



ASIAN DEVELOPMENT BANK

Project No.

**NORTH EASTERN STATE ROAD IMPROVEMENT PROGRAM
(NESRIP) - Tranche 2**

INITIAL ENVIRONMENTAL EXAMINATION

(MZ 02: Serchhip - Buarpui)

February, 2013

The initial environmental examination is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature.

ABBREVIATIONS

ADB	-	Asian Development Bank
BGL	-	Below Ground Level
BOD	-	Biological Oxygen Demand
BIS	-	Bureau of Indian Standard
CPCB	-	Central Pollution Control Board
DO	-	Dissolved Oxygen
DoE	-	Department of Environment
DPMC	-	Design and Project Management Consultant
EA	-	Executing Agency
EIA	-	Environmental Impact Assessment
EMP	-	Environmental Management Plan
EMoP	-	Environmental Monitoring Plan
ESO	-	Environmental and Safety Officer
GDP	-	Gross Domestic Product
Gol	-	Government of India
IEE	-	Initial Environmental Examination
IMD	-	Indian Meteorological Department
IRC	-	Indian Road Congress
IS	-	Indian Standard
MDONER	-	Ministry of Development of North Eastern Region
MDRs	-	Major District Roads
MFF	-	Multi Tranche Financial Facility
MoEF	-	Ministry of Environment and Forests
MoRT&H	-	Ministry of Road Transport and Highways
MPWD	-	Mizoram Public Works Department
MSL	-	Mean Sea Level
MW	-	Mega Watt
NEC	-	North Eastern Council
NER	-	North Eastern Region
NESRIP	-	North Eastern State Road Improvement Program
NGO	-	Non Government Organization
NH	-	National Highway
NOx	-	Oxides of Nitrogen
NSDP	-	Net State Domestic Product
PIU	-	Project Implementation Unit
PRF	-	Proposed Reserve Forest
PWD	-	Public Works Department
RF	-	Reserve Forest
ROW	-	Right of Way
SARDP-NE	-	Special Accelerated Road Development Program in the North Eastern Region
SC	-	Supervision Consultant
SH	-	State Highway
SPCB	-	State Pollution Control Board
SPM	-	Suspended Particulate Matter
SO ₂	-	Sulphur Dioxide
SSI	-	Small Scale Industries
SPCB	-	State Pollution Control Board
TA	-	Technical Assistance
TDS	-	Total Dissolved Solids
TSS	-	Total Suspended Solid
UGF	-	Unclassified Government Forest
VCs	-	Village Councils

WEIGHTS AND MEASURES

lakh	–	100 thousand = 100,000
crore	–	100 lakhs = 10,000,000
$\mu\text{g}/\text{m}^3$	–	micrograms per cubic meter
km	–	kilometer
lpd	–	liters per day
m	–	meter
mg/l	–	milligrams per liter
mm	–	millimeter
ppm	–	parts per million

NOTE{S}

- (i) In this report, "\$" refers to US dollars.
- (ii) "INR" and "Rs" refer to Indian rupees

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EXECUTIVE SUMMARY

1. The project road MZ 02: Serchhip-Buarpui is a part of North Eastern State Road Improvement Program (NESRIP) –Tranche 2, being implemented with funding support from Asian Development Bank (ADB). Ministry of Development of North Eastern Region (MDONER) is the executing agency at centre and will be implemented by State Public Works Department (PWD), in this case the Mizoram PWD. Proposed improvement will not result to significant adverse environmental impacts. Most of impacts are site-specific and can be addressed through proven mitigation measures. The road section was classified as **Category B** and an initial environmental examination (IEE) has been conducted as per SPS, 2009.

2. The road improvement will cover 55 kilometres of the existing major district road which is segregated in two parts separated by Aizwal - Lungei State Highway. Part I (Serchhip - Sialsuk junction) starts at its junction with NH 54, about 4 km south of Serchhip town and terminates at its junction with Aizawl-Lungei State Highway (SH) near Sitvan-Hanging Garden, Sialsuk covering a length of 15.2 km. Part II (Thenzawl – Buarpui) starts at its junction with Aizawl-Lungei SH near Thenzawl and ends at Buarpui totalling 39.8 km. Project road improvement involves: (i) widening to intermediate lane with earthen shoulder in valley side and paved on hill side; (ii) curve improvement; (iii) rehabilitation and construction of cross drainage structures and side drains (iv) junctions/intersections improvement (vi) incorporating road safety measures, and (viii) providing protection works to stabilize slopes to control slides and erosion.

3. Project road is not located in any environmentally sensitive areas. However, it passes through riverine reserve forest areas requiring diversion of almost 1 hectare (ha) of forest land. Abutting landuse is predominantly privately owned forests. Approximately 1,706 trees are likely to be affected. **Since ROW is limited to the existing width of road, land acquisition will be required almost throughout along the alignment for widening and improvement works. In addition to this minor land acquisition will also be required near curve locations, retaining/breast walls, and debris disposal sites.**

4. The significant environmental impacts attributable to the upgrading of the road pertains to tree cutting, temporary deterioration of ambients during construction phase from land clearing, silt run off, hill cutting, camp operations and blasting though not required near habitations. These impacts are easily mitigated by adopting good construction practices and effective implementation of the environmental management plan (EMP). No long-term adverse impact is anticipated. Since the project road is located in landslide prone areas, adequate engineering and bio-engineering measures are proposed to stabilize slopes.

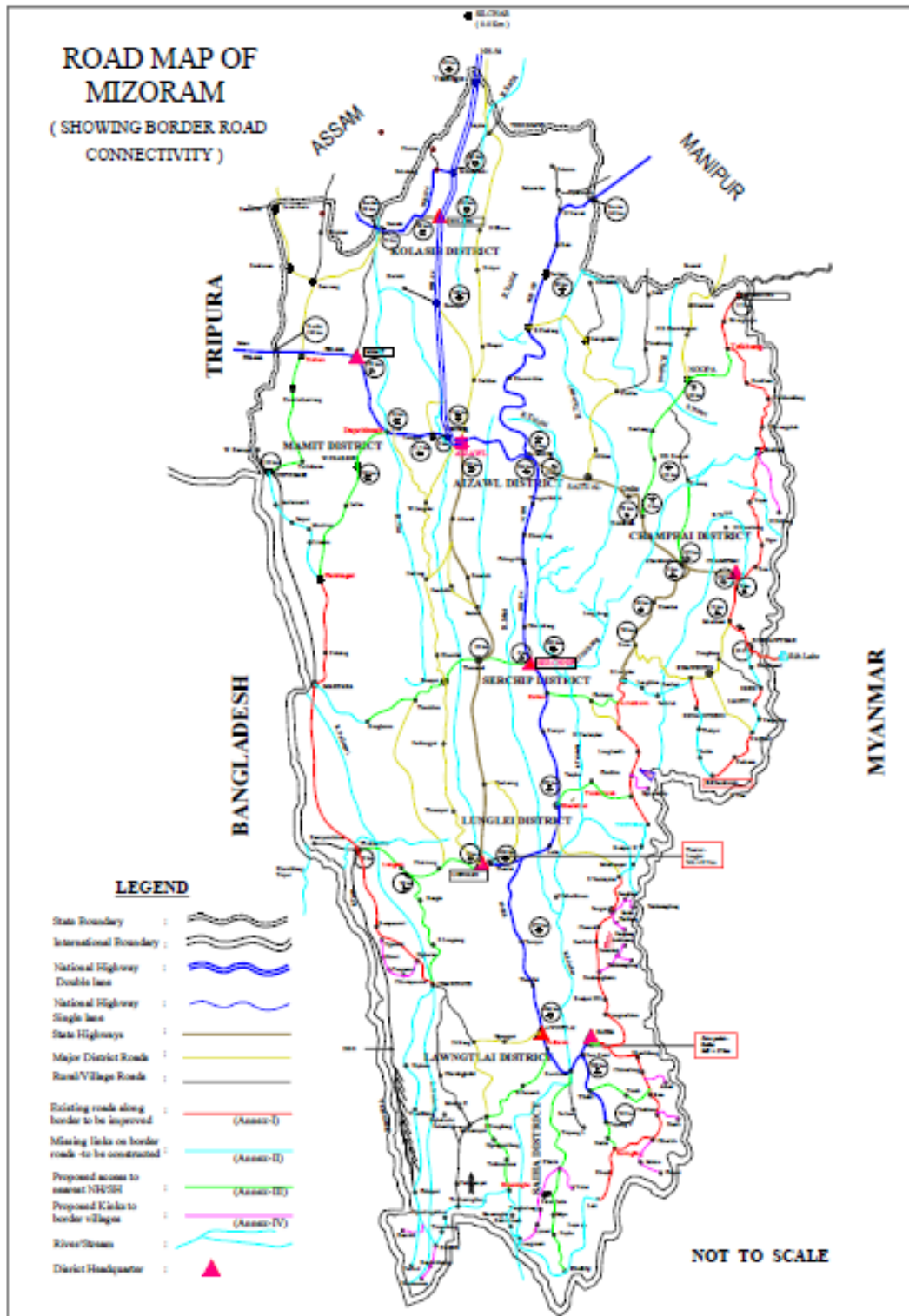
5. Several consultations were organized during the project preparation to engage major stakeholder representatives to incorporate their concerns in the overall design. These involved officials of executing agencies, Forest Department, State Pollution Control Board, Fishery, affected persons and village heads in the project area. Most of the people interviewed strongly support the project.

6. The Mizoram PWD (MPWD), through its Project Implementation Unit (PIU), will ensure the effective implementation of the environmental management plan. There is a need for the PIU to organize its environmental unit to ensure that contractors maintain environmental safeguard compliance. To provide regular monitoring information and technical advice to the PIU are the supervision consultant and the contractor's environment and social officer.

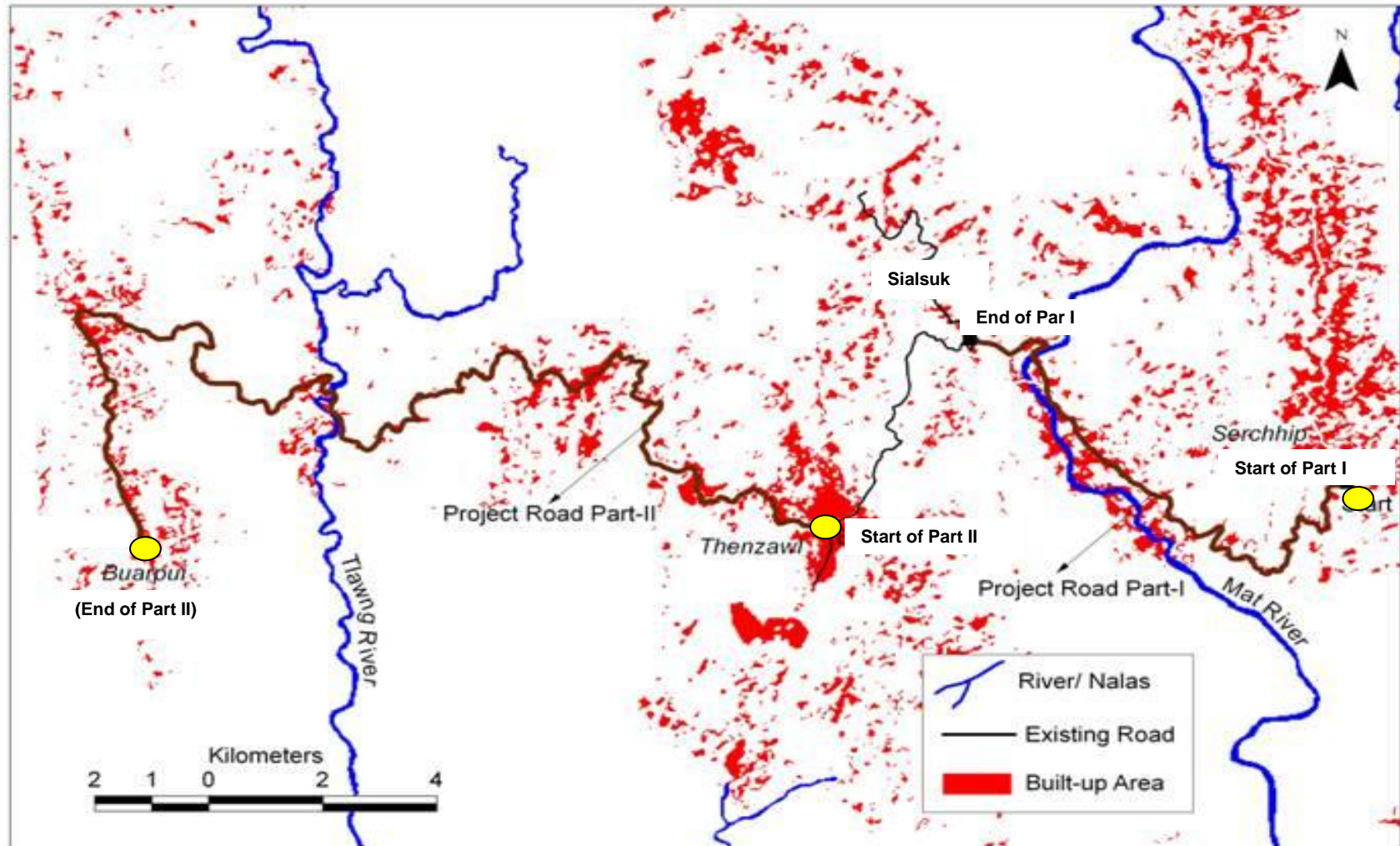
7. This IEE ascertains that upgrading is unlikely to cause any significant environmental impacts. Few impacts were identified attributable to the proposed subproject, all of which are

localized and temporary in nature and can be easily mitigated with minor to negligible residual impacts. No additional studies or need of undertaking detailed EIA is envisaged at this stage.

Map 1: Road Network of Mizoram



MAP 2: Project Road Alignment



I. INTRODUCTION

A. Project Background

1. Road is the dominant mode of transport in the North-Eastern part of the country. Road conditions in the region are very poor both in terms of coverage and riding quality. Approximately 70% roads in the region are in poor condition and hardly 20% in serviceable condition causing high transport cost and excessive travel time. This is also a main factor constraining the socio-economic development of the region and impeding country's goal of regionally balanced growth.

2. Recognizing the importance of road in providing momentum for accelerating economic development in the region, Government of India (GOI), through the Ministry of Development for North Eastern Region (MDONER) started a national investment program - Special Accelerated Road Development Program in the North Eastern Region (SARDP-NE). This aims to improve national highways and state roads in the region, providing connectivity to the state capitals and district headquarters. In this series, GOI approached Asian Development Bank (ADB) for its assistance to develop secondary road network by improving intrastate connectivity, of administrative and economic importance under North Eastern State Roads Investment Program (NESRIP).

3. **North Eastern State Road Investment Program (NESRIP).** NESRIP is an ADB's multi tranche financing facility (MFF) intended to improve about 430 kilometres (km) of priority roads in six states, namely: Assam, Manipur, Meghalaya, Mizoram, Sikkim, and Tripura in the North Eastern Region (NER) of India. NESRIP will also provide capacity building support to the executing agencies, MDONER, and the state public works departments (PWDs) or its equivalent in the six project states. The investment program targets the secondary road network and aim to enhance the performance of state roads sector in NER through investment project implementation and dedicated capacity building measures. The improved secondary road network will provide important linkage between the primary and tertiary road networks in the region, for which there are on-going national programs for improvement. The MFF is structured in two tranches as detailed in **Table 1**.

Table 1: Road Sections under North Eastern State Road Improvement Program

Package Code	Tranche/Road Name	State	Length (km)
Tranche 1			
AS-11	Futkibari – Bilasipara (NH-31)	Sikkim	16.2
AS-37C	Barpeta – Kalitakuchi	Assam	58.5
ML-N1	Garobadha – Dalu (NH-51)	Meghalaya	93.4
SK-01	Melli (NH-31A) – Nayabazar	Sikkim	14.5
SK-02	Nayabazar – Namchi (19km point)	Sikkim	19.7
Subtotal for Tranche 1			202.3
Tranche 2			
AS-02	Tamulpur – Paneri	Assam	43.0
AS-03	Paneri – Udalguri	Assam	18.6
AS02-03	Major Bridges	Assam	1.3
MN-06	Tupul (NH53) - Kasom-Khullen	Manipur	93.2
MZ-02	Serchhip – Buarpui	Mizoram	55
TR-02	Udaiphur (NH-44) - Melaghar	Tripura	20.3
Subtotal for Tranche 2			231.4
Grand Total for investment program			433.7

Source: Report and Recommendation of the President to the Board of Directors, June 2011

B. Purpose and Objectives of the Study

4. The environmental assessment study was conducted from September 2005 to January 2006 as part of feasibility study under ADB financed technical assistance to meet ADB requirements. The report was updated in 2008, and in 2010 as part of detailed design. This 2013 final version disaggregates this road section from a bigger civil works package and provides more detailed environmental baseline and assessment of **Serchhip – Buarpui MZ 02** road section in the state of Mizoram, one of the six roads under Tranche 2 of NESRIP prior to initiation of civil works. It has been categorized as **Category ‘B’** and hence an initial environmental examination (IEE) has been conducted.

5. The IEE report covers the general environmental profile of the study area and includes an overview of the potential environmental impacts and their magnitude on physical, ecological, economic, and social and cultural resources within the project's influence area during design, construction, and operation stages. An EMP was prepared that contains mitigation measures for significant environmental impacts during implementation of the project, environmental monitoring program, and the responsible entities for mitigation and monitoring. IEE has four basic objectives; (i) identify the environmental issues that should be taken into account due to project interventions (ii) determine the magnitude of potential environmental concerns and to ensure that environmental considerations are given adequate weight at planning/design stage (iii) identify need for further environmental studies or Environmental Impact Assessment (EIA) and, (iv) suggest enhancement measures, if any.

B. Extent of the IEE Study

6. This IEE report has been prepared on the basis of detailed engineering design, field investigations and stakeholder consultations to meet the requirements for environmental assessment process and documentation as per ADB's Safeguard Policy Statement (SPS, 2009). The extent of the IEE extent was decided considering all likely impacts and risks analyzed in the context of the project's area of influence encompassing: (i) the primary project site(s) and related facilities like site clearance, utility shifting etc. (ii) associated facilities project viz. borrowing, quarrying, disposal of debris, construction camp etc. (iii) areas and communities potentially affected by cumulative impacts, and (iv) potential impact from unplanned but predictable developments caused by the project that may occur at later stage or at a different location.

7. The core zone of impact is taken as 15 m on the either side of the alignment. However, the study area is considered up to 10 km on either side of road alignment for larger analysis of landuse and other environmental features.

C. IEE Methodology

8. IEE commenced with the review of the technical details provided by the DPR team and preceding environmental assessment reports conducted for the project road. This was followed by a reconnaissance site visit and discussion with the implementing agency to reconfirm the technical details of the project road improvement work. This helped identify environmental attributes which may get altered due to the project and incorporate additional information to the baseline environmental scenario/environmental setting of the project to meet the ADB Safeguard requirements. Further steps followed for IEE has been concisely described in following paragraphs.

1. Primary Data Collection

9. Inventory of all environmental features viz. terrain, geologically unstable areas, waterways/water bodies, road side vegetation, sensitive receptors, common property

resources, utilities, flooding/water logging, and industries was conducted along the project road within the area of interest/core zone. Since some portion of the project road is passing through the reserved forest areas though outside the right of way, a rapid bio-diversity study was also undertaken. The data collection from the field was completed with the help of trained enumerators / investigators.

2. Secondary Data Collection

10. Published reports, government websites, recognized institutions and relevant government departments were consulted to gather informations and maps of the project influence area. For information on ambient air quality, soil quality, background noise level, surface and groundwater quality, environmental assessment done by Design and Project Management Consultant (DPMC) was referred.

3. Public Consultation

11. Besides consultations with the government agencies, consultations with local people/beneficiary population were held at all major habitations to collect baseline information to better understand of potential impacts and appreciate the perspectives/concerns of the stakeholders. Information gathered were integrated in project design and formulating of the EMP.

4. Other Tools

12. Remote sensing and GIS based landuse map of the study area has been prepared through recent satellite imagery and verified on the ground.

13. Information collected from both primary and secondary sources has been summarised in **Table 2**.

Table 2: Primary and Secondary Information Sources

Informations	Sources
Technical Details	PWD and Design and Project Management Consultant (DPMC)
Inventory of road features	Ground Physical surveys
Climatic condition	Indian Meteorological Department Websites
Geology, Seismicity, Soil and Topography	State of Environment Report, Pollution Control Board, DPR and Primary Surveys
Land Use/ Land Cover	State of the Environment Report, Satellite Imagery based land use analysis
Drainage Pattern	Google Image, Detail Project Report and onsite observations
Roadside Forest/Vegetation	Forest Range Offices/State Forest Department, Mizoram.
Archaeological / Cultural Heritage sites	Archaeological Survey of India
Status of fishing activity	District Fisheries offices
Air quality Noise, Soil and Water	Primary survey by DPMC
Borrow areas, quarries and other construction material source	PWD, Detailed Project Report and Consultation
River geo-morphology, hydrology, drainage, flood patterns,	Detailed Project Report, Consultation and site verification
Soil profile and measures to control soil erosion	Soil Conservation Department, Govt. Of Mizoram.
Groundwater Conditions	Central Groundwater Board
Socio-economic environment	Different Govt. agencies/civic bodies, official websites maintained by state govt., census of India 2011, and public Consultation during the Field survey

5. Assessment of Potential Impacts

14. Potential significant impacts were identified on the basis of: analytical review of baseline data; review of environmental conditions at site; analytical review of the underlying socio-economic conditions with the project influence area.

6. Preparation of the Environment Management Plan

15. An EMP for the project was prepared to specify the steps required to ensure that the necessary measures will be taken. The EMP includes the monitoring plan giving details of the resources budgeted and the implementation arrangements.

D. Structure of the report

16. The IEE has been structured as recommended in SPS, 2009. An introduction section has been included to have a general overview of the project. Executive Summary describing critical facts, significant findings, and recommended actions has been presented in the beginning of the report. The report has been compiled and presented as follows.

Executive Summary

- Chapter 1- Introduction
- Chapter 2- Policy, Legal and Administrative Framework
- Chapter 3- Description of Project
- Chapter 4- Description of the Environment
- Chapter 5- Anticipated Impacts and Mitigation Measures
- Chapter 6- Information Disclosure, Consultation, and Participation
- Chapter 7- EMP and Grievance Redress Mechanism
- Chapter 8 - Conclusion and Recommendation.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

17. This chapter presents a review of the existing institutions and legislations relevant to the project at the national and state levels. The environmental assessment process considered the following environmental regulations and guidelines of Government of India (GoI) and ADB safeguard requirements.

A. Country's Legal Framework and Regulatory Requirements

18. The Government of India has laid out various policy guidelines, acts and regulations for the safeguard and conservation environment. The Environment (Protection) Act, 1986 provides umbrella legislation for the protection of environment. As per this Act, the responsibility to administer the legislation has been jointly entrusted to the Ministry of Environment and Forests (MoEF) and the Central Pollution Control Board (CPCB)/Mizoram State Pollution Control Board (SPCB) in the present context.

B. Recent Policy Initiatives

19. Ministry of Environment & Forest (MoEF) vide O.M. No. L-11011/47/2011-IA.II(M) dated 18th May, 2012 in view of the Order of Hon'ble Supreme Court dated 27.2.2012 in I.A. no. 12-13 of 2011 in SLP (C) no. 19628-19629 of 2009 in the matter of : Deepak Kumar etc. Vs State of Haryana and others has informed that it has been decided in the MoEF that: (i) All mining projects of minor minerals including their renewal, irrespective of the size of the lease would henceforth require prior environment clearance, (ii) mining projects with lease area up to less than 50 ha including projects of minor mineral with lease area less than 5 ha would be treated as category „B“ as defined in the EIA Notification, 2006 and will be considered by the respective State/ UT Level Environment Impact Assessment Authority (SEIAAs), (iii) all the respective SEIAAs in dealing with the applications regarding environment clearance should be disposed within ten days from the date of receipt of the applications in accordance with law. All State Governments should take action as per the decision of the MoEF. **Table 3** presents all relevant policies/acts/rules and regulations and its applicability to the project.

Table 3: Environmental Regulations/ Legislations and its Applicability to the Project

SR. No	Act / Rules	Purpose	Ap	Reason for Applicability	Authority
1	Environment Protection Act-1986	To protect and improve overall environment	yes	It is umbrella legislation and notifications, rules and schedules are promulgated under this act.	MoEF. GoI; DoE, Mizoram State Gov. SPCB

SR. No	Act / Rules	Purpose	Ap	Reason for Applicability	Authority
2	Environmental Impact Assessment Notification 14th Sep-2006 ¹	To provide environmental clearance to new development activities following environmental impact assessment	No	This notification is not applicable to the project road since it is neither a state highway nor a national highway.	MoEF. SEIAA
3	Fly Ash Notification, 1999 as amended upto 17th August 2003:	Reuse large quantity of fly ash discharged from thermal power plant to minimize land use for disposal	NO	No thermal power Plant located within 100 Km radius	MoEF
4	Coastal Regulation Zone(CRZ) Notification 1991 (2002)	Protection of fragile coastal belt	NO	Road is not located along coastal belt	SCZMA and MOEF
5	National Environment Appellate Authority Act (NEAA) 1997	Address Grievances regarding the process of environmental clearance.	Yes	Grievances if any will be dealt with, within this act.	NEAA
6	The Land Acquisition Act 1894	Set out rule for acquisition. of land by government	Yes	This act will be applicable to as there may be some acquisition of land for widening, geometric improvements	Revenue Department State Government.
7	Forest Conservation Act (1980)	To check deforestation by restricting conversion of forested areas into non-forested areas	Yes	Diversion of riverine reserved forest (0.9963 ha) is involved. Permission for tree felling and its transit permission is required for tree cutting in non notified forest areas	Tree removal will be guided as per state government rules.
8	Wild Life Protection Act 1972	To protect wildlife through certain of National Parks and Sanctuaries	No	This act is not applicable since no wild life protected areas within 10 km radius	Principal Chief Conservator Wildlife,
9	Air (Prevention and Control of Pollution) Act, 1981	To control air pollution by & Transport controlling emission of air Department. Pollutants as per the prescribed standards.	Yes	This act will also be applicable during construction; for obtaining NOC for establishment of hot mix plant, workers' camp, construction camp, etc.	SPCB
10	Water Prevention and Control of Pollution) Act 1974	To control water pollution by controlling discharge of pollutants as per the prescribed standards	Yes	This act will be applicable during construction for (establishments of hot mix plant, construction camp, workers' camp, etc.	SPCB

¹ **Category A -i)** New National High ways; and ii) Expansion of National High ways greater than 30 KM, involving additional right of way greater than 20m involving land acquisition and passing through more than one State.

Category B-i) All State High ways; and ii) Expansion projects in hilly terrain (above 100 m msl and or ecologically sensitive areas)

Note: A general condition applies to both of the above category: "Any project or activity specified in Category 'B' will be treated as Category A, if located in whole or in part within 10 km from the boundary of: (i) Protected Areas notified under the Wild Life (Protection) Act, 1972, (ii) Critically Polluted areas as notified by the Central Pollution Control Board from time to time, (iii) Notified Eco-sensitive areas, (iv) inter-State boundaries and international boundaries".

SR. No	Act / Rules	Purpose	Ap	Reason for Applicability	Authority
11	Noise Pollution (Regulation and Control Act) 1990	The standards for noise for day and night have been promulgated by the MoEF for various land uses.	Yes	This act will be applicable as vehicular noise on project routes required to assess for future years and necessary protection measure need to be considered in design.	SPCB
12	Ancient Monuments and Archaeological Sites and Remains Act1958	Conservation of cultural and historical remains found in India	No	No impact on such structures	Archaeological Dept Gol,
13	Public Liability and Insurance Act 1991	Protection form hazardous materials and accidents.	Yes	Contractor need to stock hazardous material like diesel, Bitumen, Emulsions etc.	
14	Explosive Act 1984	Safe transportation, storage and use of explosive material	Yes	For transporting and storing diesel, bitumen etc.	Chief Controller of Explosives
15	Minor Mineral and concession Rules	For opening new quarry.	Yes	Regulate use of minor minerals like stone, soil, river sand etc.	District Collector
16	Central Motor Vehicle Act 1988 and Central Motor Vehicle Rules1989	To check vehicular air and noise pollution.	Yes	These rules will be applicable to road users and construction Machinery.	Motor Vehicle Department
17	National Forest Policy1952 National Forest Policy(Revised) 1988	To maintain ecological stability through preservation and restoration of biological diversity.	Yes	This policy will be applicable as project intervention requires forest land to be acquired.	Forest Department, Gol and GoB
18	The Mining Act	The mining act has been notified for safe and sound mining activity.	Yes	The construction of project road will require aggregates. These will be procured through mining from riverbeds and quarries	Department of mining. State Gov.

C. ADB's Safeguard Requirement

20. The Asian Development Bank has defined its Safeguard requirements under its "Safeguard Policy Statement" (SPS, 2009). Project categorisation has been done using REA checklist and the project is categorised as category B. As per SPS 2009, category B projects warrants preparation of an IEE which has been conducted in consistent to it.

III. DESCRIPTION OF THE PROJECT

A. Location

21. The project road is located in Serchhip and Lunglei districts of Mizoram. It is distinctly divided in 2 sections separated by Aizawl - Lunglei SH. Part I, Serchhip- Sialsuk junction, starts at its junction with NH 54, about 4 km south of Serchhip town and terminates at its junction with **Aizawl-Lunglei** SH near Sitvan-Hanging garden, Sialsuk covering a length of 15.2 km. Part II, Thenzawl – Buarpui, starts at its junction with Aizawl-Lunglei SH near Thanzawl and ends at Buarpui totalling 39.8 km. The total length of the project road is 55.0 kms. Geo-coordinates of the project road is between 23⁰18'0"N / 92⁰49'59"E and 23⁰16'0"N / 92⁰40'0"E. Road network map of Mizoram and the project alignment are shown in **Map 1 and Map 2**, respectively.

B. Type, Category and Need

22. **Type:** Project road improvement involves: (i) widening/strengthening of the existing lane to intermediate lane with sealed shoulder on hill side and earthen shoulder on valley side of 0.9 m; (ii) improving road geometry; (iii) rehabilitation and construction of cross drainage structures; (iv) construction of side drains on hill side of 0.9 m; (v) junctions/intersections improvement; (vi) protection works in landslide prone location; and (vii) incorporating road safety measures.

23. **Category.** Project categorisation was made using the ADB Rapid Environment Assessment (REA) Checklist (**Appendix 1**). Project road is not passing through any wildlife sanctuary, national park, tiger reserve, wildlife movement corridor or any other similar eco-sensitive areas. However, some sections (3.690 Km) of the project road pass through riverine reserve forest requiring the diversion of about 1 ha. of forest land. Significant stretches of the road, about 88% of Part 1 and 67% of Part II, are located inside privately owned mixed jungle/forest. Since, it is not classified/notified forest; it does not require any permission. As per discussions with the Forest Department there is no loss of rare/threatened/endangered species of flora along the project road. The Project components will only have temporary and localized impacts on the environment mainly during construction period. The project has been categorised as Category 'B' in as per ADB's Safeguard Policy Statement, 2009 and hence an IEE has been conducted.

