

# Environmental Assessment Report

---

Initial Environmental Examination  
Document Stage: Final  
Project Number: 37143-013  
February 2013

## India: North Eastern State Roads Investment Program

Tupul – Kasom Khullen Road Section in Manipur (MN-06): Tranche 2 Subproject

Prepared by the Ministry of Development of North Eastern Region (MDONER), Government of India for the Asian Development Bank

## **CURRENCY EQUIVALENTS**

(as of 31 January 2013)

Currency Unit = Indian Rupee (INR)

INR1.00 = US\$ 0.0185

US\$1.00 = INR 54.00

## **LIST OF ABBREVIATIONS**

ADB	-	Asian Development Bank
CPCB	-	Central Pollution Control Board
CRRRI	-	Central Road Research Institute
DoE	-	Department of Environment
EA	-	Executing Agency
EFRC	-	Environment Friendly Road Construction
EIA	-	Environmental Impact Assessment
EMMP	-	Environmental Mitigation and Monitoring Plan
GDP	-	Gross Domestic Product
GoM	-	Government of Manipur
GoI	-	Government of India
IEE	-	Initial Environmental Examination
IRC	-	Indian Road Congress
MDONER	-	Ministry of Development of North Eastern Region
MDRs	-	Major District Roads
MoEF	-	Ministry of Environment and Forests
MoRT&H	-	Ministry of Road Transport and Highways
MSL	-	Mean Sea Level
NEC	-	North Eastern Council
NER	-	North Eastern Region
NGO	-	Non-government Organization
NH	-	National Highway
NOx	-	Oxides of Nitrogen
NSDP	-	Net State Domestic Product
PIU	-	Project Implementation Unit
PWD	-	Public Works Department
ROW	-	Right of Way
SPM	-	Suspended Particulate Matter
SO <sub>2</sub>	-	Sulphur Dioxide
SSI	-	Small Scale Industries
SPCB	-	State Pollution Control Board
TA	-	Technical Assistance
TOR	-	Terms of Reference
WHO	-	World Health Organisation

## **NOTES**

- (i) The financial year (FY) of the Government of India ends on 31 March. FY before a calendar year denotes the year in which the fiscal year ends, e.g., FY2012 ends on 31 March 2012.
- (ii) In this report, "\$" refers to US dollars

This 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.

In preparing any country program or strategy, financing any project, or by making any designation of or reference to a particular territory or geographic area in this document, the Asian Development Bank does not intend to make any judgments as to the legal or other status of any territory or area.

## TABLE OF CONTENTS

Executive Summary	i
I. INTRODUCTION	1
A. Project Background	1
B. North Eastern State Roads Investment Program (NESRIP)	1
C. Background of the Present Report	2
D. Objective and Scope of the IEE Study	3
E. Methodology Adopted for IEE Study	3
F. Structure of the Report	3
II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORKS	5
A. National (India) Environmental Legal Framework	5
B. ADB's Environmental Safeguard Requirements	7
III. DESCRIPTION OF THE PROJECT	9
A. Type of Project	9
B. Need for the Project	9
C. Location and Features of the Project Road	10
D. Design Standards for the Project Road	14
E. Engineering Surveys and Investigations	14
F. The Design	14
G. Critical Sections	19
H. Road Construction Materials	20
I. Road Protection Work	20
J. Safety Audit	20
K. Summary of Proposed Improvement Works	20
L. Project Cost	21
M. Construction Packaging and Implementation Schedule	21
N. Project Benefits	21
IV. DESCRIPTION OF THE ENVIRONMENT	23
A. Physical Environment	23
B. Ecological Environment	27
C. Socio Economic Environment	32
V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES	37
A. Identification and Assessment of Impacts	37
B. Impacts and Mitigation Measures Due to Project Location and Design	38
C. Impacts and Mitigation Measures during Construction	41
D. Impacts and Mitigation Measures during Operation	54
E. Potential Environmental Enhancement/Protection Measures	55
VI. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION	56
VII. GRIEVANCE AND REDRESS MECHANISM	58
VIII. ENVIRONMENTAL MANAGEMENT PLAN	60
A. Summary of Impacts	60
B. Mitigation Measures	60
C. Environmental Monitoring	62
D. Institutional Requirements	62

E. Proposed Environmental Budget	64
IX. CONCLUSION AND RECOMMENDATION	65
APPENDICES	66
1. Rapid Environmental Assessment (REA) Checklist	66
2. Species wise Details of Trees to be cut	69
3. Location of Quarries and Borrow Area	72
4. List of Officials Consulted	75
5. Sample Questionnaire Used for Community Consultation	78
6. Environmental Management Plan (Matrix)	80
7. Environmental Monitoring Plan	88
8. Details of Environmental Training Program	91
9. Environmental Management Plan (EMP) Cost	92
10. General Guidelines for Environmental Management	94
11. National Standards for Water, Air and Noise Levels	117

Map showing subproject included in Manipur under NESRP



## EXECUTIVE SUMMARY

1. The environmental screening of tranche 2 subproject in Manipur i.e. MN-06: Tupul-Kasom Khullen road section revealed that the proposed improvement of this road section will not result to significant adverse environmental impacts, and all significant impacts are site-specific and can be addressed through proven mitigation measures. The tranche 2 subproject in Manipur is classified as environmental Category B and accordingly an initial environmental examination was prepared and documented in this report.
2. MN-06 road section is part of tranche 2 of the ADB's multitranche financing facility approved for the North Eastern State Roads Investment Program. The proposed Tupul-Kasom Khullen road improvement will cover 93.2 km of existing roads divided in two road sections as Section 1: Tupul-Bishnupur road and Section 2: Thoubal-Kasom Khullen road section. Section 1 takes off from NH-53 at Tupul and ends at NH-150 in Bishnupur covering a total length of 52.2 km whereas Section 2 takes off from NH-39 in built up area at Thoubal and end at Kasom Khullen covering a total length of 41 km.
3. The existing roads are sections of MDRs mostly gravel / earthen tracks (except 9 km stretch between Thoubal to Yairipok, which is a state highway with intermediate lane) with single lane carriageway. Average carriageway width is about 3.5m to 5.0 m. The road passes mostly through hilly terrain with curvilinear alignment comprising in sharp radii and bends including hair pin bends and steep gradients. Some of the sections are difficult track, with muddy and slushy roadway during rains and hardly jeepable.
4. These sections are proposed for improvement and upgradation to intermediate lane configuration (5.5m carriageway) with side drains on hill side. Total formation width will be restricted to 9.0 m in plain areas and 7.8m in hilly terrain. Table 3.1 presents the information about the subproject road.
5. The road improvements will involve paving and widening of existing carriageway to accommodate the increase in traffic; construction of new and strengthening of existing erosion control structures and cross drainage structures to ensure easy and all weather connectivity between Tupul (NH-53), Bishnupur (NH-150), Thoubal (NH-39) and further to Kasom Khullen; and improvements in horizontal, vertical geometries and installation of road safety appurtenances to minimize road crashes.
6. The significant environmental impacts attributable to the upgrading of the road sections pertains to cutting of about 4105 trees for the proposed widening; temporary deterioration of ambients during construction phase from land clearing, ground shaping, quarry and camp operations; and community and occupational health and safety. These impacts will be mitigated through compensatory afforestation; timing of construction activities to minimize fauna disturbance; control of noise, dust, wastewater, fuel combustion emissions, and construction debris generation through good construction practices; and implementation of road safety measures to separate road users from active construction fronts.
7. During operation stage, the main impacts are increase in mobile emissions, road safety to motorist, pedestrian and animals. Road safety measures will be implemented as per IRC guidelines. Road safety appurtenances like information, regulatory and warning signs copuled with crash barriers will reduce serious injuries to road users. Adequate cross drains and side drains and their proper maintenance will be implemented to avoid localised flooding.

8. Several consultations were organized during the project preparation to engage major stakeholder representatives and incorporate their concerns in the overall design. These consultations involved officials of executing agency, PWD, district rural development officials, forest department officials, affected persons and village heads in the project area. Most of the people interviewed strongly support the project.

