed down, a day previous to planting, to make sure that it may not further settle down after planting. The soil shall be pressed down firmly by treading it down, leaving a shallow depression all-round for watering.

Planting

No tree pits shall be dug until final tree position has been pegged out for approval. Care shall be taken that the plant sapling when planted is not be buried deeper than in the nursery, or in the pot. Planting should not be carried out in waterlogged soil. Plant trees at the original soil depth; soil marks on the stem is an indication of this and should be maintained on the finished level, allowing for setting of the soil after planting. All plastic and other imperishable containers should be removed before planting. Any broken or damage roots should be cut back to sound growth.

The bottom of the planting pit should be covered with 50mm to 75mm of soil. Bare roots should be spread evenly in the planting pit; and small mound in the centre of the pits on which the roots are placed will aid on even spread. Soil should be placed around the roots, gently shaking the tree to allow the soil particles to shift into the root system to ensure close contact with all roots and prevent air pockets. Back fill soil should be firmed as filling proceeds, layer by layer, care being taken to avoid damaging the roots. The balance earth shall be filled in a mixture of 1:3 (1 part sludge to 3 part earth by volume) and 50gms potash, (Mop) 50gms of Super Phosphate and 1 Kg. Neem oil cake. Aldrin or equivalent shall be applied every 15 days in a mixture of 5ml in 5 litres of water.

Staking

Newly planted trees must be held firmly although not rigidly by staking to prevent a pocket forming around the stem and newly formed fibrous roots being broken by mechanical pulling as the tree rocks.

The main methods of staking shall be:

- A single vertical stake, 900mm longer than the clear stem of the tree, driven 600mm to 900mm into the soil.
- Two stakes as above driven firmly on either side of the tree with a cross bar to which the stem is attached. Suitable for bare- rooted or Ball material.
- A single stake driven in at an angle at 45 degrees and leaning towards the prevailing wind, the stem just below the lowest branch being attached to the stake. Suitable for small bare- rooted or Ball material
- For plant material 3m to 4.5m high with a single stem a three- wire adjustable guy system may be used in exposed situations.

The end of stake should be pointed and the lower 1 m to 1.2m should be coated with a non-injurious wood preservative allowing at least 150mm above ground level.

Tying

Each tree should be firmly secured to the stake so as to prevent excessive movement. Abrasion must be avoided by using a buffer, rubber or Hessian, between the tree and stake. The tree should be secured at a point just below its lowest branch, and also just above ground level: normally two ties should be used for tree. These should be adjusted or replaced to allow for growth.

Watering

The Contractor/Concessionaire through the Landscape Contractor should allow for the adequate watering in of all newly planted trees and shrubs immediately after planting and he shall during the following growing season, keep the plant material well watered

Fertilising

Fertilising shall be carried out by application in rotation of the following fertilisers, every 15 days from the beginning of the monsoon till the end of winter:

- Sludge or organic well-rotted dry farm yard manure: 0.05 cum or tussle.
- Urea 25gm.

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- Ammonium sulphate 25gm.
- Potassium sulphate 25gm.

All shrubs, which are supplied pot grown, shall be well soaked prior to planting. Watering in and subsequent frequent watering of summer planted container- grown plants is essential.

Shrub Planting In Planter Beds

All areas to be planted with shrubs shall be excavated, trenched to a depth of 750mm, refilling the excavated earth after breaking clods and mixing with sludge in ratio 8:1 (8 parts of stacked volume of earth after reduction by 20%: 1 part of stacked volume of sludge after reduction by 8%.)

Tall shrubs may need staking, which shall be provided if approved by the Contracting-consulting engineer, depending upon the conditions of individual plant specimen. For planting shrubs and ground cover shrubs in planters, good earth shall be mixed with sludge in the proportion as above and filled in planters.

Positions of planters shall be planted should be marked out in accordance with the Design drawings. When shrubs are set out, precautions should be taken to prevent roots drying. Planting holes 40cm diameter and 40cm deep should be excavated for longer shrubs. Polythene and other non-perishable containers should be removed and any badly damaged roots carefully pruned. The shrubs should then be set in holes so that the soil level after settlement will be original soil mark on the stem of the shrub. The holes should be back filled to half of its depth and firmed by treading. The remainder of the soil can then be returned and again firmed by treading.

Grassing

Preparation

During period prior to planting, the ground shall be maintained free from weeds. Grading and preparation of the area shall be completed at least three weeks prior to the actual sowing. Regular watering shall be continued until sowing by dividing the area into portions of approximately 5m squares by constructing small bunds to retain water. These 'bunds' shall be levelled just prior to sowing of grass plants; it shall be ensured that the soil has completely settled.

Soil

The soil itself shall be ensured to the satisfaction of Environmental Specialist Consultant to be a good fibrous loam, rich in humus.

Sowing the grass roots

Grass lines will be used to provide a strong surface cover and will be planted over a well prepared surface. Slope treatments using grasses will be allowed to establish properly such that the slopes are not subject to undue stress from erosion and mass movement in its initial stages. The sowing of grasses will create a strengthened surface that will reduce the vulnerability to erosion. Median with a width of 1.5 m will have only grasses to strengthen the surface. The Contractor/Concessionaire will ensure that the condition of the site is good enough for the successful establishment of grasses.

Grass roots shall be obtained from a grass patch, seen and approved before hand. The grass roots stock received at site shall be manually cleared of all weeds and water sprayed over the same after keeping the stock in place protected from sun and dry winds. Grass stock received at site may be stored for a maximum of three days. In case grassing for some areas is scheduled for a later date fresh stock of grass roots shall be ordered and obtained.

Execution

Small roots shall be dibbled about 5cms apart into the prepared grounds. Grass will only be accepted as reaching practical completion when germination has proved satisfactory and all weeds have been removed. The Contractor/Concessionaire through the landscape contractor shall supervise all field operations like preparation of surface, sowing of grasses and quality of grasses seeds used.

- Carry out grassing such that a cover of 25 gm of grass seed per sqm of surface is achieved.
- Carry out seed sowing before the onset of monsoon [May & June] so as to achieve the desired results. The watering of the surface will be by tankers till the onset of the monsoon.
- Ensure that a mulch of prepared and dried out herbs is laid over the whole seeded area after sowing, in a thin layer, so that the grass is not affected by direct sunlight and transpiration loss.
- The grasses recommended for are *Cynodon dactylon*, *Cymbopogon purpurea*, *Solanum nigrum*, *Xanthium strumarium* etc.

Maintenance

As soon as the grass is approximately a 3cm high it shall be rolled with a light wooden roller - in fine, dry weather - and when it has grown to 5 to 8cms, above to ground weeds must be removed and regular cutting with the scythe and rolling must be begun. A top-dressing of an ounce of guano to the square yard or well decomposed well broken sludge manure shall be applied when the grass is sufficiently secure in the ground to bear the mowing machine, the blades must be raised an inch above the normal level for the first two or three cuttings. That is to say, the grass should be cut so that it is from 4 to 5cms in length, instead of the 3cm necessary for mature grass.

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In the absence of rain, in the monsoon, the lawn shall be watered every ten days heavily, soaking the soil through to a depth of at least 20cms. Damage failure or dying back of grass due to neglect of watering especially for seeding out of normal season shall be the responsibility of the Landscaping Contractor. Any shrinkage below the specified levels during the contract or defect liability period shall be rectified at the Landscaping Contractor's expense. The Landscaping Contractor is to exercise care in the use of rotary cultivator and mowing machines to reduce to a minimum the hazards of flying stones and brickbats. All rotary mowing machines are to be fitted with safety guards.

Rolling

A light roller shall be used periodically, taking care that the area is not too wet and sodden.

Edging

These shall be kept neat and must be cut regularly with the edging shears.

Fertilising

The area shall be fed once in a month with liquid manure prepared by dissolving 45gms of ammonium sulphate in 5 litres of water.

Watering

Water shall be applied at least once in three days during dry weather. Watering whenever done should be thorough and should wet the soil at least up to a depth of 20cms.

Weeding

Prior to regular mowing the Landscaping Contractor shall carefully remove rank and unsightly weeds.

Maintenance of Plants

Cultivating

The Contractor/Concessionaire through the Landscaping Contractor shall maintain all planted areas within contract boundaries for one year until the area is handed over in whole or in phases. Maintenance shall include replacement of dead plants, watering, weeding, cultivating, control of insects, fungus and other diseases by means of spraying with an approved insecticide or fungicide, pruning, and other horticulture operations necessary for proper growth of the plants and for keeping the sub-contract area neat in appearance

Pruning and Repairs

Upon completion of planting work of the sub-contract all trees should be pruned and all injuries repaired where necessary. The amount of pruning shall be limited to the necessary to remove dead or injured twigs and branches and to compensate for the loss of roots and the result of the transplanting operations. Pruning shall be done in such a manner as not to change the natural habit or special shape of trees.

Tree Guards and Protective Fencing

According to local environment, shrubs shall be protected adequately from vandalism until established. Where the tree guards are necessary, care should be taken to ensure that they do not impede natural movement or restrict growth. The specifications of the tree guard proposed are given below:

- The tree guards shall normally be brick in urban and bamboo guards in rural and semi urban areas. The specifications of the cement guards should be as per the relevant IS specification. In certain cases, if required by the Consultant, Circular Iron Tree Guard with Bars shall be provided. The specifications of such tree guard shall be as per relevant IS specification. The Consultant shall spell out in details about the cases where such exception shall be. In absence of any proper specification the decision of the Consultant and or PWD shall be binding.