24. **Need.** The project road directly connects to NH-54, the lifeline of Mizoram. Aizawl-Lunglei SH links to important population centres like Serchhip the district headquarter, Thenzawl and Buarpui which are block head quarters. The project road is extremely in poor condition and not motorable during monsoons resulting miserable condition for the local people in commuting to state capital and district headquarters. This badly affects their day to day requirements, better health care, and educational facilities. Local people are constrained to sell their cash crops especially spices like ginger, chilli, and turmeric at farm gate prices affecting their livelihood. The improved connectivity is likely to bring significant upliftment in the quality of life.

C. Description of the Project Corridor

1. General

25. The existing road is a Major District Road (MDR) with single to intermediate lane carriageway with 0.9 m shoulder on either side. Most of the road section is in poor to very poor condition. The road passes through hilly terrain having steep gradients and curvilinear alignment, all along with sharp curves and hairpin bends. The abutting landuse is privately owned mixed forest spotted with some built-up areas and agriculture. Few portions of the

road section passes through Tlawng Riverine Reserved forest requiring diversion of forest land. Project road is located in landslide prone areas.

2. Engineering Features

26. **Right of Way:** The right of way is not demarcated on ground. As per the details gathered from the MPWD, the average ROW is limited to the road formation and is not uniform. Through built-up sections, in small stretches, the ROW is restricted and varies between 8 to 10 m. In general the formation width is 5.5m – 7m.

27. **Cross Section and Pavement Condition:** The existing cross sections of the project road are generally consistent in hill slope with single lane road configuration. The average formation width varies between 5.5 to 7 m. The earthen shoulders vary between 0.5 to 0.8 m in width. The height of hill cut varies between 1.0 m to 10 m in general. The road is all along in hill cut. The shoulders are rutted, depressed in sections and eroded on valley side. Catchwater drains on hill side toe are unlined, inadequate in cross section, choked, with debris and overflow during rains. In some sections, especially in section 2, the wearing course and even the pavement has disintegrated. The condition of the existing road pavement is, in general, poor to very poor. The pavement has been damaged due to cracks, depressions, ruts and pot holes.

28. **Horizontal and Vertical Alignment:** The existing alignment generally follows the topography through hilly terrain. Project road has curvilinear alignment with a lot of horizontal curves all along, with many of these being sharp with radius as less as 15 m. The vertical profile of existing road is steep with gradients ranging up to 10% to 11%. There are a few hair pin bends. The existing road alignment runs down the hill side from Serchhip to Mat River, crossing the river and then gently moves up till Sialsuk junction. From Thenzawl, the alignment climbs up the hill along hill side for about 2 km but descends down and crosses Tlawng River in km 22 and thereafter ascends till Buarpui. In between, there are small stretches with gentle gradients.

29. **Bridges and Culverts:** There are only 2 major and 5 minor bridges on the project road. Major bridges are located at km. 13.118 of Part I and at km 21.653 of Part II. The minor bridges cross nallahs and streams. The width of carriageway over these bridges is 4 m. Both the major bridges are with Bailey super structure, temporary and narrow. Bridge on river Tlawng is reported to have been overtopped and washed away once in the past.

30. There are 228 (68 in Part I and 160 in Part II) culverts in the project road. All the culverts are reported to have been constructed during 90's when the road was built with stone masonry substructure and slab or hume pipe deck / waterway. Majority of the culverts are slab type with 6m to 7m in width. Most culverts are blocked / buried and non-functional from lack of maintenance. The parapets are damaged /missing. The conveyance capacity of some culverts are inadequate and overtopped during rains and damaging the road carriageway

31. **Drainage:** The road surface drainage, being predominantly in hilly terrain across the hill slope, is interspersed with a few minor streams / nallahs and choes (springs). Most of them have limited discharge and dry during lean flow period. Side drains exist on hill side, which are unlined and choked with debris and inadequate section resulting in overflow. The discharge from the drains is facilitated by the closely spaced culverts.

32. **Protection Work:** Retaining walls are found in locations at valley curves made of dry stone masonry/ banded stone masonry and are damaged in some locations. Breast walls are absent along the entire stretch. Over the years the hill cut slope has stabilized. No

parapet wall exists either at culverts or in retaining wall. Several concrete guard stones serving as parapet walls were noted.

33. **Junctions and Intersections:** There are 15 junctions/intersection 4 in Part 1 and 11 in Part II) on the project road. Most of them are with village roads taking off/ meeting the project road apart from few earthen tracks. All the junctions and intersections are 3 arms at grade typically set in hilly terrain topography. Important junctions are at start and end points of both sections.

34. **ROB/RUB:** There is no railway line crossed by the project road requiring rail over bridge or rail under bridge.

35. **Service Roads, Wayside Amenities/Utilities:** There are no service roads, vehicle and truck parking, and lay byes. A few passengers' shelters exist on the road side. Utilities and services, i.e., electric / telephone poles etc. have been observed close to the formation edge. Generally electric poles/ transformers exist within the shoulders of the project road in built-up areas.

36. **Critical Sections:** The hill cut shows hard soil over burden over shale and schist rock. It is generally soft when wet but very hard when dry and is prone to weathering and landslides. Detailed design team has identified 35 landslides location along the project road. The road carriageway gets blocked every year during rains due to landslides from hill side. Sometimes at a few locations, even formation in valley side also slips down, reducing the available formation width.

D. Proposed Improvement Components

1. Traffic Considerations

37. The appreciation of traffic characteristics is one of most important activity to evaluate the potential of the existing network and identify the major issues to develop various components of the proposed improvement work. Capacity analysis as per IRC: 64:1990 establishes that the existing single lane configuration will reach capacity saturation in the year 2022. It is thus established that the existing road carriageway needs to be widened to intermediate lane configuration over the design life of 20 years from now.

2. Proposed Improvements

(i) Widening of road from the existing single to intermediate lane of 5.5m carriageway with 0.9 m shoulders on each side. Additional widening with 0.5m is proposed near curve locations. Side drains of 0.5 m width are also proposed. Configuration for road and bridges have been summarised below.

- Carriageway: 5.5m+0.5m (extra widening on curves) +0.9 shoulder
- Formation Width: 7.8 m (general) and 8.7 in cut
- Structures (Culverts): Formation width 7.5 m

Typical cross-sections are given as **Fig 1** and **Fig 2**.

(i) The widening is proposed to the extent possible in hill side by cutting to accommodate the design formation width, drains and breast walls. Concentric widening is proposed near bridge approach and in the built up areas. Widening and improvement will be accommodated mostly within available ROW.

(ii) Horizontal geometry will be based on IRC: 38-1988 "Guidelines for Design of Horizontal Curves for Highways and Design Tables (First Revision)" and vertical geometry will be based on IRC: SP 23-1993. Existing gradients in

some sections are steep approaching the limiting values or even more than the exceptional values in some stretches. But due to site constraints only minor easing has been feasible

- (iii) All existing major bridges are of bailey superstructure, temporary, narrow, and unfit for heavy vehicles. 4 out of 5 minor bridges have been retained requiring improvements. Out of 228 culverts only 28 have been retained and remaining 200 will be reconstructed.
- (iv) Side drains; unlined=2.7km, lined 49.500, and lined with cover = 2.8km is designed for the project road.
- (v) 4 major junctions at start and end points of both sections are proposed for improvement as per geometrics laid down in IRC: SP: 41-1994 subject to road side structures/features constraints.
- (vi) Pavement profile will have a 210mm, 250mm, 50mm, and 40mm thicknesses for GSBC, WBM, DBM, and BC, respectively.
- (vii) Presently, lay byes/ parking areas and wayside amenities are not proposed as these are not required based on present and projected traffic volume considerations. Bus bays are proposed at 12 locations; 3 in Part I and 9 in Part II.
- (viii) Project road is located in hill terrain with some landslide/slips prone areas. Adequate protections work like retaining walls with parapets (No. = 332) and breast walls (No. =279) has been proposed to prevent slides/slips or sinking of formation width. Bioengineering measures are also recommended to avoid such anticipated impacts
- (ix) Road safety measures are proposed as per IRC: SP: 44-1996 like road delineators, signages, metal beam crash barriers (at sharp curves and bridge approaches) and guide posts (to delineate the edge of formation).

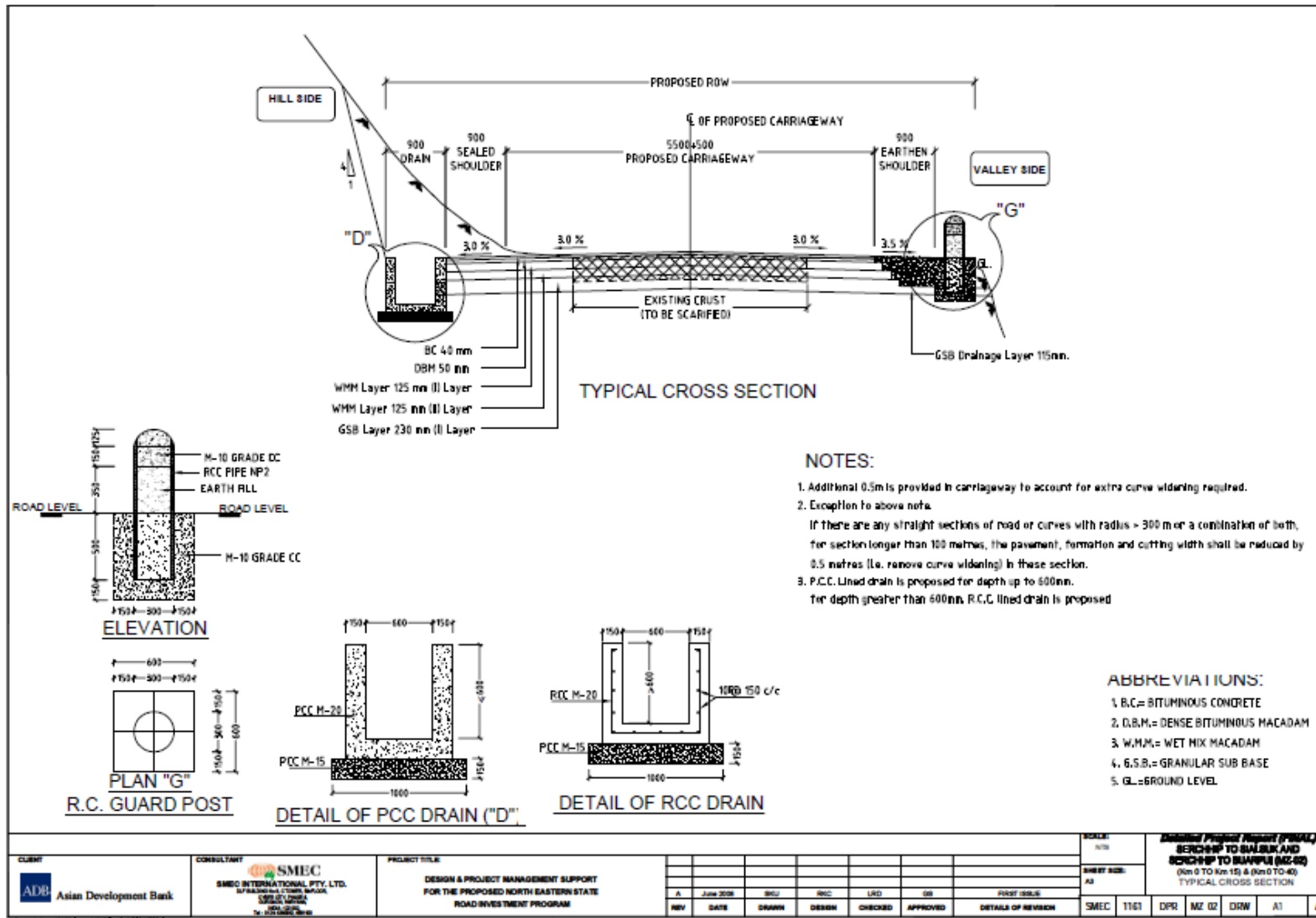


Fig 1: Typical Cross Section

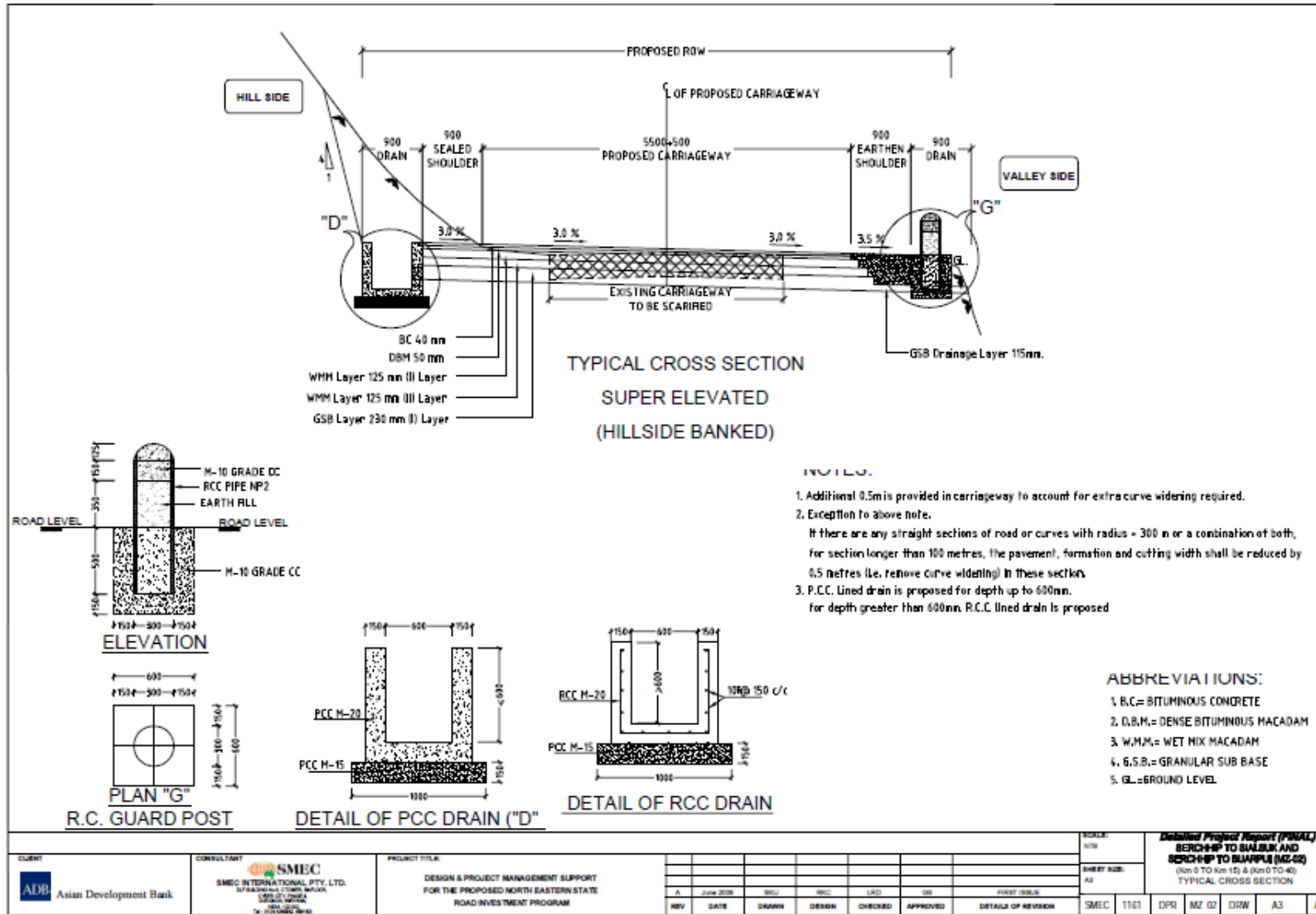


Fig 2: Typical Cross Section for Hill Side Banked

3. Construction Material Sourcing

38. **Earth Material:** Designated borrow areas have not been identified during detailed design since the project road is in hilly terrain and most of the requirement will be met through hill cutting for widening. If needed, the contractor will identify and operate the borrow area as per IRC guidelines. Stone aggregates are available from Mat River quarry and Mualvawn quarry with a lead distance of 32.75 and 2.15 km, respectively. Adequacy and suitability of these quarries have been confirmed by DPMC, but the above two quarries seems to be inadequate to cater the materials for the whole project, one or more additional quarry sources must be explored in order to have sufficient supply of materials. Sand will be obtained from established quarries of River Tlawng and Mat River located at a distance varying from 9 to 21 km. Project area is drained many perennial sources. Mainly surface water will be used for road construction purpose after requisite permissions.

E. Cost and Implementation Schedule

39. The project will be implementing in 36 months in one construction package. The estimated civil cost is 123.07crore.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Physical Resources

1. Topography and Drainage

40. **Topography:** Project districts is characterised by undulating low foothills and hill ranges running north to south tapering at both ends with narrow valleys. Physiographic units are hills, valleys and dissected hills and hillocks. The hills are steep and are separated by rivers, which flow either to the north or south, creating deep gorges between the hill ranges. River valleys are generally narrow and limited. Average height of the hills is about 900 meters. The Blue Mountains (Phawngpui) stand out tallest with a height of 2,210 meters. Flatlands adjacent to Cachar Valley and located in Champhai, Mat, Tlabung and Chamdur have immense potential for agriculture and horticulture development. The presence of valleys and ravines show physiographic expressions of the faults or structural patterns, giving origin to different types of drainage patterns. Drainage pattern is mainly dendritic and sub-parallel.

2. Geology and Soil

41. **Geology:** Mizoram, lie the southernmost end of the Himalayan ranges. Their folded structure is a synclinorium consisting of broad synclines and tight-faulted anticlines. The geological formations in the area shows tertiary deposits belonging to Surma group of Miocene and Oligocene age of Bhuban formations consisting mainly sandstone, shale, and silts stone. The rock system is weak and unstable, prone to frequent seismic influence. The terrain seems entirely immature with regard to recent structural /geological changes in earth's crust. Faulting has resulted in creation of steep faulty curves, highly dissected ranges with deep ravines, spurs etc. vulnerable to comprehensive erosion. The rocks are fractured and hence susceptible to failure during monsoon resulting in landslides.

42. **Soil:** Soil texture, in general, varies from sandy loams, clayey loams to clay. Although the soils are mature, profuse rainy spells in the region coupled with the high gradients have accelerated the problem of leaching of the loose soils. These soils are highly porous with low water holding capacity and the main cause of the low water table in Mizoram. The soils of Mizoram are deficient in potassium, phosphorous, nitrogen, and humus. The traditional jhum cultivation has adversely affected the productivity. Although superficial greenery was observed, the tract is actually in the process of fast degradation. The soils are acidic to neutral due to excessive leaching. Physio-chemical characteristic of soil along the project road is given in **Table 4**.

Table 4: Physico-chemical Characteristics of Soil in the Project Area

Sl. No.	Parameters	Km 12.325 of Part I	Km 4.875 of Part II
1	pH (at 28 ^o C) (1:5)	6.58	7.07
2	Conductivity at 27 ^o C in ms	0.035	0.089
3	Texture	Heavy clay loam	Very heavy clay
4	Water Holding Capacity in %	2.64	1.92
5	Porosity in %	62.6	67.62
6	Nitrogen as N in %	0.006	0.024
7	Phosphorus as P in %	0.0001	0.0001
8	Iron as Fe in %	1.8	1.41
9	Potassium as K in %	0.021	0.011
10	Permeability in cm/hr	6.2	7.8

Source: Primary Survey by DPMC

3. Natural Hazards

43. **Earthquake:** According to Seismic Zone Map of India prepared by Bureau of Indian Standard, Mizoram lies in seismic Zone V which is very high damage risk zone. High seismic activity in the northeastern region may be attributed to the collision tectonics in the north in Himalayan arc and sub-duction tectonics in the east in the Burmese arc. Earthquakes in this region are generally shallow, though a few quakes of intermediate depth have occurred. Mizoram's first big earthquake in recorded history occurred in 1997 with a magnitude of 6.1; it shook the southern part of the state but no damage or injuries were recorded.

44. **Landslides:** Mizoram, being a hilly terrain with high rainfall is prone to landslides. Every year a number of landslides occur in various localities. This causes a lot of misery to the public resulting in loss of life and property, disruption of communication network, and economic burden on the society. This is primarily attributed to high slope and relief, immature geology, neo-tectonic activity, heavy rainfall, and unplanned and improper land use practices. Project area is also located in landslide prone areas.

45. **Flood:** The State, being hilly does not have major flood problem. However, during rainy season, floods damage river banks causing land erosion. In September 2007, severe rainfall caused flooding in Bairabi town of Kolasib district and Tlabung town of Lunglei district, disrupting life and communication network for a month. The bridge over Tlawng River along the project road was damaged. Except in this area, the project road in general is not prone to flood.

46. **Cyclone/Wind Storms:** Owing to its proximity to Bay of Bengal, the region is prone to high wind and cyclone. The design wind speed in the whole State is cyclonic at 55m/s or 198km/h.

4. Climate

47. Mizoram has a climate ranging from moist tropical to moist sub-tropical. Winter starts from November and lasts until February followed by spring that ends in mid- April. Around this time, storms start to come occasionally heralding the coming of summer. The period from June to August is rainy season. Mizoram comes under the direct influence of the south-west monsoon; as such it generally receives an adequate amount of rainfall. Mizoram, gets an average rainfall of about 3,000mm with Aizawl receiving the most at 3,108 mm and Champai district the least at 2,028mm. Rainfall generally increases from the south-west to the north-west. Summer temperatures ranges from 11°C to 32°C and winter temperatures between 4°C to 30°C. Relative humidity in the dry season is 30-40% and increases to 90% during monsoon period.

5. Air Quality

48. There is no source of air pollution along the project corridor other than fuel wood burning. Contribution of traffic is negligible. The ambient air quality of the project corridor MZ02 (Part-I & Part-II) has been assessed by carrying out air quality monitoring. The ambient air monitoring has been done at 2 locations. The ambient air quality levels (**Table 5**) with respect to suspended particulate matter (SPM), respirable particulate matter (RPM), and nitrogen oxides (NO_x) range from 48 -59 µg/m³, 20-24 µg/m³, and 28-34 µg/m³, respectively. SO_x were recorded as 4 µg/m³ at all locations. Hydrocarbon (HC) and carbon monoxide (CO) were monitored but the values were not detectable and hence not tabulated. All values conform to the prescribed National Ambient Air Quality Standards.

Table 5: Ambient Air Quality in the Project Area

Parameters Locations	Suspended Particulate Matter	Respirable Particulate Matter (PM10)	SO ₂	NO _x
Zuangleng Villages 3 samples (Residential)	48	20	4	26
	54	23	4	30
	50	21	4	31
Kananveng Villages 3 Samples (Residential)	55	22	4	32
	59	24	4	34
	51	21	4	28
NAAQ Standard for residential Areas	----	60	80	80

Source: Primary Survey by DPMC

6. Noise Level

49. There is no major noise generating sources in the project area. Ambient noise quality adjacent to project corridor has been assessed by undertaking noise level monitoring at one residential location at Part-I of MZ02 and one residential and one sensitive location at Part-II. Noise level at all monitored locations confirms the prescribed limit to all corresponding landuse category. **Table 6** provides the equivalent noise level (Leq) in dB (A) both during day and night time.

Table 6: Noise Level in the Project Area

Noise Level Locations	Day Time (6.00 am-9.00 pm)	Night Time (9.00 pm-6.00 am)
Mat Village	45	38
Navodaya Vidyalaya ,Thanzawl-Part II	45	43
38.560 Km, Buarpui-Part II	52	42
Standard (Commercial)	65	55
Standard (Residential Zone)	55	45

Source: Primary Survey by DPMC

7. Waterways/Water Bodies

50. Project road intersects 2 main rivers, few streams and numerous f nallah/channels crossing the project road. Most of these waterways are very narrow with low discharge and dry during summer. All waterways located along the ROW are listed in **Appendix 2**. No loss of any stagnant water body/pond is envisaged. There are 7 hand pumps likely to be impacted due to widening, some of which are already abandoned.

8. Surface Water Quality

51. Drinking water source in the area is mainly from springs tapped through gravity drainage and supplemented by few hand pumps. River water in the project area is not used for drinking purpose and hence surface water sampling done at two locations (River Mat and River Tlawng) have been compared to its suitability for propagation of wild life and fish culture and tolerance limits for inland surface waters as per IS:2296. Results (**Table 7**) conforms the Class D (propagation of wild life and fish culture) of the Indian standard (IS).

Table 7: Surface water Quality in the Project Area

Sl. No.	Parameters	Mat River	Tlwan River
1	pH (at 27°C)	7.51	7.46
2	Temperature	21	21
3	Turbidity in N.T.U	8.0	7.0
4	Free Ammonia (as N) in mg/l	0.11	0.10
5	Biochemical Oxygen Demand 5 days at 20°C in mg/l	<2.0	10.0
6	Dissolved oxygen in mg/lit	5.3	4.8
7	Electrical Conductivity in ms/cm at 23°C	0.064	0.095
8	Boron as B in mg/l	<0.5	<0.5
9	Sodium Absorption Ratio	2.28	1.88
10	Total Coliform Organisms MPN/100 ml	1600	1600

Note:

- Class-A: Drinking water source without conventional treatment but after disinfection.
- Class-B: Outdoor bathing.
- Class-C: Drinking water source with conventional treatment followed by disinfection.
- Class-D: Fish culture and wild life propagation.
- Class-E: Irrigation, industrial cooling and controlled waste disposal.

9. Groundwater

52. **Occurrence and Yield:** The occurrence of ground water in such a terrain is mainly restricted to weak zones such as fractures, lineaments, and weathered residuum. These tectonic elements create seepage conduits, which are sources of springs. These springs are utilized as the main water supply to the rural population, tapped through gravity drainage. The discharge of the springs is very meagre in high altitudes and progressively increases towards lower altitudes. Water level trend is not available due to lack of ground water abstraction structures. Hills are constituted mostly of siltstone, clay stone and compact sandstone. Because of steep slopes of the hills, rainwater flows out as surface run-off. Hence, there is acute shortage of potable water during summer.

53. **Groundwater Quality:** Ground water quality in the project area, monitored at Ramhlun village (km 37.750 of Part II) is not fit for drinking purpose due to high turbidity, iron, and bacteriological parameters (**Table 8**) exceeds the permissible limits in IS 10500-1991. However, as per the study carried out by Central Ground Water Board (CGWB) in both project districts, ground water is fresh and potable and is suitable for domestic and industrial purposes. Chemical constituents are within the permissible limit.

Table 8: Groundwater Quality in the Project Area and Drinking Water Standards

Sl. No.	Parameters	Results	Norms as per IS: 10500-1991	
			Desirable limit	Permissible limit
1	Temperature	22	---	---
2	Odour	Unobjectionable	Unobjectionable	---
3	Taste	Unobjectionable	---	---
4	Turbidity in N.T.U.	22.0	5	10
5	pH (at 27°C)	7.06	6.5-8.5	No Relaxation
6	Alkalinity in mg/l	220.5	200	600
7	Total Hardness as CaCO ₃ in mg/l	208.0	300	600
8	Sodium as Na in mg/l	21.26	---	---
9	Iron as Fe in mg/l	5.0	0.3	1
10	Total Dissolved Solid mg/l	280.0	500	2000
11	Total Solid (TS) in mg/l	302.0	---	---
12	Total Suspended Solid in mg/l	22.0	---	---
13	Calcium as Ca in mg/l	49.0	75	200
14	Potassium as K in mg/l	2.0	---	---

Sl. No.	Parameters	Results	Norms as per IS: 10500-1991	
			Desirable limit	Permissible limit
15	Magnesium as Mg in mg/l	20.56	30	100
16	Sulphate as SO ₄ -2 in mg/l	< 4.0	200	400
17	Sulphite as SO ₃ -2 in mg/l	Nil	---	---
18	Phosphate as PO ₄ -3 in mg/l	0.11	---	---
19	Nitrate as NO ₃ in mg/l	<0.4	45	100
20	Nitrite as NO ₂ in mg/l	<0.4	---	---
21	Ammoniacal Nitrogen as N in mg/l	<0.02	---	---
22	Fluoride as F in mg/l	0.12	1	1.5
23	Chloride as Cl in mg/l	14.0	250	1000
24	Biochemical Oxygen Demand 5 days at 20°C in mg/l	<2.0	---	---
25	Dissolved Oxygen in mg/l	6.2	---	---
26	Chemical Oxygen Demand in mg/l	<4.0	---	---
27	Oil and Grease in mg/l	<1.4	---	---
28	Lead as Pb in mg/l	<0.05	0.05	No Relaxation
29	Electrical Conductivity in ms/cm	0.45	---	---
30	Total Coliform Organisms MPN/100 ml	300	< 10 /100ml	---
31	Faecal Coliform MPN/100 ml	170	ABSENT	---

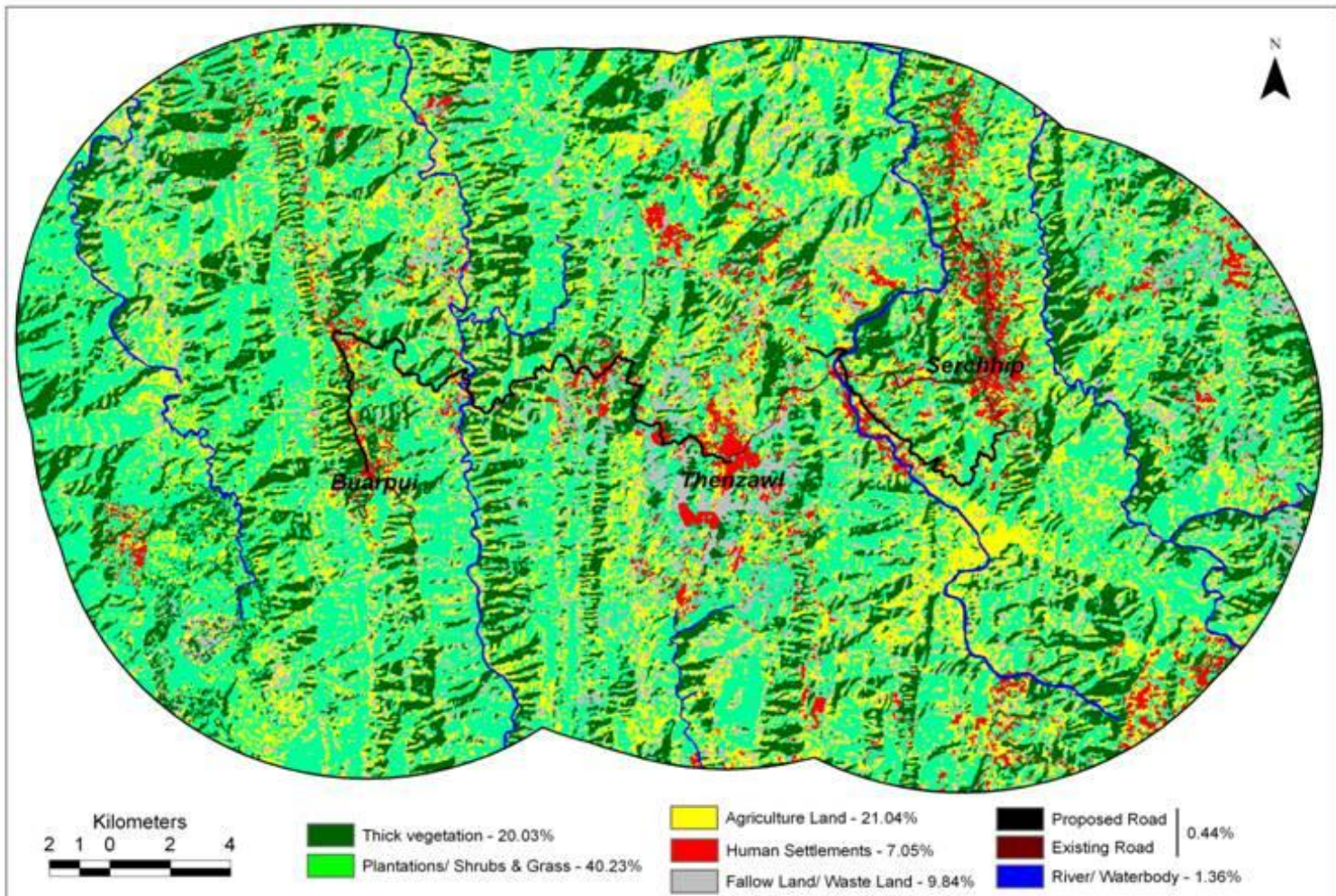
Source: Primary Survey by DPMC

10. Land use/Land Cover

54. Land use along the project road is mostly privately or communed owned forest (mixed jungle) constituting 88% of the Part I and 67% of the part II road corridor. Rest is occupied by agricultural land and built-up areas. Some portion of the road in Part II is also covered by riverine reserve forest along river Tlawng.