9. An environmental management and monitoring plan summarising likely potential impacts, mitigation measures, institutional responsibilities and cost estimate has been developed which will be included in the contractors work specifications. Total cost of the environmental management estimated at INR 7,240,775 (or USD 134,088). The PWD, Government of Manipur, 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 provide close support to the Project Director and ensure the contractors maintain environmental compliance. To provide regular monitoring information and technical advice to the PIU is the supervision consultant and the contractors environment and social officer.

10. This initial environmental examination (IEE) ascertains that upgrading of Tupul-Kasom Khullen (MN-06) road section 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 requirement of a detailed EIA is envisaged at this stage.



## I. INTRODUCTION

### A. Project Background

11. The North Eastern Region (NER) of India is bordered by Bangladesh, Bhutan, the People's Republic of China, Myanmar, and Nepal. It represents about 8% of India's total geographic area with a population of about 54 million. The region consists of eight states, namely: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Sikkim, and Tripura. The NER is connected to the rest of the country through a narrow Siliguri Corridor in the West Bengal. Except in Assam, NER has predominantly hilly to mountainous terrain and very high rainfall (among the highest in the world), which frequently results in landslides and floods.

12. Recognizing the need for accelerated development, the Government of India places special focus on the development of NER in its five-year plans, mainly through central funding of development activities in the region. Over the last two decades the government has required 10% of the budget of central ministries and departments to be allocated for NER, and created a funding mechanism for pooling the unspent allocated central funds for further assistance to the region. However, the recent growth performance of these states has not been encouraging. The government's Eleventh Five Year Plan, 2007–2012 states that "while development efforts over the years have made some impact (as reflected in some of the human development indicators, which are comparable with the rest of the country), the region is deficit in physical infrastructure which has a multiplier effect on economic development."

13. With the limited exception of the highest class roads (mostly national highways maintained by central organizations), the NER road network needs substantial improvement, through its expansion and improvement of individual road sections. This improvement will be made by widening the existing roadway, strengthening pavements, improving road geometry, raising embankments, and providing permanent structures at river-crossings. With renewed recognition that inadequate roads and bridges supporting the road transport which is the region's single most dominant transport mode, are the major constraints on development efforts, the government started a national investment program to improve road connectivity to remote places in the region.

14. The present North Eastern State Roads Investment Program (NESRIP) is being provided by ADB which was developed in parallel with SARDP-NE and is complementary to it. While SARDP- NE focuses on improving higher class roads, the investment program is developed to improve intrastate connectivity, mainly to district headquarters and other places of administrative and economic importance in the individual states, and to enhance capacity of state PWDs to manage its road assets.

### B. North Eastern State Roads Investment Program (NESRIP)

15. The North Eastern State Roads Investment Program is an ADB's multitranche financing facility (MFF) that will: improve about 430 kilometers (km) of priority roads in six states, namely: Assam, Manipur, Meghalaya, Mizoram, Sikkim, and Tripura in the North Eastern region (NER) of India; and provide capacity building support to the executing agencies, the Ministry of Development of North Eastern Region (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 ongoing national programs for improvement<sup>1</sup>. The entire MFF is structured in two tranches as detailed in Table 1.1.

**Table 1.1: Road Sections under Multitranche Financing Facility NESRIP**

Road Section Package Code	Tranche/Road Name	State	Length (km)
<b>Tranche 1</b>			
AS-11	Futkibari – Bilasipara (NH-31)	Assam	16.2
AS-37C	Barpeta – Kalitakuchi	Assam	58.5
ML-N1	Garobadha – Dalu (NH-51)	Meghalaya	93.4
SK-01	Melli (NH-31A) Km 17.10 – Nayabazar	Sikkim	14.5
SK-02	Nayabazar – Namchi	Sikkim	19.7
<b>Subtotal for Tranche 1</b>			<b>202.3</b>
<b>Tranche 2</b>			
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
<b>Subtotal for Tranche 2</b>			<b>231.4</b>
<b>Grand Total for investment program</b>			<b>433.7</b>

16. The impact of the investment program will be improved surface-transport connectivity in NER, which is expected to contribute to NER's economic growth and poverty reduction. Improved surface-transport connectivity will facilitate delivery of various development schemes in other sectors. The outcome will be improved mobility and accessibility in the project areas in NER that will be measured in terms of traffic growth rates, cost of transport and travel time. The investment program will also contribute to improved transport connectivity to the rest of India, and eventually to neighboring countries, which will facilitate inward investment in NER.

17. This road improvement will be pursued in an environmentally congenial manner that avoids, minimizes or mitigates adverse environmental impacts. This IEE contains the approach, evaluation, findings, and recommendation of the Initial Environmental Examination for tranche 2 subproject (MN-06: Tupul to Kasom-Khullen) in the State of Manipur. This road section is a component of the ADB Loan No. 2770-IND for North Eastern State Roads Project (NESRP) which aims to upgrade and improve priority state roads in the northeast region.

### **C. Background of the Present Report**

18. This Initial Environmental Examination (IEE) Report is prepared for the present assignment in order to identify the baseline environmental status of the proposed alignment, assessment of impacts due to the proposed widening of the road on various environmental parameters and preparation of environmental management plan to mitigate the negative impact on these parameters.

<sup>1</sup> "Proposed Multitranche Financing Facility and Administration of Technical Assistance Grant India: North Eastern State Roads Investment Program" Report and Recommendation of the President to the Board of Directors, June 2011.

19. The IEE study was prepared 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 again in 2010 as part of detailed design. This is the final IEE report prepared to meet the requirements of the ADB's Safeguard Policy Statement 2009.

#### **D. Objective and Scope of the IEE Study**

20. The objective of this IEE study is to identify potential environmental impacts of the proposed road improvement measures and formulate strategies to avoid / mitigate the same. The scope of work to accomplish the above objective, comprise the following.

- understanding the baseline environmental conditions of the project area,
- identifying the potential environmental impacts of the project proposal,
- recommending appropriate mitigation measures to avoid / minimise the environmental impacts, and
- preparing an environmental management plan for implementation.

21. The IEE study has been confined to the situation around the deemed areas of direct influence caused by constructional and operational facilities along the proposed road sections. Following sections of this report discusses the methodology adopted by the consultants in conducting the IEE study and presents the results of the same.

#### **E. Methodology Adopted for IEE Study**

22. This IEE has been carried out, in accordance with the requirements of the ADB's Safeguard Policy Statement (SPS) 2009. The IEE methodology has been adopted in such a manner to ensure that environmental concerns are given adequate weightage in the selection of alignment and design of proposed road improvements. This IEE study employs an iterative approach in which potential environmental issues have been examined at successive levels in detail and specificity, at each step in the process.

23. The IEE is based on the information collected from secondary as well as primary sources on various environmental attributes. Environmental features within the ROW and significant issues were examined during field survey to determine the magnitude of significant environmental impacts.

#### **F. Structure of the Report**

24. This report has ten sections following the prescribed IEE outline of the ADB's SPS and starts with this introduction followed by:

- Policy, Legal, and Administrative Frameworks section summarizing the national and local legal and institutional frameworks that guided the conduct of the assessment
- Description of the Project Section presenting the key features and components of the proposed project
- Description of the Environment section discussing the relevant physical, biological, and socioeconomic features that may be affected by the proposed project.

- Anticipated Environmental Impacts and Mitigation Measures section presenting the environmental assessment of likely positive and adverse impacts attributed to the proposed project and concomitant mitigation measures.
  - Information Disclosure, Consultation, and Participation section describing the consultation process undertaken during the environmental examination and its results, their consideration in the project design, and manner of compliance to the ADB's Publication Policy and related national laws.
  - Grievance Redress Mechanism section describing the formal and informal redress procedures for registering, resolving, and reporting complaints.
  - Environmental Management Plan section discussing the lessons from the impact assessment and translated into action plans to avoid, reduce, mitigate or compensate adverse impacts and reinforces beneficial impacts. This plan is divided into three sub-sections; mitigation, monitoring, and implementation arrangements.
  - Conclusion and Recommendation section stating whether there is a need for further environmental assessment and highlights key findings and recommendations to be implemented by the borrower.
25. An executive summary is also prepared and presented in the beginning of the report.