Nursery Stack

Planting should be carried out as soon as possible after reaching the site. Where planting must be a necessity and / or be delayed, care should be taken to protect the plants from pilfering or damage from people / animals. Plants with bare-roots should be heeled-in as soon as received or otherwise protected from drying out, and others set closely together and protected from the wind. If planting is to be delayed for more than a week, packaged plants should be unpacked, the bundles opened up and each group of plants heeled in separately and clearly labelled. If for any reason the surface of the roots becomes dry the roots should be thoroughly soaked before planting.

Completion

On completion, the ground shall be formed over and left tidy.

6. SPECIAL CONDITIONS AND PARTICULAR SPECIFICATIONS.

- Wherever applicable, work shall be done according to specifications in vogue, at the time of invitation of tender.
- The Plantation area should avoid the stretches within the settlement area and the Ecological Sensitive area.
- The stretches identified should be free from encumbrances and should not lead to impact on any private or community asset. No

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fresh land acquisition shall be made under the project for the purpose of plantation.

- Contractor/Concessionaire through the Landscaping Contractor shall make his own arrangement for drawing water from there.
- The work included in the schedule of Quantities includes grassing as well as planting of trees and shrubs. The quoted rates shall include execution of these works at different levels and nothing extra shall be paid for any item, for working at these levels
- The Landscaping Contractor shall not be entitled to any compensation for any losses suffered by him and/or revision in the rates originally quoted by him.
 - On account unforeseen delay in commencing the work, whatever the cause of such delays is.
 - On account of reduction in the scope of work.
 - On account of suspension of work, or abandon after award of work.
- The Contractor/Concessionaire shall provide all facilities to Environmental Specialist / Project Engineer and / or his authorized representatives to make frequent inspection of their Nursery and ascertain the process / quality of various categories of trees / plants etc., grown by them.
- The quote rate shall include the cost of transportation of tools and plants to and from the site, sales tax, excise duty, octroi, etc. It shall be clearly understood that no claim for any extra payment on account of sales tax, excised duty, octroi etc., shall be entertained after the opening of the tender.
- The safe custody and up-keep of various categories of plants brought to site is the sole responsibility of the Contractor/Concessionaire and he shall employ sufficient supervisory personnel to ensure the safety of these items.
- The site of work may be handed over to the Contractor/Concessionaire in phases, as soon as the same are available and the Contractor/Concessionaire in turn shall work in these areas forthwith. Nothing extra shall be payable for such phased execution of work.
- While excavating / executing the work the Contractor/Concessionaire shall ensure that the existing cables / pipe lines / structures / fittings are not damaged and if due to his negligence, these are damaged, the same shall be set right with no extra cost to the clients.
- The Contractor/Concessionaire shall co-ordinate his work with other agencies employed by the Clients and ensure that the works of other agencies are not hampered in any way during the duration of contract.
- The Contractor/Concessionaire shall keep the site of works neat and clean during the execution of the work. Any debris found at or near the site of work shall be moved immediately as and when so required by the Environmental Specialist / Project Engineer.
- On completion of the work, the site of work shall be thoroughly cleaned and all debris removed before the work is handed over satisfactorily.
- The Contractor/Concessionaire shall, without any additional charge to the clients, renew or replace any dead or defective plants/grass for a period of 12 months after the certified date of completion.
- "General condition of contract and standard contract Forms of shall also form part of the contract.
- All Tree saplings should be two years (2) years old before they are planted. The numbers of the plants shall be as specified in the schedule of quantities and shall be straight and symmetrical with a crown and having a persistent main stem. The size of crown shall be in good overall proportion to the height of the tree.
- Small trees and shrubs shall be well formed with the crown typical of the species or variety.

General requirements of plants

- Plants shall be typical of their species and variety, well-developed branches, and well foliated with fibrous root system. Plants shall be free from defects and injuries. Plants shall not be pruned before planting.
- Plants shall be free from defects and injuries.
- Plants shall not be freshly dug and nursery grown.
- Nursery grown plants shall have been at least once transplanted
- Bark shall be free from abrasion.
- All trees, soon after planting, shall be properly supported with bamboo stocks to ensure their safety against winds or any other factor, which may affect it adversely.

Protection of "tree to be preserved"

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- The Contractor/Concessionaire through the Landscaping Contractor shall be responsible for the protection of tops, trunks and roots of existing trees on site. Existing trees subject to the construction damage shall be boxed, fenced or otherwise protected before any work is started.

General Requirements of Earth Manure and Fertilisers

- EARTH: Good earth shall be agricultural soil of loamy texture, free from kankar, morrum, shingles, rocks, stones, building rubbish and any other foreign matter. The earth shall be free from clods or lumps of sizes bigger than 50mm in any direction. It shall have pH ranging in between 6.5 to 7.5.
- MANURE: Manure shall be of well-decayed organic matter obtained in dry state from the Municipal dump or other similar source approved by the Environmental Engineer/ Project Engineer. The manure shall be free from earth, stone or other extraneous matter. Manure shall be supplied, at site well screened.
- FERTILISER: If the soil tests indicate pH value not as per the above specification namely in between 6.5 to 7.5, following measures need to be taken.
- If pH exceeds 7.5, aluminium sulphate or equivalent fertilizer should be added at the rate of 1 kg per cubic metre to lower the pH by one full point.
- If pH is below 6.5, add ground limestone or equivalent fertilizer at the rate of 1 kg per cubic metre to raise pH by one full point.

7. TEAM FOR THE ASSIGNMENT

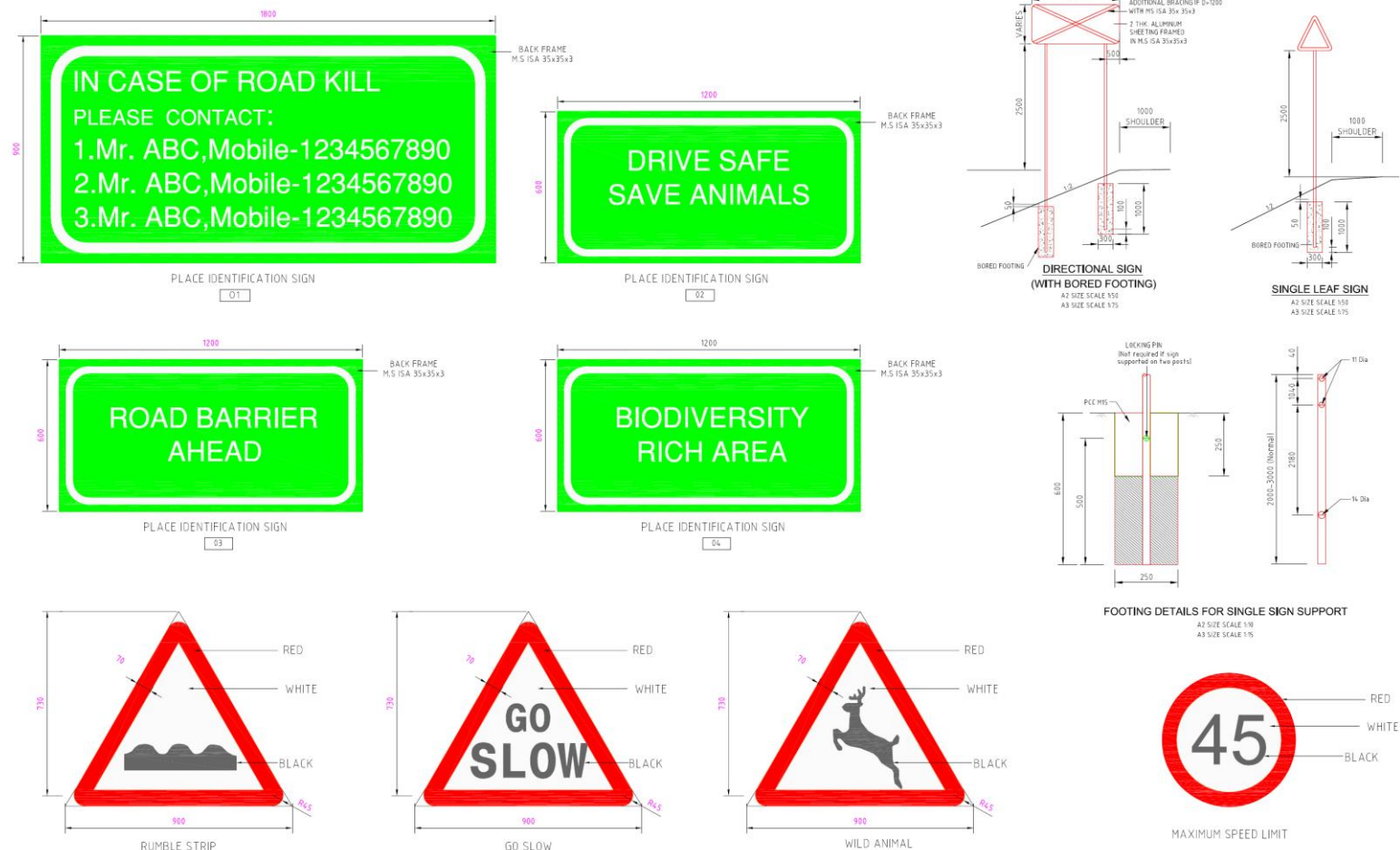
The Contractor/Concessionaire is free to recommend a team commensurate with the requirements of the project.