55. Land use of the study area (10 km buffer) has been prepared based on satellite imagery using remote sensing and GIS technique and supported by ground verification. The predominant landuse of the study area is forest cover/vegetation (60%) followed by agricultural land with 21% and rest is shared by fallow/barren land, habitation, water bodies and miscellaneous land use. Landuse of the study area in **Fig 3**.

Fig 3: Land use/Land Cover of the Study Area



B. Ecological Resources

56. **Forest Cover and its Management:** According to the Forest Survey of India, the forest area in the state is 17,717 Sq. Km which works out to be 79.30%. Reserved Forests constitute 47.13%, Protected Forests 21.34%, and Unclassed Forests 31.35%. The forest cover, based on satellite data of January, 2009 is 19,117 sq.km. which is 90.48% of the total geographical area. Among the project district, Serchhip has total forest cover of 84.94% of which only 0.34% is under very dense forest, 28.6% under moderate dense, and remaining 56.0% is covered with open forest. In Lunglei district, total forest area is 92.72% of its total geographic area of which 27.22% is occupied by moderately dense forests and 65.5% by open forests.

57. Reserved Forests such as riverine forests, inner-line forests, and other reserve forests are managed by the state's Forest Department. The community forests such as, safety forests, supply forests bamboo reserves, and unclasped forest are under the management of Village Councils (VCs). For the project road, Land Passes for such forest is required from the Revenue Department. Inside private forests, the owners have to secure Land Passes from Revenue Department.

58. **Forest Types:** forest types of the State based mainly on altitude, rainfall and dominant species composition. The classification is as follows:-

- Tropical Wet Evergreen and Semi-evergreen Forest
- Montane sub-tropical Forest
- Temperate Forests
- Bamboo Forests
- Quercus Forests
- Jhumland.

59. Study area is characterised mainly by tropical wet and semi-evergreen forest. These forests usually occur below an altitude of 900m and form one of the major forest types of the State with rich species diversity. Patches of these forests can be seen usually on the steep slopes, rocky and steady river banks and areas not suitable for shifting cultivation. Tropical wet evergreen forests are usually found in southern and western part of Mizoram, while semi-evergreen forests occur in northern, north-western, and central part of the State. The distinction between the tropical evergreen forests and tropical moist deciduous forests is difficult as they are found only in the small hill ranges. Other forest types are bamboo forests and Jhum cultivation. Bamboo forests occur mostly between 40m - 1,520m in tropical and sub-tropical areas. It appears that bamboos have resulted from jhumming system of cultivation. Jhum cultivation is very common in Mizoram more particularly in eastern part.

1. Ecologically Sensitive Areas

60. The state's protected area network is comprised of 2 national parks, 7 wildlife sanctuaries, and a tiger reserve. None of these is located in the vicinity of the project corridor or within 10 km radius.

2. Forest in the Project Area

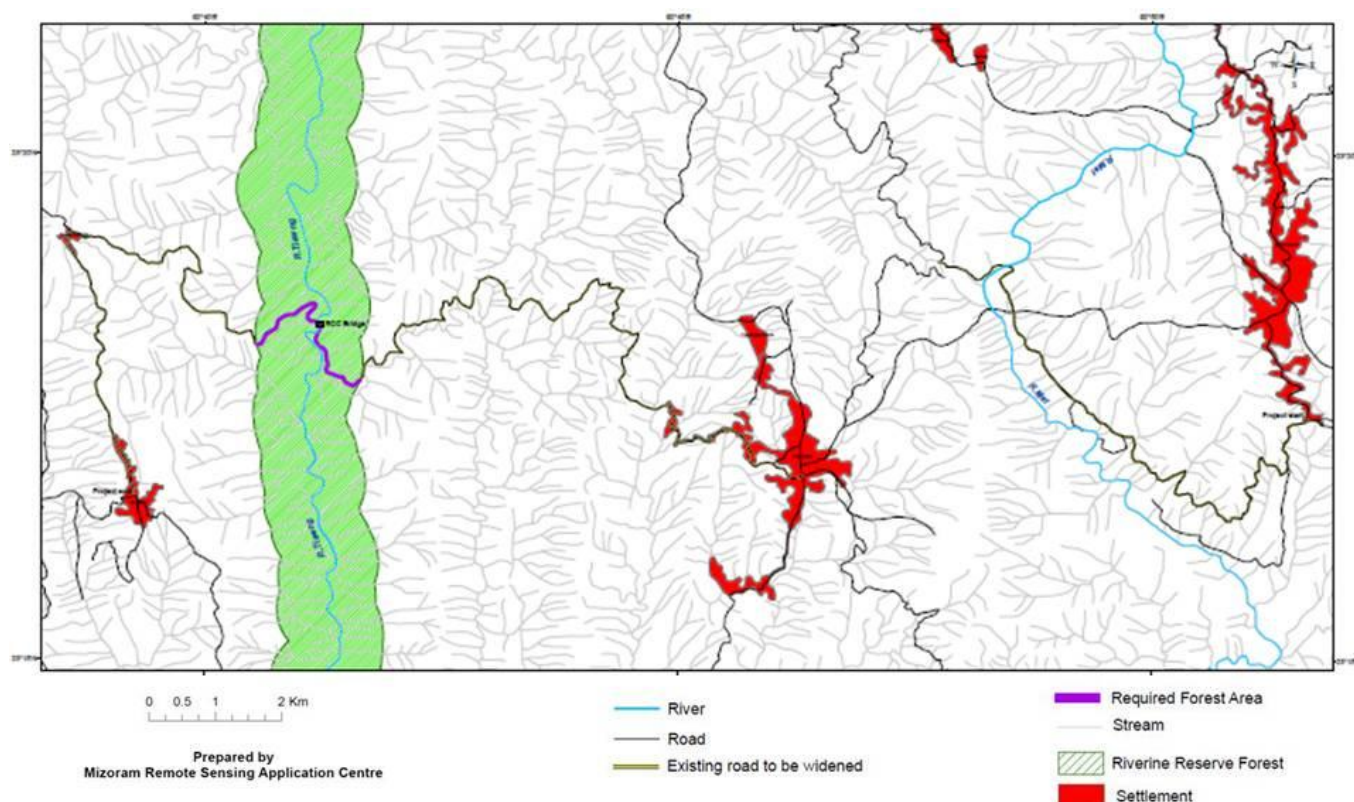
61. Project corridor in following stretches, passes along/through the reserve forests. However, the project road in following stretches of Part II passes through Tlwanng Riverine Reserve Forest for a length of 3.690 Km (**Fig 4**).

- Km 19.640 to Km 20.000
- Km 20.000 to Km.21.000
- Km 21.000 to Km 21.360
- Km 21.360 to Km 22.000
- Km. 22.000 to Km 23.000
- Km. 23.000 to Km 23.330

62. Diversion of forest land is only 0.9963 Ha. This requires permission from Sate Advisory Group of the State Forest Department. MPWD has already completed all formalities and in advance stage of obtaining the permission. As per the Forest Department, no loss of any rare/threatened/endangered species of flora is envisaged.

63. In addition to above riverine reserve forest patches, abutting landuse for significant length of the project road (88% in Part I and 67% of the Part II) is under forest (mixed jungle). They are not classified/notified by the Forest Department. Ownership of such forest is with private individuals.

Fig 4: Riverine Reserved Forests intersected by the project Road



3. Roadside Vegetation

64. The road side plantation is mixed type and natural regeneration is seen. Common species found along road are *Khuangshi*, *Neem*, *Mango*, *Zuang*, *Thiang*, *Cedar*, *Dewa*, *Kathal*, *Theihai*, *Vang*, *Chest nut*, *Fartuah*, *Thinsia*, *Far*, *Lamkhuang*, *Khawmhma*, *Hnahkiah*, *Thingkha*, *Khiang*, *Tawitawsuak*, *Lamkhuang*, *Kawkpui*, *Khuangthli*. List of all species found in the Thenzawl forest range, covering entire project influence area, is listed in **Appendix 3**. A total of 1,706 trees (373 in Part I and 1373 in Part II) were enumerated within required formation width by DPMC. The chainagewise list of affected trees is given as **Appendix 4**.

4. Fauna

65. **Terrestrial:** Systematic fauna survey has not been conducted in the State. So far, 48 species of mammals from 18 families, 13 species of amphibians from 4 families, 37 species of reptiles from 10 families, and 201 species of avifauna from 46 families have been recorded. List of mammals found in the Thengzwal forest division is listed in **Appendix 5**. Some are on the endangered category but confined to the deeper portion/core zone of the Khawnglung Wildlife Sanctuary and reserve forest areas.

66. **Aquatic:** Fisheries in Mizoram are only fresh water fisheries. The existing total water area for fish farming is estimated to be 1,700 hectares. The total inland fish production during 2000-01 was 2,900 M tonnes and at present 4,700 families of small and marginal fish farmers are engaged in this trade. The important fishes commonly found in the region's plain and river basins are *Catla catla*, *Labeo rohita*, *Labeio calbase*, *Cirrihinus mirigale*, *Clarius batrachus*, *Rita rita*, *Heteropneustus fonilis*, *Notopterus nontopterus*, *N. Chitala*, *Macrobrachum rosenbergij*, *M. malconsoni*, *M. Chapral*, *Channa punetatus*, *C. gaehua*, and *C. Striatusetc.*

67. **Avifauna:** Various types of birds are found in Mizoram that includes both residential as well as migratory birds. Some of the common avifauna seen includes Great Indian hornbill, Emerald Dove, Peacock Pheasant, Malbar Pied Hornbill, Crested Serpent Eagle, and Red Jungle Fowl.

68. Project area is largely devoid of wildlife. Forest area close to the project road barely forms any habitat for wildlife. No wildlife movement was either reported or observed during site visit. As per consultation held with the forest officials, wildlife is limited to the deeper portion of the forest.

C. Economic Development

69. Economy of Mizoram depends mainly on the agricultural sector as more than 70% of the people of the state are engaged in this sector. The people follow the method of shifting cultivation which is also known as Jhumming method of cultivation. This sector has given a major boost to the Economy of Mizoram. The Economy of the state of Mizoram also gets its revenue from the horticulture sector. The state has around 4.40 lakh hectares of land under horticulture cultivation. The main crops grown in the horticulture sector in the state of Mizoram includes pine- apple, orange, and banana. The horticulture sector has witnessed a sharp increase in recent years and this has given a major boost to the Economy in Mizoram. Mizoram Economy gets revenue from the forest products sector as the state has a huge forest cover. The various kinds of forest products manufactured are cane works, bamboo works, and wood works. The products manufactured are sold all over the country and even exported all over the world. The contribution of the industrial and tourism sector to the economy is also very less due to the geographical isolation of the state.

1. Agriculture, Forestry and Fisheries

70. **Agriculture:** About 80 per cent of the people of Mizoram are engaged in agricultural pursuits. The main pattern of agriculture followed is Jhum or Shifting cultivation. Of the total 21 lakh ha. of land estimated, 6.30 lakh hectares of land is available for cultivation of horticulture crops. The existing area under different horticulture crops account for about 4127.6 hectares, which is only 6.55 per cent of the estimated potential area. This indicates the vast scope for horticulture crops to flourish in Mizoram. The main horticulture crops are fruit crops viz. Mandarin Orange, Banana, Passion Fruit, Grapes, Hatkora, Pineapple, Papaya, etc., and flowers like Anthurium, Bird of Paradise, Orchid, Chrysanthemum, Rose and other subsidiary seasonal flowers. Spices like Ginger, Turmeric, Black Pepper and Bird's eye Chillies are also grown. People have also started extensive cultivation of oil palm, medicinal and aromatic plants.

2. Industries and Mineral Resources

71. **Industries:** Mizoram is less industrial state. As per the record of the Industries department, the State has only 2 industrial estates and 10 large and medium industries giving employment to only 746 persons. In addition, there are about 4668 small scale industries (SSIs) giving employment to 21940 persons. Allocation of site for industries is not regularised. Only a handful of industries are located in industrial estate. As a result, industries are set up irrespective of landuse. It has scattered here and there without any restrictions. Most of them are in capital city of Aizwal. This has put tremendous pressure on the environment in terms of noise, sanitation air and water quality. With new industrial policy in force, Government of Mizoram has set up a number of specialized agencies to promote various development activities in the field of industry. Prominent among these are Zoram Industrial Development Corporation Limited (ZIDCO), Mizoram Khadi and Village Industries Board (MKVIB), Zoram Electronic Development Corporation (ZENICS), and Mizoram Food and Allied Industries Corporation (MIFCO).

72. **Minerals:** The north eastern region is also endowed with reasonable resources of mineral and oil and gas. Occurrences of minerals such as Oil & Natural Gas, Coal, Clay, Shell Limestone are reported. However, any detailed inventory of the mineral resources of the state is not available till date. The rocks of Mizoram are limestone, sandstone and shale. According to government data, the potential mineral deposit locations are Oil & Natural Gas occurs at Theiduhkan, Bairabi and Kolasib, Coal at Kolasib, Clay on the banks of the rivers Tut, Tuirial, Chawngte Lui, Phura, Morai and Lokicherra, Shell Lime at Sesawng near Kawrtethawveng (inferred reserve of 5.2 million tons) and at Kawnpui.

3. Infrastructure Facility

73. **Roads:** Mizoram has a road network of around 4,000 km (2,500 mi) or minor or village roads and a small number of national highways. The village roads are primarily single lane or unmetalled tracks that are typically lightly trafficked. The State is connected to the Indian network through National Highway 54. Another highway, NH-150 connects the state with Seling Mizoram to Imphal Manipur and NH-40A links the State with Tripura.

74. **Railway:** There is a rail link at Bairabi rail station but it is primarily for goods traffic. The nearest practical station to Mizoram is at Silchar in Assam, some 6 hours drive from Aizawl. Bairabi is about 110 km (68 mi) and Silchar is about 180 km (110 mi) from the state capital. The Government is now planning to start a broad gauge Bairabi Sairang Railway connection for better connectivity in the state.

75. **Aviation:** Mizoram has an airport, Lengpui Airport, near Aizawl and this is linked from Kolkata – a 40 minute flight.. Mizoram can also be reached from Kolkata via Silchar Airport, which is about 200 km (120 mi), around 6 hours) from Aizawl. A Helicopter service by Pawan Hans[28] has been started which connects the Aizawl with Lunglei, Lawngtlai, Saiha, Chawngte, Serchhip, Champhai, Kolasib, Khawzawl and Hnahthial

76. **Water Ways:** Mizoram is in the process of developing water ways with the port of Akyab Sittwe in Burma along Chhimtuipui River. India is investing \$103 million to develop the Sittwe port on Burma's northern coast, about 160 km (99 mi) from Mizoram. State Peace and Development Council of Burma has committed \$10 million for the venture, which is part of the Kaladan Multi-modal Transit Transport Project..[30] though the connection is arguably of limited use.

77. **Power:** The State is power deficient. It has two sources of generation of electricity namely, hydro diesel stations. The total generated power through these two sources is 20 MW. It imports 35 MW from other states. The total power availability is 55 MW against the total demand of 110 MW, the shortfall of being more than 50%. Mizoram hasanexploitable hydroelectric potential for 2005 MW. State government has also given paramount importance on exploitation of small hydro projects.

C. Social and Cultural Resources

78. **Demography:** As per details from Census 2011, Mizoram has population of 10.91 Lakh, an increase from figure of 8.89 Lakh in 2001 census. Total population of Mizoram as per 2011 census is 1,091,014 of which male and female are 552,339 and 538,675 respectively. Tribal population constitutes 95% of the total population. In 2001, total population was 888,573 in which males were 459,109 while females were 429,464). Literacy rate in Mizoram has seen upward trend and is 91.58% as per 2011 census. Of that, male literacy stands at 93.72% while female literacy is at 89.40 percent. Density of Mizoram is 52 per sq km which is lower than national average 382 per sq km. In 2001, density of Mizoram was 42 per sq km, while nation average in 2001 was 324 per sq km. Sex Ratio in Mizoram is 975 i.e. for each 1000 male, which is below national average of 940 as per census 2011. In

2001, the sex ratio of female was 938 per 1000 males in Mizoram. **Table 9** provides facts on demography vis-a-vis state and the country.

Table 9: Demography of the Project Districts, State and Country

Description	India	Mizoram	Serchhip	Lungei
Population	1,21,01,93,422	1,091,014	64,875	154,094
Male	62,37,24,248	552,339	32,824	79,252
Female	58,64,69,174	538,675	32,051	74,842
Population Growth	17.64	22.78%	20.45%	12.29%
Sex Ratio	940	975	976	944
Density/km2	382	52	46	34
Literacy	74.04%	91.58 %	98.76	89.40
Male Literacy	82.14	93.72 %	99.24	92.74
Female Literacy	65.46	89.40 %	98.28	85.85

Source: Census of India, 2011

79. **Educational Facility:** Mizoram stands at top after Kerala in literacy rates. However, the scenario in higher education is not impressive. Merely 3.9 % of the literate population is having educational level graduate and above. Mizo (Lushai) tribe is educationally better off, as they have the highest (4.3 %) population having this level.

80. **Work Participation:** In Mizoram 51.7 per cent of the population has been registered as workers among the STs. This is significantly higher than the national average of 49.1 per cent recorded for ST population. 55.3 per cent males and 48.1 per cent females are workers, thus showing equitable participation of both males and females in workforce. Three fourth of the tribal workers are main workers in the state. 67.2 per cent ST females are main workers, which is significantly higher than 53.3 per cent recorded at the national level for ST female workers

81. **Tourism:** Though Mizoram has rich tourism wealth in terms of eco-tourism, health tourism, rural tourism and adventure tourism, these potentials could not be exploited to advantage mainly due to lack of basic amenities like roadways & transportation, accommodation etc. There is hardly any employment generation and revenue collection from this sector.

82. Reference may be made to the Resettlement Plan for detailed socio-economic standing of project area and project affected persons.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND ITS MITIGATION MEASURES

83. Road improvement projects are likely to bring several changes in the local environment both beneficial and adverse. This section of IEE identifies nature, extent, and magnitude of likely changes vis-a-vis project activities for all stage of project cycle i.e. pre-construction, construction, and operation. Beneficial impacts are mostly long-term and permanent whereas adverse impacts are localized and temporary in nature and are likely to occur mostly during construction stage.

A. Beneficial Impacts

84. The immediate benefits of road construction and improvement will come in the form of direct employment opportunities during construction for the roadside communities specially those engaged as wage labourers and petty contractors and suppliers of raw materials.

85. During operation stage, road-side economic activities supporting transport like gasoline stations, automotive repair shops, lodging, and restaurants will increase due to increased number of vehicles. Increase in agro-industrial activities is also expected to take advantage of improved access to urban centres where there are higher demands and better prices for agricultural products. Project area is vulnerable to landslides obstructing road traffic mainly during monsoon. The road improvement component includes the stabilization of slopes to minimise this impact facilitating all weather connectivity. Other benefits of road improvement projects include: (i) reduction in travel time; (ii) better mode and increase frequency of transport; (iii) better access to quality health care facilities, educational and other infrastructural facilities; (iv) enhanced tourism activities in the area and state which in many terms will boost the local economy; and (v) better investment climate for industries creating more employment opportunities to local people.

B. Adverse Impacts

86. Some of the major impacts arising from the road improvement projects like borrowing and quarrying will be minimal since as all aggregates will be procured from existing licensed quarries. No adverse impacts on bridge improvement are expected as all bridges are existing and no piling is required for pier in the riverbeds. Blasting, if needed for hill cutting, will also be minimal impact as there are no settlements near potential blasting sites. Cutting of trees is limited to narrow strip of 3-4m and change in landuse is minor. No alteration in surface water hydrology is expected.

87. All other impacts are temporary and localised in nature limited to construction period. The most significant impact identified during site visit is water quality deterioration of large number of ponds abutting the project road. The following subsections describes anticipated impacts and its mitigation measures on all aspects of physical, ecological and socio-cultural environment during construction and operation stage of the projects.

C. Pre-construction Impacts

88. Project road is not located in any eco-sensitive areas. Diversion of riverine forest is limited to 0.9963 ha. There is no major bottleneck along the project road requiring realignment/bypasses. Proposed widening will follow the existing alignment. As a result, minimal acquisition of any agricultural land is required. Impact on private and community structure is also insignificant. Road design has considered all major preconstruction impacts and taken avoidance measures at an early stage of planning.

- (i) **Alignment:** Final alignment has been determined to avoid/minimise land acquisition, impact on structures, archaeological/cultural sites, interference with water sources, shifting of existing utilities etc.
- (ii) **Water bodies:** construction of culverts and bridges during lean flow period. If technically not feasible toe walls/retaining walls will be installed. Aggregate will be procured from existing licensed quarries.
- (iii) **Tree Cutting:** restrict tree cutting to formation width. To the extent possible, road has been aligned on other side of dense vegetation/mature trees.
- (iv) **Construction material Sourcing:** Borrow areas have been identified at non-agricultural land. Quarrying is not proposed.
- (v) **Dust and air pollution:** No new borrow areas/quarry sites to be opened for the project. Aggregates will be sourced from existing licensed quarries. Waste disposal sites and asphalt mixing sites have been sited away from habitated areas.
- (vi) **Noise and Vibration:** Time regulation for blasting and construction near sensitive receptors and residential areas. No crusher operation near these locations.
- (vii) **Soil Erosion, Cut and fill:** The design attempted to equalise cut and fill. Adequate erosion control measures included in design.
- (viii) **Construction Camp and Waste Disposal:** No such facility is sited near any water bodies, forest area, and settlements.
- (ix) **Natural Hazards:** The project area is located in seismic zone V which is very high damage risk zone. Relevant IS codes were adopted while designing the civil structures to sustain the earthquake of highest magnitude in Seismic zone V. Retaining walls and breast walls have been provided in the design at all potential landslide locations.

D. Construction Stage Impacts

1. Climate and Air Quality

89. The potential sources of air emission during the construction phase of the project are: (i) earth works during site preparation; (ii) operation of equipment, machines and vehicles; (iii) transport of construction materials; (v) combustion of hydrocarbons particularly from the hot mix plants and process of heating bitumen, and; (vi) rock cutting and blasting. Most of the emissions will be in the form of coarse particulate matter which will settle down in close vicinity of construction site.

90. The stone aggregate will be sourced from licensed quarries. No new quarries shall be open for the project. The pollution related aspects to these quarries are independently complied by the quarry owners. The aggregate will be transported in the tarpaulin covered trucks.

Mitigation Measures

- (i) Vehicles delivering loose and fine materials shall be covered.
- (ii) Loading and unloading of construction materials in covered area or provisions of water fogging around these locations.
- (iii) Storage areas should be located downwind of the habitation area.
- (iv) Water shall be sprayed on earthworks periodically
- (v) Regular maintenance of machinery and equipment. Vehicular pollution check shall be made mandatory.

- (vi) Hot mix plants should be located at least 1.5 km from the nearest habitation, school, hospital, archaeological site, forest, rivers, streams and lakes, 500 m from ponds, and national highway, 250 m from state highway, unless otherwise required by statutory requirements after securing a No-Objection Certificate (NOC) from the SPCB. Hot mix plant shall be fitted with stack of adequate height as may be prescribed by SPCB to ensure enough dispersion of exit gases.
- (vii) Bitumen emulsion and bitumen heaters should be used to extent feasible.
- (viii) Only crushers licensed by PCB shall be used.
- (ix) LPG should be used as fuel source in construction camps instead of wood.
- (x) Regular water sprinkling of unpaved haulage roads².
- (xi) Mask and other PPE shall be provided to the construction workers
- (xii) Diesel Generating (DG) sets shall be fitted with adequate height as per regulations (Height of stack = height of the building + $0.2 \sqrt{\text{KVA}}$. Low sulphur diesel shall be used in DG sets as well as machineries.
- (xiii) Contractor should submit a dust suppression and control programme to the PWD prior to construction.

2. Noise and Vibration

91. Noise level may increase temporarily in the close vicinity of construction activities, maintenance workshops, and earthwork site. These construction activities are expected to produce noise levels in the range of 80 – 95 dB(A) (at a distance of about 5 m from the source) . Although this level of noise is higher the permissible limit for ambient noise level for residential/commercial levels but will occur only intermittently and temporary. This noise level will attenuate fast with increase in distance from noise source. Although there are a number of noise sensitive locations (**Appendix 6**) especially schools close to the alignment, installation of solid noise barrier is not recommended due to terrain condition and their oblique location either on terrace of hill side or in the valley side.

Mitigation Measures

- (i) Blasting, if required shall be restricted to daytime only. Blasting should be carried out as per “The Explosive Act, 1884 and the rules, 1983” pertaining to procurement, transport, storage, handling and use of explosives.
- (ii) Blasting schedules shall be carried out as per pre announced scheduled which shall be also displayed in advance in areas where residents may be affected by the blasting operations.
- (iii) Red danger flags shall be displayed prominently in all directions during the blasting operations. The flags shall be planted 200 m and 500 m from the blasting site in all directions for blasting at.
- (iv) People, except those who actually light the fuse, shall be prohibited from entering this area, and all persons including workmen shall be excluded from the flagged area at least 10 minutes before the firing, a warning siren being sounded for the purpose.
- (v) The Contractor shall notify each public utility body having services in proximity to the site of the work of his intention to use explosives.
- (vi) The Contractor shall adequately compensate in a timely manner for any damage to property/services and life caused by their blasting”
- (vii) All equipment shall be timely serviced and properly maintained to minimize its operational noise. Noise level will be one of the considerations in equipment

² Water suppression of fugitive dust can reduce emissions from 12% 98%

selection which will favour lower sound power levels. Construction equipment and machinery shall be fitted with silencers and maintained properly.

- (viii) Stationary noise making equipment shall be placed along un-inhabited stretches.
- (ix) Timing of noisy construction activities shall be regulated near sensitive receptors. Maximum construction activities shall be undertaken during night time and weekends when there are minimal activities by the sensitive receptor, concurrent noisy operations may be separated to reduce the total noise generated, and if possible re-route traffic during construction to avoid the accumulation of noise beyond standards.
- (x) If the above mentioned schemes prove to be inadequate, the provision of temporary noise barrier shall be made near identified sensitive locations or near the noise source during construction.
- (xi) Protection devices (ear plugs or ear muffs) shall be provided to the workers operating in the vicinity of high noise generating machines.
- (xii) Noise measurements should be carried out to ensure the effectiveness of mitigation measures.
- (xiii) Develop a mechanism to record and respond to complaints on noise

3. Impact on Land and Soil

92. **Topography and aesthetics:** Activities like clearing of vegetation, hill cutting, waste/debris disposal, and establishment of labour camps may change the topography and appearance of the landscape.

Mitigation Measures

- (i) Cut materials should be used to widen the road or disposed in an environmentally acceptable manner.
- (ii) Cut slopes should be re-vegetated immediately after widening activities
- (iii) Borrow areas, if required should be rehabilitated and brought back as far as possible to their previous appearance. Some borrows shall be converted into ponds to compensate loss of water bodies. This will also enhance the local aesthetics
- (iv) Cut off material should be used to widen the road or disposed of at proper disposal sites
- (v) Provision and allocation of proper waste disposal bins and sites are required. Supply of cooking gas should be provided by the contractor to eliminate the use of fire wood.

93. **Landslides:** The lithology of the project area combined with high rainfall makes the hill slopes unstable. There are as many 35 landslide prone locations along the project. Destabilization of slopes due to hill cutting may cause extensive erosion resulting to siltation in water bodies and impact on properties. To avoid/minimise the impact of landslide on the road and vice versa, following mitigations have been included in the design.

- (i) Retaining walls for stabilisation of uphill
- (ii) Breast walls down slopes and
- (iii) Parapet walls/guide posts/railings/edge stones

Bio-engineering measures will be implemented for slope stabilization. In addition to controlling soil erosion, this will generate employment to local people, savings from avoided masonry structures, increase productivity of hill slopes, and reduce carbon emissions.

MPWD officials are well acquainted with these time and cost effective measures as they have employed it during World Bank funded State Highway Improvement Project. These measures are:

- (i) Bamboo terracing, bamboo crib walls, and bamboo knitting a slope
- (ii) Contour trenching
- (iii) Series of check dams on hill slopes etc.

94. **Loss of Productive Soil and Change in Land use:** Road widening and improvement is limited to available ROW and encroachment on agricultural land is expected to be minimal. Following set of mitigation measures will be implemented with regards to conversion of agricultural lands:

Mitigation Measures

- (i) The top soil from the productive land shall be preserved and reused for plantation purposes. It shall also be used as top cover of embankment slope for growing vegetation to protect soil erosion.
- (ii) Ensured that the land taken on lease for access road, borrow areas, construction camp is restored back to its original land use.

95. **Soil Erosion/Silt Runoff:** Soil erosion may take place near cutting areas, at steep and uncompacted embankment slope, and wherever vegetation is cleared. Accumulated eroded soil will result to siltation, embankment damage, and drainage problem . Loss of soil due to run off from earth stock-piles may also lead to siltation.

Mitigation Measures

- (i) Bank protection measures shall be taken at erosion prone areas.
- (ii) Provision of side drain to guide the water to natural outfalls.
- (iii) Retaining walls with parapets and breast walls have been included in the design to check erosion.
- (iv) When soil is spread on slopes for permanent disposal, it shall be buttressed at the toe by retaining walls.
- (v) Side slopes of the embankment shall not be steeper than 2H: 1V. Turfing of embankment slopes shall be done along the stretch.
- (vi) IRC: 56 -1974 recommended practice for treatment of embankment slopes for erosion control shall be taken into consideration.