## II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORKS

### A. National (India) Environmental Legal Framework

26. The legal framework of the country consists of several acts, notifications, rules and regulations to protect environment and wildlife. In 1976, the 42<sup>nd</sup> Constitutional Amendment created Article 48A and 51A, placing an obligation on every citizen of the country to attempt to conserve the environment.

27. The environmental impact assessment requirement in India is based on the Environment (Protection) Act, 1986, the Environmental Impact Assessment Notification, 2006 (amended 2009), all its related circulars, MOEF's Environmental Impact Assessment Guidance Manual for Highways 2010 and IRC Guidelines for Environmental Impacts Assessment (IRC:104-1988) of highway projects. In addition to road widening and rehabilitation including establishment of temporary workshops, construction camps, hotmix plants, and opening of quarries for road construction work require to comply with provisions of The Forest (Conservation) Act 1980 (Amended 1988) and Rules 1981 (Amended 2003); The Wildlife (Protection) Act, 1972 (Amended 1993); The Water (Prevention and Control of Pollution) Act 1972 (Amended 1988) and Rules 1974; The Air (Prevention and Control of Pollution) Act, 1981 (Amended 1987) and Rules 1982; The Noise Pollution (Regulation and Control) Rules, 2000 (Amended 2002) and Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules 2008 (Amended 2009).

28. These Acts and Regulations require projects to comply with the following:

- a) As per provisions of Environmental Impact Assessment Notification 2006 (amended 2009), all State Highways (construction of new roads or construction of new bypasses) and expansion of state roads in hilly terrain (above 1000 m above msl and or ecologically sensitive areas) fall under category B projects and require Environmental Clearance from State Environmental Impact Assessment Authority.
- b) Further, under the same notification, it is stated that any category B project 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; and (iv) interstate boundaries and international boundaries.<sup>2</sup>
- c) Forest Clearance from Department of Forests is required for diversion of forest land to non-forest purpose. Prior permission is required from Forests Department to carry out any work within the forest areas and felling of road side trees. Cutting of trees need to be compensated by compensatory afforestation as required by the Forest Department.<sup>3</sup>

<sup>2</sup> As per Government of India Regulation all road projects are categorized as "A" or "B" depending on its environmental sensitivity as **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. And **Category B-i)** All New State Highways Projects; and ii) State Highway Expansion projects in hilly terrain (above 1000 m above mean sea level and or ecologically sensitive areas)

<sup>3</sup> In tranche 2 (MN-06) subproject in Manipur, permission would be required for cutting of road side trees from District authorities and forest department as project roads mostly passes through forest area.

- d) As per Office Memorandum issued by MOEF on 31 March 2011 and 9 September 2011, for projects requiring environmental clearance and involving diversion of forests land, the project proponent must first apply for Stage-I forestry clearance, and thereafter only submit the proposal for obtaining Terms of Reference for undertaking Environmental Impact Assessment study to the respective Expert Appraisal Committee (EAC). The Stage-I forestry clearance must be submitted to the respective EAC within 12 months, extendable upto a maximum of 18 months, of the recommendation for grant of environmental clearance. Only after submission of the stage-I forestry clearance, will the formal environmental clearance be issued. In case the stage-I forestry clearance is not submitted within the stipulated time the project proposal will stand rejected and the process for obtaining environmental clearance will have to be initiated from the beginning.
- e) Placement of hot-mix plants, quarrying and crushers, batch mixing plants, discharge of sewage from construction camps requires No Objection Certificate (Consent to Establish and Consent to Operate) from State Pollution Control Board prior to establishment.
- f) Permission from Central Ground Water Authority is required for extracting ground water for construction purposes, from areas declared as critical or semi critical from ground water potential prospective by them.

29. Specifically for the proposed subproject MN-06 in the state of Manipur, the following (Table 2.1) environmental laws and regulations are applicable:

**Table 2.1: Applicable Environmental National and State Requirements**

Sl. No.	Activity	Statute	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance	Time Required
1	Cutting of road side trees	The Forest (Conservation) Act 1980 (Amended 1988) and Rules 1981 (Amended 2003) and Environmental Protection Act of 1986 and as amended	Permit from Forest Department	State Department of Forests	The PWD	3-9 months
2	Establishing stone crusher, hot mix plant, wet mix plant and Diesel Generator Sets	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environmental Protection Act of 1986 and as amended	Consent-for-establishment	State Pollution Control Board	The Contractor	2-3 months
3	Operating stone crusher, hot mix plant, wet mix plant and Diesel Generator Sets	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environmental Protection Act of 1986 and as amended	Consent-for-operation	State Pollution Control Board	The Contractor	2-3 months

Sl. No.	Activity	Statute	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance	Time Required
4	Use and storage of explosive for quarry blasting work	India Explosive Act 1984	Explosive licence for use and storage	Chief Controller of Explosives	The Contractor	2-3 months
5.	Storage of fuel oil, lubricants, diesel etc. at construction camp	Manufacture storage and Import of Hazardous Chemical Rules 1989	Permission for storage of hazardous chemical	State Pollution Control Board or Local Authority (DM/DC)	The Contractor	2-3 months
6	Quarry operation	State Minor Mineral Concession Rules, The Mines Act of 1952, Indian Explosive Act of 1984, Air Act of 1981 and Water Act of 1974	Quarry Lease Deed and Quarry License	State Department of Mines and Geology	The Contractor	2-3 months
7	Extraction of ground water	Ground Water Rules of 2002	Permission for extraction of ground water for use in road construction activities	State Ground Water Board	The Contractor	2-3 months
8	Use of surface water for construction	-	Permission for use of water for construction purpose	Irrigation Department	The Contractor	2-3 months
9	Engagement of labour	Labour Act	Labour license	Labour Commissioner	The Contractor	2-3 months

30. Before the start of civil works for the any subproject the state PWD must obtain necessary clearances / permits from the regional office of the Ministry of Environment and Forests and State Pollution Control Board. Since the project road does not pass through any of the sensitive areas, the EIA notification 2006 is not applicable to this subproject hence environmental clearance from the MOEF is not required. However, for cutting of roadside trees, necessary permits from the state forest departments must be obtained by PWD prior to start of civil work on those sections.

## **B. ADB's Environmental Safeguard Requirements**

31. This environmental assessment is carried out in compliance with requirements of ADB's SPS so as to ensure that potential adverse environmental impacts are identified, avoided where possible and managed or addressed.

32. As per the SPS the objective of Environmental Safeguard is to ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision-making process. To help achieve the desired outcomes, ADB adopts eleven policy principles for guiding the assessment of projects that trigger

environmental risks and impacts. ADB categorizes projects into categories A, B, C, and FI according to the significance of likely impacts.

33. Based on the ADB's SPS, the proposed tranche 2 subproject in Manipur (MN-06) of the investment program is categorized as category B project based on the most sensitive component. Project categorization is carried out using Rapid Environmental Assessment (REA) Checklist (Appendix 1). The category of the project is confirmed during the FF mission in November 2011. Category B projects are judged to have some adverse impacts, but of lesser degree and/or significance than category A. An initial environmental examination (IEE) is required to determine whether or not significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report. Accordingly this IEE is prepared to meet the requirements of the government as well as ADB's SPS requirements.