8. DATA TO BE PROVIDED BY THE CLIENT

Client will provide to the Contractor/Concessionaire the map showing settlements and the forest areas

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Annexure 7.8: Conceptual Drawing for Roadside Signage - Wildlife



Annexure 7.9: Traffic Control and Safety during Construction

A. TRAFFIC MANAGEMENT PRACTICES

The traffic on roads has increased manifold and most of the roads are expected to operate at their maximum capacity in the near future. Under the circumstances, the existing methods of maintenance and construction which compromise safety and cause delay are no longer acceptable and a change in work procedures and method has become inevitable. Under the existing method of maintenance and reconstruction, the traffic is invariably diverted over unprepared shoulders or forced to use part of the existing roads under maintenance. This results in the increase in vehicle operating cost and reduction in safety besides causing environmental pollution. Therefore, the existing work procedure and contract conditions are required to be changed to provide for proper management of traffic during the execution of work. The traffic management strategies to be used at traffic control zones must include the following fundamental principles:

- (i) Make traffic safety an integral and high priority element of every project
- (ii) Avoid inhibiting traffic as much as possible
- (iii) Guide drivers in a clear and positive way
- (iv) Perform routine inspection of traffic control elements and traffic operations
- (v) Give care and attention to roadside safety

B. TRAFFIC CONTROL DEVICES

The primary traffic control devices used in work zones are signs, delineators, barricades, cones, pylons, pavement markings and flashing lights. The following general rules should apply to all traffic control devices within the traffic control zone.

- (i) **Comprehension:** All traffic control devices should be capable of being easily understood. A particular device must convey one and only one meaning. Good and clean condition of the device aids comprehension.
- (ii) **Visibility and Stability:** Devices should be within the cone of vision of the driver and be placed such that it allows adequate time at the average approach speed or the desired speed through the traffic control zone. All traffic control devices should be clearly visible by day and night, at these speeds and under the usually prevailing climatic conditions. They should be kept properly aligned and legible at all times. Foliage or any other obstruction should not be allowed to impede the view of these devices, nor should wind, road dirt or the like be allowed to obscure their face. The traffic control devices must be able to resist the local wind pressure, rain and the vibrations etc. of the passing traffic but these should not act as rigid obstacles in the event of a collision;
- (iii) **Installation and Removal:** All traffic control devices should be installed for the minimum required time. Traffic control devices by their nature are a hindrance to the normal traffic flow and should be removed immediately after the need, being met by these is fulfilled. Existing devices like signs or lane markings should be removed during the temporary works and reinstated thereafter or covered while the temporary devices are in operation. The installation and removal of the temporary traffic control devices and the reinstatement of the pre-existing or new (where the scheme improves the road) traffic control devices must, therefore, be meticulously supervised to ensure the minimum period when there are no signs or markings

C. SIGNS

The road construction and maintenance signs fall into the same three major categories as do other traffic signs, that is Regulatory Signs, Warning Signs and Direction (or Guidance) Signs. The IRC: 67 (Code of Practice for Road Signs) provides a list of traffic signs. Where possible, the size, colours and placement of sign shall conform to IRC: 67. This also covers signs that are not included in IRC: 67 but are considered desirable to aid drivers' comprehension of the route through the road works. Each sign should be well located so that its message is seen and is clear, which will be assisted if the surroundings are devoid of "unnecessary" signs and other clutter. These signs should be of retroreflective sheets of high intensity grade or engineering grade depending upon the importance of the road as directed by the Engineer.

Annexure 7.10: Guidelines for Sitting and Layout of Construction Camp

SITING

The Contractor/Concessionaire based on the following guidelines shall identify the location of the construction site. The construction site shall be located:

- The construction camps will be located at least 500 m away from habitations at identified sites. The living accommodation and ancillary facilities for labour shall be erected and maintained to standards and scales approved by the Environmental Specialist of Consultant.
- On non agricultural lands, as far as possible
- Not within 1000m of either side of locations of Forest areas.
- All sites used for camps must be adequately drained. They must not be subject to periodic flooding, nor located within 300 feet of pools, sink holes or other surface collections of water unless such water surface can be subjected to mosquito control measures.
- The camps must be located such that the drainage from and through the camps will not endanger any domestic or public water supply.
- All sites must be graded, ditched and rendered free from depressions such that water may get stagnant and become a nuisance.

(B) LAYOUT

A conceptual layout of a typical construction site has been presented in Figure A. The Contractor/Concessionaire during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour to standards and scales approved by the engineer. All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. Safe drinking water should be provided to the dwellers of the construction camps. Adequate washing and bathing places shall be provided, and kept in clean and drained condition. Construction camps are to be sited away from vulnerable people and adequate health care is to be provided for the work force.

Sanitation Facilities: Construction camps shall be provided sanitary latrines and urinals. Sewerage drains should be provided for the flow of used water outside the camp. Drains and ditches should be treated with bleaching powder on a regular basis. The sewage system for the camp must be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place. Compliance with the relevant legislation must be strictly adhered to. Garbage bins must be provided in the camp and regularly emptied and the garbage disposed off in a hygienic manner

Shelter at Workplace: At every workplace, there shall be provided free of cost, four suitable shelters, two for meals and two others for rest, separately for use of men and women labourers. The height of shelter shall not be less than 3m from floor level to lowest part of the roof. Sheds shall be kept clean and the space provided shall be on the basis of at least 0.5m² per head.

Canteen Facilities: A cooked food canteen on a moderate scale shall be provided for the benefit of workers wherever it is considered necessary. The Contractor/Concessionaire shall conform generally to sanitary requirements of local medical, health and municipal authorities and at all times adopt such precautions as may be necessary to prevent soil pollution of the site.

First aid facilities: At every workplace, a readily available first-aid unit including an adequate supply of sterilized dressing materials and appliances will be provided as per the Factory Rules. Workplaces remote and far away from regular hospitals will have indoor health units with one bed for every 250 workers. Suitable transport will be provided to facilitate taking injured and ill persons to the nearest hospital. At every workplace an ambulance room containing the prescribed equipment and nursing staff will be provided.

Health Care Facilities: Health problems of the workers should be taken care of by providing basic health care facilities through health centres temporarily set up for the construction camp. The health centre should have at least a doctor, nurses, duty staff, medicines and minimum medical facilities to tackle first-aid requirements or minor accidental cases, linkage with nearest higher order hospital to refer patients of major illnesses or critical cases.

The health centre should have MCW (Mother and Child Welfare) units for treating mothers and children in the camp. Apart from this, the health centre should provide with regular vaccinations required for children.

Day Crèche Facilities: At every construction site, provision of a day crèche shall be worked out so as to enable women to leave behind their children. At construction sites where 20 or more women are ordinarily employed, there shall be provided at least a hut for use of children under the age of 6 years belonging to such women. Huts shall not be constructed to a standard lower than that of thatched roof, mud walls and floor with wooden planks spread over mud floor and covered with matting. Huts shall be provided with suitable and sufficient openings for light and

ventilation. There shall be adequate provision of sweepers to keep the places clean. There shall be two maidservants (or aayas) in the satisfaction of local medical, health, municipal or cantonment authorities. Where the number of women workers is more than 25 but less than 50, the Contractor/Concessionaire shall provide with at least one hut and one maidservant to look after the children of women workers. Size of crèches shall vary according to the number of women workers employed.