96. **Borrow Areas and Quarries:** Need for opening borrows areas and quarries are not anticipated since abundant material will be available from hill cutting. However, if requirement emerged, it may cause some adverse impacts if left un-rehabilitated. It may pose risk to people, particularly children and animals of accidentally falling into it as well as become potential breeding ground for mosquitoes and vector born disease. Illegal quarrying may lead to unstable soil condition; destroy the landscape of the terrain, air and noise pollution. Opening of new quarries is not envisaged due to the proposed project. Quarry material will be sourced from existing licensed quarries. The dredging and use of dredged material, if involved, may have its impact in terms of localised sedimentation level increase and dispersion of pollutants present in the dredged material in the river water.

Mitigation Measures

- (i) Borrow areas if required, shall not be located near forest areas. The edges of borrow sites shall be no closer than 3 metres from any fence line or boundary. Adequate clearance shall be provided for the construction of catch drains.

Borrow sites shall have adequate drainage outlets unless the relevant landowner has agreed that the borrow area is to create a permanent tank or dam. Cut batter slopes shall not be steeper than 3 to 1 and shall be left by the Contractor in a tidy and safe condition to the satisfaction of the Engineer. Written clearance from the land owner/village head shall be obtained before leaving a site

- (ii) Obtain statutory approval from competent authority as detailed in chapter II (recent policy initiatives on mining of minor mineral)
- (iii) Borrow pits shall be selected from barren land/wasteland to the extent possible. Borrow areas should not be located on cultivable lands except in the situations where land owners desires to level the land. The top soil shall be preserved and depth shall be restricted to the desired level.
- (iv) Borrow areas should be excavated as per the intended end use by the owner. The Indian Road Congress (IRC):10-1961 guideline should be used for selection of borrow pits and amount that can be borrowed.
- (v) The dredged material from the river bank shall be tested for presence of heavy metals and other pollutants before its reuse.
- (vi) The depths in borrow pits to be regulated so that the sides shall not be steeper than 25%, To the extent possible, borrow areas shall be sited away from habitated areas. Borrow areas shall be levelled with salvaged material or other filling materials which do not pose contamination of soil.
- (vii) Monitoring of rehabilitation plan of borrow areas.

97. **Compaction and Contamination of Soil:** Compaction of haulage roads and construction camp area due to movement of construction vehicles, machineries and equipment, and due to sitting of construction camps and workshops. Soil may get contaminated due to inappropriate disposal of liquid waste (lubricating oil and fuel spills, waste oil and lubricant and vehicle/equipment washing effluent) and solid waste (fuel filters, oily rags) likely to be generated from repair and maintenance of transport vehicles, construction equipment and machinery.

98. Soil may also get contaminated due to inappropriate disposal of domestic solid waste and sewage from construction camps. Sub soil contamination may also be attributed to: scarified bitumen wastes, operation of the emulsion sprayer and laying of hot mix, storage and stock yards of bitumen and emulsion, excess production of hot mix and rejected materials

Mitigation Measures

- (i) Fuel and lubricants shall be stored at the predefined storage location. The storage area shall be paved with gentle slope to a corner and connected with a chamber to collect any spills of the oils.
- (ii) Unavoidable waste shall be stored at the designated place prior to disposal. To avoid soil contamination at the wash-down and re-fuelling areas, "oil interceptors" shall be provided. Oil and grease spill and oil soaked materials are to be collected and stored in labelled containers (Labelled: WASTE OIL; and hazardous sign be displayed) and sold off to SPCB/ MoEF authorized re-refiners.
- (iii) Movement of construction vehicles, machinery and equipment shall be restricted to the designated haulage route.
- (iv) Approach roads shall be designed along the barren and hard soil area to reduce the compaction induced impact on soil.
- (v) The productive land shall be reclaimed after construction activity.

- (vi) Septic tank or mobile toilets fitted with anaerobic treatment facility shall be provided at construction camp.
- (vii) Domestic solid waste at construction camp shall be segregated into biodegradable and non-biodegradable waste. Non biodegradable and non saleable waste shall be disposed off to authorised land fill site. If land fill site not available then burial of the waste in a secured manner shall be ensured.

4. Surface Water Resources

99. **Siltation and Deterioration in Surface Water Quality:** Siltation and water quality deterioration of rivers will be minimal since no piling is involved. Open foundations have been proposed for most of the bridges. The temporary pollution of water bodies from spillage of chemicals and oil at construction sites and waste from construction camps may occur. Accidental oil and chemicals spills can contaminate the ponds close to alignment.

Mitigation Measure

- (i) Required mitigation to prevent siltation as suggested in soil erosion section shall be implemented.
- (ii) Construction works near waterways/water bodies shall not be undertaken during the monsoon season
- (iii) Retaining walls will be constructed on hill slopes and breastwalls on down slopes to prevent erosion of road embankment.
- (iv) Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies;
- (v) No construction camp within 500m of any water body
- (vi) Locate all parking, repair, and fuel and hazardous material storage area away from any water body. Vehicle parking and maintenance areas shall have waterproof floors from which drainage is collected and treated to legal standards.
- (vii) Refuel vehicles only in dedicated areas with waterproof floors from which drainage flows to an oil/water separator before discharge
- (viii) Collect all waste oil, store in sealed damage-proof containers and dispose it to recyclers.
- (ix) All equipment operators, drivers, and warehouse personnel will be trained in immediate response for spill containment and eventual cleanup.
- (x) temporary retention ponds, interception drains, and silt traps are installed to prevent silt laden water from entering adjacent water bodies/waterways;
- (xi) The slopes of embankments leading to water bodies should be modified and rechannelised to prevent entry of contaminants.

100. **Alteration of Surface Water Hydrology/Drainage:** Diversion of rivers and major streams construction is not envisaged. Reconstruction/new construction of culverts will be done during lean flow period. Diversion of some nallahs may be required for a very short period and their courses will be maintained as soon as construction is completed.

101. **Groundwater:** Water for construction purpose will be sourced mainly through river sources. Suitable arrangement for drinking water in the campsite will be managed by contractor without affecting availability to local community. The area is not classified as critical semi-critical or overexploited by CGWB. However, uncontrolled abstraction can deteriorate the situation. Contamination of groundwater is not envisaged since all construction camps will have septic tanks or mobile toilets depending on the number of workers in each camp.

Mitigation Measures

- (i) Requisite permission shall be obtained for abstraction of groundwater.
- (ii) The contractor shall make arrangements for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected.

5. Impact due to Construction Debris/Waste

102. Debris can be generated by dismantling of pavement. Quarry dust and unused iron bars or damaged support structures constitute significant wastes. Mitigation for solid waste from construction camp has been given in construction camp section.

Mitigation measures

- (i) The existing bitumen surface can be utilized for paving of cross roads, access roads, and paving works in construction sites and camps, temporary traffic diversions, haulage routes etc.
- (ii) All excavated materials from roadway, shoulders, verges, drains, cross drainage and the like will be the property of the EA and will be used for backfilling embankments, filling pits, and landscaping.
- (iii) Unusable debris material should be suitably disposed 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.
- (iv) Unusable and surplus materials, as determined by the Project Engineer, will be removed and disposed off-site.

Following consideration shall be made during selection of dumping sites.

- (i) 1.5 km from habitation and forest areas and 500 m from ponds.
- (ii) Dumping sites do not contaminate any water sources, rivers etc, and
- (iii) Public consent from the village council has to be obtained before finalizing the location.
- (iv) Form works will be re-used to the extent possible, more than 20 times as dictated by good practice. All stripped formworks will be examined for any damage and rectified in the workshop for re-use.

6. Ecological Resources

103. **Terrestrial:** There are no national parks, wildlife sanctuaries or any other similar eco-sensitive areas in the project area. No wildlife movement was reported/observed. Project road, passes through riverine reserve forest for a length of 3.690 kms and diversion of 0.6693 ha. forest land is required. Forest along remaining stretches is owned by private individuals and about 1,706 trees are likely to be affected.

104. **Forest Fires:** Risk of forest fire cannot be ruled out if uncontrolled burning of grasses/shrubs for clearing is employed or from fuel accumulation due to accidental spillage or improper storage of explosives.

Mitigation Measures

- (i) Requisite permission from Forest Department shall be obtained for cutting of roadside trees. Compensatory plantation as per prevailing guidelines of State's forest department on 1:3 basis. Besides, additional plantation shall be done on areas exposed after site clearance. All tree plantations will be carried out in close consultation with forest department.

- (ii) For safe traffic operation, vertical clearance between the crown of the carriageway and lowest part of overhang of the tree available across the roadway shall conform to the standards laid down in IRC: SP: 21-2009. The pit size, fencing, watering, and manuring requirements shall also conform to the above standard. Excess use of pesticides shall be restricted.
- (iii) Immediate removal of fuel accumulations near forest areas;
- (iv) Clearance of vegetation shall not be done by burning along forested/thickly vegetated areas.
- (v) Planting and management of fire-resistant species adjacent to and within ROW.
- (vi) Provision of fire lines to avoid further spread over of fire.

105. **Aquatic Ecology:** Temporary sedimentation and water quality deterioration is expected from the project during the construction stage. Improvement of existing embankments particularly along the waterways may increase silt while accidental spill of materials, chemicals, and fuels will deteriorate receiving water quality.

Mitigation Measures

106. Siltation shall be avoided by measures suggested above in impact on surface water resource section.

107. **Impacts due to Construction Camp and Immigration of Workers:** Poor siting and improper management of construction camp may lead to several adverse impacts on environment viz: (i) loss of vegetation due to use of wood as fuel for cooking; (ii) deterioration in nearby surface water quality; (iii) compaction and contamination of soil due to uncontrolled disposal of solid waste; and (iv) poor sanitation may result to transmission of communicable diseases among the workers and the host communities to include sexually transmitted disease, diseases from improper handling and supply of foodstuffs, poor water supply, insect-borne diseases, and alcoholic and drug.

Mitigation measures

- (i) No productive land will be utilised for construction camp. All sites must be graded, ditched, and rendered free from depressions to avoid water stagnation. Accommodation and ancillary facilities including recreational facility for workers shall be erected and maintained to standards and scales approved by the resident engineer. All camps should maintain minimum distance of 500 m from habitation and water bodies.
- (ii) All construction camps shall be provided sanitary toilet with provision of septic tanks attached with soak pits. Storm water drains shall be provided for the flow of used water outside the camp. Drains and ditches shall be treated with bleaching powder on a regular basis. Garbage bins must be provided in the camp and regularly emptied and disposed off in a hygienic manner. LPG cylinders shall be provided as fuel source for cooking to avoid any tree cutting.
- (iii) At every workplace, the Contactor will ensure that a readily available first-aid unit. Workplaces away from regular hospitals shall have indoor health units. Suitable transport shall be provided to approach the nearest hospital. At every workplace an ambulance containing the prescribed equipment and nursing staff shall be provided.
- (iv) The Contractor will ensure the good health and hygiene of all workers to prevent sickness and epidemics. These include the HIV/AIDS prevention program to reduce the risk and transfer of HIV virus. Activities under the

- program include monthly information, education, and communication campaigns to workers, drivers, delivery crew, and communities on the risk.
- (v) The Contractor will provide adequate and safe water supply for the use of the workers. The Contractor will ensure that all precautions to protect the workers from insect and pest to reduce the risk to health. This includes the use of insecticides which should comply with local regulations. No alcoholic liquor or prohibited drugs will be imported to, sell, give, and barter to the workers of host community.
 - (vi) Migrant workers may be the potential carriers of various diseases. Local community may get exposed to the diseases carried by migrant workers. Regular health check-up and immunization camps shall also be organized for the workers and nearby population.

108. **Safety of Construction Workers and Accident Risk to Local Community:** The following safety aspects: (i) safety of construction workers, (ii) safety of road users including pedestrians and cyclists, (iii) safety to cattle, (iv) safety of local community, (iv) unsafe/hazardous traffic conditions due to construction vehicle movement need to be considered during design and construction stage, and (v) conduct of safety audit. Impact and mitigations due to blasting operation as already been detailed in Noise and Vibration section.

Mitigation measures

- (i) During the construction phase, contractors shall be required to adopt and maintain safe working practices. Internationally accepted and widely used safety procedures should be followed during (i) road works (ii) handling of large construction equipment and machineries, (iii) handling of chemicals and hazardous materials and inflammable substances (iii) welding (iv) electrical works etc.
- (ii) Contractor shall arrange all PPEs for workers, first aid and fire fighting equipments at construction sites. An emergency plan shall be prepared duly approved by engineer in charge to respond to any instance of safety hazard.
- (iii) To avoid disruption of the existing traffic due to construction activities, comprehensive traffic management plan shall be drawn up by the concessionaire. Traffic in construction zones shall be managed as per the provisions of IRC SP 55.
- (iv) After construction is completed in a particular zone, it shall be opened for normal operation. All diversions/access roads should be closed before start of normal operation.
- (v) Use of retro-reflectorized traffic signs, and cantilever/gantry types overhead signs, thermoplastic road marking paints, delineators, traffic cones, empty bitumen drums, barricades, and flagmen will be used to ensure traffic management and safety. Conduct of regular safety audit on safety measures adopted during construction. The audit will cover manpower and their safety, machinery, temporary works, equipment and vehicles, materials storage and handling, construction procedures, environment, site safety guidelines, and miscellaneous services.

109. **Obstruction and Disruption of Traffic:** Disruption of access to infrastructure or social resource due to construction activity will cause nuisance and to a certain extent additional cost to the public in terms of longer travel period due to diversion or heavier traffic. It will also pose risk of accident to motorist at night if these blockages and disruption are not clearly demarcated.

Mitigation Measures

- (i) The contractor will submit a Traffic Plan to the Project Engineer at least two weeks before the construction starts that will result to obstruction. This Plan will recommend for approval, the safe and convenient temporary diversion of traffic during construction, design of barricades, delineators, signs, markings, lights, and flagmen, among others.
- (ii) For widening of existing carriageway and part of it will be used for passage of traffic, paved shoulder will be provided on one side of the existing road by the contractor with the following minimum requirements:
 - (iii) At least one 3.5 m lane to remain to traffic at all times
 - (iv) The surface used by the through traffic will be firm bituminous compacted surface free of defect
 - (v) The maximum continuous length over which construction under traffic may take place is limited to 750 meters.
 - (vi) Construction activity will be restricted to only one side of the existing road.
 - (vii) On stretches where it is not possible to pass the traffic on the part width of existing carriageway, temporary paved diversions will be constructed. These paved diversions will comply with standards on junctions and temporary cross drainage.
- (viii) Transportation of quarry material to the construction sites through heavy vehicles shall be done through existing major roads to the extent possible. This will restrict wear and tear to the village/minor roads. Small vehicles/unmotorised vehicle can also be used for its further transportation to the construction sites from temporary storage areas.

110. **Transport and Storage of Materials:** The construction material primarily will consist of aggregate, sand, cement, bitumen, lubricating oil and fuel for vehicle and construction equipment. These will be primarily stored temporarily at construction camps. The oils, fuels, and chemicals will be stored on concreted platform with spills collection pits. The cement will be stored under cover. All these temporary storage areas will be located at least 150m away from the habitat.

111. **Impact on Land and Private Properties:** The assessment made in resettlement plan shall be referred for exact loss of private properties and measures to compensate such losses. Besides monetary compensation for any loss of private trees, compensatory afforestation and extensive plantation are incorporated in the EMP. Income restoration measures/livelihood options for vulnerable group/resource poor sections and other affected persons as recommended by social development/resettlement expert shall be implemented.

112. **Impact on Common Property Resources:** There are various types of community structures/ facilities/utilities along the proposed alignment. Geometric adjustments have been made to minimize the loss to any such facilities. Alternate access has to be provided to these structures during construction stage. All community structures likely to be dismantled shall be suitably relocated. For exact extent of impact on these structures and mode of compensation, resettlement/land acquisition plan shall be referred

E. Operation Stage Impacts

113. **Road Maintenance:** Lack of proper maintenance may deteriorate the road condition over the years resulting into numerous problems such as rise in accidents, disruption of transportation services, tree survival. PWD/PIU must allocate adequate resources and logistics to ensure that the road is being maintained and intended benefits are generated thereof.

114. **Soil Erosion and its Cumulative Impacts:** The consequences of soil erosions are far wider than repair and maintenance of the road. Along the project road, the inflow of water into ponds during rains causes erosion of the embankment besides seepage of water into embankment and subgrade resulting in softening of the subgrade. This may also increase siltation in water bodies. Project design includes provisions of retaining walls/retaining walls for the protection. Regular checks shall be made to ensure its effectiveness.

115. **Air Pollution:** Likely rise in traffic after road improvement may cause air and noise pollution in the vicinity of the project. Vehicular emission will be the principle source of pollution during operation stage. The project road is located in thickly vegetated and open agricultural land which will provide adequate dispersion dynamics of gaseous pollutants. Vegetation acts as sink to air pollutants. Further, the improved road condition will facilitate free flow of traffic thereby reducing the emission level significantly.

116. **Noise Pollution:** Noise level is likely to increase due to increased traffic. 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 noise mitigation should be monitored and if need be, solid noise barrier shall be placed.

117. **Water Pollution:** Accidental oil spillage, washing of vehicles, used engine oils can contaminate the nearby water bodies. Expansion joints and drainage spouts may be choked due to silt and vegetation growth. In order to prevent water pollution; communities should not allow drivers washing their vehicles near the streams and ponds. Regular removal/cleaning of deposited silt shall be done from drainage channels and outlet points before the monsoon season. Rejuvenation of the drainage system by removing encroachments/ congestions will be regularly conducted.

118. **Ribbon Development/Encroachment of ROW:** Increase in economic activities results in ribbon development along highways. This may cause congestion to road users and increase in accident. PWD shall explore options like avenue plantation and/or fencing and initiating regulatory provisions to stop encroachment of ROW.

VI. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

119. Meaningful consultations in consistent to SPS, 2009 was carried out during the IEE preparation. All the five principles of information dissemination, information solicitation, integration, co-ordination, and engagement into dialogue were incorporated in the consultation process. A framework of different environmental impacts likely from the project was strengthened and modified based on opinions of all those consulted, especially in the micro level by setting up dialogues with the village people from whom information on site facts and prevailing conditions were collected. The requirement of public consultation during the implementation of the project will be implemented as part of the mitigation plan.

A. Objectives of the Public Consultations

120. Public consultations were held early and throughout the project development stage to allow the incorporation of relevant views of the stakeholders in the final project design, mitigation measures, and overall project implementation. Stakeholder's consultations were held to understand their concerns, apprehensions, overall opinion, and solicit recommendations to improve project design and implementation. Informal meetings, interviews were organized to maximize inputs from the participants regarding their acceptability and environmental concerns arising out of the sub-project.

B. Project Stakeholders

- (i) Residents, shopkeepers and businesspeople who live and work along the project road specially the project affected persons
- (ii) All type of road users/commuters
- (iii) Executing Agency;
- (iv) Other government institutions whose remit includes areas or issues affected by the project (state environment and forest department, irrigation department, Public Health Engineering (PHED) department, fishery department
- (v) Non-government organizations (NGOs) and community-based organizations (CBOs)
- (vi) Other community representatives (prominent citizens, religious leaders, elders, women's groups); and
- (vii) The beneficiary community in general.

C. Methodology

121. Key issues were identified in initial consultations during reconnaissance site visit with local people and government departments and framework for comprehensive consultations was designed. Detailed consultations based on road alignment and project improvement components were held in December, 2012. This IEE also includes the key findings of the consultations conducted by the DPMC in 2010.

122. Consultation with the stakeholders, beneficiaries, and community leaders were carried out using standard structured questionnaires to obtain background information and details of general environmental issues. The official consultations with the stakeholders were carried out at respective offices in state capital and project district headquarters.

D. Consultation with Government Departments

123. Detailed discussions with MPWD officials; relevant government departments including forest and wildlife, fisheries, pollution control board, economics and statistics, and

tribal welfare were consulted. The list of government officials contacted, along with purpose/objective has been summarised in **Table 10**.

Table 10: Summary of Consultation Held with Government Departments.

Sl. No.	Department	Name and Designation	Topic Discussed
2	Archaeological Survey of India	Mr. Sanjay Panda, Asst. Archaeologist, Guwahati	Gathered information about any archaeological sites within 10 km Response: no such sites
3	PWD	Project Director, Executive Engineer (Environment) and Assistant Engineer	Discussed about various clearances required prior to construction Information about proposed locations for camps, debris disposal and construction material availability and sourcing was obtained
4	Forest Department	DFO, Thenzawl Forest Division DFO, working plan, Aizwal	Information collected about legal status of the forest and forest types, presence of any endangered floral species and wildlife movement. Response: road intersects riverine forest for 3.6 km Mixed Jungle along the project road is either owned by individual or village councils. There is no endangered/threatened floral species along the project road. No wildlife movement along the project road.
5	Soil Conservation Department	Director, Soil Conservation	He suggested various bio-engineering methods of preventing landslide/slope destabilisation.
6.	SPCB (Mizoram)	Ms. Lalmuanpui Asst. Engineer, Aizawl	Enquired about availability of environmental quality data of the project areas, List of Industries within 10 km radiu. And restrictions/permission about establishment of new crusher/ hot mix plant/ wet mix plant and list of existing ones.
6	CENTRAL GROUND WATER BOARD	Mr. B.K. Saha Regional Director- NER Tarunnagar, Guwahati- Mr. U. Gogoi, Scientist-D Tarunnagar, Guwahati-5	Availability of Ground Water Quality assessment data of project road region.
7	India Meteorological Department	Mr. C.K. Bhuina T.S. Section Regional Meteorological Section, LGBI Air Port Guwahati: 781015	Availability of Meteorological Data of project road region.
8	GSI	Mr.D.D.Raju, Director- Shillong	Availability of Geological information.

E. Consultations with Local people/Beneficiaries

124. The informal consultation generally started with explaining the sub projects, followed by potential impacts. Issues discussed are:

- (i) Awareness and extent of the project and development components;
- (ii) Benefits of the project for the economic and social upliftment of community;
- (iii) Labour availability in the project area or requirement of outside labour involvement;
- (iv) Local disturbances due to project construction work;
- (v) Necessity of tree felling etc. at project sites;
- (vi) Impact on water bodies, water logging and drainage problem if any;
- (vii) Drinking water problem;
- (viii) Health issues
- (ix) Flora and fauna of the project area
- (x) Socio-economic standing of the local people and
- (xi) Willingness to contribute/co-operate

Summary of consultations held during different stages with affected persons, local communities, panchayat members, shop owners is given in **Table 11**.

Table 11: Summary of Consultation with Local Community

Date	Venue / Place	Participants
Consultations Held by environment and social team during Detailed Design -2010		
1	Serchhip Sailiamkawn Village,	8 participants from village community including farmers both male and female.,
1	Thenzwal Village Venue: VEC member house	8 participants both male and female including farmers, service holders and businessman
2	Buarpuui Village Venue: Market Place	4 nos of participants including service holders and cultivator
3	Buarpuui Village Venue: VC	6 nos of participants from the community. All the participants were females and they are house wives.
4	New Khawlek Village	14 participants from the village community. All of them cultivators
5	New Khawlek Village	6 participants from the community. All the participants are females and they are house wives
6	Mat Village	Panchayat members (6) and village community (19).
7.	Thenzwal	10 participant including village council members, shopkeepers, drivers
Consultations Held during IEE Finalization (Dec, 2012)		
1	Burapui	13 members comprising village council president and members, womens, students foresters and farmers
2	Thengzwal	11 persons, mainly businessmen, drivers and wage eaners

F. Outcome of Public Consultations

125. Project receives wide acceptance from local people with some apprehensions/concerns. They perceived that the project road improvement will definitely bring out positive socio-economic changes. They also made some demands and suggestions for maximum benefits to the local community and other road users. Results of the public consultations has been summarised in **Table 12**.

Table 12: Outcome of Public Consultations

Perceived Benefits	Concern/ Apprehension	Demands and Suggestions
<ul style="list-style-type: none"> • Reduction in travel time and fuel due to improved road • better access to educational, medical facilities markets, • improvement in road safety; • more employment opportunities • farmers will get better prices for their local produces especially vegetables and spices • Appreciation in land cost. • After slope stabilization, landslide will reduce and thus all weather connectivity can be maintained 	<ul style="list-style-type: none"> • physical and economic displacement • Compensation for pvt. and community properties • Impact due to loss of trees • Impacts due to hill cutting and blasting • impact on places of worship and water sources • air and noise pollution during construction 	<ul style="list-style-type: none"> • Adequate compensation at market value for loss of land and other assets • No water sources and water harvesting structures shall be disturbed • Employment and petty contracts to local people in construction activities • Lines/concrete covered drains in Buarpui and New Khawlek • Residents of the Buarpui informed that drinking water is a major problem. Project authorities should improve the availability of water as an enhancement measures • Measures to avoid siltation and water pollution of nearby waterways.

G. Future Consultation

126. This process shall be extended during implementation. Appointed supervision consultant and implementing NGO for RP shall develop public consultation and disclosure program which is likely to (i) Public meetings with affected communities to discuss and plan work programmes and allow issues to be raised and addressed once construction has started; and (ii) smaller-scale meetings to discuss and plan construction work with individual communities to reduce disturbance and other impacts, and provide a mechanism through which stakeholders can participate in subproject monitoring and evaluation.

H. Disclosure

127. The IEE report will be made available in the office of PWD. The same will be posted on its website. The full reports will also be available to interested parties on request from office of PWD. Based on ADB requirements, documents to be posted on its website are: (i) this IEE, upon receipt; (ii) a new or updated IEE, if prepared, reflecting significant changes in the Project during design or implementation; (iii) corrective action plan prepared during Project implementation to address unanticipated environmental impacts and to rectify non-compliance to EMP provisions; and (iv) environmental monitoring reports, upon receipt.

VII. ENVIRONMENTAL MANAGEMENT PLAN, MONITORING PLAN AND GRIEVANCE REDRESSAL MECHANISM

A. Environment Management Plan

128. Environmental Management Plan (EMP) is intended to set out clearly and unambiguously the likely negative impacts of construction and/or operation of the project, the action that is required to avoid or mitigate each impact and the responsibility for taking each action. Responsibility is made legally binding when actions are subsequently specified in contracts. The EMP (**Appendix 7**) also ensures that the positive impacts are conserved and enhanced. In addition, it provides measures for institutional strengthening and effectiveness assessment through defined monitoring plan, reporting and corrective & preventive action planning. More specifically the objectives of the EMP are:

- (i) To ensure compliance with Asian Development Bank's applicable safeguard policies, and regulatory requirements of Sikkim and the Government of India;
- (ii) To formulate avoidance, mitigation and compensation measures for anticipated adverse environmental impacts during construction and maintenance and ensure that environmentally sound, sustainable and good practices are adopted;
- (iii) To stipulate monitoring and institutional requirements for ensuring safeguard compliance; and
- (iv) The project road should be environmentally sustainable.

B. Environment Monitoring Program

129. The monitoring and evaluation are critical activities in implementation of the Project. Monitoring involves periodic checking to ascertain whether activities are going according to plan or not. It provides the necessary feedback for project management to ensure project objectives are met and on schedule. The reporting system is based on accountability to ensure that the environmental mitigation measures are implemented. Environmental monitoring program has the underlying objective to ensure that the intended environmental mitigations are realized and these results in desired benefits to the target population causing minimal deterioration to the environmental parameters. Such program targets proper implementation of the EMP. The broad objectives are:

- (i) To evaluate the performance of mitigation measures proposed in the EMP.
- (ii) To evaluate the adequacy of environmental assessment.
- (iii) To suggest ongoing improvements in management plan based on the monitoring and to devise fresh monitoring on the basis of the improved EMP.
- (iv) To enhance environmental quality through proper implementation of suggested mitigation measures.
- (v) To meet the requirements of the existing environmental regulatory framework and community obligations.

C. Performance Indicators

130. The significant physical, biological and social components affecting the environment at critical locations serve as wider/overall Performance Indicators. However, the following specific environmental parameters can be quantitatively measured and compared over a period of time and are, therefore, selected as specific Performance Indicators (PIs) for monitoring because of their regulatory importance and the availability of standardized procedures and relevant expertise. A comprehensive monitoring plan for all performance indicators has been prepared for all stages appended as **Appendix 8**. This includes parameters to be measured, methods to be used, sampling locations, frequency of

measurements, detection limits, cost and responsibility for implementation and supervision. Performance indicators requiring quantitative measurements are:

- (i) Air Quality with respect to PM_{2.5}, PM₁₀, CO, NO_x and SO₂ at selected location.
- (ii) Water Quality with reference to DO, BOD, Oil and grease, COD, Suspended Solids and Turbidity, Alkalinity rivers/streams and water bodies at selected points.
- (iii) Noise levels at sensitive receptors (schools, hospitals, community/religious places).
- (iv) Survival rates of trees planted as compensatory plantation to compensate for lost forestlands and compensatory plantation raised for removal of roadside trees.

131. **Ambient Air Quality (AAQ) Monitoring:** Ambient air quality parameters recommended for monitoring road development projects are PM_{2.5}, PM₁₀, Carbon Monoxide (CO), Oxides of Nitrogen (NO_x) and Sulphur Dioxide (SO₂). These are to be monitored, right from the commencement of construction activity at selected locations of plants and machinery, crushers on sites, excavation works etc. Data should be generated once in a season excluding monsoon in accordance with the National Ambient Air Quality Standards as per CPCB recent notification of 2009 (**Appendix 9**).

132. **Water Quality Monitoring:** The physical and chemical parameters recommended for analysis of water quality relevant to road development projects are pH, total solids, total dissolved solids, total suspended solids, oil and grease, COD, Chloride, Lead, Zinc and Cadmium. The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are given in the Environmental Monitoring Plan. The monitoring of the water quality is to be carried out at locations identified along the project road during construction and operation phase. The Indian Standard Specifications – IS10500: 1991 is given in **Appendix 10**. Surface water quality will be monitored as per fresh water classification of CPCB (**Appendix 11**).

133. **Noise Level Monitoring:** The measurements for monitoring noise levels would be carried out at sensitive receptors and construction sites along the project roads. The Ambient Noise Standards formulated by Central Pollution Control Board (CPCB) in 1989 or the standards by State Pollution Control Board if such standards are stringent than those of the CPCB are to be complied. The CPCB standards are given in **Appendix 12**. Sound pressure levels would be monitored on twenty-four hour basis. Noise should be recorded at “A” weighted frequency using a “slow time response mode” of the measuring instrument.

134. **Success of Re-vegetation:** compensatory plantation will be taken up in lieu of tree cutting @ 1:3 basis. These compensatory plantations will have to be monitored by the implementing agency with the help of the Forest Department. Such monitoring will be conducted through random samples. Such sampling should cover at least 5% of the area planted up. 75% survival rate shall be ensured.

D. Institutional Arrangement

135. The PWD, through its Project Implementing Unit (PIU), is the Executive Agency of the Project. The Project Director is overall responsible for EMP implementation. The following groups are involved in EMP implementation during construction stage:

- (i) PIU and its environmental unit;
- (ii) Construction Supervision Consultant (SC) i.e. Engineer and his representatives; and

(iii) Contractor.