### III. DESCRIPTION OF THE PROJECT

#### A. Type of Project

34. The present report deals with the Initial Environmental Examination of the MN-06: Tupul to Kasom-Khullen road section in the State of Manipur. This road section is included in tranche 2 of NESRIP and divided in two sections as: Section 1: Tupul to Bishnupur and Section 2: Thoubal to Kasom-Khullen. Section 1 takes off from NH-53 at Tupul and ends at NH-150 in Bishnupur covering a total length of 52.2 km whereas Section 2 takes off from NH-39 in built up area at Thoubal and end at Kasom Khullen covering a total length of 41 km. Total length of the project road MN-06 is therefore 93.2km. The existing roads are sections of MDRs mostly gravel / earthen tracks (except 9 km stretch between Thoubal to Yairipok, which is a state highway with intermediate lane) with single lane carriageway. Average carriageway width is about 3.5m to 5.0 m. The road passes mostly through hilly terrain with curvilinear alignment comprising in sharp radii and bends including hair pin bends and steep gradients. Some of the sections are difficult track, with muddy and slushy roadway during rains and hardly jeepable.

35. These sections are proposed for improvement and upgradation to intermediate lane configuration (5.5m carriageway) with side drains on hill side. Total formation width will be restricted to 9.0 m in plain areas and 7.8m in hilly terrain. Table 3.1 presents the information about the subproject road.

**Table 3.1: Information of the Project Road MN-06**

Name of the Project	Package No.	Length (km)	District	State
MN-06 (Section 1): Tupul to Bishnupur	NESRIP, Tranche 2 (MN-CW1)	52.2	Tamenglong and Bishnupur	Manipur
MN-06 (Section 2): Thoubal to Kasom Khullen	NESRIP, Tranche 2 (MN-CW2)	41.0	Thoubal and Ukhul	Manipur
<b>Total</b>		<b>93.2 km</b>		

#### B. Need for the Project

36. Manipur one of the eight sisters of the north eastern region in India, is an isolated hill-grit state stretching between 90°03'E and 94°42'E longitude and 23°50' and 25°42'N latitude. It is a charming place encircled by nine hill ranges on all sides with a small and beautiful oval valley at the centre. The state has 352 km long international border with Burma to the south-east and 502 km border with the adjacent states of Nagaland on the north, Cachar districts of Assam in the on the west and Mizoram on the south and the south west. The altitude of the state above the mean seal level varies from 790 meters to 2020 meters. It has subtropical temperate climate. The annual rainfall of Manipur in 2001 was to be 1769 mm as against the normal rainfall of 2000mm. The state has a salubrious climate. The state has a total geographical area of about 22327 sq km. which constitutes 0.7 percent of the total land surface of the country. Ninety percent of the total area of state is covered by hills; remaining area is a small valley. About 68 percent of the area is recorded as under forest. About 68 percent of the area is recorded as under forest. The population of the state stood at 2.39 million in 2001 of which 76 percent is rural.

37. There is practically no railway network in the state. Two rail heads – one at Dimapur in Nagaland (215 km away from Imphal) and the other at Jiribam (225 km away from Imphal)

serves the state. The state has one airport at Imphal, which connects up with the rest of the country. Waterways are also not feasible. Roads, therefore, constitute the only means of transport system in the state for movement of men, materials and services within and outside the state. The total road network stands at around 7200 km, of which 2600 km are unsurfaced roads.

38. State roads just serve to provide nominal connectivity; otherwise they are deficient in geometrics and pavement crust. They lack in cross-drainage structures and protection works (retaining walls, breast walls and parapets). There is lack of funds for maintenance which is aggravating the condition of roads. The total number of motorized vehicles as per data available is around 76400 (1999-2000) including 6000 trucks, 2050 buses and 11000 cars and jeeps. The growth of vehicles is over 7 percent per annum. The traffic is bound to increase further with the economic and industrial growth. Improvement and maintenance of the existing road network is urgent. Roads are considered to be the key to the facilitation of economic development in the remote rural areas. To achieve the development objectives, it will be necessary to improve the road sector. The existing road infrastructure urgently needs repair and improvement.

### C. Location and Features of the Project Road

39. Project road sections under MN-06 are located in Tamenglong, Bishnupur, Thoubal and Ukhrul districts of Manipur state. Figure 3.1 and Figure 3.2 shows the location map of the subproject road sections on state road map and on Google Earth image respectively. Existing conditions of the subproject roads are described in following paragraphs.

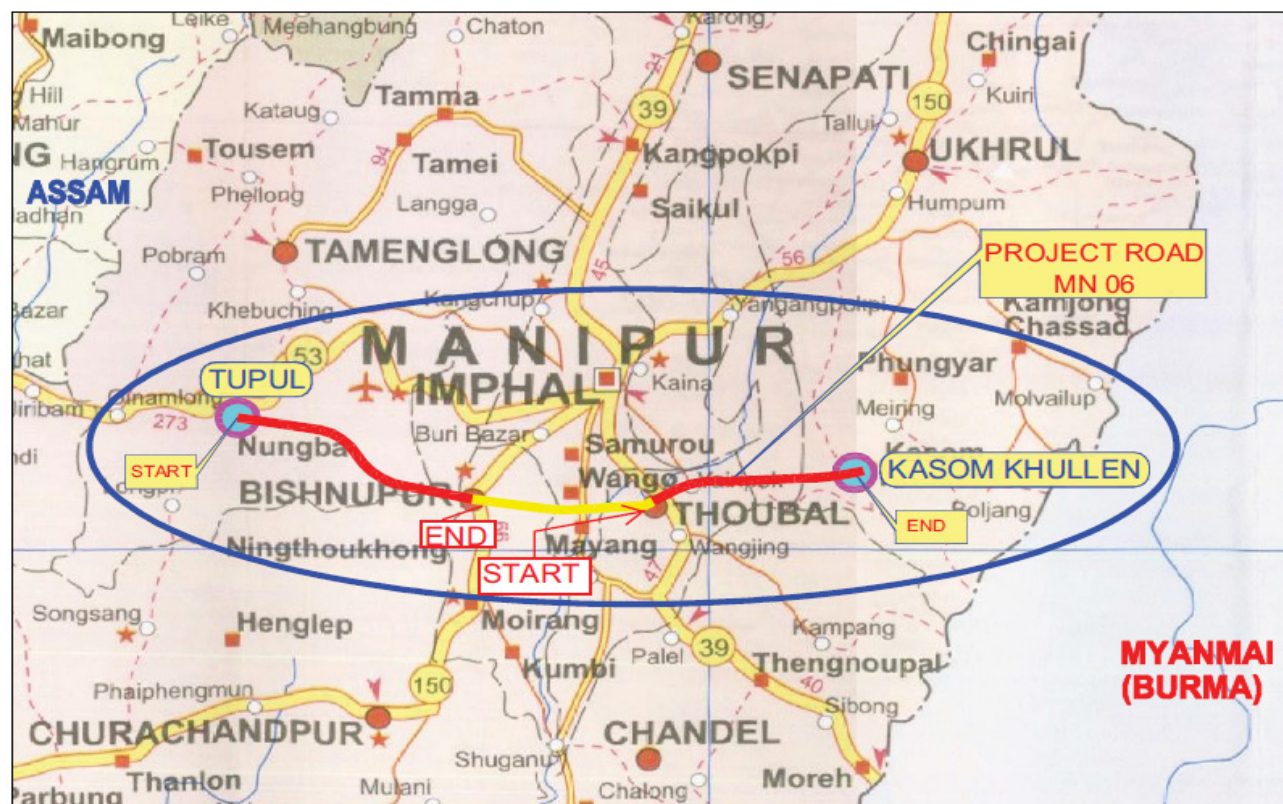
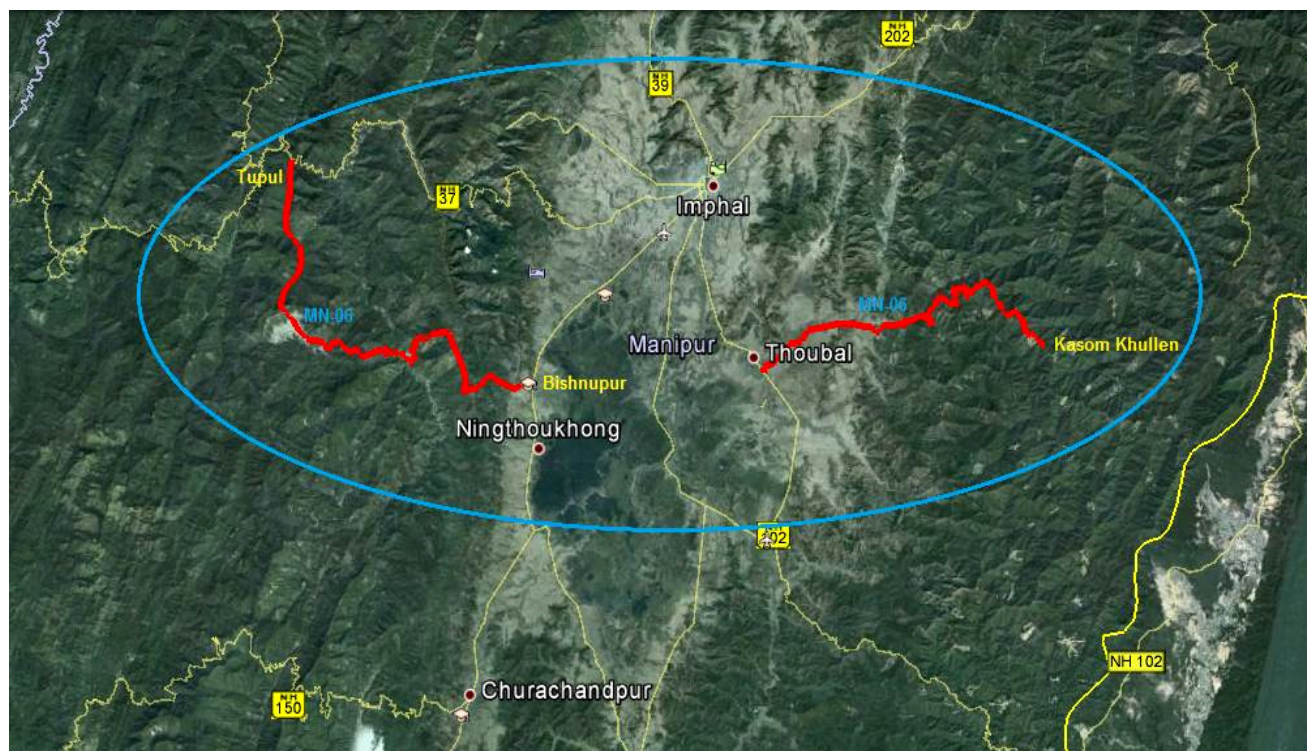