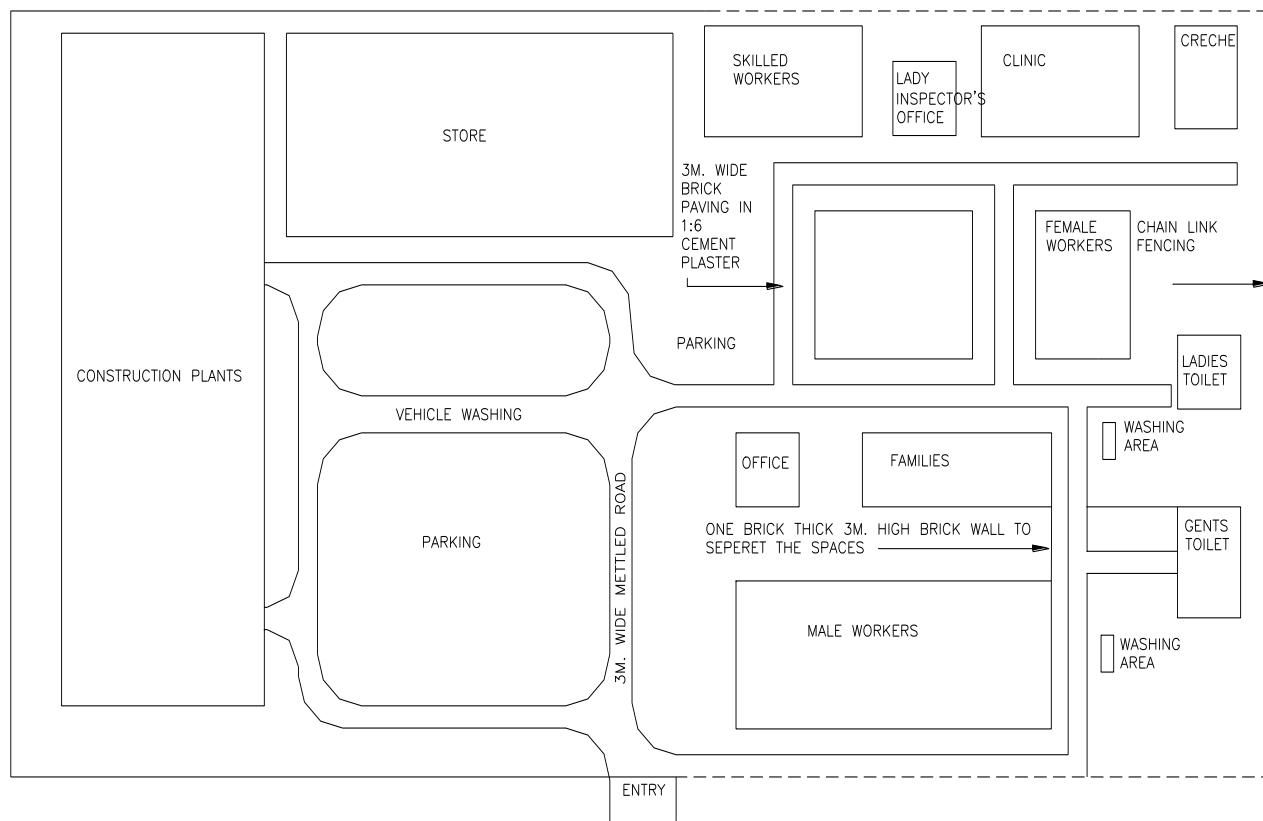


FIGURE A: TYPICAL LAYOUT OF CONSTRUCTION CAMP

Annexure 8.1: Format for Reporting of Road Kill

Date				Time	
Chainage (Km)-		Village-		Distance from Road (m)	
Local/ Common Name of Species		Scientific Name (if known)		Sighting / Kill	
Photographs of Road Kill					
Top View		View from LHS		View from RHS	
Signature (Contractor)		Signature (Concessionaire)		Signature (IE)	

Annexure 9.1: Environmental Management Plan

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implementation	Supervision
A. Pre-construction and Design Stage									
1. Alignment									
1.1 Pavement damage and inadequate drainage provisions in habitation areas	<ul style="list-style-type: none">• Pavement Construction in habitation areas considering alignment level and drainage• Raise road level above the nearby areas with provision of adequate side drains to evacuate the rain water and domestic discharges (drained by inhabitants occasionally) to prevent damage to road and rain water entry to habitation area as per IRC SP No 42-1994 and 50-1999.• Existing Culverts / causeways are to be widened / upgraded / reconstructed as per the need.• 6.180km lined drain and 126.613 km of unlined drains are proposed along the road in either side	Design requirement	All habitation areas, throughout the alignment	Design of both cross & side drains	Design of both side drain in urban area should be incorporated in design	Review of detail design documents & drawings	Included in construction cost	Design Consultant	PWD / MC
1.2 Safety along the proposed alignment	<ul style="list-style-type: none">• Provision of Road signage and pavement marking as per IRC No 67-2012.• Provision of speed regulator in habitat / sensitive areas to regulate vehicle speed• Provision of signage and other safety measure for pedestrian crossing near habitat areas, school, hospital, religious places• Provision of footpath cum drain in habitation areas• Compliance with norms specified in IRC codes for major	Design requirement	Accident prone areas, habitat areas and bridge area, Wild Life Movement area	No. of accident & Vehicle collision, Accidental Kill of Wild life	Provision of cautionary sign board, Speed regulator and signage in habitat and sensitive areas	Field observation, interview of locals	Included in construction cost	Design Consultant	PWD / MC

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implementation	Supervision
	district road for curvature								
2. Natural Hazards									
2.1 Protection for damage from Earthquake	<ul style="list-style-type: none"> Design considering relevant IRC specifications No 6-2010 for earthquakes in bridges 		Throughout the stretch	Incorporation of IRC guidelines for earthquake in bridge design	Incorporation of IRC guidelines	Review of bridge design	Project preparation Cost	Design Consultant	PWD / MC
2.2 Protection of Road embankment in Flood prone / water logged areas	<ul style="list-style-type: none"> Improvement in existing culverts to maintain or increase their carrying capacity. Provision of adequate drainage and cross drainage structures 	IRC:34 Recommendations for road construction in waterlogged area and IRC: 75 and MORT&H guidelines for Design of High Embankments	All the existing culverts / bridges	Design of both cross & side drains	Design after consideration of flood hazard	Review of design	Included in construction cost	Design Consultant	PWD / MC
3. Shifting of utility structures									
3.1 Disruption of utility services to local community	<ul style="list-style-type: none"> About 555 electric poles, 3 Light Poles, 53 transformers and 104 Telephone poles are likely to be shifted before start of construction. Necessary permission and payments should be made to relevant utility service agencies to allow quick shifting and restoration of utility services Local people must be informed through appropriate means about the time of shifting of utility structures and potential disruption of services if any 	Project requirement	Throughout the corridor	Utility shifting plan Complaints from local people Status of local utility services	Necessary approval from regulatory body with proper safety provisions	Interaction with concerned utility authorities and local public	Included in construction .	Concessionaire/Contractor	PWD / MC
B. Construction Stage									
1. Air Quality									
1.1 Dust Generation due to construction activities and	<ul style="list-style-type: none"> Transport of construction materials in covered vehicles. Storage areas to be located downwind of the habitation area 	MORT&H Specifications for Road and Bridge works (Clause No	Throughout project corridor	Particulate matter concentration measurements,	Zero complaint from locals Level of	Standards CPCB methods Observations	Included in project cost	Concessionaire/Contractor	PWD / MC

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implementation	Supervision
transport, storage and handling of construction materials	<ul style="list-style-type: none"> Water spraying on earthworks, unpaved haulage roads and other dust prone area. Provision of PPEs to workers. 	111) Air Act, 1974 and Central Motor and Vehicle Act, 1988		Dust pollution or complaint of locals	pollution should not exceed the NAAQ standards	Public consultation			
1.2 Emission of air pollutants (SO ₂ , NO _x , CO etc.) from vehicles due to traffic congestion and use of equipment and machinery	<ul style="list-style-type: none"> Regular maintenance of machinery and equipment. Batching plant, Asphalt mixing plants and crushers at downwind (1 km) direction from the nearest settlement. Only crushers licensed by the PCB shall be used Use of low sulphur diesel as fuel in DG sets. Ambient air quality monitoring Use of PUC certified vehicles 	The Air Act, 1981 and Rules 1982	Asphalt mixing plants, crushers, DG sets locations	Monitoring of ambient air quality & checking PUC certificates	Zero complaint from locals Level of pollution should not exceed the NAAQ standards	Standards CPCB methods	Included in project cost	Concessionaire/Contractor	PWD / MC
2. Noise									
2.1 Noise from construction vehicle, equipment and machinery.	<ul style="list-style-type: none"> All equipment to be timely serviced and properly maintained. Construction equipment and machinery to be fitted with silencers and maintained properly. Only IS approved equipment shall be used for construction activities. Timing of noisy construction activities shall be done during night time and weekends near schools and selected suitable times near temples when there are no visitors, Time regulation near residential, built up and construction shall be restricted to daylight hours. Initiation of multi layered plantation in open areas (if any) Honking restrictions near sensitive 	Noise Pollution (Regulation and Control) Rules, 2000	Throughout project section especially at construction sites, residential and identified sensitive locations	Noise levels Measurements Complaints from local people	Zero Complaints from locals Leq should not exceed as per prescribed limit	As per Noise rule, 2000 Consultation with local people	Included in Project Cost	Concessionaire/Contractor	PWD / MC

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implementation	Supervision
	areas <ul style="list-style-type: none"> • PPEs to workers • Noise monitoring as per EMoP • Provision of 535m of Noise Barrier at 7 sensitive receptors likely to experience high noise. 								
3. Land and Soil									
3.1 Land use Change and Loss of productive / top soil	<ul style="list-style-type: none"> • Non-agricultural areas to be used as borrow areas to the extent possible (if required). 	Project requirement	Throughout the project section and borrow areas	Borrow pit locations Top soil storage area	Productive land should be avoided for borrowing / construction purpose	Review borrow area plan, site visits	Included in construction cost	Concessionaire/Contractor	PWD / MC
3.2 Slope failure and Soil erosion due to Construction activities, earthwork, and cut and fill, stockpiles etc.	<ul style="list-style-type: none"> • Care should be taken that the slope gradient shall not be greater than 2:1. • The earth stockpiles to be provided with gentle slopes to prevent soil erosion. 	IRC:56 - 1974 recommended practice for treatment of embankment slopes for erosion control	Throughout the entire project road	Occurrence of slope failure or erosion issues	Necessary provisions as per column 2 should be implemented	Review of design documents and site observation	Included in Construction cost	Design consultant and Contractor/Concessionaire	PWD / MC
3.3 Borrow area management	<ul style="list-style-type: none"> • Non-productive, barren lands, upland shall be used for borrowing earth with the necessary permissions/consents. • Depths of borrow pits to be regulated and sides not steeper than 25%. • Topsoil to be stockpiled and protected for use at the rehabilitation stage. • Transportation of earth materials through covered vehicles. • Borrow areas shall be leveled with salvaged material or other filling materials which do not pose contamination of soil. Else, it shall be converted into fishpond in 	IRC specifications No 10-1961 on borrow areas (Environmental Protection Act and Rules, 1986; Water Act, Air Act)	Borrow sites location	Existence of borrow areas in inappropriate unauthorized locations. Poor borrow area management practices. Incidents of accidents. Complaints from local people.	Productive land should be avoided for borrowing purpose Borrow area should be selected as per MoRTH and IRC-10, 1961 specifications	Review of design documents and site observation	Included in Construction cost	Design consultant and Contractor/Concessionaire	PWD / MC