136. There is a need to establish Environmental and Social Management Unit (EMSU) within the PIU. Since it is not envisaged that significant environmental impacts will result from the road upgrading, it is recommended that one of the senior officers of PIU will be designated as Environmental and Social Officer for monitoring implementation of proposed safeguard measure. EMSU will be headed by the Project Director but coordinating and supervising implementation of safeguard measures will be undertaken by the designated Environmental and Social Officer. There is a need for capacity building of environmental unit through various trainings.

137. The Project Director of PIU with the assistance of designated Environmental and Social Officer will be overall responsible for ensuring compliance of safeguard measures and will be reporting to the regulatory bodies and ADB certifying that relevant environmental safeguard measures have been complied with during project implementation. At the field level, the Executive Engineer with his Assistant Engineer/s will supervise implementation of safeguard measures for this subproject and submit monthly reports to PIU.

138. PIU may engage independent agencies for carrying out pollution monitoring activities. The Supervision Consultant (SC) will be interacting with these agencies and facilitate them in carrying out such activities.

139. The SC will liaise with PIU environment unit to ensure that Contractor complies with the requirements of various environmental safeguard measures through supervision, monitoring and reporting. Efforts must be made by SC to ensure that environmental mitigation and good-construction-practices are implemented as integral component of each civil activity. Implementation of environmental safeguard measures needs team effort and as such the Team Leader of SC will delegate the responsibilities to each member of the supervision team with respect to their core responsibilities. The project should have a provision of part time input of Environmental Specialist within SC to supervise implementation of safeguard measures. His role would be more on advisory. He will assist the Team Leader of SC on the following:

- (i) Advise PIU on preparing reports to ADB and other statutory bodies;
- (ii) Preparing procedures for implementing EMP;
- (iii) review Contractor's EMP, traffic management plan and safety plan and recommend for its approval / improvements, to the Team Leader;
- (iv) provide training to PIU, SC and Contractors' staff on implementing EMP;
- (v) advise on obtaining various statutory environmental clearances on time;
- (vi) conduct periodic field visits to examine environmental compliances and suggest corrective actions ; and
- (vii) any other issues as will be required to ensure environmental compliance.

140. Besides, the Team Leader of SC will nominate a senior engineer from the site office responsible for day-to-day supervision of EMP implementation. He will provide guidance to the field staff of SC and Contractor for implementing each of the activities of the EMP. He will be responsible for record keeping, providing instructions through the Engineer for corrective actions, ensuring compliance of various statutory and legislative requirements and assist Engineer for submitting reports to PIU. He will maintain a close co-ordination with the Contractors and PIU for successful implementation of the environmental safeguard measures. To ensure the EMP is properly implemented, Contractor shall appoint a full time qualified and experienced Environmental and Safety Officer (ESO) from the commencement to completion of the project. The qualification and responsibilities of ESO as stipulated below should be considered. The qualification of ESO will be as given below:

- (i) Diploma or Graduate in Civil Engineering with post graduate specialization in Environmental Engineering or Environmental Science or equivalent;
- (i) 5 to 10 years of total professional experience; and
- (ii) About 3 to 5 years of experience in similar projects i.e. management of environmental issues in design and construction of road / highway / flyover / bridges

The responsibilities of ESO of Contractor will include the following:

- (i) Directly reporting to the Project Manager of the Contractor;
- (ii) Discussing various environmental issues and environmental mitigation, enhancement and monitoring actions with all concerned directly or indirectly;
- (iii) Preparing Contractor's EMP, traffic management plan and safety plan;
- (iv) Ensuring contractor's compliance with the EMP stipulations and conditions;
- (v) Assisting project manager to ensure environmentally sound and safe construction practices;
- (vi) Assisting project manager to ensure the timely procurement of materials that are included in the BOQ relating to environmental mitigations and enhancement;
- (vii) Conducting periodic environmental and safety training for contractor's engineers, supervisors and workers;
- (viii) Preparing a registers for material sources, labour, pollution monitoring results, public complaint and as may be directed by the Engineer;
- (ix) Assisting the PIU on various environmental monitoring and control activities including pollution monitoring; and
- (x) Submitting monthly reports to SC on status of implementation safeguard measures.

141. As mentioned above, there is a need for capacity building of PIU on various environmental and social aspects of the project through various environmental training. Recently, there has been change of statutory requirements for this similar projects based on new EIA Notification. This has changed the landscape of legal and administrative framework for implementing the projects. Thus, there is a need for the PIU staff to updating the information and keeping abreast with the changing legal and administrative requirement.. For successful implementation of EMP, it is essential to orient engineers of PIU, SC and Contractor who would be mobilized for this project. One day environmental orientation workshop will be conducted each at by PIU, once most of the staff has been mobilized. The details of the training program are included in **Table 13**.

Table 13: Details of Environmental Training Program

Module	Title	Objectives	Duration (Day)	Target Group
1	Environmental Legislations and Bank's Safeguard Policies	<ul style="list-style-type: none"> • Brush up latest on environmental legislations • Brush up safeguard policies 	1	PIU and SC staff
2	Environmental Supervision and Monitoring	<ul style="list-style-type: none"> • EMP requirements • Implementation, Supervision and Monitoring Mechanism • Provision made in Contract Documents for Works • Provision made in contract Agreement for Supervision Services 	1	PIU and SC staff
3	Orientation Workshop on EMP Implementation	<ul style="list-style-type: none"> • EMP requirements • Implementation, Supervision and Monitoring Mechanism • Roles and Responsibilities of Contractors and SCs 	1	PIU, Contractors and SCs
4	Focused Training on Specific Issue/s (three during course of implementation)	<ul style="list-style-type: none"> • Analyzing problems, referring stipulations in Contract and EMP and agreed to feasible solution within specified timeframe 	0.5	PIU, Contractors and SCs

E. Grievance Redressal Mechanism

142. A project-specific grievance redress mechanism (GRM) will be established to receive, evaluate and facilitate the resolution of affected people's concerns, complaints and grievances about the social and environmental performance at the level of the Project. The GRM will aim to provide a time-bound and transparent mechanism to voice and resolve social and environmental concerns linked to the project. The project-specific GRM is not intended to bypass the government's own redress process, rather it is intended to address affected people's concerns and complaints promptly, making it readily accessible to all segments of the affected people and is scaled to the risks and impacts of the project.

143. The PIUs will make the public aware of the GRM through public awareness campaigns. The contact phone number of the respective PIUs will serve as a hotline for complaints and will be publicized through the media and placed on notice boards outside their offices and at construction sites. The project information leaflet will include information on the GRM and will be widely disseminated throughout the corridor by the R&R officers in the PIUs with support from the NGO engaged to implement the RP. Grievances can be filed in writing using the Complaint Register and Complaint Forms or by phone with any member of the PIU.

144. **First tier of GRM.** The PIU is the first tier of GRM which offers the fastest and most accessible mechanism for resolution of grievances. The Resettlement Officer in the PIU will be designated as the key officer for grievance redress. Resolution of complaints will be done within seven working (7) days. Investigation of grievances will involve site visits and consultations with relevant parties (e.g., affected persons, contractors, traffic police, etc.). Grievances will be documented and personal details (name, address, date of complaint, etc.) will be included unless anonymity is requested. A tracking number will be assigned for each grievance, including the following elements:

145. Initial grievance sheet (including the description of the grievance) with an acknowledgement of receipt given to the complainant when the complaint is registered;

146. Grievance monitoring sheet with actions taken (investigation, corrective measures);

147. Closure sheet, one copy of which will be handed to the complainant after he/she has agreed to the resolution and signed-off.

148. The updated register of grievances and complaints will be available to the public at the PIU office, construction sites, and other key public offices along the project corridor (offices of the ward members, local Resident Welfare Association offices etc). Should the grievance remain unresolved it will be escalated to the second tier.

149. **Second Tier of GRM.** The Environment Officer in the PIU will activate the second tier of GRM by referring the unresolved issue (with written documentation) to the Grievance Redress Committee (GRC)³. The GRC will be established before commencement of site works. A hearing will be called with the GRC, if necessary, where the affected person can present his/her concern/issues. The process will facilitate resolution through mediation. The local GRC will meet as necessary when there are grievances to be addressed. The GRC will suggest corrective measures at the field level and assign clear responsibilities for implementing its decision within fifteen (15) working days. If unsatisfied with the decision, the existence of the GRC will not impede the complainant's access to the Government's judicial or administrative remedies.

150. The PIU Officers will be responsible for processing and placing all papers before the GRC, maintaining database of complaints, recording decisions, issuing minutes of the meetings and monitoring to see that formal orders are issued and the decisions carried out.

151. **Third tier of GRM.** In the event that a grievance cannot be resolved directly by the PIUs (first tier) or GRC (second tier), the affected person can seek alternative redress in the appropriate court of law. The PIUs or GRC will be kept informed by the district, municipal or national authority.

152. The monitoring reports of the resettlement plan implementation will include the following aspects pertaining to progress on grievances: (i) number of cases registered with the GRC, level of jurisdiction (first, second and third tiers), number of hearings held, decisions made, and the status of pending cases; and (ii) lists of cases in process and already decided upon may be prepared with details such as Name, ID with unique serial number, date of notice, date of application, date of hearing, decisions, remarks, actions taken to resolve issues, and status of grievance (i.e., open, closed, pending).

153. **Costs:** All costs involved in resolving the complaints (meetings, consultations, communication and reporting / information dissemination) will be borne by the Project.

³ The GRC will consist of the following persons: (i) Project Director; (ii) representative of the affected person(s); (iv) representative of the local Deputy Commissioners office (land). The functions of the local GRC are as follows: (i) resolve problems quickly and provide support to affected persons arising from various environmental issues and including dust, noise, utilities, power and water supply, waste disposal, traffic interference and public safety as well as social and resettlement related issues such as land acquisition (temporary or permanent); asset acquisition; and eligibility for entitlements, compensation and assistance; (ii) reconfirm grievances of displaced persons, categorize and prioritize them and aim to provide solutions within a month; and (iii) report to the aggrieved parties about developments regarding their grievances and decisions of the GRC.

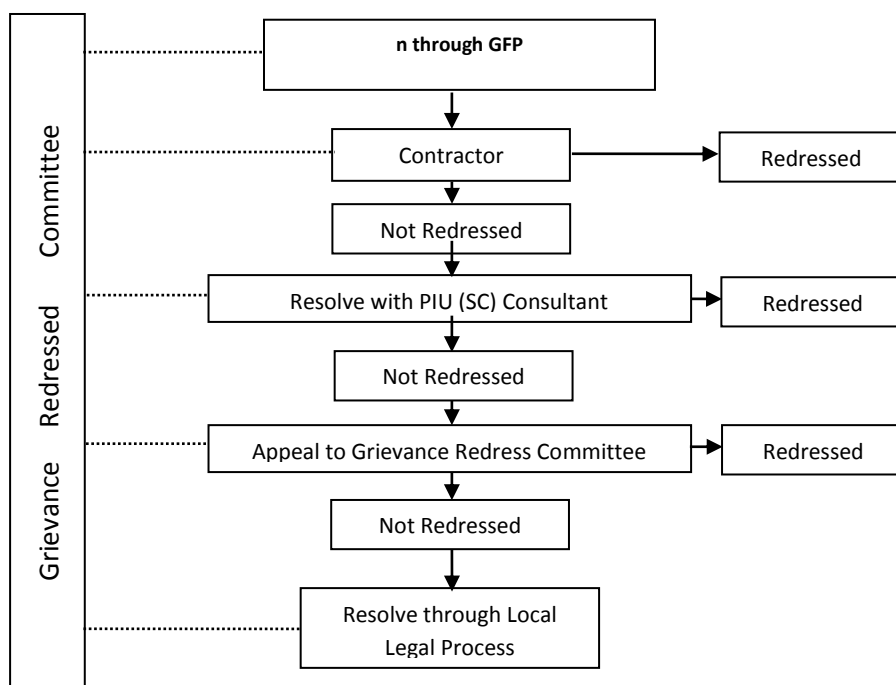


Figure 7.1: Grievance Redress Mechanism

F. Environment Management Budget

154. An environmental management budget of INR 32.5 Lakhs has been estimated for implementation of the environmental management plan. This budget also includes cost of environmental monitoring and associated trainings. A detail of environmental management budget is given in **Table 16**.

G. Generic Guidelines for Implementing EMP

155. A set of generic guidelines have been formulated to avoid potential impacts due to construction and its allied activities. Quarry and Borrow area Management has been excluded since no new borrow areas or quarries are likely to be opened quarrying is not involved. Quarry materials will be obtained from licensed quarries. Earth material obtained from hill cutting will be used for road construction. These guidelines have been attached as Appendices with following headings.

Appendix 13- Management of Construction Plants, equipment and vehicles

Appendix 14- Campsite Management

Appendix 15- Management of Construction Waste and Debris Disposal

Appendix 16- Borrow Area Management

Table 16: Environment Management Budget

SL. NO.	ITEM DESCRIPTION	QUANTITY	UNIT	RATE (Rs.)	AMOUNT (Rs.)	Responsibility
A	Tree Plantation					
A.1	Compensatory Plantation@1:3 basis for 1706	5118	No.	750	38,38,500	PIU through Forest Department
A.2	Bamboo tree guard of height 1.2 meters above ground and 0.20 meter below ground for all trees other than bamboo tree.	5118	No.	300	15,35,400	
A.3	Diversion of Riverine Reserved Forests (including NPV+7 years Maintenance	0.993	Ha	-	780,000	
A-4	Turfing of slopes by roughgrass and maintaining,watering etc for one year	25000	sqm	15	375,000	
B	Environmental Monitoring					
B.1	Ambient air quality monitoring as per Appendix 8	24	No.	7500	180,000	PIU through Approved Monitoring Agency
B.2	Ambient noise level monitoring as per Appendix 8	24	No.	7500	180,000	
B.3	Water quality monitoring of surface water as per Appendix 8	24	No.	7500	180,000	
B.4	Water quality monitoring of drinking water	6	No.	7500	45,000	
D	Enhancement of cultural properties as per directed by the engineer including the following items					
D.1	Provision and erection of cement concrete, standard sitting benches including clearing of the area around the benches.	40	No.	1000	40,000	
D.2	Boundary fencing with barbed wire fencing of approved make and specification including provision and erection of struts	300	Rm.	550	165,000	
D.3	Redevelopment of borrow area for mitigation of soil pollution as per Environment Management Plan. etc	2000	sqm	300	6,00,000	
E	Environmental Training					
E.1	Training at site as per Appendix E of EMP.	1		75000	75,000	PIU through Supervision consultant
Grand Total = INR 79,93,900.00 Say 79.94 lakhs						

VIII. CONCLUSION AND RECOMMENDATION

156. The proposed MZ 02: Serchhip - Buarpui road section improvement has been categorized as Category 'B' based on environmental screening and assessment of likely impacts. Initial environmental examination ascertains that it is unlikely to cause any significant environmental impacts. Few impacts were identified attributable to the proposed subproject, most of which are localized and temporary in nature and easy to mitigate.

157. Project road is not located in any environmentally sensitive areas. However, it passes through riverine reserve forest in very few stretches. Diversion of forest land is minimal at 0.9963 ha. Widening and improvement will mostly be accommodated within available land. Land acquisition is required only for curve important and locations where protection works are proposed.

158. The significant environmental impacts attributable to the upgrading of the road sections pertains to tree cutting, temporary deterioration of environmental attributes/ambients during construction phase from land clearing, slope destabilization due to hill cutting, blasting operations, silt run off, camp operations and community and occupational health and safety. These impacts are easily mitigated by adopting good construction practices and effective implementation of Environmental Management Plan (EMP). During operation stage, the main impacts are increase in mobile emissions, noise level, accident risk to motorist, pedestrian and animals. Road safety measures are proposed as per IRC: SP: 44-1996 like road delineators, signage, metal beam crash barriers and guide posts etc. Toe walls and stone pitching has been proposed on embankment slopes where ponds are abutting to avoid seepage into sub grade and erosion of road embankment.

159. In general, the subproject received immense support from local people. The local people appreciated that improved connectivity will bear out several socio-economic positive benefits resulting to improved quality of life

160. The initial environmental examination of the subproject ascertains that the project is unlikely to cause any significant environmental impacts. No additional studies or need of undertaking detailed EIA is envisaged at this stage. The Executing Agency shall ensure that EMP and EMoP are included in Bill of Quantity (BOQ) and forms part of bid document and civil works contract. The same shall be revised if necessary during project implementation or if there is any change in the project design and with approval of ADB.

APPENDIX 1

RAPID ENVIRONMENTAL ASSESSMENT (REA) CHECKLIST

ROADS AND
HIGHWAYS**Instructions:**

- (i) The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Environment and Safeguards Division (RSES), for endorsement by Director, RSES and for approval by the Chief Compliance Officer.
- (ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.
- (iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

Country/Project Title: **MZ02: Srchhip-Buarpui in the State of Mizoram (NESRIP-Tranche 2)**Sector Division: **Roads and Highways**

Screening Questions	Yes	No	Remarks
A. project siting is the project area adjacent to or within any of the following environmentally sensitive areas?			
▪ Cultural heritage site		x	No cultural heritage site is located within the road ROW or vicinity
▪ Protected area		x	There are 9 designated protected areas in the state. None of them is in the vicinity or within 10 km radius.
▪ Wetland		x	No designated wetland in the project area.
▪ Mangrove		x	No mangrove area is located in the project site
▪ Estuarine		x	Not applicable
▪ Buffer zone of protected area		x	
▪ Special area for protecting biodiversity		x	No special biodiversity area is located within the ROW
B. potential environmental impacts will the project cause...			
▪ Encroachment on historical/cultural areas; disfiguration of landscape by road embankments, cuts, fills, and quarries?	x		The topography of project road is hilly. Project activities are not of large scale and mostly confined to available ROW. Minor impacts of landscape by road embankments, cuts and fills are anticipated.

Screening Questions	Yes	No	Remarks
			<p>No additional borrow areas is required. Excess cut material produced from cutting the hillside can be used as fill where required.</p> <p>No encroachment of historical places. However, some temples / shrines / exist along the project road may get impacted.</p> <p>Opening of new quarries is not proposed. Quarry material will be sourced from existing quarries.</p>
<p>▪ Encroachment on precious ecology (e.g. sensitive or protected areas)?</p>		x	<p>No National Parks, wildlife sanctuaries or similar ec0-sensitive areas along the project road However, the project road in following stretches of Part II passes through Tlwang Riverine Reserve Forest for a length of 3.690 Km occupying an area of only 0.9963 Ha</p> <ul style="list-style-type: none"> • Km 19.640 to Km 20.000 • Km 20.000 to Km.21.000 • Km 21.000 to Km 21.360 • Km 21.360 to Km 22.000 • Km. 22.000 to Km 23.000 • Km. 23.000 to Km 23.330 <p>As per the forest department, no loss of any rare/threatened/endangered species of flora is envisaged.</p>
<p>▪ Alteration of surface water hydrology of waterways crossed by roads, resulting in increased sediment in streams affected by increased soil erosion at construction site?</p>	x		<p>Project road intersects two major rivers (River Mat and River Tlwang) and few other perennial streams. Most of the bridges are having open foundation without restricting flow. Water courses of these rivers and streams will not be disturbed.</p> <p>There are also large no of nallas being crossed by the project road. Most of them are seasonal. Culverts reconstruction will be done during lean flow period. In some cases these minor channels may be diverted for a very short period (15-30 days) and will be bring back to its original course immediately after construction.</p> <p>Adequate measures like retaining walls/breast walls have been proposed to avoid/reduce siltation in the water bodies/ponds close to the alignment.</p>
<p>▪ Deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction?</p>		x	<p>Adequate sanitary facilities and drainage in the workers camps will help to avoid this possibility. as the construction activity in this project will not contain any harmful ingredients, no impact on surface water quality is anticipated.</p> <p>Measures like embankment slope stabilisation, RCC retaining walls are proposed to prevent siltation of waterways.</p>

Screening Questions	Yes	No	Remarks
<ul style="list-style-type: none"> Increased local air pollution due to rock crushing, cutting and filling works, and chemicals from asphalt processing? 	x		Local air pollution level is likely to be increased for short duration during construction period. appropriate distance from settlement area and wind direction may be taken into account to locate air polluting facility like stone crushing unit etc. use of environment friendly equipments/machineries will help to reduce air pollution. Moreover there are very few settlement
<ul style="list-style-type: none"> Risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation? 		x	<p>Workers may get exposed to dust and noise during construction activities. However the exposure levels are likely to be short and insignificant. Workers will be provided requisite PPEs to minimise such exposure and associated harmful occupational health effects.</p> <p>Traffic on roads is expected to be low and as such, no occupational health hazard is anticipated during operation phase.</p>
<ul style="list-style-type: none"> Noise and vibration due to blasting and other civil works? 	x		<p>Blasting may be required at few places. However, there is very few habitation near potential blasting sites. Blasting will be done as per Indian Explosive Act in controlled manner considering potential impact on community.</p> <p>Ambient noise level is expected to increase in the range of 80-90 db(a) due to various construction activities, maintenance workshops, and earthmoving equipment. Although this level of noise exceeds national standards, their occurrence will be intermittent and co-terminus with the project construction.</p> <p>All stationary noise making sources equipment like dg set, compressors will be installed with acoustic enclosures. Timings of noise construction activities will be regulated near sensitive receptors. Noise barriers have been proposed at sensitive locations very close to the alignment.</p>
<ul style="list-style-type: none"> dislocation or involuntary resettlement of people 		x	Since widening will be mostly accommodated within available ROW, this impact is expected to be low. Exact number of displaced persons to be confirmed by RP. this is under preparation
<ul style="list-style-type: none"> Dislocation and compulsory resettlement of people living in right-of-way? 		x	Minimal. To be confirmed by RP under preparation.
<ul style="list-style-type: none"> Disproportionate impacts on the poor, women and children, indigenous peoples or other vulnerable groups? 		x	To be minimal
<ul style="list-style-type: none"> Other social concerns relating to inconveniences in living conditions in the project areas that may trigger cases of upper respiratory problems and stress? 		x	Deterioration in ambient air quality will be localised and temporarily during construction activity. The project area is largely located in open areas. Plantation along the highway and improved road conditions will improve the air quality of the area.

Screening Questions	Yes	No	Remarks
<ul style="list-style-type: none"> Hazardous driving conditions where construction interferes with pre-existing roads? 		x	Suitable traffic management plan will be designed and implement by the contractor to prevent any hazardous driving condition in above situations.
<ul style="list-style-type: none"> Poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases from workers to local populations? 		x	Proper provisions for sanitation, health care and solid waste disposal facilities will be available in the contract documents to avoid such possibility. workers will be made aware about communicable diseases
<ul style="list-style-type: none"> Creation of temporary breeding habitats for diseases such as those transmitted by mosquitoes and rodents? 		x	No such condition is anticipated. No borrow areas are likely to be opened since hill cut material will be used for road.
<ul style="list-style-type: none"> Accident risks associated with increased vehicular traffic, leading to accidental spills of toxic materials? 		x	Adequate safety measures will be adopted to avoid such conditions.
<ul style="list-style-type: none"> Increased noise and air pollution resulting from traffic volume? 	x		<p>Increase in noise and air pollution is expected during construction phase. Adequate mitigation measures will be adopted to minimise them.</p> <p>During operation phase, the main source of noise and air will be traffic. Improved road conditions, extensive plantation will help reduce the noise and air impact. Moreover, the alignment mostly passes through open agricultural land which will provide adequate dispersion of gaseous emission.</p> <p>if measures suggested for noise sensitive receptors prove inadequate, solid noise barrier will be placed.</p>
<ul style="list-style-type: none"> Increased risk of water pollution from oil, grease and fuel spills, and other materials from vehicles using the road? 	x		This is expected from accidental spillage. Adequate safety provisions have been proposed to avoid such situation.
<ul style="list-style-type: none"> Social conflicts if workers from other regions or countries are hired? 		x	Most of the workers will be from local areas and hence such conflict is not anticipated.
<ul style="list-style-type: none"> Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)? 		x	Workers will be mostly from local villages. Worker from remote places will be provided with adequate facility. The ratio of local and outside workers will be such balanced that there is minimum burden on existing social infrastructures and services.
<ul style="list-style-type: none"> Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation? 		x	IEE has outlined such anticipated risks and recommended necessary mitigative measures to avoid them.
<ul style="list-style-type: none"> Community safety risks due to both accidental and natural causes, especially where the structural elements or components of the 		x	<p>Adequate measures have been adopted to mitigate such risks.</p> <p>Adequate awareness will be created amongst</p>

Screening Questions	Yes	No	Remarks
project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning.			people and workers through information disclosure, safety signage and public consultation about safety aspects.

Based on the above assessment the project is categorized as 'B' as per SPS, 2009

Project does not require Environmental Clearance under the preview of EIA Notification 2006 and its subsequent amendments.

APPENDIX 2**LIST OF WATERWAYS AND TYPE OF CROSS-DRAINAGE STRUCTURES**

Sl. No.	Type of water bodies	Village name	Crossing from Ch. (Km) to Ch. (Km)	Availability of water during a year
1	Nullah	Zawlpuipeng	0.125 km-0.150 km	Seasonal
2	Stream	Zawlpuipeng	0.250 km-0.275 km	Seasonal
3	Stream	Zawlpuipeng	0.900 km-0.925 km	Seasonal
4	Stream	Zawlpuipeng	0.950 km-1.000 km	Seasonal
5	Stream	Zawlpuipeng	1.250 km-1.275 km	Seasonal
6	Nullah	Zehtet	1.350 km-1.375km	Seasonal
7	Nullah	Zehtet	1.750 km-1.775 km	Seasonal
8	Nullah	Zehtet	1.925 km-1.950 km	Seasonal
9	Stream (RCC Bridge Present)	Zehtet	2.275 km-2.325 km	Year Long
10	Nullah	Zehtet	2.425 km-2.450 km	Seasonal
11	Nullah	Zehtet	2.475 km-2.525 km	Seasonal
12	Nullah	Zehtet	2.750 km-2.775 km	Seasonal
13	Nullah	Zehtet	3.425 km-3.450 km	Seasonal
14	Nullah	Zehtet	3.625 km-3.650 km	Seasonal
15	Nullah	Zehtet	3.775 km-3.800 km	Seasonal
16	Nullah	Zehtet	3.950 km-3.975 km	Seasonal
17	Nullah	Zehtet	4.550km-4.600 km	Seasonal
18	Nullah	Zehtet	4.625 km-4.650 km	Seasonal
19	Nullah	Zehtet	4.800 km-4.850 km	Seasonal
20	Nullah	Zehtet	5.050 km-5.075 km	Seasonal
21	Nullah	Zehtet	5.325 km-5.350 km	Seasonal
22	Nullah	Zehtet	5.550 km-5.575 km	Seasonal
23	Nullah	Zehtet	5.750 km-5.800 km	Seasonal
24	Nullah	Zehtet	6.150 km-6.175 km	Seasonal
25	Nullah	Zehtet	6.350 km-6.375 km	Seasonal
26	Stream	Zehtet	6.450 km-6.475 km	Year Long
27	Nullah	Thuhruk	6.750 km-6.775 km	Seasonal
28	Nullah	Thuhruk	6.950 km-6.975 km	Seasonal
29	Nullah	Thuhruk	7.125 km-7.150 km	Seasonal
30	Nullah	Thuhruk	7.175 km-7.225 km	Seasonal
31	Nullah	Thuhruk	7.425 km-7.450 km	Seasonal
32	Nullah	Thuhruk	7.500 km-7.525 km	Seasonal
33	Nullah	Thuhruk	7.825 km-7.850 km	Seasonal
34	Nullah	Thuhruk	8.150 km-8.175 km	Year Long
35	Stream	Thuhruk, Thliarpui	8.400 km-8.425 km	Year Long
36	Nullah	Thliarpui	8.675 km-8.700 km	Seasonal
37	Nullah	Thliarpui	8.950 km-8.975 km	Seasonal
38	Nullah	Thliarpui	9.325 km-9.375 km	Seasonal
39	Nullah	Thliarpui	9.575 km-9.600 km	Seasonal
40	Nullah	Thliarpui	9.625 km-9.675 km	Year Long
41	Nullah	Zuangleng	9.875 km-9.900 km	Seasonal
42	Nullah	Zuangleng	10.050 km-10.100 km	Seasonal
43	Nullah	Zuangleng	10.300 km-10.325 km	Seasonal
44	Nullah	Zuangleng	10.375 km-10.400 km	Seasonal
45	Nullah	Zuangleng	10.550 km-10.575 km	Seasonal
46	Nullah	Zuangleng	10.675 km-10.700 km	Seasonal
47	Nullah	Zuangleng	10.900 km-10.925 km	Seasonal
48	Nullah	Zuangleng	11.150 km-11.175 km	Seasonal
49	Nullah	Zuangleng	11.500 km-11.525 km	Seasonal

Sl. No.	Type of water bodies	Village name	Crossing from Ch. (Km) to Ch. (Km)	Availability of water during a year
50	Nullah	Zuangleng	11.825 km-11.850 km	Seasonal
51	Nullah	Zuangleng	12.000 km-12.025 km	Seasonal
52	Nullah	Zuangleng	12.325 km-12.350 km	Seasonal
53	Nullah	Zuangleng	12.525 km-12.550 km	Seasonal
54	Nullah	Mat	12.775 km-12.800 km	Seasonal
55	Nullah	Mat	12.925 km-12.975 km	Seasonal
50	Mat River (Bridge Present)	Mat	13.050 km-13.150 km	Year Long
51	Nullah	Mat	13.300 km-13.325 km	Seasonal
52	Nullah	Mat	13.450 km-13.500 km	Seasonal
53	Stream	Thenzawl	13.500 km-13.525 km	Year Long
54	Nullah	Thenzawl	13.600 km-13.625 km	Seasonal
55	Nullah	Thenzawl	13.725 km-13.750 km	Seasonal
56	Nullah	Thenzawl	14.225 km-14.250 km	Year Long
57	Nullah	Thenzawl	14.350 km-14.375 km	Seasonal
58	Nullah	Thenzawl	14.500 km-14.525 km	Seasonal
59	Nullah	Thenzawl	14.575 km-14.600 km	Seasonal
60	Nullah	Thenzawl	14.700 km-14.725 km	Seasonal
61	Nullah	Thenzawl	14.900 km-14.925 km	Seasonal
62	Nullah	Thenzawl	15.000 km-15.025km	Seasonal