Figure 3.1: Index Map of the Project Road



**Figure 3.2: Project Road Sections on Google Earth Image**

40. **MN-06 (Section 1): Tupul to Bishnupur:** The project road section takes off from NH 53 in km 52.3 at Tupul and joins NH 150 at Bishnupur, about 26 km south of Imphal, the state capital. The project road section lies in mountainous terrain with curvilinear alignment comprising in sharp radii and bends including hair pin bends and steep gradients. The first 2 km stretch of the road, though MDR is a difficult track, with muddy and slushy roadway during rains and hardly jeepable. The remaining section upto Thangal is an earthen track without crust/pavement, suitable for jeepable traffic only. The section Thangal to Zouzangtek, though in hilly terrain with gentle slope, is again an earthen but jeepable track. The alignment is curvilinear in geometrics with not so steep gradients as compared to first section. The section from Zouzangtek to Bishnupur also lies in hilly terrain with comparatively flatter hill slope; once bituminous road, but now reduced to gravel road. The alignment is curvilinear in geometrics but the gradients are comparatively flatter. The road section passes through a few villages and settlements enroute, such as: Tupul (km 0), Charoi (km 4), Thangol (km 16), Dolang (km 28), Zouzangtek (km 32), Ngariyan (km 48) and Bishnupur town (km 51).

41. **MN-06 (Section 2): Thoubal to Kasom Khullen:** This section consists of three roads as:

42. **i) Thoubal to Yairipok road section** takes off from NH 39 in built up area. This section of the project road is State Highway, in a length of about 9 km. This is the only section of the project road, which has adequate traffic, generally local. The carriageway is intermediate lane, bituminous surface and it is in fair condition and well maintained. Land use along the road is generally agriculture and the road passes through built up areas scattered all along in plain terrain. The geometrics are easy and gradients flat. There are no major rivers or canal crossings. The project road section joins State Highway from Imphal to Yairipok. The road section passes through following villages' enroute such as Thoubal (km 1), Wangkhem (km 1), Bishnunanha (km 5), and Yairipok (km 8 and 9).



43. **ii) Yairipok to Chandrakhong section** of the project road takes off at the intersection with Thoubal – Yairipok road and is classified as State Highway. The road section passes through Yairipok town built up area for about 3 km intermittently. The road section passes through plain / rolling terrain with low embankment and some sections prone to submergence. The land use is mainly agricultural, besides quarrying alongside for sand and gravel. The existing road is single lane, bituminous surface but damaged in stretches. The road caters to local traffic mainly. The road passes through following villages and built up area as enroute such as Yairipok (km 1), Bamolleikai (km 4), Keikru (km 6), Khoirom (km 7), and Chandrakhong (km 9). The road alignment follows the topography of the terrain with flat geometrics and easy gradients.

44. **iii) Chandrakhong to Kasom Khullen section** is designated as State Highway, starting from Chandrakhong and joins Moreh – Kasom Khullen road and then leads to Kasom Khullen, a sub divisional headquarter in the Eastern part of Manipur. The road lies in Ukhrul district and passes through hilly terrain with a small length of about 2 km near Chandrakhong in the rolling terrain. The length of the section is about 35 km, subsequently confirmed by the state PWD, as there are no existing kilometre stone or distance markers, prior to carrying out topography survey. This section of the project road is single lane with WBM / gravel paved and some sections are even earthen, without any pavement. The existing pavement is badly damaged and even slushy in small stretches during rains. The road passes through forest area all along except for the initial 2 km which is agricultural and minor built up sections. There are not many villages except Chandrakhong (km 1), Bungba Khullen (km 14), Khamlong (km 17), and Kasom Khullen (km 23).

45. A number of streams cross the road sections which are bridged by narrow bridges. Two of these are temporary timber structure, narrow, damaged and without railings. The existing gradients of the road sections are not steep.

46. The project road passes through hilly terrain. Tupul to Bishnupur and Chandrakhong to Kasom Khullen sections pass through hilly terrain (about 59 km) whereas remaining portion passes through plain to undulating terrain (about 32 km). Pockets of reserve forests where exists on the hillocks. However, the improvement work will be done along the existing alignment and the available ROW is sufficient to accommodate the proposed improvement work. Therefore, there will be no acquisition of forest land and impacts of the proposed work will be minor and short duration. There are no environmentally critical areas in the project road. The cross sections are not uniform and vary widely in respect of formation width and the width of carriageway. Table 3.2 present details of existing road sections.