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implementation	Supervision
	consultation with fishery department. <ul style="list-style-type: none"> Garland drain all along the Borrow area Detailed borrow area management plan is given as Annexure 7.3. 								
3.4 Quarry Operations	<ul style="list-style-type: none"> Aggregates will be sourced from existing licensed quarries In case Contractor/Concessionaire decides in opening new stone quarries he shall follow the stipulated GoI norms 	Clause No. 111.3 MORT&H Specifications for Road and Bridge works Guidelines	Quarry area locations	Existence of licenses for all quarry areas from which materials are being sourced	Only licensed quarry should be used	Review of design documents, contractor documents and site observation	Included in Construction cost	Contractor/Concessionaire	PWD / MC
3.5 Compaction of soil and impact on quarry haul roads due to movement of vehicles and equipment	<ul style="list-style-type: none"> Construction vehicles, machinery, and equipment to be stationed in the designated RoW to avoid compaction. Approach roads / haulage roads shall be designed along barren and hard soil area to reduce the compaction. Transportation of quarry material to the dumping site through heavy vehicles shall be done through existing major roads to the extent possible to restrict wear and tear to the village/minor roads. Land taken for construction camp and other temporary facility shall be restored to its original conditions. 	Design requirement	Parking areas, Haulage roads and construction yards.	Location of approach and haulage roads Presence of destroyed / compacted agricultural land or land which has not be restored to its original condition	Ensure 3times water sprinkling on all haul roads	Site observation	Included in construction cost	Contractor/Concessionaire	PWD / MC
3.6 Contamination of soil due to leakage / spillage of oil, bituminous and non - bituminous	<ul style="list-style-type: none"> Construction vehicles and equipment will be maintained and refueled in such a fashion that oil / diesel spillage does not contaminate the soil. Fuel storage and refueling sites to be kept away from drainage channels. 	Design requirement	Fuelling station, construction sites, and construction camps and disposal location.	Quality of soil near storage area Presence of spilled oil or bitumen in project area	Should ensure proper storage to achieve zero contamination	Site observation	Included in construction cost.	Contractor/Concessionaire	PWD / MC

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implementation	Supervision
debris generated from demolition and road construction	<ul style="list-style-type: none"> All excavated materials from roadway, shoulders, verges, drains, cross drainage will be used for backfilling embankments, filling pits, and landscaping. To avoid soil contamination 2 nos of Oil-Interceptors shall be provided at wash down and refueling areas. Waste oil and oil soaked cotton/cloth shall be stored in containers labeled 'Waste Oil' and 'Hazardous' sold off to MoEF/SPCB authorized vendors only Unusable and non-bituminous debris materials should be suitably disposed of in an environmentally acceptable manner at pre-designated disposal locations as directed by MC, with approval of the concerned authority. The bituminous wastes shall be disposed in secure landfill sites only in environmentally accepted manner. For removal of debris, wastes and its disposal MoRTH guidelines should be followed 								
4. Water Resources									
4.1 Sourcing of water during Construction	<ul style="list-style-type: none"> Requisite permission shall be obtained for abstraction of groundwater from Central Groundwater Authority and Surface Water from Irrigation Department and/or CWC or other concerned authorities. Extraction of Groundwater should be avoided since the project area is located in 	-	Throughout the project construction	Approval from competent authority Complaints from local people on water availability	No complaints from downstream users	Checking of documentation Discussion with local people	Included in construction cost	Contractor/Concessionaire	PWD / MC

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implementation	Supervision
	water scarce zone • Arrangements shall be made by contractor/concessionaire that the water availability and supply to nearby communities remain unaffected.								
4.2 Disposal of waste water	• Waste water will be disposed at suitable location. • No-runoff water will be discharged to existing pond being used for domestic and recreational purposes.	Environment Protection Act, 1986 and Water Act, 1974	Throughout the Project construction	Existence of proper drainage system for disposal of waste water	Reutilization for water sprinkling and horticulture purpose	Standards methods Site observation and review of documents	Included in construction cost	Contractor/Concessionaire	PWD / MC
4.3 Alteration in surface water hydrology due to embankment	• Existing drainage system to be maintained and further enhanced.	Design requirement, Clause No 501.8.6. MORT&H Specifications	Near all drainage channels, river, cross drainages structures, etc.	Design of road side drains	No alteration	Review of design documents Site observation	Included in construction cost	Contractor/Concessionaire	PWD / MC
4.4 Siltation in water bodies due to construction activities / earthwork	• Provision of 2500m of Silt fencing shall be made for 11 water bodies • Earthworks and stone works to be prevented from impeding natural flow of streams and water canals or existing drainage system. • Periodic monitoring of water quality as per Environmental Monitoring Plan.	MoRT&H Specifications for Road and Bridge works and worldwide best practices	Near all water bodies, river embankment slopes.	Siltation of rivers, streams, ponds and other water bodies in project area	Ensure provision of silt fencing near water bodies to ensure zero siltation due to construction activities	Field observation	Included in construction cost	Contractor/Concessionaire	PWD / MC
4.5 Deterioration in Surface water quality due to leakage from vehicles and equipment and waste from construction camps.	• No vehicles or equipment should be parked or refuelled near water-bodies, so as to avoid contamination from fuel and lubricants. • 2 Nos of Oil-Interceptors shall be provided at wash down and refueling areas. • All chemicals and oil shall be stored away from water and	The Water Act, 1974 and amendments thereof.	Water bodies, refuelling stations, construction camps.	Water quality of ponds, streams, rivers and other water bodies in project Presence of oil floating in	Construction camp should be 500 m away from nearest water body Zero Contamination	Conduction of water quality tests as per the monitoring plan Field observation	Included in project cost	Contractor/Concessionaire	PWD / MC

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implementation	Supervision
	concreted platform with catchment pit for spills collection. <ul style="list-style-type: none"> Construction camp to be sited away from water bodies. Wastes must be collected, stored and taken to approve disposal site only. Water quality shall be monitored periodically 			water bodies in project area					
4.6 Sewage discharge from the construction camp	<ul style="list-style-type: none"> Septic tank with soak pit will be provided in construction camp 	The Water Act, 1974 and amendments thereof.	Construction Camp	Discharge practice of sewage	Provision of septic tank with soak pit in construction camp	Visual observation	Construction Cost	Contractor/Concessionaire	PWD / MC
5. Flora and Fauna									
5.1 Vegetation loss due to site preparation and construction activities	<ul style="list-style-type: none"> Minimize tree cutting to the extent possible. Approx. 682 roadside trees to be removed with prior approval of competent authority. Compensatory plantation of 1364 at 1:2 basis as per the legal requirement Additional avenue plantation & maintenance of 50526 trees Regular maintenance of all trees planted. Provision of LPG in construction camp as fuel source to avoid tree cutting, wherever possible. Plantation of trees on both sides of the road to the extent possible. Speed control & provision of signage for wildlife movement areas must be taken Accidental road kill record must be documented and maintained as per 	Forest Conservation Act, 1980	Throughout project corridor	ROW width Number of trees for felling Compensatory plantation plan- Number of trees replanted	Proposer permission and compensatory afforestation as per legislation	Review of relevant documents, tree cutting permit, compensatory plantation plan Field observations	Road side & Compensatory plantation cost is included in project costs.	Contractor/Concessionaire, Relevant agency specialized in afforestation	PWD / MC

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implementation	Supervision
	the format of Annexure – 8.1 <ul style="list-style-type: none"> Special care to be taken during construction so that the wildlife are not driven away Ponds (Existing Ch 25.200, 27.000, 27.800) being used by WL must not be disturbed for any cause In the event of design changes during the construction stages additional assessments including the possibility to save trees shall be made by the Environment Expert of MC. Road side Plantation Strategy as per IRC SP21:2009 specifications including manuring 								
6. Construction Camps									
6.1 Impact associated with location	<ul style="list-style-type: none"> All camps should maintain minimum distance from following: <ul style="list-style-type: none"> ➤ 500 m from habitation ➤ 500 m from water bodies where possible ➤ 500 m from through traffic route where possible The average distance between two camps should be 50 km 	Design Requirement	All construction camps	Location of campsites and distance from habitation, forest areas, water bodies, through traffic route and other construction camps	Guidelines as mentioned in column 2 should be followed	On site observation	Included in construction cost	Contractor/Concessionaire and MC	PWD / MC
6.2 Worker's Health in construction camp	<ul style="list-style-type: none"> The location, layout and basic facility provision of each labor camp will be submitted to CSC prior to their construction. The contractor, no later than 30 days after the issuance of the Notice to proceed will prepare and submit a Health and Safety Plan to the 	The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996	All construction camps	Camp health records Existence of proper first aid kit in camp site	One qualified doctor supported by one compounder in each camp	Camp records Site observation	Part of the Contractors costs	Contractor/Concessionaire	PWD / MC