APPENDIX 3

List of Plants under Thenzawl Forest Division

A. TREE

SI No.	Mizo	Common Name	Botanical Name
1.	April Par	Gulmohar	<i>Delonix regia</i>
2.	Archangkawm	Trumpet Flower	<i>Oxoxylum indicum</i>
3.	Banphar	Kadam	<i>Anthocephalues chinensis</i>
4.	Borai	Indiam plum	<i>Ziziphus mauritiana</i>
5.	Bil	Indiam red pear	<i>Protium siretum</i>
6.	Bung	Banyan	<i>Ficus beangalensis</i>
7.	Bungbutui ram	Garuga	<i>Garuga pinnata</i>
8.	Changkhen		<i>Heteropanax fragranas</i>
9.	Char	Hollock	<i>Terminalia myriocarpa</i>
10.	Chawnpui	Queen's flower	<i>Lagerstroemia speciosa</i>
11.	Chengkek		<i>Garcinia cowa</i>
12.	Chhawntual		<i>Aporusa octandra</i>
13.	Chingit	Mullilan	<i>Zanthoxylum rhetsa</i>
14.	Fartuah	Coral tree	<i>Erythrina variegata</i>
15.	Herhse	Iron-wood tree	<i>Mesua ferrea</i>
16.	Hlingsi	Soap-nut tree	<i>Sapindus mukorossi</i>
17.	Hmawng	Ficus/ Pilkhan/ Pipal	<i>Ficus religiosa</i>
18.	Hnahkhar		<i>Macaranga denticulate</i>
19.	Hnahkiah		<i>Callicarpa arborea</i>
20.	Hnahpawte		<i>Litsea lancifolia</i>
21.	Hnaibung	Kurta or Tali	<i>Palagium polyanthum</i>
22.	Hnum	Silapoma	<i>Engelhardtia spicata</i>
23.	Hriang	Alder Birch	<i>Betula alnoides</i>
24.	Kangtek	White siris	<i>Albizzia procera</i>
25.	Kawrhreihia	Ping	<i>Maniltoa polyandra</i>
26.	Kawrthindeng	Elephant apple	<i>Dillemia indica</i>
27.	Kharuan		<i>Elsoncarpus lanceifolius</i>
28.	Khaukhim		<i>Femiana colorata</i>
29.	Khaupui	Udal	<i>Sterculia villosa</i>
30.	Khawkherh	Walnut tree	<i>Juglans regia</i>
31.	Khawmhma		<i>Rhus semialata</i>
32.	Khiang	Needle	<i>Schima Walichii</i>
33.	Khuang thli	Bishop tree/ wood	<i>Bischofia javanica</i>
34.	Lamkhuang	Jackfruit tree	<i>Artocarpus heterophyllus</i>
35.	Lawngthing	Wood oil tree	<i>Artocarpus Chaplasha</i>
36.	Lenhmui	Black plum/ Black berry	<i>Syzygium cuminii</i>
37.	Lungkhup	Haldu	<i>Adina cardifolia</i>
38.	Makpazangkang	Pink & white shower	<i>Cassia javanica</i>
39.	Meihle	Palm tree	<i>Caryota mitis</i>
40.	Mualhawih	Asoka tree	<i>Saraca indica</i>
41.	Mukpui		<i>Cordia fragrantissima</i>

SI No.	Mizo	Common Name	Botanical Name
42	Nauthak	Common Grey Mango Laurel	<i>Litsea monopelata</i>
43	Ngiau	Champ	<i>Michelia Champaca</i>
44	Pang	Didu	<i>Bombax insigne</i>
45	Pangkai	Lutgua or Bhooby Tre	<i>Baccaurea ramiflora</i>
46	Phaithing		<i>Scaphigera/ Trewia nudiflora</i>
47	Phan	Eastern Elm	<i>Ulmus Lancifolia</i>
48	Phuanberhpui	Gokul	<i>Ailanthus integrifolia</i>
49	Phunchawng		<i>Brombax Malabaricum</i>
50	Pualeng		<i>Mitragyna diversifolia</i>
51	Reraw	Citrine	<i>Terminalia Citrlina</i>
52	Sahatah	Berdam	<i>Dysoxylum binectaniferum</i>
53	Sehawr	Chestnut	<i>Castanopsis indica</i>
54	Sentizel	Poon	<i>Calophyllum polyanthum</i>
55	Sihneh		<i>Eurya cerasifolia</i>
56	Sunhlu	Emblic Myrobalan/ Amla	<i>Phyllanthus emblica</i>
57	Tatkawng	Chaplash	<i>Artocarpus Chaplasha</i>
58	Tawitaw	Hog- plum tree	<i>Spondias pinnata</i>
59	Tawitawsuak	Jhingan	<i>Lannea coromandelica</i>
60	Teak	Teak	<i>Tectona Grandis</i>
62	Tei	Toon or Red cedar	<i>Toona ciliate</i>
63	Tengtere	Tamarind	<i>Tamarindus Indica</i>
64	Thakthing	True cinnamon	<i>Cinnamomum Venum</i>
65	Theichek	Cluster fig	<i>Ficus Racemosa</i>
67	Theifeimung	Lichi	<i>Litchi chinensis</i>
68	Theihai	Mangoo tree	<i>Mangifera indica</i>
69	Theiherawt	Carambola tree	<i>Averrhoa Carambola</i>
70	Theihmuisawi		<i>Garnicia Xanthochymus</i>
71	Theikum	Riber Ebony	<i>Diospyros Malabrica</i>
72	Theipalingkawng		<i>Bruinsmia Polysperma</i>
73	Theipui	Khini	<i>Ficus semicorlata</i>
74	Theiria	Carralia or Maniawaga	<i>Carallia brachiata</i>
75	Theitat	Monkey Jack	<i>Artocarpus lakoocha</i>
76	Theikelek		<i>Elaeocarpus aristatus</i>
77	Thingalu	Pitali	<i>Thewia nudiflora</i>
78	Thingdawl	Maina	<i>Tetrameles nudiflora</i>
79	Thinghlu		
80	Thingkha		<i>Derros robusta</i>
81	Thingkhawilu		<i>Vitex peduncularis</i>
82	Thingpawnychhia		<i>Glochidion khasicum</i>
83	Thingrai		<i>Aquilaria agallocha</i>
84	Thingrimchhia		
85	Thingsawr		
86	Thingsen	Hollong	<i>Dipterocarpus retusus</i>
87	Thingsia	Chestnut	<i>Castanopsis tribuloidesi</i>
88	Thingthupui		<i>Dysoxylum goborum</i>
89	Thingtum bu		<i>Magnolia rabaniana</i>
90	Thingvandawt	Belleric Myrobolan	<i>Terminalia bellirica</i>
91	Thingvawkpui		<i>Sapium baccatum</i>

SI No.	Mizo	Common Name	Botanical Name
92	Thlado		<i>Jagerstoemia speciosa</i>
93	Thlanvawng	Gomari	<i>Gmelina arborea</i>
94	Thlengreng		<i>Vitex heterophylla</i>
95	Thuamriat	Scholar or Devil tree	<i>Alstonia scholaris</i>
96	Tripui		<i>Cedrela toona</i>
97	Tufar	Phum-yew	<i>Cephalotaxus griffithii</i>
98	Tuaihabet		<i>Garcinia xanthochymus</i>
99	Tuipuisuthlah	India willow	<i>Salix tetrasperma</i>
100	Tuairam	Laurel	<i>Terminatia crenulata</i>
101	Vaiza		<i>Hibiscus macrophyllus</i>
102	Vang	Siris	<i>Albizzia chinensis</i>
103	Vaube	Mountain Ebony or camels foot tree	<i>Bauhinia variegata</i>
104	Vawmbal	Telsur	<i>Drimycarpus racemosus</i>
105	Vawmva		<i>Garcinia sopsapia</i>
106	Vawngthla		<i>Gmelina ablongifolia</i>
107	Zairum	Yon	<i>Anogessus acuminate</i>
108	Zawngtah		<i>Parkia timoriana</i>
109	Zawngtei	Chittagong wood	<i>Chukrasia velutina</i>
110	Zihhaw		<i>Stereospermum neuranthum</i>
111	Zihngthal	Padri	<i>Stereospermum</i>
112	Zothinghang		<i>Diospyros topasia</i>
113	Zuang	Lampati	<i>Duabanga gandiflora</i>

B. SHRUBS

SI No.	Mizo	Common Name	Botanical Name
1	Anpangthuam		<i>Lepionurus</i>
2	Arngeng		<i>Maesa indica</i>
3	Builukham		<i>Malestoma malabatchricum</i>
4	Belphuar		<i>Tremay oriatatis</i>
5	Borai		<i>Ziziphus jujube</i>
6	Chhawntual		<i>Aporusa roxburghii</i>
7	Chengkek		<i>Garcinia lanceaefolia</i>
8	Saisiak		<i>Securiniga</i>
9	Sebehliang		<i>Desmidium triangulance</i>
10	Sehren		<i>Ficus rigida</i>
11	Sizu		<i>Citrus aurantium</i>
12	Kawlelai		
13	Khatual		<i>Guranga amasa</i>
14	Tiar		<i>Sauravia punduane</i>
15	Tiarrep		<i>Rhyncotechum ellipticum</i>
16	Thakpui	Devil nettle	<i>Dentromide sinuate</i>
17	Thilthek		<i>Zalacca beccarli</i>
18	Tawkpui		<i>Solanum tarvum</i>
19	Tuiatit		<i>Antedesmabunias</i>
20	Tuipuisutthla		<i>Satih tetrasperma</i>
21	Phakbek		<i>Bridelia tomentsa</i>
22	Par arsi		
23	Pelh		<i>Gnetum gnemon</i>
24	Perhpawng chaw	Sweet broom weed	<i>Scopari dulcis</i>
25	Rairuang	Wild sugar cane	<i>Saccharum arundinaceum</i>

26	Vakep		<i>Muraenda parryonnum</i>
27	Pangbal		<i>Manihat esculenta</i>
28	Pumphir		<i>Arundo donax</i>
29	Phuihnamchhia		<i>Clerodendron viscorum</i>
30	Mau		<i>Bamboos</i>
31	Hnahthap		<i>Colona floribunda</i>
32	Luang		<i>Saccharum longietorum</i>

C. HERBS

SI No.	Mizo	Common Name	Botanical Name
1	Aidu		<i>Amomum dealbatum</i>
2	Anchiri	Gandi	<i>Homalomena aromatica</i>
3	Anhling	Black nightshade	<i>Solanum nigrum</i>
4	Ankasa		<i>Spilanthes paniculata</i>
5	Ar aw keu		<i>Torenia violacea</i>
6	Arhmarcha		<i>Polygonum glabrum</i>
7	Arthladawn	Sun fern	<i>Gleichenia linearis</i>
8	Buar	Ashcolour fleabane	<i>Vermonia cineria</i>
9	Chabet		<i>Desmodium sequax</i>
10	Changel	Wild plantation	<i>Musa sylvestris</i>
11	Chimchawk		<i>Aralia foliosa</i>
12	Dawl	Taro	<i>Calocasia esculenta</i>
13	Di	Subgrass/ Thatch grass	<i>Imperata cylindrical</i>
14	Hlo chang vawm		<i>Andrographis laxiflora</i>
15	Hlonuar	Sensitive/ Touch me not	<i>Mimosa pudica</i>
16	Hmunphiah	Broom grass	<i>Thysanolaena maxima</i>
17	Hnahthial		<i>Phrynium capitalum</i>
18	Hrat		<i>Thalictrum punduanum</i>
19	Hratzang		<i>Inalictum punduanum</i>
20	Japan hlo ral	Dodder plant	<i>Cuscuta reflexa</i>
21	Kaiha		<i>Smilax perfoliata</i>
22	Kangthai	Nilgiri nettle	<i>Rerardinia diversifolia</i>
23	Katchat	Fern	<i>Microlipia strigosa</i>
24	Kelte beng-beh		<i>Papilionanthe teres</i>
25	Khiangawi	India lettuce	<i>Latua indica</i>
26	Lambak	India penny wort	<i>Centella asiatica</i>
27	Lenhling		<i>Cirsium shansiense</i>
28	Phaitual hnim	Dog grass	<i>Cynodon dactylon</i>
29	Rairuang	Wild sugar cane	<i>Saccharum arundinaceum</i>
30	Saitluang hlo		
31	Sekhup thur	Common burbush	<i>Begonia dioica</i>
32	Sumbul	Spiral ginger	<i>Costus speciosus</i>
33	Telhawng	Cobra plant	<i>Ariseama speciosum</i>
34	Thasuih		<i>Lindernia ruellioides</i>
35	Tlamsam	Common floss flower	<i>Chromolaena odorata</i>
36	Uichhume/Uiteme	Wild ladies finger	<i>Albesmoschas manihot</i>
37	Uithing thang		<i>Houttuynia cordata</i>
38	Vahmim a bung		<i>Mullogo pantaphylla</i>
39	Vaihlehlo	Goat weeds	<i>Ageratum conizoyides</i>
40	Vangvat hlo		<i>Achyranthes bidentata</i>
41	Vawkpui thal		<i>Bidens biternata</i>

D. CLIMBERS

SI No.	Mizo	Common Name	Botanical Name
1	Ankhapui		<i>Marsdenia maculate</i>
2.	Ankhate		<i>Marsdenia formosana</i>

3	Arke bawk	Spring asparagus	<i>Asparagus racemosus</i>
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APPENDIX 4**Tree cutting details within Formation width (Project Road MZ02) Part-I**

Location (Km)	LHS	RHS
0+1	7 (Khuangshihuangshi-7)	H. NIL
1+2	10 (Khuangshi-9,Neem-1)	NIL
2+3	I. NIL	NIL
3+4	2 (Krishnasura-1,Thindal-1)	NIL
4+5	2 (Khuangshi-2)	1 (Zeirung-1)
5+6	3 (Khuangshi-2,Kohimala-1)	2 (Gameri-1,Simalu-1)
6+7	2 (Khuangshi-2)	J. NIL
7+8	35 (Khuangshi-34,Z-1)	NIL
8+9	26 (Khuangshi-18, Neem-2,Krishnasura-1,Kathal-5)	6 (Modar-1,Kohimala-2,Simalu-2,Amara1)
9+10	33 (Kathal-5,Dewa-13,Neem-7,Khuangshi-8)	11 (Sagun-7,Dombaru-1,Simalu-2,Gameri-1)
10+11	23 (Neem-9,Kathal-4,Khuangshi-7,Dewa-3)	1 (Dombaru-1)
11+12	45 (Kathal-4,Khuangshi-17,Dewa-13,Mango-1,Neem-9,Poma-1)	2 (Zeirung-1,Gohara-1)
12+13	18 (Dewa-5,Neem-13)	K. NIL
13+14	37 (Bogori-1,Khuangshi-36)	NIL
14+15	92 (Khuangshi-91,Gameri-1)	9 (Krishnasura-2,Khuangshi-7)
15+15.110	6 (Khuangshi-6)	L. NIL
Total No. of Trees To Be Cut	341	32

Part-II of MZ02

Location (Km)	LHS	RHS
0 - 1	63 (Theihai-9,Lamkhuang-1,Papaya-8,Far-7,Saryuk-5,Fartuah-9,Cedar-3,Khiang-11,Herhse-2,Thingsia-8)	23 (Far-1,Khiang-1,Teak-1,Theihai-4,Sunhlu-2, Fartuah-1, Kawlthei-1,PANG-1,Lamkhuang-2, NEEM-1,Chawnpui-3, Hnahkhar-1, Khawmhma-1, Hlai-1, Tiar- 1, Thingsia-1)
1 - 2	46 (Mango-4,J-2,NEEM-11,Cedar-2,Papaya-5,Sunhlu-9,April Par-2,Lamkhuang-1,Thingkha-3,Thingri-4,Theiria-1,Khiang-2)	15 (Khawmhma-1,Sunhlu-1,Kawlthei-1,Khiang-1,Vang-1,Vawmbuh-1,Sing-1,Far-1,Thingkha-1,Thingvawkpui-1,Hnahkhar-1,Kangtek-2,Chawnpui-2)
2 - 3	96 (Khawmhma-17,April Par-3,Papaya-4,Kangtek-2,Sunhlu-5,Khiang-17,Thingkha-15,Thingsia-2, Vang-8,Hnahkiah-12,Hnahkhar-7,Zuang-4)	14 (Sunhlu-1,Theihai-3,Vang-4,Khiang-2,Hnahkhar-2,Thingkha-2)
3 - 4	16 (Thingsia-7,Hnahkhar-4,Zuang-3,Thingkha-1,Khiang-1,)	12 (Khiang-2,Khawmhma-1,Sunhlu-1,Vawmbuh-1,Thingsia-1,Chawnpui-6)

Location (Km)	LHS	RHS
4 - 5	13 (Thingkha-3, Khiang-1, Khawmhma-1, Sunhlu-1, Neem-2, Thlanvawng-1, Hnahkhar-1, Zuang-1, Thingsia-2)	9 (Khiang-1, Tiar-1, Vang-1, Theihai-1, Thingsia-1, Vawmbuh-1, Thingkha-3)
5 - 6	6 (Khawmhma-1, Vang-1, Thlanvawng-1, Belphuar-1, Hnahkiah-1, Theiria-1)	6 (Hnahkiah-1, Vang-1, Thingkha-1, Sunhlu-1, Khiang-2)
6 - 7	16 (Khiang-2, Hnahkiah-1, Hnahkhar-2, Thingsia-3, Khawmhma-1, Zuang-1, Thingsia-2, Vang-4,)	10 (Teak-3, Theiria-1, Khiang-1, Chawnpui-2, Kawlthei-2, Thingsia-1)
7 - 8	15 (Khiang-4, Thingkha-2, Hnahkhar-1, Vang-1, Zuang-1, Thingsia-1, Hnahkiah-3, Belphuar-1, Sunhlu-1)	11 (Theihai-1, Teak-6, Sunhlu-1, Thlanvawng-1, Vawmbal-1, Khiang-1)
8 - 9	10 (Thingkha-1, Thingsia-1, Belphuar-2, Zuang-2, Kangtek-2, Hnahkhar-1, Neem-1)	7 (Teak-1, Far-1, Sunhlu-1, Tiar-2, Thingsia-2)
9 - 10	9 (Thingri-1, Thingkha-1, Khiang-3, Kangtek-3, Khawmhma-1)	18 (Khiang-2, Chawnpui-6, Sunhlu-3, Thingsia-5, Kawlthei-1, Teak-1)
10 - 11	15 (Zuang-4, Belphuar-1, Thingkha-1, Khiang-5, Thingkha-1, Khawmhma-1, Hnahkiah-2)	16 (Vang-1, Thingkha-2, Hnahkhar-1, Theihai-1, Teak-11)
11 - 12	5 (Theipui-1, Thlanvawng-1, Theiria-1, Hnahkiah-1, Khiang-1)	12 (Teak-7, Khiang-2, Theihai-1, Vawmbal-1, Chawnpui-1)
12 - 13	6 (Theipui-2, Hnahkiah-2, Thlado-1, Thingkha-1)	11 (Khiang-2, Teak-1, Kawlthei-1, Zuang-3, Khuangthli-1, Hnahkhar-1, Sunhlu-2)
13 - 14	11 (Khuangthli-2, Theipui-4, Zuang-1, Thingkha-1, Thulit-1, Khiang-1, Thingri-1)	12 (Teak-7, Theitit-2, Khiang-1, Thingkha-2)
14 - 15	10 (Theipui-1, Thingsia-1, Khiang-6, Khawmhma-1, Hnahkiah-1)	24 (Teak-10, Theitit-4, Vang-7, Khiang-1, Vawmbal-2)
15 - 16	8 (Theitit-1, Hnahkhar-2, Khawmhma-1, Khuangthli-1, Vang-3)	10 (Teak-6, Theipui-1, Theitit-1, Sunhlu-1, Zuang-1)
16 - 17	5 (Theipui-2, Vang-1, Tiar-1, Zuang-1)	6 (Balhla-1, Khawmhma-1, Thlanvawng-4)
17 - 18	15 (Belphuar-6, Tiar-1, Mau-1, Theipui-4, Theiria-3)	12 (Teak-8, Belphuar-1, Theitit-1, Khiang-2)
18 - 19	5 (Belphuar-1, Thlanvawng-1, Theipui-3,)	10 (Balhla-1, Teak-7, Vang-1, Vawmbal-1)

Location (Km)	LHS	RHS
19 - 20	10 (Teak-10)	7 (Chhohe-1, Theiria-2, Theipui-3, Zuang-1)
20 - 21	17 (Teak-10, Thingkha-3, Khuangthli-1, Thlanvawng-1, Belphuar-2)	15 (Khang-1, Teak-9, Zuang-1, Thlanvawng-1, Tiar-1, Belphuar-2)
21 - 22	5 (Hnahkiah-1, Hnahkhar-1, Theipui-2, Thlanvawng-1)	17 (Thlanvawng-1, Teak-10, Thingpawncchia-2, Balhla-3, Thingkha-1)
22 - 23	11 (Hnahkhar-4, Hnahkiah-6, Zuang-1)	17 (Thingkha-10, Balhla-1, Kangtek-2, Vang-1, Teak-3)
23 - 24	29 (Theipui-1, Thingvawkpui-2, Kangtek-1, Vang-2, Hnahkiah-1, Hnahkhar-3, Thlanvawng-2, Thingkha-1, Tawitawsuak-5, Mau-1, Rawltha-1, Khuangthli-3, Bul-6)	17 (Thingkha-4, Vang-1, Hnahkhar-3, Theipui-1, Bamboo-2, Balhla-6)
24 - 25	18 (Thingkha-6, Thingvawkpui-3, Khuangthli-1, Thlanvawng-1, Zuang-2, Thingpawncchia-2, Bul-3)	9 (Thlanvawng-2, Hnahkiah-1, Khuangthli-1, Zuang-2, Bul-3)
25 - 26	33 (Thingvawkpui-1, Thlanvawng-1, Khuangthli-1, Tuairam-2, Bul-3, Thingkha-5, Hnahkhar-2, Mau-1, Tawitawsuak-1, Bulfek-4, Zuang-1, Kangtek-3, Thingpawncchia-7, Hnahkiah-1)	15 (Thingkha-1, Balhla-10, Thingpawncchia-1, Vang-1, Lamkhuang-2)
26 - 27	22 (Thingba-1, Tuairam-2, Hnahkiah-3, Hnahkhar-1, Mau-2, Bulfek-1, Zuang-4, Thlanvawng-1, Lamkhuang-1, Thingkha-5, Tiar-1)	11 (Balhla-1, Tawitawsuak-3, Hnahkhar-1, Theihai-2, Vang-1, Thingkha-2, Thingba-1)
27 - 28	11 (Hnahkiah-1, Hnahkhar-1, Zuang-1, Thingkha-1, Thlanvawng-1, Tuairam-2, Bul-1, Theiria-1, Thingri-1, Tiar-1)	18 (Td-3, Tawitawsuak-4, Thingkha-2, Thlanvawng-1, Neem-2, Zuang-6)
28 - 29	25 (Thlanvawng-1, Zuang-2, Thingkha-1, Hnahkiah-1, Hnahkhar-4, Tuairam-1, Thingri-5, Theiria-2, Lamkhuang-1, Bulfek-1, Kawkpui-1, Tiar-3, Thingsia-2)	15 (Zairum-2, Kawkpui-5, Tuairam-5, Zuang-1, Neem-2)
29 - 30	7 (Tuairam-2, Hnahkiah-1, Khang-1, Sunhlu-1, Wause-1, Teak-1)	15 (Zairum-3, Kawkpui-2, Tuairam-4, Thingkha-5, Hnahkiah-1)
30 - 31	34 (Teak-12, Vang-1, Khang-2, Tawitawsuak-1, Theitit-1, Tuairam-10, Thingsia-1, Hnahkiah-5, Hnahkhar-1)	11 (Thlanvawng-4, Thingkha-2, ZI-1, Thingba-3, Zuang-1)
31 - 32	33 (Khuangthli-9, Khang-2, Hnahkiah-1, Tiar-2, Zairum-3, Hnahkhar-2, Vang-1, Thingsia-4, Thingkha-8, Thlanvawng-1,)	10 (Thingkha-2, Sihneh-4, Theihai-2, ZI-1, Khuangthli-1)

Location (Km)	LHS	RHS
32 - 33	35 (Ze-4,Co-3,Papaya-1,Kuva-8Si-2,Mango-3,Hnahkiah-10,Vang-3,Kawlthei-1)	8 (Sihneh-1,Thingkha-4,Khiang-1,Zuang-2)
33 - 34	17 (Hnahkhar-1,Tuairam-4,Fartuah-3,Khiang-2,Thingkha-3,Hnahkiah-1,Vang-1,PANG-2)	10 (Zh-1,Kawlthei-1,Hnahkiah-2,Sunhlu-2,Thingkha-3,Lamkhuang-1)
34 - 35	29 (Hnahkhar-1,Hnahkiah-7,Zuang-9,Vang-1,Thingkha-1,Lamkhuang-4,Zh-3,Tuairam-2)	11 (Thingkha-4,Thlanvawng-2,Zuang-1,Lamkhuang-3,Hnahkiah-1)
35 - 36	20 (Thingsia-4,Thlanvawng-2,Tuairam-2,Zuang-1,Zh-4,Thingkha-1,Thlado-3,Tiar-2,Thingkhawilu-1)	8 (Teak-3,Khiang-4,Zuang-1)
36 - 37	28 (Zuang-6,Thingkha-4,Zh-11,Sunhlu-2,Hnahkiah-2,Teak-3)	53 (Khiang-6,Thlanvawng-12,Theiria-3,Tawitawsuak-5,Theihai-7,Khawmhma-8,Thingkha-4,Zairum-8)
37 - 38	20 (Hnahkhar-8,Thingkha-10,Hnahkiah-1,Zuang-1)	9 (Cedar-1,Theihai-4,Theiria-1,Sunhlu-2,Kawlthei-1)
38 - 39	19 (Neem-4,Kawlthei-1,Cedar-6,Sertalum-2,Tum-3,Theihai-3)	5 (Thingkha-1,Khiang-3,Kawlthei-1)
39 - 39.800	19 (Neem-5,Lamkhuang-8,Kawlthei-6,)	2 (Sunhlu-1,Hnahkiah-1)
Trees to be cut	812	521
Total no. of trees to be cut in Part-I and Part-II (LHS & RHS)	1153	553
Total no. of trees to be cut in Part-I and Part-II (MZ02)	1706 nos.	

APPENDIX 5**Mammals of Thenzawl Forest Division**

Sl. No	Mizo Name	Common Name	Scientific Name
1.	Awr-rang	Malayan Giant Squirrel	Ratufa bicolor
2.	Bak-sai	Indian Flying Fox	Pteropus giganteus
3.	Bui	Short-tailed Mole	Talpa micrura
4.	Bui-sen	Bay Bamboo Rat	Cannomys badius
5.	Chai-chim	Indian Field Mouse	Mus booduga
6.	Che-pa	Northern Tree-shrew	Tupaia belangeri
7.	Chhim-tir	Grey Musk Shrew	Suncus murinus
8.	Chinghnia	Wild Dog/Dhole	Cuon alpinus
9.	Dawr	Phayre's Leaf Monkey	Presbytis phayrei
10.	Hauhuk	Hoolock Gibbon	Hylobates hoolock
11.	Hleikapsen	Red-bellied Palla's Squirrel	Callosciurus erythraeus
12.	Hleilubial	Orange-bellied Himalayan Squirrel	Dremomys lokriah
13.	Keipui	Tiger	Panthera tigris
14.	Keisen	Golden Cat	Felis temmincki
15.	Keite	Leopard	Panthera pardus
16.	Kelral	Clouded Leopard	Neofelis nebulosa
17.	Mang-tir/Sa-mang	Malayan Sun Bear	Ursus malayanus
18.	Ngau	Capped Langur	Trachypithecus pileatus
19.	Nghar-thing-awn	Spotted Linsang/Tiger Civet	Prionodon pardicolor
20.	Ngharbuang	Fishing Cat	Felis veverrina
21.	Phivawk	Hog Badger	Arctonyx collaris
22.	Ramsial/Sele	Indian Bison/ Gaur	Bos gaurus
23.	Sa-huai	Slow Loris	Nycticebus coucang
24.	Sahram	Clawless Otter	Aonix cinerea
25.	Sakhi	Barking Deer	Muntiacus muntjak
26.	Kuhsi	Asiatic Brushtailed porcupine	Atherurus macrourus
27.	Sakuh	Himalayan Porcupine	Hystrix brachyuran
28.	Sanghal	Wild Boar	Sus scrofa
29.	Sanghar	Leopard Cat	Felis Bengalensis
30.	Saphu	Chinese pangolin	Manis pentadactyla
31.	Sa-phai-ruang	Crab-eating Mongoose	Herpestes urva
32.	Sathar	Goral	Naemorhaedus goral
33.	Sanghar/Sa-uak	Jungle Cat	Felis chaus
34.	Savawm	Himalayan Black Bear	Ursus urinus/U.thibetanus
35.	Saza	Serow	Capricornis sumatraensis
36.	Sa-zaw(Zaw-buang)	Himalayan Palm Civet	Paguma larvata
37.	Sa-zaw(Zaw-hang)	Toddy Cat/Common Palm Civet	Paradoxurus hermahrotidus
38.	Sazuk	Sambar	Cervus unicolor
39.	Sihal	Bengal Fox	Vulpes bengalensis
40.	Tlum-therh	Small Indian palm Civet	Viverricula indica
41.	Tlum-pui	Large Indian Palm Civet	Viverra zibetha
42.	Vahluk	Common Flying Squirrel	Petaurista petaurista
43.	Zamphu	Binturong/Bear Cat	Arctictis binturong
44.	Zawng	Rhesus Macaque	Macaca mulatta
45.	Zawng-mawt	Stump-tailed Macaque	Macaca arctoides
46.	Zawng-hmeltha	Pig-tailed Macaque	Macaca nemestrina
47.	Zutam	Bandicoot Rat	Bandicota indica
48.	Zuthel	White-tailed Wood Rat	Rattus blanfordi

APPENDIX 6**LIST OF NOISE SENSITIVE RECEPTORS ALONG THE PROJECT ROAD**

Sl. No.	Name of School/ college/ hospital	Name of the village	Chainage (km)
1	Presbyterian School	Thenzawl	0.190 km
2	C. Zalaum School	Thenzawl	0.260 km
3	Angan Wadi Centre	Thenzawl	1.265 km
4	Govt. Primary School	Thenzawl	1.420 km
5	Jawhar Navodaya Vidyalaya	Thenzawl	4.220 km
6	Public Health Centre	New Khalek	32.270 km
7	Health Sub-Centre	Buarpui	38.650 km
8	Privet English medium School	Buarpui	38.700 km
9	Govt. Middle School	Buarpui	39.710 KM
10	Govt. primary School	Buarpui	37.750 km
11	Std. Middle School	Buarpui	38.900 KM

APPENDIX 7**ENVIRONMENTAL MANAGEMENT PLAN**

S.No.	Environmental Issue	Location/sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
PRE-CONSTRUCTION PHASE					
1	Tree cutting	Cutting of about 1706 nos. trees during site clearance	<ul style="list-style-type: none"> Restricting tree cutting within construction limit Avoiding tree cutting at ancillary sites Providing and maintaining compensatory plantation of 5556 trees i.e. three times of cutting All trees to be cleared will be numbered and clearly marked with paint 	Forest Dept. / PIU	PIU
2	Removal of utilities	Work site clearance	<ul style="list-style-type: none"> Necessary planning and coordination with concerned authority and local body Prior notice to and consultation with concerned authority, local body and public to be affected so as to ensure that work does not get affected and impact on public is minimum All above ground utilities that will be shifted will be clearly marked with paint to guide workers 	Concerned utility agencies / PIU	SC/ PIU