**Table 3.2: Details of the Existing Road Sections (MN-06)**

Sl. No.	Road	Terrain	Cut / Fill	Formation width (m)	Pavement width (m)	Shoulder width (m)
<b>Section 1: Tupul to Bishnupur</b>						
1.	Tupul to Thangal	Hilly	Hill cut	3-6	-	-
2.	Thangal to Zouzangtek	Hilly	Hill cut	4-6	Earthen/ No Pavement	-
3.	Zouzangtek to Bishnupur	Hilly	Hill cut	5-7	3 – 3.5m Granular / Worn out	1-1.5
<b>Section 2: Thoubal to Kasom Khullen</b>						
4.	Thoubal to Yairipok	Plain	Embankment height 0 – 1.5m	8	Intermediate lane - 5.5m	Earthen 0.7 – 1.5m

Sl. No.	Road	Terrain	Cut / Fill	Formation width (m)	Pavement width (m)	Shoulder width (m)
5.	Yairipok to Chandrakhong	Plain / Rolling	Embankment height 0-5 – 1.0m	5-6	Single lane WBM /BT road 3.5m	Earthen 1.0 – 1.5m
6.	Chandrakhang to Kasom Khullen	Rolling / Hilly	Embankment / Hill cut	4-6	Single lane WBM /gravel road 3.0 m 3.5m	Earthen 0.5 – 1.0m

47. The road sections are either only an earthen track or WBM / gravel road and in small stretches the pavement is bituminous. The present status of the pavement in various sections is given Table 3.3:

**Table 3.3: Details of Pavement on the Existing Road Sections (MN-06)**

Sl. No.	Road	Width (m)	Pavement thickness (mm)	Components	Condition
<b>Section 1: Tupul to Bishnupur</b>					
1.	Tupul to Thangal	-	-	-	Earthen track
2.	Thangal to Zouzangtek	-	-	-	Earthen track with small stretches in gravel
3.	Zouzangtek to Bishnupur	3.0 – 3.5	100-150	WBM / Gravel	Poor
<b>Section 2: Thoubal to Kasom Khullen</b>					
4.	Thoubal to Yairipok	5.5 (Intermediate lane)	150 – 200	Bituminous	Fair
5.	Yairipok to Chandrakhong	3.5 (Single lane)	100 – 150	Bituminous	Poor
6.	Chandrakhang to Kasom Khullen	3.0 – 3.5 (Single lane)	100 – 150	Bituminous /WBM / Gravel	Poor

48. The existing junctions and intersections are substandard and do not conform to IRC Standards. Tupul to Bishnupur section has 2 junctions whereas Thoubal to Kasom Khullen section has 4 major and 12 minor junctions.

49. There is only one bridge on Section 1 (Tupul – Bishnupur) at Chainage 49+130 which is a Bailey bridge 30 m span across a stream. On Section (Thoubal – Kasom Khullen) there are only 10 minor bridges. The width of carriageway over these bridges varies between 3.5 m to 7.5 m. Besides there are 75 culverts on Section 1 and 149 culverts on Section 2.

50. Following critical sections exist on the road.

- Steep gradient / substandard geometrics
- Low lying stretches
- Sections of road passing through reserve forest areas.

#### **D. Design Standards for the Project Road**

51. The IRC design standards have been followed in consultation with ToR, while formulating the road design standards. As the project road sections pass mainly through flat terrain, the ruling design speeds considered for the formulation of design standards are 100 km/hr. for plain sections. The purpose of formulation of design standards is to avoid any inconsistency in design during the road construction and operation.

#### **E. Engineering Surveys and Investigations**

52. Following surveys and investigations had been carried out on the Project roads for collection of data for incorporation in the DPR and evolve the design for improvement and upgradation.

- topographic surveys,
- traffic surveys,
- road and pavement condition survey and inventory,
- culverts and bridges condition survey and inventories,
- material surveys,
- hydrology studies for new bridge structures,
- Geotechnical investigations & subsoil exploration for structures, and
- existing utilities surveys.

53. These surveys had been carried out in accordance with the guidelines in IRC:SP:19 to fulfil requirement in the TOR.

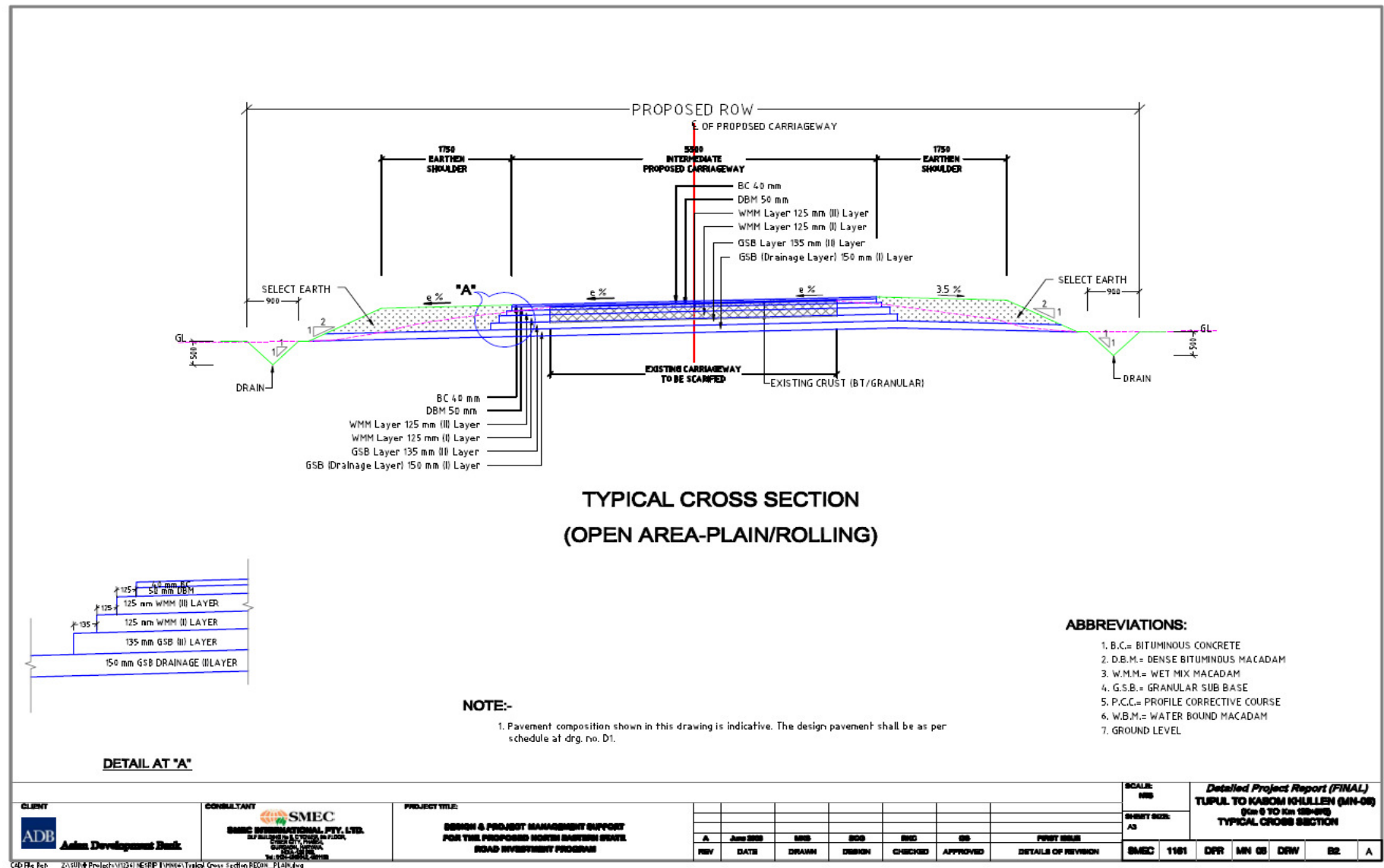
#### **F. The Design**

54. The improvement proposal involving design for the Project road specifies widening and strengthening of existing road. The design of the Project road incorporates the following design components:

- analysis of present traffic and future projections,
- analysis of present pavement structure and its strength and design requirements for the new pavement and overlay over the design period for widening and strengthening,
- determination of adequacy of the hydraulic capacity and structural parameters of the existing structures,
- determination of adequacy of the road's geometry (horizontal as well as vertical); and
- ensuring road safety aspects are addressed.