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implementation	Supervision
	<p>Engineer (MC) for review and approval.</p> <ul style="list-style-type: none"> The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner as approved by MC. Adequate water and sanitary latrines with septic tanks attached to soak pits shall be provided. Preventive medical care to be provided to workers including a First-Aid kit that must be available in the camp. Waste disposal facilities such as dust bins must be provided in the camps and regular disposal of waste must be carried out. No alcoholic liquor or prohibited drugs will be imported to, sell, give and barter to the workers of host community. Awareness raising to immigrant workers / local community on communicable and sexually transmitted diseases. 	and The Water (Prevention and Control of Pollution) Act, 1974 and amendments thereof		Complaints from local people					
7. Management of Construction Waste / Debris									
7.1 Selection of Dumping Sites	<ul style="list-style-type: none"> Unproductive / waste lands shall be selected for dumping sites. Away from residential areas and water bodies Public perception and consent / approval from the village Panchayats and other concerned authorities has to be obtained before finalizing the location. 	Design Requirement and MORT&H guidelines	At all Dumping Sites	Location of dumping sites Public complaints	No dumping without permission from Gram Sabha / Municipal Corporation	Field survey and interaction with local people	Included in construction cost.	Contractor/Concessionaire	PWD / MC
7.2 Reuse and	<ul style="list-style-type: none"> The existing bitumen surface shall be utilized for paving of access 	MORT&H guidelines	Throughout the project	Percentage of reuse of	Ensure Zero contamination	Contractor records	Included in construction	Contractor/Concessionaire	PWD / MC

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implementation	Supervision
Disposal of construction and dismantled waste	<p>roads and paving works in construction sites and camps temporary traffic diversions, and haulage routes.</p> <ul style="list-style-type: none"> Unusable and non-bituminous debris materials should be suitably disposed of in an environmentally acceptable manner at pre-designated disposal locations, with approval of the concerned authority. The bituminous wastes shall be disposed in secure landfill sites only in environmentally accepted manner. For removal of debris, wastes and its disposal MoRTH guidelines should be followed 		corridor	existing surface material Method and location of disposal site of construction debris	to land, soil and water bodies	Field observation Interaction with local people	cost.		
8. Traffic Management and Safety									
8.1 Management of existing traffic and safety	<ul style="list-style-type: none"> Temporary traffic diversion shall be planned by the contractor and approved by the MC. The traffic control plans shall contain details of diversions; traffic safety arrangements during construction; safety measures for night time traffic and precautions for transportation of hazardous materials. Traffic control plans shall be prepared in line with requirements of IRC's SP 55 document'. The Contractor/Concessionaire will ensure that the diversion/detour is always maintained in running condition, particularly during the monsoon to avoid disruption to traffic flow. On stretches where it is not possible to pass the traffic on the part width 	Design requirement and IRC SP:55, 2001	Throughout the project corridor especially at intersections.	Traffic management plan Safety signs on site Number of traffic accidents	Approved Traffic Management Plan should be in place before start of construction activities Zero complaints from locals	Review traffic management plan Field observation of traffic management and safety system Interaction with people in vehicles using the road	Included in construction cost.	Contractor/Concessionaire	PWD / MC

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implementation	Supervision
	<p>of existing carriageway, temporary paved diversions will be constructed.</p> <ul style="list-style-type: none"> • Restriction of construction activity to only one side of the existing road. • The contractor/concessionaire shall inform local community of changes to traffic routes, and pedestrian access arrangements with assistance from MC • Use of adequate signages to ensure traffic management and safety. Conduct of regular safety audit on safety measures. 								
8.2 Pedestrians, Cattle movement	<ul style="list-style-type: none"> • Access to the schools, temples and other public places will be maintained when construction takes place in nearby locations. 	Design requirement and IRC: SP: 27-1984 IRC:SP: 32 -1988 Road Safety for Children (5-12 Years Old) IRC:SP:44-1994 Highway Safety Code	Near habitation on both sides of schools, temples, hospitals, graveyards, construction sites, haulage roads, diversion sites.	Road signage as per IRC guideline Complaints from local people	Ensure Road signage is in place as per IRC guideline	Field observation Interaction with local people	Included in construction cost.	Contractor/Concessionaire	PWD / MC
8.3 Safety of Workers and accident risk from construction activities	<ul style="list-style-type: none"> • The contractor/concessionaire, no later than 30 days after the issuance of the Notice to proceed will prepare and submit a Health and Safety Plan to the Engineer (MC) for review and approval. • Contractor/Concessionaire to adopt and maintain safe working practices. • Usage of fluorescent and 	Child Labour Act, 1986 Indian Labour Laws	Construction sites	Availability of Safety PPEs to workers Safety signage Training records on safety Number of safety related	Ensures Zero accident due to construction activities	Site observation Review records on safety training and accidents Interact with construction workers	Included in construction cost	Obligation of Contractor/Concessionaire	PWD / MC

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implementation	Supervision
	retroreflectory signage, in local language at the construction sites <ul style="list-style-type: none"> • Training to workers on safety procedures and precautions. • Mandatory appointment of safety officer. • All regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means shall be complied with. • Provision of PPEs to workers. • Provision of a readily available first aid unit including an adequate supply of dressing materials. • The contractor will not employ any person below the age of 18 years for any work • Use of hazardous material should be minimized and/or restricted. . If used, hazardous material shall be handled as per Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008 • Emergency plan (to be approved by engineer) shall be prepared to respond to any accidents or emergencies. 			accidents					
8.4 Accident risk to local community	<ul style="list-style-type: none"> • Restrict access to construction sites to authorized personnel. • Physical separation must be provided for movement of vehicular and human traffic. • Adequate signage must be provided for safe traffic movement 		Construction sites	Safety signs and their location Incidents of accidents Complaints from local	Ensures Zero accident due to construction activities	Site inspection Consultation with local people	Included in construction cost	Contractor/Concessionaire	PWD / MC

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implementation	Supervision
				people					
9. Site restoration and rehabilitation									
9.1 Clean-up Operations, Restoration and Rehabilitation	<ul style="list-style-type: none"> Contractor/Concessionaire will prepare site restoration plans, which will be approved by the MC The clean-up and restoration operations are to be implemented by the contractor prior to demobilization. All construction zones including river-beds, culverts, road-side areas, camps, hot mix plant sites, crushers, batching plant sites and any other area used / affected by the project will be left clean and tidy, at the contractor's expense, to the satisfaction of the Environmental officer of MC. All the opened borrow areas will be rehabilitated and CSC will certify in this regard. 	Project requirement	Throughout the project corridor, construction camp sites and borrow areas	Clean and restored camp sites Presence / absence of construction material / debris after completion of construction works on construction site	NOC from respective authority / land owners	Site observation Interaction with locals Issue of completion certificate after restoration of all sites	Included in construction cost.	Contractor/Concessionaire	PWD / MC
C. Operation stage									
1. Air quality									
1.1 Air pollution due to vehicular movement	<ul style="list-style-type: none"> Roadside tree plantations shall be maintained. Regular maintenance of the road will be done to ensure good surface condition Vehicular air pollution will be monitored on regular basis. Ambient air quality monitoring as per Environmental Monitoring Plan. If monitored parameters are above the prescribed limit, suitable control measures must be taken. Road signs shall be provided reminding the motorist to properly maintain their vehicles to 	Environmental Protection Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981	Throughout the Corridor	Ambient air quality (PM 2.5, PM10, CO, NOx, SO2) Survival rate of trees planted	No traffic congestion	As per CPCB requirements Site inspection	Included in Operation / Maintenance cost	PWD through monitoring agency	PWD

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implementation	Supervision
	economize on fuel consumption and protect the environment.								
2. Noise									
2.1 Noise due to movement of traffic	<ul style="list-style-type: none"> Effective traffic management and good riding conditions shall be maintained to reduce the noise level throughout the stretch and speed limitation and honking restrictions may be enforced near sensitive locations. The effectiveness of the multilayered plantation should be monitored and if needed, solid noise barrier shall be placed. Create awareness amongst the residents about likely noise levels from road operation at different distances, the safe ambient noise limits and easy to implement noise reduction measures while constructing a building close to the road Noise monitoring as per as per Environmental Monitoring plan Provision of 80 m of Noise Barrier at 2 sensitive receptors likely to experience high noise 	Noise Pollution (Regulation and Control) Rules, 2000 and amendments thereof	Sensitive receptors	Noise levels	No horn key zone near sensitive receptor	Noise monitoring as per noise rules, 2000 Discussion with people in sensitive receptor sites	Included in Operation / Maintenance cost	PWD through monitoring agency	PWD
3. Land and Soil									
3.1 Soil erosion at embankment during heavy rain fall.	<ul style="list-style-type: none"> Periodic checking to be carried to assess the effectiveness of the stabilization measures viz. turfing, stone pitching near water bodies, slope management, etc. Necessary measures to be followed wherever there are failures 	Project requirement	At slopes and other probable soil erosion areas.	Existence of soil erosion sites Number of soil erosion sites	No soil erosion	On site observation	Included in Operation / Maintenance cost	PWD through monitoring agency	PWD
4. Water resources/Flooding and Inundation									
4.1 Siltation	Regular checks shall be made for	Project	Near	Water quality	No siltation	Site	Included in	PWD through monitoring	PWD