S.No.	Environmental Issue	Location/sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
4	Contractor Preparatory Works (Upon issuance of Notice to Proceed)		<p>The Contractor will complete the following activities no later than 30 days upon issuance of Notice to Proceed</p> <ol style="list-style-type: none"> 1.) Submit appointment letter and resume of the Contractor's Environmental Focal Person (EFP) to SC/PIU 2.) EFP will engage CSC-Environment Specialist and to a meeting to discuss in detail the EMP, seek clarification and recommend corresponding revisions if necessary 3.) EFC will request CSC-ES copy of monthly monitoring formats and establish deadlines for submission. 4.) EFC will submit for CSC-ES approval an action plan to secure all permits and approvals needed to be secured during construction stage which include but not limited to: i) operation of crushers and hot mix plants, ii) transport and storage of hazardous materials (e.g. fuel, lubricants, explosives), iii) waste disposal sites, iv) temporary storage location, iv) water use, and v) emission compliance of all vehicles. Arrangements to link with government health programs on hygiene, sanitation, and prevention of communicable diseases will also be included in the action plan. 5) EFC will submit for approval of CSC-ES the construction camp layout before its establishment. 	Contractor	PIU
3	Religious places	Work site	<ul style="list-style-type: none"> • Suitable mitigation measures are incorporated in resettlement plan. 	PIU	SC / PIU
CONSTRUCTION PHASE					
1	Air Pollution	Construction plants, equipment and vehicles	Refer Appendix 13 and Appendix 14	Contractor	SC/PIU
		Temporary diversion	<ul style="list-style-type: none"> • Maintaining diversion and detour for road traffic in good shape and traffic regulated. • Regular sprinkling of water, as necessary. 	Contractor	SC/PIU

S.No.	Environmental Issue	Location/sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
		Dust during earth works or from spoil dumps	<ul style="list-style-type: none"> Maintaining adequate moisture at surface of any earthwork layer completed or non-completed unless and until base course is applied, to avoid dust emission. Stockpiling spoil at designated areas and at least 5 m away from traffic lane. Refer Appendix 15 	Contractor	SC/PIU
		Borrow pits and haul road	Refer Appendix 16	Contractor	SC/PIU
		Storage of construction materials	<ul style="list-style-type: none"> Sprinkling of water as necessary. 	Contractor	SC/PIU
2	Water Pollution	Construction of Bridges or Culverts - Earthwork and marginal spillage of construction materials causing temporary turbidity and suspended solids	<ul style="list-style-type: none"> Constructing and maintaining diversion channel, sedimentation basin, dykes, etc. as may be required to temporarily channelise water flow of streams / river Storage of construction material and excavated soil above high flood level 	Contractor	SC/PIU
		Construction vehicles	<ul style="list-style-type: none"> Strictly avoiding cleaning / washing of construction vehicle in any water body 	Contractor	SC/PIU
		Soil erosion from construction site	<ul style="list-style-type: none"> Proper planning of site clearing and grubbing so as not to keep the cleared site before working for long duration. Providing temporary side drains, catch water bank or drains, sedimentation basin, as necessary to avoid or minimize erosion and prevent sedimentation to receiving water bodies 	Contractor	SC/PIU
		Seepage from Construction Debris	<ul style="list-style-type: none"> Refer Appendix 15 		
		Construction camp and workers' camp	<ul style="list-style-type: none"> Refer Appendix 14 	Contractor	SC/PIU
3	Ground water Pollution	Wastewater logging	<ul style="list-style-type: none"> All wastewater will be diverted to a ditch that will be managed for the period of construction and after construction such ditches will be filled and restored to original condition. 	Contractor	SC/PIU
		Borrow pit excavation	<ul style="list-style-type: none"> Excavation of borrow pit should not touch the aquifer 	Contractor	SC/PIU

S.No.	Environmental Issue	Location/sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
		Human wastes and wastewater at construction camp	<ul style="list-style-type: none"> • Providing septic tanks for treating sewage from toilets before discharging through soak pits • Locating soak pits at least 50m from any ground water sources • Decanting and or controlled disposal of oil and grease as collected at collection tanks of maintenance yard and chemical storage areas • Refer Appendix 14 	Contractor	SC/PIU

S.No.	Environmental Issue	Location/sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
4	Noise Pollution and Vibration	Vehicles and Construction machinery	<ul style="list-style-type: none"> • Site Controls: Stationary equipment will be placed along un-inhabited stretches as per distance requirements computed above as far as practicable to minimize objectionable noise impacts. • Scheduling of Project Activities: Operations will be scheduled to coincide with period when people would least likely to be affected. Construction activities will be avoided between 9 P.M. and 6 A.M. near residential areas. • Protection devices (ear plugs or ear muffs) will be provided to the workers operating in the vicinity of high noise generating machines. • Construction equipment and machinery should be fitted with silencers and maintained properly. • Source-control through proper maintenance of all equipment. • Use of properly designed engine enclosures and intake silencers. • Noise measurements should be carried out along the road to ensure the effectiveness of mitigation measures. • Vehicles and equipment used should conform to the prescribed noise pollution norms. • Blasting operations will be carried as per Appendix 16. • Movements of heavy construction vehicles and equipment near public properties will be restricted. • Comply with siting criteria for stone crushers, Hot Mix Plant/s (HMP) and concrete batching plant/s (CBP), and installations and maintenance of pollution control devices as mentioned in Appendix 13 	Contractor	SC/PIU

S.No.	Environmental Issue	Location/sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
5	Land Pollution	Spillage from plant and equipment at construction camp	<ul style="list-style-type: none"> • Providing impervious platform and oil and grease trap for collection of spillage from construction equipment vehicle maintenance platform • Collection oil and lubes drips in container during repairing construction equipment vehicles • Providing impervious platform and collection tank for spillage of liquid fuel and lubes at storage area • Providing bulk bituminous storage tank instead of drums for storage of bitumen and bitumen emulsion • Providing impervious base at bitumen and emulsion storage area and regular clearing of any bitumen spillage for controlled disposal • Reusing bitumen spillage • Disposing non-usable bitumen spills in a deep trench providing clay lining at the bottom and filled with soil at the top (for at least 0.5 m) • Refer Appendix 13 and 14 	Contractor	SC/PIU
		Domestic solid waste and liquid waste generated at camp	<ul style="list-style-type: none"> • Collecting kitchen waste at separate bins and disposing of in a pit at designated area/s • Collecting plastics in separate bins and disposing in deep trench at designated area/s covering with soil • Collecting cottons, clothes etc. at separate bins and burning in a pit (with sand bed) 	Contractor	SC/PIU
		Borrow pits	<ul style="list-style-type: none"> • Controlled operation and redevelopment of borrow pits to avoid water logging and land contamination 	Contractor	SC/PIU
7.	Landslides	Destabilization of hill slopes causing erosion and threat to life and damage to properties	<ul style="list-style-type: none"> • Retaining walls for stabilisation of uphill slopes • Breast walls for down slopes and • Parapet walls/guide posts/railings/edge stones • Bamboo terracing, bamboo crib walls, and bamboo knitting a slope • Contour trenching • Series of check dams on hill slopes etc. 	Contractor	SC/PIU

S.No.	Environmental Issue	Location/sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
8	Loss of topsoil	All construction sites	<ul style="list-style-type: none"> The topsoil from all areas of cutting and all areas to be permanently covered shall be stripped to a specified depth of 150 mm and stored in stockpiles. At least 10% of the temporarily acquired area shall be earmarked for storing topsoil. 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, the edges of the pile shall be protected by silt fencing. Stockpiles will not be surcharged or otherwise loaded and multiple handling will be kept to a minimum to ensure that no compaction will occur. The stockpiles shall be covered with gunny bags or tarpaulin. It shall be ensured by the contractor that the topsoil will not be unnecessarily trafficked either before stripping or when in stockpiles. Such stockpiled topsoil will be returned to cover the disturbed area and cut slopes. Residual topsoil will be distributed on adjoining/proximate barren/rocky areas as identified by the SC in a layer of thickness of 75mm – 150mm. Top soil shall also be utilized for redevelopment of borrow areas, landscaping along slopes, medians and incidental spaces. 	Contractor	SC/PIU
9	Compaction of soil	All construction sites	<ul style="list-style-type: none"> Construction vehicle, machinery and equipment shall move or be stationed in the designated area (RoW or Col, as applicable) only. While operating on temporarily acquired land for traffic detours, storage, material handling or any other construction related or incidental activities, topsoil from agricultural land will be preserved as mentioned above. 	Contractor	SC/PIU
10	Ecology	Site clearance	<ul style="list-style-type: none"> Restricting tree cutting within corridor of impact 	Contractor	SC/PIU

S.No.	Environmental Issue	Location/sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
		Ancillary sites	<ul style="list-style-type: none"> Minimizing tree cutting and vegetation clearance during site selection Preservation of trees within ancillary sites and avoiding impact on forest resources by providing buffer area from boundary of PF, RF, national park and wildlife sanctuary of 1km for locating construction plants, construction camp and 500 m for borrow areas Preservation of trees of ecological, socio-cultural importance Providing cooking at camp for discouraging and prohibiting use of fire-wood i.e. cutting of trees by the workers. 	Contractor	SC/PIU
11	Occupational health and safety of workers	Construction camp	<ul style="list-style-type: none"> Water supply, sanitation, drainage and medical health facilities at campsite Providing and using PPEs Using working reverse horn for all construction equipment and vehicles Providing earth link circuit breaker (ELCB) for all electrical connections Maintaining first aid at construction sites Maintaining emergency response system Refer Appendix 14 	Contractor	SC/PIU
12	Accidents and safety	Construction sites	<ul style="list-style-type: none"> Providing and maintaining traffic management comprising diversion; warning, guiding and regulatory signage; channelisers and delineators; lighting, flagmen; dust control system etc. as specified in the contract. Providing adequate light at construction zone if working during night time is permitted by the Engineer Conducting induction and periodic training for all workers and supervisors 	Contractor	SC/PIU
		Construction camp	<ul style="list-style-type: none"> Conducting periodic mock drilling on critical accident prone activities Conducting periodic training for all personnel working at plant site 	Contractor	SC/PIU
OPERATION PHASE					

S.No.	Environmental Issue	Location/sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
1	Air Pollution	Vehicular gaseous emission	<ul style="list-style-type: none"> Periodicals monitoring of air pollutants and if values exceed the standard limits, suitable mitigation measures to be taken. 	PIU	SPCB and Traffic Police
2	Noise Pollution	Vehicular	<ul style="list-style-type: none"> Periodical monitoring of noise level will be carried out. If values exceed the standard limits, suitable measures will be taken. Providing and maintaining signage on noise regulation at silence zones 	PIU	SPCB
3	Road Safety	Traffic and Vehicles	Maintenance of standard Highway Safety Signage and Traffic Management.	PIU	PIU and Traffic Police
		Lighting	Maintenance of road / flyover lighting.	PIU	PIU/Traffic police
4	Tree plantation	-	Roadside tree plantation three times of cutting	Forest Dept. / PIU	PIU
5	Contamination of Soil and Water Resources from Spills due to traffic & Accidents	Vehicular Traffic	<ul style="list-style-type: none"> Contingency plans to be in place for cleaning up of spills of oil, fuel and toxic chemicals. Spill of oil, fuel and automobile servicing units without adequate preventive systems in place to be discouraged. 	PIU	PIU
6	Landslides, Soil Erosion and Sedimentation		<ul style="list-style-type: none"> Maintaining the slope protection measures provided at stretches of high embankment and protection measures for bed scouring at cross drainage locations as per maintenance manual to be prepared before operation 	PIU	PIU
7	Maintenance of drainage system	-	<ul style="list-style-type: none"> The drains will be periodically cleared to maintain storm water flow. Road drains will be cleared of debris before onset of every monsoon. 	PIU	PIU

APPENDIX 8

ENVIRONMENTAL MONITORING PLAN

Component	Project Stage	MONITORING						RESPONSIBILITY	
		Parameters	Measurement Method	Standards	Location	Frequency	Duration	Implementation	Supervision
Air	Construction Stage	PM 2.5 PM 10 SO ₂ NO _x CO	Methods of Measurement as prescribed in National Ambient Air Quality Standard (Appendix 9)	National Ambient Quality Standards (Appendix 9)	Hot mix plant /Batching plant (1 location) and 1 location where construction is ongoing	Once in a Quarter and as may be instructed by SC (for 3 years) other than monsoon	Continuous 24 hourly twice a week for	Contractor through approved monitoring agency	SC, PIU
	Operation Stage	Same as above	Same as above	Same as above	2 locations throughout the stretch during operation	Once in a year other than monsoon season	Continuous 24 hourly twice a week	PIU through approved monitoring agency	PIU
Water Quality	Construction stage (surface water)	pH, temperature, turbidity, DO, BOD, COD, TDS, TSS, Oil & Grease	Grab sample collected from source and analyzed as per IS : 2488 (Part 1-5) methods for sampling and testing of Industrial effluents	Water quality standards by CPCB (Appendix 11)	2 locations trough out the corridor will be monitored till end of construction period	Once in a Quarter for 3 years	-	Contractor through approved monitoring agency	SC, PIU
	Construction stage (ground water)	All parameters of drinking water		IS: 10500, 1991 (Appendix 10)	1 location at each camp site Camp site	half yearly for 3 years	-	Contractor through approved monitoring agency	SC, PIU

Component	Project Stage	MONITORING						RESPONSIBILITY	
		Parameters	Measurement Method	Standards	Location	Frequency	Duration	Implementation	Supervision
	Operation Stage (surface water)	pH, temperature, turbidity, DO, BOD, COD, TDS, TSS, Oil & Grease and Pb	Grab sample collected from source and analyzed as per IS : 2488 (Part 1-5) methods for sampling and testing of Industrial effluents	Water quality standards by CPCB	2 location trough out the corridor will be monitored till end of construction period	half yearly for one year	-	PIU through approved monitoring agency	PIU
Noise levels	Construction stage	Noise levels on dB (A) scale	Equivalent noise levels using an integrated noise level meter kept at a distance of 10-15 m from edge of pavement	Noise standards by CPCB (Appendix 12)	As directed by the Engineer (At maximum 2 locations)	Once in a Quarter for 3 years	Readings to be taken at 15 seconds interval for 15 minutes every hour and then Leq should be estimated.	Contractor through approved monitoring agency	SC, PIU
	Operation Stage	Noise levels on dB (A) scale	Equivalent noise levels using an integrated noise level meter kept at a distance of 10-15 m from edge of pavement	Noise standards by CPCB (Appendix 12)	2 location throughout the stretch during operation	Half-yearly for one year	Continuous 24 hours/ or for 1 full working day	PIU through approved monitoring agency	PIU
Tree plantation	Operation stage	Rate of Survival	Physical verification	Ensuring at least 75% survival	Area of plantation along the road will be specified by PIU	For three years	-	Forest Dept.	PIU

APPENDIX 9

National Ambient Air Quality Standards

Pollutant	Concentration in ambient Air			
	Average	Industrial, Residential and other rural area	Ecologically Sensitive Area (Notified by Central Government)	Methods of Measurement
SO ₂ ug/m ³	Annual*	50	20	- Improved West and Geake
	24 hours**	80	80	- Ultraviolet Fluorescence
NO _x ug/m ³	Annual*	40	30	- Modified Jacob and Hochheiser
	24 hours**	80	80	- Chemiluminescence
PM ₁₀ ug/m ³	Annual*	60	60	- Gravimetric
	24 hours**	100	100	- TEOM - Beta Attenuation
PM _{2.5} ug/m ³	Annual*	40	40	- Gravimetric
	24 hours**	60	60	- TEOM - Beta Attenuation
Ozone (O ₃) ug/m ³	8 Hours**	100	100	- UV Photometric
	1 Hour**	180	180	- Chemiluminescence - Chemical Method
Lead ug/m ³	Annual*	0.50	0.50	- AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper
	24 hours**	1.0	1.0	- ED-XRF using Teflon filter
CO ug/m ³	8 Hours**	2000	2000	- Non Dispersive Infra Red Spectroscopy
	1 Hour**	4000	4000	
NH ₃ ug/m ³	Annual*	100	100	- Chemiluminescence
	24 hours**	400	400	- Indophenol blue method
Benzene (C ₆ H ₆) ug/m ³	Annual*	05	05	- Gas Chromatography based Continuous Analyzer - Adsorption followed by GC Analysis
Benzo Pyrene-Particulate Phase only ug/m ³	Annual*	01	01	- Solvent extraction followed by HPLC/GC analysis
Arsenic ng/m ³	Annual*	06	06	- AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper
Nickel ng/m ³	Annual*	20	20	- AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper

Source: Gazette of India, Part II-Section -3-Subsection (i)

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

** 24-hourly / 8-hourly values or 0.1 hourly monitored values shall be complied with 98% of the time in the year. However, 2% of the time, it may exceed but not on two consecutive days.

APPENDIX 10**Drinking Water Quality Standards (as per IS: 10500-1991)**

Sl. No.	Parameter and Unit	Desirable Limit	Permissible Limit in Absence of Alternate Source
1.	Colour (Hazen units)	5	25
2.	Odour	Unobjectionable	-
3.	Taste	Agreeable	-
4.	Turbidity (NTU)	5	10
5.	pH	5-8.5	No relaxation
6.	Total Coliforms (MPN/100 mL)	nil	-
7.	Pathogenic Organisms or Virus	nil	-
8.	TDS (mg/L)	500	2000
9.	Mineral Oil (mg/L)	0.01	0.03
10.	Free Residual Chlorine (mg/L)	0.2	-
11.	Cyanide (mg/L as CN)	0.05	No relaxation
12.	Phenol (mg/L C ₆ H ₅ OH)	0.001	0.002
13.	Total Hardness (mg/L as CaCO ₃)	300	600
14.	Total Alkalinity (mg/L as CaCO ₃)	200	600
15.	Chloride (mg/L as Cl)	250	1000
16.	Sulphate (mg/L as SO ₄)	200	400
17.	Nitrate (mg/L as NO ₃)	45	100
18.	Fluoride (mg/L as F)	1	1.5
19.	Calcium (mg/L as Ca)	75	200
20.	Magnesium (mg/L as Mg)	30	100
21.	Copper (mg/L as Cu)	0.05	1.5
22.	Iron (mg/L as Fe)	0.3	1
23.	Manganese (mg/L as Mn)	0.1	0.3
24.	Zinc (mg/L as Zn)	5	15
25.	Boron (mg/L as B)	1	5
26.	Aluminium (mg/L as AL)	0.03	0.2
27.	Arsenic (mg/L as As)	0.05	No relaxation
28.	Mercury (mg/L as Hg)	0.001	No relaxation
29.	Lead (mg/L as Pb)	0.05	No relaxation
30.	Cadmium (mg/L as Cd)	0.01	No relaxation
31.	Chromium (VI) (mg/L as Cr)	0.05	No relaxation
32.	Selenium (mg/L as Se)	0.01	No relaxation
33.	Anionic Detergents (mg/L MBAS)	0.2	1
34.	PAH (mg/L)	nil	-
35.	Pesticides (µg/L)	Absent	0.001
36.	Alpha Emitters (10 ⁻⁶ µc/mL)	nil	0.0001
37.	Beta Emitters (10 ⁻⁶ µc/mL)	nil	0.001

APPENDIX 11**Water Quality Criteria and Standards for Freshwater Classification (CPCB, 1979)**

Parameters	BOD mg/l	pH	D.O. in mg/l	Oil & Grease mg/l
CPCB standard Class A (drinking water without conventional treatment but after disinfections)	≤ 2.0	6.5 – 8.5	≥ 6.0	--
CPCB standard Class B (for outdoor bathing)	≤ 3.0	6.5 – 8.5	5.0	--
CPCB standard Class C (drinking water after conventional treatment and disinfections)	≤ 2.0	6 – 9	≥ 4.0	--
CPCB standard Class D (for propagation of wild life, fisheries)	--	6.5 – 8.5	≥ 4.0	≤ 0.1
CPCB standard Class E (for irrigation)	--	6.0-8.5	--	--

'--' *Indicates not applicable/relevant*

APPENDIX 12**National Ambient Noise Standards**

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

Gazette Notification dated 26th December 1989. It is based on the weighted equivalent noise level (Leq).

* Day time is from 6 am to 9 pm whereas night time is from 9 pm to 6 am

** Silence zone is defined as area up to 100 meters around premises of hospitals, educational institutions and courts. Use of vehicles horns, loud speakers and bursting of cracking are banned in these zones

These noise standards have been given the status of statutory norms vide Noise Pollution (Regulation and Control) Rules, 2000. However, these rules have changed the periods for 'Day Time' and 'Night Time' to 6 a.m. to 10 p.m. and 10 p.m. to 6 am respectively.

APPENDIX 13

MANAGEMENT OF CONSTRUCTION PLANTS, EQUIPMENT AND VEHICLES PLANT MANAGEMENT

Purpose

- To ensure that statutory / regulatory requirements are complied with
- To ensure that safeguard measures are taken to avoid / mitigate / minimize environmental impacts

Site selection criteria

Following criteria are to be met wherever possible for crusher and HMP:

- 1.5 km away from settlement, school, hospital on downwind directions
- 1.5 km from any archaeological site
- 1.5 km from ecologically sensitive areas i.e. forest, national park, sanctuary etc.
- 1.5 km from rivers, streams and lakes
- 500 m from ponds
- 250 m from State and National Highway boundary
- away from agricultural land
- preference to barren land

Concrete batching plant should be located at least 200 m from the settlement, preferably on leeward side, whenever possible.

The format for submission of details to the Engineer during finalisation of plant site is given as follows (**Site identification for Plants**).

Statutory Requirements

- Obtaining Consent-for-Establishment (CFE) under Air and Water Acts from the State Pollution Control Board (SPCB) before start of installation
- Obtaining Consent-for-Operation (CFO) under Air and Water Acts from the State Pollution Control Board (SPCB) before start of commissioning and trial run
- Complying with the terms and conditions laid down in the CFE and CFO, which generally include providing metallic road inside plant campus for movement of vehicles, plantation, periodic (monthly) pollution monitoring i.e. ambient air, noise and stack emission
- The suspended particulate matter contribution value at a distance of 40 m from a controlled isolated as well as from a unit located in a cluster should be less than 600 $\mu\text{g}/\text{m}^3$ or as shall be prescribed by SPCB.
- Obtain certificates from manufacturer for Type Approval and Conformity of Production for Diesel Generator (DG) set/s.
- For DG sets of capacity up to 1000 kVA, the noise level at 1 m from the enclosure surface shall not exceed 75 dB (A).

Pollution control measures

- Dust control measures in stone crusher plant i.e. water sprinkling at primary crusher and secondary crusher, conveyor & return belts, covered conveyor system, chute at outfall of aggregates, cyclone separator, wind braking wall etc.
- For HMP, ensure adequate stack height as stipulated in CFE, install emission control devices such as bag house filters, cyclone separators, water scrubbers etc., as attached with the plant by the manufacturer or stipulated in CFE.
- Prefer bulk bitumen storage with mechanized handling facilities that storage in drums with manual operation at HMP to prevent / minimize bitumen spillage and thereby contaminating soil and ground water.
- Impervious platform for storage of bituminous and other liquid hazardous chemical
- Bag house filter / multi-cone cyclone for emission control. For bag house, cartridge filters reported to be more efficient than fabric filters
- Pollution control measures for Diesel Generator (DG) set i.e. stack height, acoustic enclosure etc.
- Greenbelt along the periphery of plant site.

SITE IDENTIFICATION FOR PLANTS

Construction Stage Report:One Time

Date:

Installed Capacity:

Location of Plant (Ch. & offset):

Sl. No.	Item / Requirement	Details as per Actual
1	Predominant wind direction	
2	Size and area of the proposed plant site (m xm & Sq.m)	
3	Present land use (barren or fallow land having no prominent vegetation should be preferred)	
4	No dwelling units within 1.5km from the plant boundary in downwind direction	
5	Distance of nearest boundary of State Highways and National Highways (should be at least 250 m from the plant boundary)	
6	Sensitive areas such as religious places, schools/educational institutions, reserved / protected forest, sanctuary etc. within 1.5 km (should be nil)	
7	River/Stream/Lake within 1.5 km and ponds within 500 m	
8	No other trees of girth>0.3m present and will be affected (no tree should be affected)	
9	Width of Haul road (m)	
10	Total Length of Haul Road (km)	
11	Length of non-metal Haul Road (km) (should be as minimum as possible)	

Documents to be attached:

- I. Site plan showing wind direction, haul road and other environmental features.
- II. Certified that the furnished information is correct and all relevant information as required is attached.

Contractor:

APPENDIX 14

CAMPSITE MANAGEMENT

Purpose

Campsite of a contractor represents the single potentially most polluting location during implementation of any road project. Air pollution may be caused by emissions from Crushers, Hot-Mix, and Concrete Batching Plants. Water pollution may be caused by discharge of sediment, oil & grease, and organics laden run-off from these plants and their ancillary facilities as well as workshops, residential quarters for the labor. Land may be polluted due to indiscriminate disposal of domestic waste or (accidental) release of hazardous solids from storage areas.

While the installation and operation of Crushers and Hot-Mix Plants are regulated by the respective Pollution Control Boards, the other sources described above usually do not appear to be causes of significant concern. Items to be considered for labor camps are mentioned briefly in Clause 105.2 (as part of 105: Scope of Work) of the Ministry of Road Transport and Highways (MoRTH) publication: Specifications for Road and Bridge Works. Some specific requirements for labor accommodation and facilities are to be met by the Contractor in line with Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. Currently, there is no one-point guidance regarding the environmental management aspects of the Contractor's campsite. This guideline on Campsites is designed to fill this gap.

Scope

This guideline covers the Contractors' camp sites – whether used by in-house crew or by any sub-contractors' crew. It covers siting, operation, maintenance, repair and dismantling procedures for facilities for labor employed on project (and ancillary) activities as well as equipment and vehicles. ***It does not include siting, operation, maintenance, repair and dismantling of major plants – Hot-mix Plant, Concrete Batching Plant, Crusher or Wet Mix Macadam Plant.***

M. Siting, Establishing, Operation and Closure of Construction Camp

7. Potential Environmental Impacts

Construction camps require large areas for siting facilities like major plants, storage areas for material, residential accommodation for construction labor and supervisors, and offices. Removal of topsoil and vegetation from the land to be utilized for camps is the first direct impact of any such establishment. In addition, local drainage may be impaired if proper drainage is not effected by grading. Other impacts may include damage to ecologically important flora and fauna, if campsites are located close to such areas. Water pollution because of discharge of sediment, fuel and chemicals is also a possibility. Pollution of land due to indiscriminate disposal of construction wastes including scarified pavement, concrete and even substantial quantities of domestic wastes from residential areas can also be potentially disastrous, especially if the site is reverted to its original use after the project (mostly agriculture).

Mitigation Measures

8. Siting of Construction Camps

The following guidelines will assist the Contractor to avoid any environmental issues while siting construction camps:

- Maintain a distance of at least 1.5 km from boundaries of designated Reserved Forests, Sanctuary or National Park area for locating any temporary or permanent camps.
- Maintain 1.5 km from river, stream and lake and 500m from ponds
- Maintain 250 m from the boundary of state and national highways
- Locate facilities in areas not affected by flooding and clear of any natural or storm water courses.
- Locate campsites in the (most prevalent) downwind direction of nearest village(s). The boundary of the campsite should be at least 1.5 km from the nearest habitation so that the incoming labor does not stress the existing local civic facilities.
- The ground should have gentle slope to allow free drainage of the site.
- Recorded consultations should be held with residents of the nearest settlement and/or their representatives to understand and incorporate where possible, what they would like to see within their locality.

9. Establishment, Operation, and Closure of Camps

- The facilities within the camp site should be laid out so that the separation distances suggested in other guidelines are maintained. A notional lay-out of the facilities except the major plants is included in this guideline.
- Topsoil from the area of the plant shall be stored separately for the duration of the operation of the camp and protected from being washed away, unless agreed otherwise in writing with the owner. If stored, it will be returned on to its original location at the time of closure of the site.
- The Contractor shall prepare, make widely available (especially to staff responsible for water and material management), and implement a Storm water Management Plan (SWMP) for (all) the site(s) following approval of the same by the Engineer. .
- The Contractor shall prepare an Emergency and Spill Response Plan as per the requirements of Appendix 1 to Clause 501 of Specifications for Road and Bridge Works to cover the spillage of bitumen and/or chemicals like retarders, curing compounds, etc.
- The Contractor shall prepare a Waste Management Plan describing the types and quantities that are likely to be generated from within the camp site, with the period and duration during the construction schedule; methods to be adopted to minimize these; methods of removal, treatment and (on-site or off-site) disposal for each type; as well as location of final disposal site, if any.
- The Contractor shall provide safe ingress and egress for vehicles from the site and public roads and shall not impact existing through traffic.
- Water tankers with sprayers must be available at the camp site at all times to prevent dust generation.

- In case of stockpiles of stored material rising higher than wind-breaking perimeter fencing provided, sprinklers shall be available to prevent dusting from the piles during windy days.
- On completion of works, the Contractor shall restore the site to the condition it was in before the establishment of the campsite, unless agreed otherwise in writing with the owner(s) of the site(s). If such a written agreement has been made, the Contractor shall hand over the site to the owner(s) in accordance with such an agreement.

Equipment and Vehicle-related issues

Potential Environmental Impacts

The maintenance and repair of equipment and vehicles in Contractor's camp are activities that can have significant adverse impacts if not carried out properly. The concern mainly arises from discharge of wash water contaminated with oil and grease, whether from washing of vehicles or degreasing of equipment and vehicle parts. Vehicle washing, especially dirt from tires, also gives rise to sediment-laden run-off. No such discharges should be directly allowed into surface water bodies since they can be harmful to aquatic species.

Mitigation Measures

1. Vehicles

- All vehicles used by the Contractor must have copies of currently valid Pollution Under Control Certificates displayed as per the requirement of the Motor Vehicles Department for the duration of the Contract.
- All vehicles and equipment will be fitted with silencers and/or mufflers which will be serviced regularly to maintain them in good working condition and conforming to the standard of 75dB (A) at 1m from surface of enclosure.

2. Workshop and Maintenance areas

- These areas must have impervious flooring to prevent seepage of any leaked oil & grease into the ground. The area should be covered with a roof to prevent the entry of rainwater.
- The flooring shall be sloped to from both directions to one corner where an oil-and-grease trap with sufficient capacity should be installed. All discharges from the workshop area must pass through the trap to remove the floating oil and grease before entering the drainage system of the site. The trap should be designed to provide a hydraulic residence time of about 20 minutes for the peak hourly discharge anticipated from the area (**as per following figure**).
- Alternatively, degreasing can also be carried out using mechanical spray type degreaser, with complete recycle using an enclosure with nozzles and two sieves, coarse above and fine below, may be used as shown in the adjacent photograph. This arrangement will require some initial investment and running cost for the pump, but the payback period, in terms of the use of diesel, under Indian conditions, has been reported to be less than 1 year.