55. Figure 3.2a, and Figure 3.2b, shows the typical cross sections of the proposed roads.

Figure 3.2a: Proposed cross section in Open Area – Plain /Rolling



**TYPICAL CROSS SECTION  
(BULTUP AREA-PLAIN/ROLLING)**



<div> <b>Asian Development Bank</b></div>	<div> <b>SMEC</b> <b>SMBC INTERNATIONAL PTY. LTD.</b> <small>SU Kailash Road, 11 Crows Nest Rd, Chats City, NSW 1585 NSW, AUSTRALIA TEL: +61 (0)2 9550 6100 FAX: +61 (0)2 9550 6101</small></div>	<div>PROJECT TITLE:  <b>DESIGN &amp; PROJECT MANAGEMENT SUPPORT FOR THE PROPOSED NORTH EASTERN STATE ROAD INVESTMENT PROGRAM</b></div>								SCALE: NTH	<div><i>Detailed Project Report (FINAL)</i> <b>TUPUL TO KABOM KHULEN (MN-08)</b> (Km 0 TO Km 12+00) <b>TYPICAL CROSS SECTION</b></div>				
										SHEET SIZE: A3					
			A	June 2002	MNS	SGS	SHG	SB	FIRST ISSUE						
			REV	DATE	DRAWN	DESIGN	CHECKED	APPROVED	DETAILS OF REVISION						
											SMBC	1101	DFR	MN 08	DRW



56. **Lane Configuration:** As envisaged in traffic analysis, the Project roads need to be widened from single lane to intermediate lane configuration over the design life.

57. **Horizontal Alignment:** Horizontal alignment for the Project roads is proposed to follow the existing alignment, this being an existing road improvement proposal by way of widening and strengthening. The project road passes through different terrain e.g. plain / rolling / mountainous and the alignment is proposed to be designed accordingly. In the plain area the widening will be mostly concentric. But depending on the ground situation eccentric widening may also be evolved. For the road section passes through the mountainous terrain the widening is proposed to the extent possible by hill side cutting to accommodate the formation width, drains and breast walls.

58. In approaches to bridges and structures, which are proposed to be retained, and in the built up areas the widening is proposed concentric. Widening scheme and improvement proposal for the Project road is proposed mainly within the available ROW to avoid land acquisition/private properties, as far as possible.

59. **Horizontal Geometry:** The design is based on IRC: 38-1988. For the road sections passing through plain terrain the horizontal radii of the curves are kept in such a way so that land acquisition can be avoided. For the sections of the road that pass through hilly terrain the scope being limited to widening and strengthening, major changes in horizontal geometrics are not possible. The existing horizontal curves have been eased to the extent feasible considering the ground constraints.

60. **Vertical Geometry:** The Project road's vertical geometry has been designed following the guidelines contained in IRC: SP: 23-1993 and conform to the draft standards.

61. **Formation Width:** The project road sections are proposed to be widened from single lane to intermediate lane standards within the available ROW. Formation width for the proposed intermediate lane configuration shall be 9 m in plain areas and 7.8m in hilly terrain. All cross drainage structures, for culverts (upto 6 m), the formation width shall be normal roadway width given above in the plain / hilly terrain. For structures greater than 6 m in span, the minimum width (clear roadway between kerbs) shall be 7.5 m without footpaths.

62. **Carriageway Width:** The width of existing carriageway varies widely from section to section and so also the formation width. The road carriageway will be designed as intermediate lane carriageway (5.5 m).

63. **Right of Way (ROW):** The existing ROW is not demarcated on ground. As per PWD, ROW, between 15 to 20 m but is not of uniform width throughout the length of the road sections. Through built up sections, in small stretches, the ROW is restricted and varies between 8 m to 10 m. It is proposed to have minimum ROW, as per IRC:73-1980 ROW for a State Highway is 45 m in open areas and 30 m in built up areas. In some locations, in built up areas, the available ROW between properties lines on either side is as low as 7 m. In such locations, ROW shall need to be made up to accommodate improvement proposal.

64. **Bridges:** The improvement proposals of existing bridges and new construction of bridges have been included in the scope road work. Summary of existing bridges and improvement proposal / new construction is given in Table 3.4.

**Table 3.4: Existing and New Bridges under Road Work**

Particular	Type of Bridge					
	Section 1			Section 2		
	Major	Minor	Total	Major	Minor	Total
Existing bridges	0	1	1	0	10	10
To be retained with repairs	-	-	-	0	3	3
Under construction	-	-	-	0	0	0
To be reconstructed	0	1	1	0	7	7
New bridges proposed	0	0	0	0	0	0

65. **Culverts:** There are 224 culverts existing on the project road. Existing substandard HP culverts are proposed to be replaced with NP4 type culverts. Existing slab type culverts are narrow. The slab type culverts are proposed to be repaired/ replaced, depending upon condition and widened, if feasible. Similarly the Box culverts in good condition will be retained /widened. Other type of culverts like SPT and the buried ones will be reconstructed with Box/HP, as per site conditions. The proposal for existing culverts and new culverts is summarized in Table 3.5.

**Table 3.5: Existing and New Culverts Proposed for Improvement**

Particular	Type of Culvert					
	Section 1			Section 2		
	HP	Stone	RCC Slab	HP	Stone	RCC Slab
Existing culverts	64	2	9	120	11	149
To be retained	28	0	4	7	2	9
To be widened	0	0	1	0	0	0
To be reconstructed	36	2	4	113	18	9
New construction	129	0	0	0	0	0

66. **Pavement:** Pavement composition for widening / new construction / reconstruction of Project roads is given Table 3.6.

**Table 3.6: Pavement Composition for Project Road**

Crust Composition	Thickness (mm)
GSB	285
WMM	250
DBM	60
BC	40
<b>Total</b>	<b>635</b>

67. **Bus Bays / Lay byes:** Presently there are no bus bays on the Project roads. Bus bays have been proposed at appropriate locations on Project roads. Their locations are however, subject to confirmation by the State PWD with State Transport Department and the local authorities, to enable them arrange additional land for the bus bays and bus passenger shelters.

68. **Traffic Signs:** The Project roads are deficient in traffic signs. New traffic signs, as per guidelines, in IRC:67-2001, IRC:31-1969 and IRC:SP:31 are proposed. The traffic signs are broadly categorized as cautionary signs, mandatory signs and informatory signs.

69. **Traffic markings:** Road traffic markings with hot applied thermoplastic paint are proposed in accordance with clause 803 of MORT&H Specifications and IRC : 35-1997.

70. **Traffic Safety Features:** The project roads lack in required traffic safety features such as traffic signals, road safety barriers, delineators and footpaths etc. that should ensure safety of road users, vehicles and pedestrians as well as the road side population, through built-up areas especially near schools, educational institutions, commercial areas, religious places and other public utility locations. Following road traffic safety measures are provided:

- (i) Road Delineators
- (ii) Triangular Object Markers
- (iii) Rectangular hazard Markers
- (iv) RCC Guide Posts
- (v) Metal Beam Crash Barriers

71. The provision and installation of above safety features is proposed in conformity with guidelines contained in relevant IRC codes and MORT&H specifications.

72. **Arboriculture and Landscaping:** No landscaping except tree plantation under compensatory afforestation in lieu of trees to be cut is proposed under this project. The tree plantation is proposed to be got done through Forest Department. No landscaping is proposed along the Project roads due to budgetary constraints.

## **G. Critical Sections**

73. On sections of the road are prone to landslides and slips, provision of breast walls to check the slips and landslides and so also the vegetation growth in due course of time is made in the DPR.

74. **Steep gradients / substandard Geometrics:** The existing project road alignment section from km 0+250 to km 1+200 is sub standard both from horizontal alignment and vertical profile standards. The improvement along this is not possible / feasible. It has been proposed to realign the road in this section along an alternative alignment in a length of about 3.20 km, as a new road altogether. This alignment has been identified in consultation with the state PWD engineers.

75. **Land Slides & Slip prone stretches:** Section between Yairipok and Chandrakhang,(i.e. between km 89+125 and km 96+450) is low lying stretch and get submerged and overtopped during rains and floods. Due consideration has been taken while doing the vertical profile of the project road to raise the low lying sections above the HFL to avoid submergence.

76. **Section of the road passing through Reserve Forest Areas:** Approximately 50 km in Section 1 of the project road passes through what appeared to be reserved forest and approximately 23 km in Section 2 of the project road passes through what appeared to be reserved forest. Land acquisition from reserve forest has been avoided by restricting the proposed improvement work to the available land. Clearance from district forest office shall be obtained for cutting of road side trees.