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implementation	Supervision
	soil erosion and turfing conditions of river • Provision of side drain on both side of the road • Regular water quality monitoring	requirement	surface Water bodies			observation	Operation / Maintenance cost	agency	
4.2 Water logging due to blockage of drains, culverts or streams	• Regular visual checks and cleaning of drains shall be done along the alignment to ensure that flow of water is maintained through cross drains and other channels / streams • Monitoring of water borne diseases due to stagnant water bodies	Project requirement	Near surface Water bodies	Areas with water stagnation	No water logging or blockage of side drains / CD structures	Site observation	Included in Operation / Maintenance cost	PWD through monitoring agency	PWD
5. Flora									
5.1 Vegetation	• Planted trees, shrubs and grasses to be properly maintained • The tree survival audit to be conducted at least once in a year to assess the effectiveness	Forest Conservation Act, 1980	Project tree plantation sites	Minimum of 70% of tree survival	70% survival	Records and fields observations	Operation and Maintenance Cost	PWD through monitoring agency	PWD
6. Fauna									
6.1 Wildlife	• Speed control & Condition of signage for wildlife movement areas must be monitored, checked and maintained properly • Accidental road kill record must be documented and maintained as per the format of Annexure – 8.1 • Ponds (Existing Ch 25.200, 27.000, 27.800) being used by WL must not be disturbed for any cause •	Wildlife Conservation Act, 1972	Throughout project corridor & Specific stretches	Number of accidental road Kill of wildlife	Zero (0) accidental road kill of any Schedule I species	Audit/Review of efficacy of EMP, Condition of mitigation measures taken	Considered in EMP	Contractor/Concessionaire	PWD / MC
7. Maintenance of Right of Way and Safety									
6.1 Accident Risk due to uncontrolled	• Efforts shall be made to make shoulder completely clear of vegetation	Project requirement	Throughout the project route	Presence of and extent of vegetation	Necessary pruning	Visual inspection	Included in operation / Maintenance	PWD	PWD

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implementation	Supervision
growth of vegetation	<ul style="list-style-type: none"> Regular maintenance of plantation along the roadside 			growth on either side of road Accident data		Accident records	cost		
6.2 Accident risks associated with traffic movement.	<ul style="list-style-type: none"> Traffic control measures, including speed limits, will be enforced strictly. Further encroachment of squatters within the ROW will be prevented. Monitor/ensure that all safety provisions included in design and construction phase are properly maintained Tow-away facility for the break down vehicles if possible 	IRC:SP:55	Throughout the Project route	Police records on accident Condition and existence of safety signs, rumble strips etc. on the road	Zero Accident	Review accident records Site observations	Included in Operation / Maintenance cost	PWD	PWD

Annexure 9.2: Environmental Standards & Environmental Monitoring Plan

0 MONITORING PARAMETERS AND STANDARDS

The Environmental monitoring of the parameters involved and the threshold limits specified are discussed below:

Ambient Air Quality Monitoring (AAQM)

The air quality parameters as per CPCB standard procedure and further recommendation of the World Bank as per direction of Environment Specialist of IE shall be regularly monitored at identified locations from the initiation of the project just after award of job to concessionaire. Ambient air quality shall be monitored in accordance with the National Ambient Air Quality Standards as given in Table 1.

The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan Table 5.

Table 1: National Ambient Air Quality Standards

Sl. No.	Pollutants	Time-weighted average	Concentration in Ambient Air		Methods of Measurement
			Industrial, Residential, Rural & other Areas	Ecologically Sensitive Areas (notified by Central Government)	
1	Sulphur Dioxide (SO ₂) µg/m ³	Annual*	50	20	- Improved West & Gaeke - Ultraviolet fluorescence
		24 hours**	80	80	
2	Nitrogen Dioxide (NO ₂) µg/m ³	Annual*	40	30	- Modified Jacob and Hochheiser (Na-Arsenite) - Chemilumiscence
		24 hours**	80	80	
3	Particulate Matter (size less than 10 µm) or PM ₁₀ µg/m ³	Annual*	60	60	- Gravimetric - TOEM - Beta attenuation
		24 hours**	100	100	
4	Particulate Matter (size less than 2.5µm) or PM _{2.5} µg/m ³	Annual*	40	40	- Gravimetric - TOEM - Beta attenuation
		24 hours**	60	60	
5	Ozone (O ₃) µg/m ³	8 hours**	100	100	- UV photometric - Chemilumiscence - Chemical Method
		1 hours**	180	180	
6	Lead (Pb) µg/m ³	Annual*	0.50	0.50	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper - ED-XRF using Teflon filter
		24 hours**	1.0	1.0	
7	Carbon Monoxide (CO) (mg/m ³)	8 hours**	02	02	- Non Dispersive Infra-Red (NDIR) spectroscopy
		1 hours**	04	04	
8	Ammonia (NH ₃) µg/m ³	Annual*	100	100	- Chemilumiscence - Indophenol Blue Method
		24 hours**	400	400	

Preparation of Feasibility Study and Detailed Project Report for Construction of 2 lane/2 lane with paved shoulder from Kohima to Nagaland/Manipur border section of NH-29 (Old NH-150) in the State of Nagaland

Sl. No.	Pollutants	Time-weighted average	Concentration in Ambient Air		Methods of Measurement
			Industrial, Residential, Rural & other Areas	Ecologically Sensitive Areas (notified by Central Government)	
9	Benzene (C ₆ H ₆) µg/m ³	Annual*	05	05	- Gas chromatography based continuous analyser - Adsorption and Desorption followed by GC analysis
10	Benzo(a) Pyrene Particulate Phase only ng/m ³	Annual*	01	01	- Solvent Extraction followed by HPLC/GC analysis
11	As ng/m ³	Annual*	06	06	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper
12	Ni ng/m ³	Annual*	20	20	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper

* Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

** 24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be compiled with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

Note: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or monitoring and further investigation.

Source: MoEF Notification dated 16th November, 2009

Noise Quality Monitoring

The noise levels shall be monitored at already designated locations in accordance with the Ambient Noise Quality standards given in Table 2 below. The location, duration and the noise pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan Table 5.

Table 2: National Ambient Noise Quality Standards

Category of Area / Zone	Limits in dB(A) Leq	
	Day Time	Night Time

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Industrial area	75	70
Commercial area	65	55
Residential area	55	45
Silence Zone	50	40

Note: (1) Day time shall mean from 6.00 a.m. to 10.00 p.m. (2) Night time shall mean from 10.00 p.m. to 6.00 a.m. (3) Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority (4) Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

Water Quality Monitoring

Water quality parameters such as pH, BOD, COD, DO, coliform count, total suspended solids, total dissolved solids, Iron, Fluorides etc. shall be monitored at all identified locations from initiation of the project just after award of job to concessionaire as per standards prescribed by Central Pollution Control Board and Indian Standard Drinking water specifications IS 10500:2012, presented in Table 3 & 4 respectively. The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed out in the Environmental Monitoring Plan 5.

Table 3: Primary Water Quality Standards

S. No.	Designated Best Use	Class of Water	Criteria
1	Drinking Water source (with conventional treatment)	A	Total Coliform MPN/100 ml shall be 50 or less pH between 6.5 to 8.5 Dissolved Oxygen 6 mg / l or more Biochemical Oxygen demand (BOD) 5 days 20°C 2 mg/l or less
2	Outdoor bathing (organised)	B	Total Coliform MPN/100 ml shall be 500 or less pH between 6.5 to 8.5 Dissolved Oxygen 5 mg / l or more Biochemical Oxygen demand (BOD) 5 days 20°C 3 mg/l or less
3	Drinking Water source (without conventional treatment)	C	Total Coliform MPN/100 ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4 mg / l or more Biochemical Oxygen demand (BOD) 5 days 20°C 3 mg/l or less
4	Propagation of Wildlife	D	pH between 6.5 to 8.5 for fisheries Dissolved Oxygen 4 mg / l or more Free Ammonia (as N) 1.2 mg/l or less
5	Irrigation, Industrial Cooling, Controlled Waste	E	pH between 6.0 to 8.5 Electrical Conductivity at 25°C µmhos/cm Max. 2250 Sodium absorption ratios Max. 26 Boron, Max.2 mg/l

Ref: CPCB (1999). Bio mapping of rivers, Parivesh New Letter, 5 (iv), Central Pollution Control Board, Delhi, PP.20.