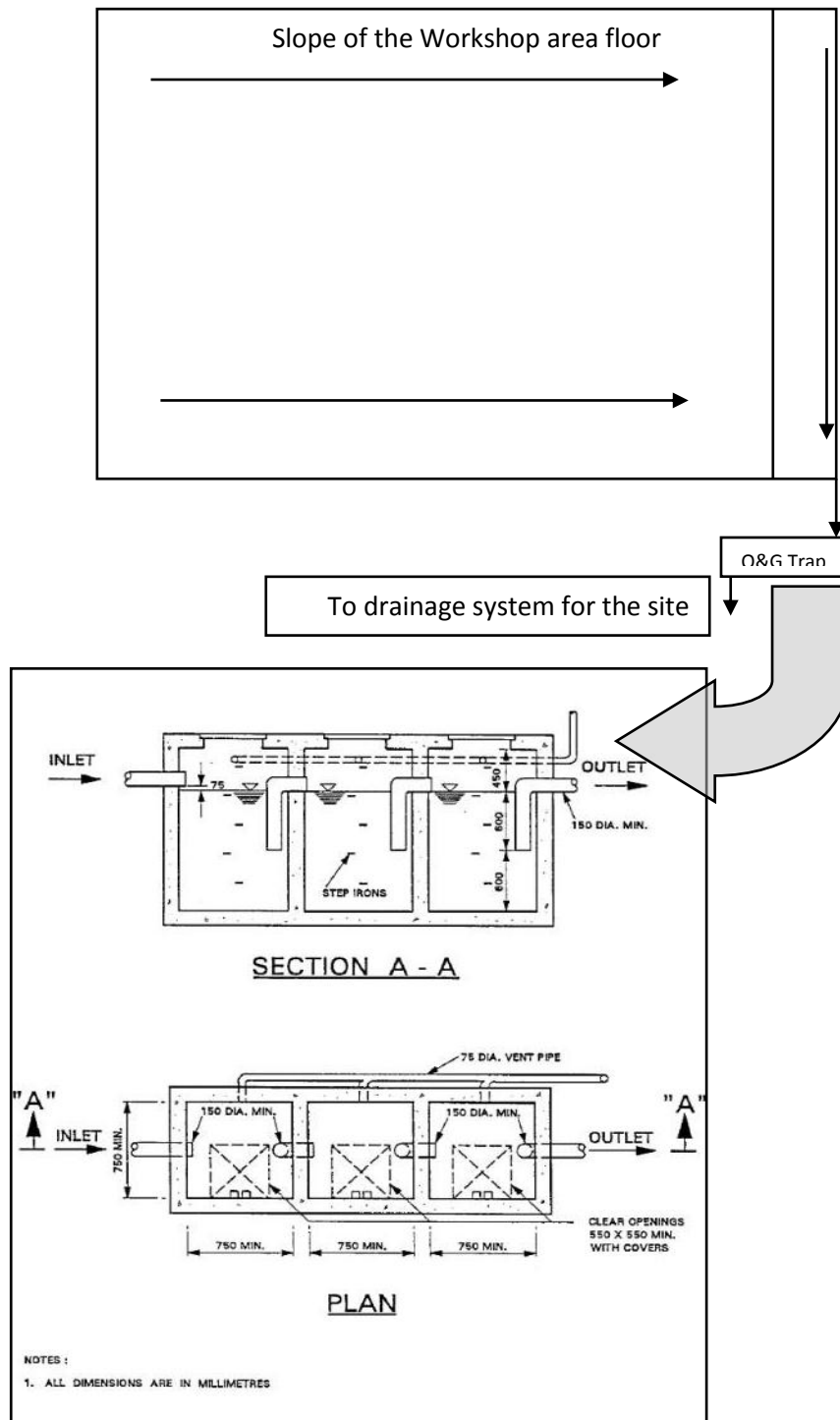
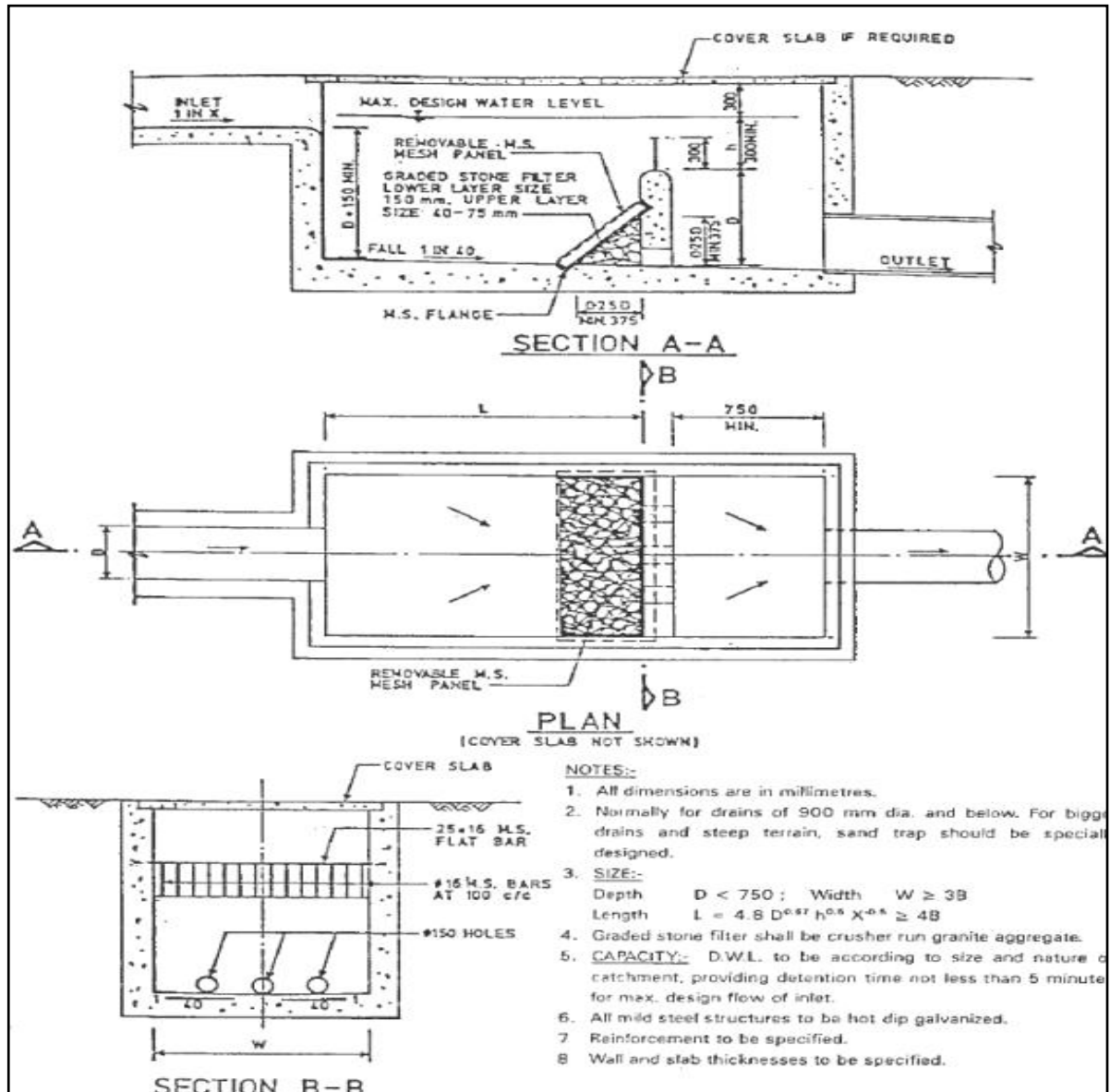


Figure: Workshop Area Pollution Control

- All the waste oil collected, from skimming of the oil trap as well as from the drip pans, or the mechanical degreaser shall be stored in accordance with the Environment Protection (Storage and Disposal of Hazardous Wastes) Rules, 1989. For this purpose, metallic drums should be used. These should be stored separately in sheds, preferably banded. The advantage of this arrangement is that it allows for accurate accounting in case the waste material is sold to oil waste recyclers or other users like brick-kiln owners who can burn such inferior fuel.

- A separate vehicle washing ramp shall be constructed adjacent to the workshop for washing vehicles, including truck mounted concrete mixers, if any, after each day's construction is over, or as required. This ramp should have an impervious bottom and it should be sloped so that it drains into a separate chamber to remove the sediment from the wash water before discharge. The chamber should allow for a hydraulic residence time of about 10 minutes for discharge associated with the washing of each truck. Following figure shows an outline sketch for a sedimentation chamber.

Figure: Sedimentation Chamber for vehicle washing ramp discharge



Facilities for Labour

Potential Environmental Impacts

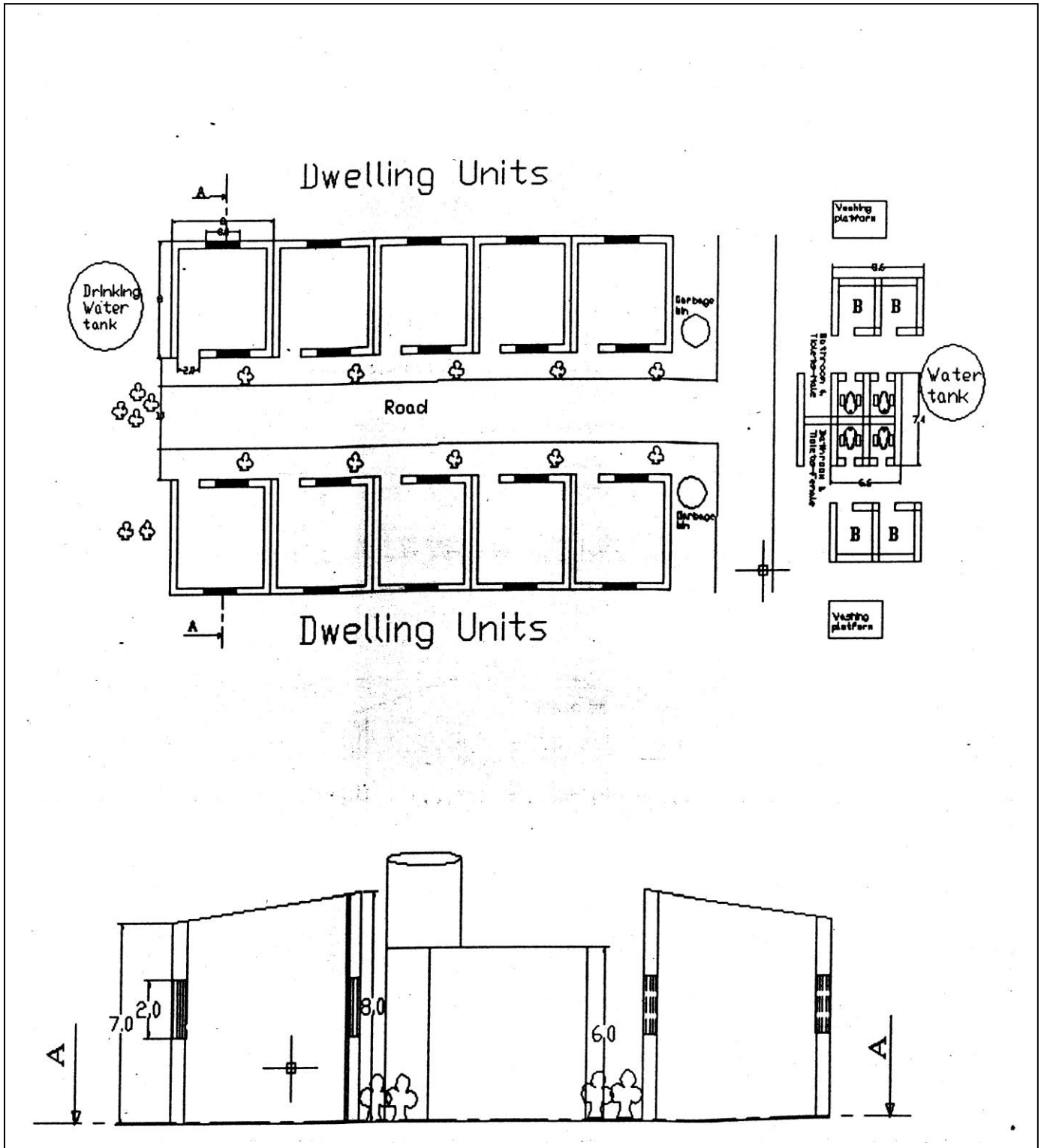
The sudden arrival and relatively longer duration of stay of construction crew can cause substantial strain on the existing infrastructure facilities like water supply, sanitation and medical care, especially in rural areas. Pollution from domestic wastes can affect local sources of water supply and may harm the crew themselves as well as local residents. Improper sanitation and inadequate health care also potential bottlenecks that the Contractor can eliminate with relatively little effort.

Mitigation Measures

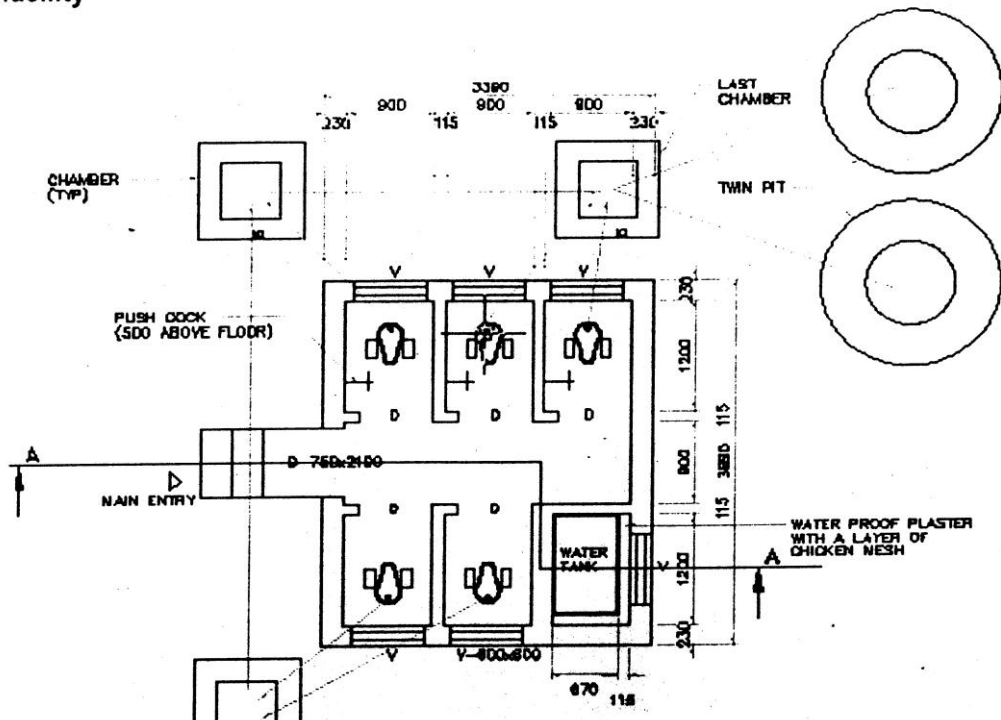
It should be emphasized that the Indian Law requires that the Contractor provide several facilities to for the workers as per Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. Some of the provisions described herein are more stringent to act as benchmark for improved environmental performance of road projects:

- The contractor shall provide free-of-charge temporary accommodation to all the labour employed for the project. The accommodation includes separate cooking place, bathing, washing and lavatory facilities. At least, one toilet will be provided for every 35 people and one urinal will be provided for every 20 persons. More toilets and/or urinals may have to be provided if the Engineer decides that these numbers are insufficient. In case female labourers are employed, separate toilet and urinals will be provided in locations clearly marked “Ladies Toilets” in a language understood by most labourers.
- The contractor shall ensure the supply of wholesome water for all the labour, including those employed by any other agency working for the contractor. These locations will be marked “Drinking Water” in the language most commonly understood among the labour. In hot season, the contractor shall make efforts to ensure supply of cool water. No water point shall be located within 15 m of any washing place, urinal, or latrine.
- The contractor shall ensure that adequate cooking fuel, preferably kerosene or LPG, is available on-site. The contractor will ensure that wood/ coal are not used as fuel on the site. Workers need to be made aware of this restriction. In cases where more than 250 labours are employed, canteen facility should be provided by the Contractor.
- A crèche must be provided in each campsite where more than 50 female labourers are employed, whether directly or indirectly, for the project or its ancillary activities.
- Contractor must provide adequate facilities for first-aid treatment at the campsite. A doctor / ambulance should be available on call for the duration of project implementation.
- The contractor shall obtain the approval of the Engineer for these facilities within 30 days of mobilization.

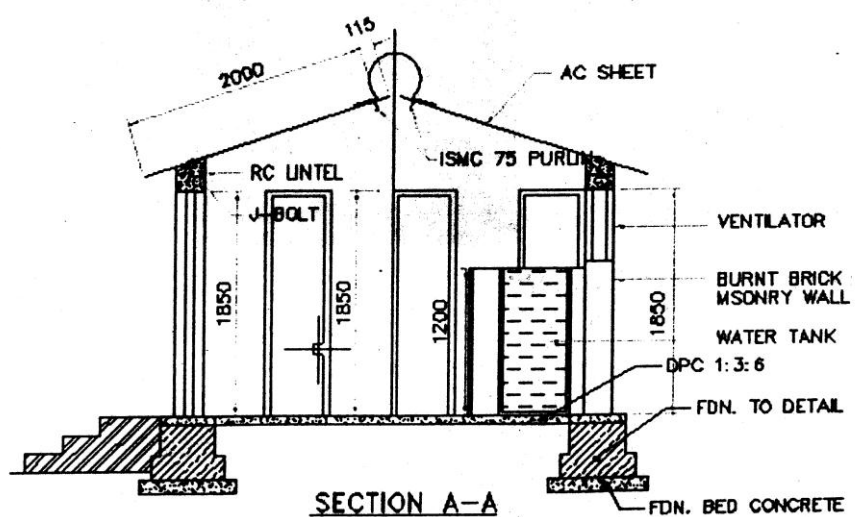
IX. TYPICAL DRAWING OF WORKERS' CAMP SANITARY FACILITY



Sanitary facility



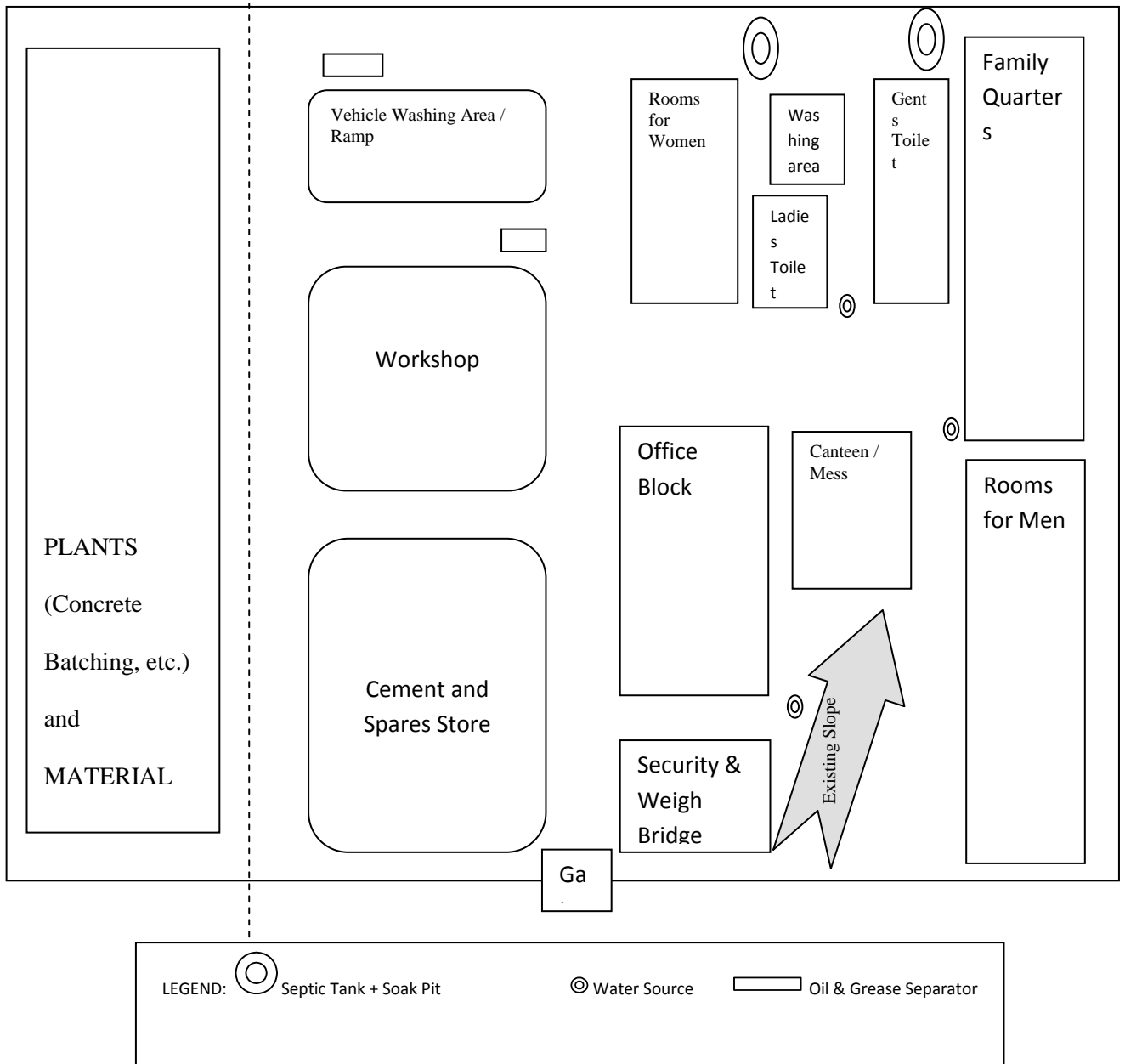
PLAN
 SIZE OF EACH TOILET BOOTH : 1050x1200
 (TYPICAL WITH 8 WC ENCLOSURE FOR SCHOOLS, SHOPPING AREAS)



NOTES:

1. INSPECTION CHAMBER (IC)
 600x600x600 DEEP WITH
 AIRTIGHT MH COVER
2. SEPTIC TANK & SOAK PIT
 AS PER SITE CONDITIONS

Layout of a Construction camp



APPENDIX 15

MANAGEMENT OF CONSTRUCTION WASTE DEBRIS DISPOSAL

1. Purpose

- To maximize re-use of material generated during construction and
- To avoid environmental hazards due to improper disposal of construction waste material.

2. Procedure

The following procedures should be followed for upkeep of storage and disposal sites;

- Contractor shall maintain register for keeping records on kilometer-wise quantities of material generated during grubbing, stripping, excavation and scarifying;
- Contractor shall re-use construction material to the extent possible based on engineering properties. Possible re-use areas are fill sections, embankment slope, village approach roads etc. Debris without bitumen could be used for backfilling of quarry / borrow areas as recommended by the Engineer. At locations identified for dumping of residual bituminous wastes, the dumping shall be carried out over a 60mm thick layer of rammed clay so as to eliminate the possibility of the leaching of the wastes into the ground water. The contractor shall ensure that the filled area is covered with a layer of preserved topsoil layer of preserved topsoil.
- Contractor shall estimate the chainage-wise quantities of various waste material to be disposed of;
- Contractor shall restrict waste disposal strictly at approved site/s only;
- Contractor shall prepare a plan including detailed lay out plan and cross-section for disposal of debris and bitumen waste and get approval of the same by the Engineer;
- Bentonite slurry or similar debris generated from pile driving or other construction activities shall be disposed such that it does not flow into the surface water bodies or form mud puddles in the area;
- Contractor and Engineer shall ensure that disposal areas are properly treated as per agreed plan;
- Contractor and Engineer's representatives shall undertake joint weekly inspection to ensure compliance of various environmental requirements.
- Engineer's representatives shall issue non-compliance if disposal site is not managed as per agreed plan;
- All arrangement for transportation during construction including provision, maintenance, dismantling and clearing debris, where necessary will be considered incidental to the work and should be planned and implemented by the contractor as approved and directed by the SC.

3. Site Inspection

Weekly joint site inspection shall be undertaken for all the storage areas. The details of attributes, which are to be inspected, are given as follows. The Contractor shall ensure compliance of the requirements.

Details to be inspected for Monitoring Construction Material Reuse & Disposal

Attributes	Requirements
Construction material generation and re-use	<ul style="list-style-type: none"> ✓ Segregating debris and bitumen during generation; ✓ Segregating re-usable portion of debris and bitumen and storing preferably near areas of re-use; and ✓ Temporary storage of waste material at sites as directed by the Engineer.
Waste disposal	<ul style="list-style-type: none"> ✓ Disposal of waste material at approved disposal site within a week of generation; ✓ Disposal site should be properly demarcated; ✓ Proper leveling / grading at disposal site/s; ✓ Recommended / agreed safeguard measures to avoid ground water contamination by leachate from disposal of scarified material are to be implemented; ✓ Recommended / agreed safeguard measures to avoid soil erosion are to be implemented; ✓ Recommended / agreed plan for surface treatment of waste disposal site/s are to be implement.

APPENDIX 16

BLASTING OPERATIONS

1 General

Blasting shall be carried out in a manner that completes the excavation to the lines indicated in drawings, with the least disturbance to adjacent material. It shall be done only with the written permission of the Engineer. All the statutory laws, regulations, rules, etc., pertaining to the acquisition, transportation, storage, handling and use of explosives shall be strictly followed by the Contractor. The Contractor may adopt any method or methods of blasting consistent with the safety and job requirements. Prior to starting any phase of the operation, the Contractor shall provide information describing pertinent blasting procedures, dimensions and notes. The magazine for the storage of explosives shall be built to the designs and specifications of the Explosives Department concerned and located at the approved site. No unauthorized person shall be admitted into the magazine which, when not in use, shall be kept securely locked. No matches or inflammable material shall be allowed in the magazine. The magazine shall have an effective lightning conductor. The following shall be hung in the lobby of the magazine:

- I. A copy of the relevant rules regarding safe storage both in English and in the language with which the workers concerned are familiar,
- II. A statement of up-to-date stock in the magazine,
- III. A certificate showing the last date of testing of the lightning conductor, and
- IV. A notice that smoking is strictly prohibited.
- V. All explosives shall be stored in a secure manner in compliance with all laws and ordinances, and all such storage places shall be marked. Where no local laws or ordinances apply,
- VI. storage shall be provided to the satisfaction of the Engineer and in general not closer than 300 m from the road or from any building or camping area or place of human occupancy.
- VII.

In addition to these, the Contractor shall also observe the following instructions and any further additional instructions which may be given by the Engineer and shall be responsible for damage to property and any accident which may occur to workmen or public on account of any operations connected with the storage, handling or use of explosives and blasting. The Engineer shall frequently check the Contractor's compliance with these precautions.

2. Materials, Tools and Equipment

All the materials, tools and equipment used for blasting operations shall be of approved type. The Engineer may specify the type of explosives to be allowed in special cases. The fuse to be used in wet locations shall be sufficiently water-resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and definitely known to permit such a length being cut as will permit sufficient time to the firer to reach safely before explosion takes place. Detonators shall be capable of giving effective blasting of the explosives. The blasting powder, explosives, detonators, fuses, etc., shall be fresh and not damaged due to dampness, moisture or any other cause. They shall be inspected before use and damaged articles shall be discarded totally and removed from the site immediately.

3 Personnel

The blasting operation shall remain in the charge of competent and experienced supervisor and workmen who are thoroughly acquainted with the details of handling explosives and blasting operations.

4 Blasting Operations

- The blasting shall be carried out during the pre-determined hours of the day preferably during the mid-day luncheon hour or at the close of the work as ordered in writing by the Engineer. The hours shall be made known to the people in the vicinity.
- The Contractor shall notify each public utility company having structures in proximity to the site of the work of his intention to use explosives. Such notice shall be given sufficiently in advance to enable the companies to take such steps as they may deem necessary to protect their property from injury. In advance of any blasting work within 50 m of any railway track or structures, the Contractor shall notify the concerned Railway Authority of the location, date, time and approximate duration of such blasting operation.
- Red danger flags shall be displayed prominently in all directions during the blasting operations. The flags shall be planted 200 m from the blasting site in all directions. People, except those who actually light the fuse, shall be prohibited from entering this area and all persons including workmen shall be kept away from the flagged area, and all persons including workmen shall be removed from the flagged area at least 10 minutes before the firing. A warning siren shall be sounded for the above purpose.
- Only controlled blasting shall be resorted to along with the safeguard above at locations where built-up area, huts, abodes of people and livestock lie within 200 m. Similarly excavation of hard rock without blasting is mandatory where people live within 20 m of blast site. The charge holes shall be drilled to required depths and at suitable places. Blasting should be as light as possible consistent with thorough breakage of the material necessary for economic loading and hauling.
- Any method of blasting which leads to overshooting shall be discontinued. When blasting is done with powder, the fuse cut to the required length shall be inserted into the hole and the powder dropped shall be gently tamped with copper rods with rounded ends. The explosive powder shall then be covered with tamping material which shall be tamped lightly but firmly.
- When blasting is done with dynamite and other high explosives, dynamite cartridges shall be prepared by inserting the square cut end of a fuse into the detonator and finishing it with nippers at the open end, the detonator gently pushed into the primer leaving 1/3rd of the copper tube exposed outside. The paper of the cartridge shall then be closed up and securely bound with wire or twine. The primer shall be housed into the explosive.
- Boreholes shall be cleared of all debris and explosives inserted. The space of about 200 mm above the charge shall then be gently filled with dry clay, pressed home and the rest of the tamping formed of any convenient material gently packed with a wooden rammer.
- At a time not more than 10 such charges will be prepared and fired. The man in charge shall blow a siren in a recognized manner for cautioning the people. All the people shall then be required to move to safe distances. The charges shall be lighted by the man-in-charge only. The man-in-charge shall count the number of explosions. He shall satisfy himself that all the charges have been exploded before allowing the workmen to go back to the work site.
- After blasting operation, the Contractor shall compact the loose residual material below subgrade and replace the material removed below subgrade with suitable material.

5 Misfire

In case of misfire, the following procedure shall be observed:

- i) Sufficient time shall be allowed to account for the delayed blast. The man-in-charge shall inspect all the charges and determine the missed charge.
- ii)
- iii) If it is the blasting powder charge, it shall be completely flooded with water. A new hole shall be drilled at about 450 mm from the old hole and fired. This should blast the old charge. In case, it does not blast the old charge, the procedure shall be repeated till the old charge is blasted:

- iv) In case of charges of gelignite, dynamite, etc., the man-in-charge shall gently remove the tamping and the primer with the detonator. A fresh detonator and primer shall then be used to blast the charge. Alternatively, the hole may be cleared of 300 mm of tamping and the direction then ascertained by placing a stick in the hole. Another hole may then be drilled 150 mm away and parallel to it. This hole shall then be charged and fired when the misfired hole should explode at the same time. The man-in-charge shall at once report to the Contractor's office and the Engineer all cases of misfire, the cause of the same and what steps were taken in connection therewith. If a misfire has been found to be due to defective detonator or dynamite, the whole quantity in the box from which defective article was taken must be sent to the authority directed by the Engineer for inspection to ascertain whether all the remaining materials in the box are also defective.