Table 4: Indian Standard Drinking Water Specifications: IS 10500:2012

S. No.	Substance / Characteristics	Requirement (acceptable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
Essential Characteristics						
1	Colour, Hazen Units, Max.	5	Above 5, consumer acceptance decreases	15	IS 3025 (Part 4)	Extended to 15 only if toxic substances, in absence of alternate sources.
2	Odour	Agreeable	-	Agreeable	IS 3025 (Part 5)	A test cold and when heated. Test at several dilution
3	Taste	Agreeable	-	Agreeable	IS 3025 (Part 7 & 8)	Test to be conducted only after safety has been established
4	Turbidity NTU, Max.	1	Above 5, consumer acceptance decreases	5	3025 (Part 10): 1984	
5	PH value	6.5 to 8.5	Beyond this range the water will not affect the mucous membrane and /or water supply system	No relaxation	IS 3025 (Part 11)	

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S. No.	Substance / Characteristics	Requirement (acceptable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
6	Total hardness (as CaCO ₃) mg/1, Max.	300	Encrustation in water supply structures an adverse effect on domestic use	600	IS 3025 (Part 21)	
7	Iron (as Fe) mg /1 Max.	0.3	Beyond this limit taste/appearance are affected has adverse effect on domestic uses and water supply structures and promotes iron bacteria	No relaxation	IS 3025 (Part 53)	Total concentration of manganese (as Mn) and iron (as Fe) shall not exceed 0.3 mg/1
8	Chlorides (as Cl) mg/1 Max.	250	Beyond this limit, taste corrosion and palatability are affected	1000	IS 3025 (Part 32)	
9	Residual, free chloride, mg/1 Min.	0.2		1	IS 3025 (Part 26)	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be Min. 0.5 mg/1
Desirable characteristics						
1	Dissolved solids mg/1 Max.	500	Beyond the palatability decreases and may cause gastro intestinal irritation	2000	IS 3025 (Part 16)	
2	Calcium (as Ca) mg/1 Max.	75	Encrustation in water supply structure and adverse effects on domestic use	200	IS 3025 (Part 40)	
3	Magnesium (as Mg) mg/1, Max.	30	Encrustation in water supply structure and adverse effects on domestic use	100	IS 3025 (Part 46)	
4	Copper (as Cu) mg/1 Max.	0.05	Beyond taste, discoloration of pipes, fitting and utensils will be caused beyond this	1.5	IS 3025 (Part 42)	
5	Manganese (as Mn) mg/1, Max.	0.1	Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures.	0.3	IS 3025 (Part 59)	
6	Sulphate (as 200 So ₂), mg/1, Max.	200	Beyond this causes gastro intestinal irritation when magnesium or sodium are present	400	IS 3025 (Part 24)	May be extended up to 400 provided (as Mg) does not exceed 30
7	Nitrate (as No ₂) mg/1, Max.	45	Beyond this methaemoglobinemia take place	No relaxation	IS 3025 (Part 34)	To be tested when pollution is suspected
8	Fluoride (as F) mg/1, Max.	1.0	Fluoride may be kept as low as possible. High fluoride may cause fluorosis	1.5	IS 3025 (Part 60)	To be tested when pollution is suspected
9	Phenolic compounds (as C ₆ H ₅ OH) mg/1, Max.	0.001	Beyond this it may cause objectionable taste and odour	0.002	IS 3025 (Part 43)	To be tested when pollution is suspected
10	Mercury (as Hg) mg/1, Max.	0.001	Beyond this the water becomes toxic	No relaxation	IS 3025 (Part 48)	To be tested when pollution is suspected
11	Cadmium (as cd), mg/1, Max.	0.003	Beyond this the water becomes toxic	No relaxation	IS 3025 (Part 41)	To be tested when pollution is suspected

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S. No.	Substance / Characteristics	Requirement (acceptable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
12	Selenium, (as Se). mg/l, Max.	0.01	Beyond this the water becomes toxic	No relaxation	IS 3025 (Part 56)	To be tested when pollution is suspected
13	Arsenic (As) mg/l, Max.	0.01	Beyond this the water becomes toxic	0.05	IS 3025 (Part 37)	To be tested when pollution is suspected
14	Cyanide (as CN) mg/l, Max.	0.05	Beyond this the water becomes toxic	No relaxation	IS 3025 (Part 27)	To be tested when pollution is suspected
15	Lead (as Pb), mg/l, Max.	0.01	Beyond this the water becomes toxic	No relaxation	IS 3025 (Part 47)	To be tested when pollution is suspected
16	Zinc (as Zn) mg/l, Max.	5	Beyond this limit it can cause astringent taste and an opalescence taste and an opalescence in water	15	IS 3025 (Part 49)	To be tested when pollution is suspected
17	Anionic detergents (as MBAS) mg/l, Max.	0.2	Beyond this it can cause a light froth in water	1	Annex K of IS 13428	To be tested when pollution is suspected
18	Chromium (as Cr6+) mg/l, Max.	0.05	May be carcinogenic above this limit	No relaxation	IS 3025 (Part 52)	To be tested when pollution is suspected
19	Poly nuclear aromatic hydrocarbons (as PAH) mg/l, Max.	0.0001	May be carcinogenic above this limit	No relaxation	APHA 6440	-
20	Mineral oil mg/l, Max.	0.5	Beyond this limit undesirable taste and odour after chlorination take place.	0.03	IS 3025 (Part 39)	-
21	Pesticides mg/l, Max.	-	Toxic	-	-	-
22	Radioactive material	-	-	-	IS 14194	-
23	Alpha emitters bq/l, Max.	0.1	-	No Relaxation	-	-
24	Beta emitter pci/l, Max.	1.0	-	No Relaxation	-	-
25	Total alkalinity (as CaCO ₃), mg/l, max	200	Beyond this limit taste becomes unpleasant	600	IS 3025 (Part 23)	-
26	Aluminium (as Al) mg/l, Max.	0.03	Cumulative effect is reported to cause dementia	0.2	IS 3025 (Part 55)	-
27	Boron mg/l, Max.	0.5	-	1.0	IS 3025 (Part 57)	-

Source: Indian Standard Drinking Water Specification – IS 10500:2012

1 ENVIRONMENTAL MONITORING PLAN

The environmental monitoring plan is given below in table 5.

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Table 1: Environmental Monitoring Plan

Environmental Components	Monitoring			Location	Frequency	Institutional Responsibility	
	Parameters	Special Guidance	Standards			Implementation	Supervision
Air	PM2.5, PM10, SO ₂ , NO _x , CO	As per CPCB guidelines	The Air (Prevention and Control of Pollution) Rules, CPCB, 1982	At hot mix plant, batching plant, sensitive areas and chainages as directed by Environment Specialist of Monitoring Consultant	8 Locations twice in week for 3 season in a year for 1.5 years for construction period (8x2x4x9X1.5) and 2 Locations once in a month for 3 months x 3 season in every alternate year for 10 years (2x3x3x5) during operation period	Contractor/Concessionaire through NABL/MOEF approved monitoring agency	PWD, MC
Water	pH, BOD, COD, TDS, TSS, DO, Total coliform, Conductivity, Oil & Grease other Baseline Parameters	Grab sample collected from source and analyze as per standard methods for examination of water and wastewater	Water quality standards by CPCB	River tributaries, roadside ponds and ground water at construction camp sites and chainages as directed by Environment Specialist of Monitoring Consultant	7 Locations once in a season for 2 season (pre & Post Monsoon) in a year for 1.5 years for construction period (7x2x1.5) and 3 Locations once in a year for 2 season (pre & Post Monsoon) in every alternate year for 10 years for operation period (3x 2x5)	Contractor/Concessionaire through NABL/MOEF approved monitoring agency	PWD, MC
Noise Levels	Noise level for day and night on dB(A) scale	In free field at 1m distance from the equipment to be monitored	Noise standard by CPCB	At equipment yards, camp and villages along the alignment and chainages as directed by Environment Specialist of Monitoring Consultant	10 Locations three times in a year for 1.5 years for construction period (10x3x1.5) and 3 Locations once in every alternate year for 10 years for (3x5)	Contractor/Concessionaire through NABL/MOEF approved monitoring agency	PWD, MC
Soil quality	Monitoring of NPK & heavy metals, grease and other Baseline Parameters		ICAR Criteria of Soil Quality	Sensitive Landuse and chainages as directed by Environment Specialist of Monitoring Consultant	5 Locations twice in a year for 1.5 years for construction period (5x2x1.5) and 2 Locations once in every alternate year for 10 years for operation period (2x5)	Contractor/Concessionaire through NABL/MOEF approved monitoring agency	PWD, MC
Road side plantation	Monitoring of felling of	It should be ensured	As given in the IEE	All along the corridor	During the felling of trees	Forest department	PWD, MC

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Environmental Components	Monitoring			Location	Frequency	Institutional Responsibility	
	Parameters	Special Guidance	Standards			Implementation	Supervision
	trees	that the marked trees are felled only	report				
	Survival rate of trees, success of re-vegetation	The number of trees surviving during each visit should be compared with the number of saplings planted	The survival rate should be at- least 75% below which re-plantation should be done	At locations of compensatory afforestation	For 3 years after completion of construction period	PWD	PWD
Wildlife	Accidental Road Kill	Format attached as Annexure 8.1	Zero accidental kill of Schedule – I species	Entire Project Stretch	As and when required	Contractor/Concessionaire	PWD, MC
	Condition of Roadside Signage	Visual observation	as per IRC code	Roadside Signage Locations	At least twice in ayear		
	Plying Vehicular speed	Random Speed checking	-	Speed Limit Sections	At least twice in ayear		