## **H. Road Construction Materials**

77. Material Survey for road construction materials for the Project roads, i.e. earth, aggregates, water, bitumen etc. has been carried out in the Project corridor and the indicative lead charts have been prepared.

78. Besides, the field in-situ investigations were conducted. The materials samples collected were tested in the laboratory and results data compiled in Material Report Volume III of the DPR.

79. The lead involved for the project roads and the investigations are quite representative, but more extensive investigation shall need to be conducted by the contractors at the time of construction, for earth and aggregates available from such sources.

## **I. Road Protection Work**

80. The project road passes through plain / hilly terrain. The terrain in hill side is undulating in horizontal geometry, resulting in frequent zig zag configuration in the horizontal alignment necessitating protective works to retain earth fill in stretches as well as to retain unstable hill side cut particularly in soil and soil mixed with boulders and soft rock. The stability of road formation and safety of road traffic are ensured by providing protective works in hilly terrain, as made by providing retaining walls, breast walls and parapet walls/guide posts/railings/edge stones.

## **J. Safety Audit**

81. A separate safety audit has not been carried out because most of the recommendations would not be possible to be implemented as these would involve extensive land acquisition, adverse environmental issues, and rehabilitation and resettlement concerns. The designers have attempted to eliminate the most serious safety issues through a smart design, to ensure improvement within the available ROW as far as possible.

## **K. Summary of Proposed Improvement Works**

82. The salient proposals for upgradation and improvement of the existing road are classified into the following engineering aspects.

- Widening of the carriageway width to 5.5 m with shoulders and side drains. Total formation width is 7.8 m (general) and 8.7 m including drains. The road more or less follows the existing alignment and profile. The widening will be accommodated within available land-width and there will not be any significant land acquisition either forest land or private land.
- All the structures greater than 6m span the minimum width formation width shall be 7.5 m without footpaths. In plain terrain, the formation width proposed is 9m.
- Horizontal alignment for the project roads is proposed to follow existing alignment. The widening is proposed to the extent possible by hill side cutting except for the bridges and structures proposed to be retained and in these sections the proposed widening will be concentric. Widening and improvement scheme is done in such a fashion so that the land acquisition will be minimal.
- Horizontal geometry will be based on IRC:38-1988 "Guidelines for Design of Horizontal Curves for Highways and Design Tables (First Revision)".

- Vertical geometry will be based on “IRC:SP 23-1993”.
- The existing ROW is not demarcated on ground. As per PWD, the average ROW is limited to the formation width in hilly terrain and not uniform. Through built up sections, in small stretches, the ROW is restricted and varies between 7 m to 10 m. It is proposed to have minimum ROW, as per IRC:73-1980.
- Bridges: There is only one bridge on Section 1 (Tupul – Bishnupur) at Chainage 49+130 which is a Bailey bridge 30 m span across a stream. It is proposed to replace this bridge. On Section (Thoubal – Kasom Khullen) there are 10 minor bridges. 3 bridges will be retained 7 will be reconstructed.
- Cross drains: There are 75 culverts on Section 1 and 149 culverts on Section 2. Existing substandard HP culverts are proposed to be replaced with NP4 type culverts. Existing slab type culverts are narrow. The slab type culverts are proposed to be repaired/ replaced, depending upon condition and widened, if feasible. Similarly the Box culverts in good condition will be retained /widened. Other type of culverts like SPT, and the buried ones will be reconstructed with Box/HP, as per site conditions.
- Pavement profile will have a 285mm, 250mm, 60mm, and 40mm thicknesses for GSBC, WMM, DBM, and BC respectively.
- Tupul to Bishnupur section has 2 junctions whereas Thoubal to Kasom Khullen section has 4 major and 12 minor junctions. These junctions will be improved.
- Road protection work such as retaining walls, breast walls and parapet walls/guide posts/railings/edge stones are provided at critical sections.
- Road safety measures like road delineators, signages, crash barriers, and guide posts will be installed.

#### **L. Project Cost**

83. The cost of civil works including maintenance amounts to Rs.277.01 crores ( or USD 51.3 millions. These costs are based on 2011 rates as per analytical rates. The maintenance component in Part D of the Cost Estimate is based on an average 3% of total cost of Civil Works for 3 years (36 months. This component shall not be undertaken as part of contract for Civil Works, but to be undertaken separately subsequent to the construction.

#### **M. Construction Packaging and Implementation Schedule**

84. It is proposed to carry out construction of the Project road in two contract packages (MN-CW1 and MN-CW2) with a length of 93.2 km simultaneously in three years for each contract. The project is proposed to be undertaken through International Competitive Bidding (ICB). Currently the project is at bidding stage and scheduled to award contract in the second quarter of 2013.

#### **N. Project Benefits**

85. The implementation of the various project items is envisaged to have the following direct benefits:

- improved quality of life for the rural population in the project influence area (six districts and provide connectivity to three national highways i.e. NH-53, NH-150 and

NH-39): this as a result of better access to markets, health, education and other facilities; and the derived stimulus for local economic activity;

- a more efficient and safe road transport system: through reduced travel times, reduced road accidents, reduced vehicle operating and maintenance costs and reduced transportation costs for goods;
- the facilitation of tourism; and
- interstate connectivity to six districts of Manipur.

#### IV. DESCRIPTION OF THE ENVIRONMENT

86. A brief description of the existing environment, including its physical and ecological resources, economic development of the region, and issues relating to quality of life are presented in this section. Broad aspects on various environmental parameters like geology, soil, topography, climate, land use, water resources, water quality, air quality, noise quality, tourism, cultural resources which are likely to be affected by the proposed road improvement project are described herewith.

##### A. Physical Environment

##### 1. Topography, Geology, and Soil

87. Manipur, one of the eight sisters of the north eastern region in India, is an isolated hill-grit state located between  $90^{\circ}03'E$  and  $94^{\circ}42'E$  longitude and  $23^{\circ}50'$  and  $25^{\circ}42'N$  latitude. The state is encircled by nine hill ranges on all sides with a small oval valley at the centre. The state has 352 km long international border with Burma to the south-east and 502 km border with the adjacent states of Nagaland on the north, Cachar district of Assam in the on the west and Mizoram on the south and the south west. The altitude of the state above the mean seal level varies from 790 meters to 2020 meters.



Figure 4.1: Project road through hill section

88. The state has a total geographical area of about 22327 sq km. which constitutes 0.7 percent of the total land surface of the country. Ninety percent of the total area of state is covered by hills; remaining area is a small valley. About 68 percent of the area is recorded as under forest. The population of the state stood at 2.39 million in 2001 of which 76 percent is rural.

89. The topography of the project area is mixed type. Tupul to Bishnupur and Chandrakhong to Kasom Khullen sections pass through hilly terrain (about 59 km) whereas remaining portion passes through plain terrain (about 33 km). Pockets of reserve forests where exists on the hillocks. Land use is mainly agricultural followed by residential and forest type. Figure 4.1 shows the typical terrain along the project road whereas Figure 4.2 shows that topography and land use along



Figure 4.2: Terrain and land use along the Project road



the project road marked on the Google-earth image.

90. The oldest rocks in Manipur include shales, slates, siltstone, sandstone and quartzites. Geologically, Manipur can be said to belong to recent formation, which has implications on the prospect of mineral exploitation. The surface rock is loose and soft in nature and, therefore vulnerable to the weathering process. This peculiar characteristic also accentuates erosion, silting and sedimentation.

91. Hill soils being acidic are not suitable for much plant growth and traditional shifting cultivation together with indiscriminate cutting and burning of forest (jhum) over the years have seriously affected the ecological balance leaving the soil barren. In the valley region the deep soils are poorly drained and low in available phosphorus content. They are also susceptible to flood hazards.

92. Map showing physical features of the state is presented in Figure 4.3. It can be seen from the map that physiographically the project road sections i.e. Tupul to Bishnupur and Chandrakhong to Kasom Khullen, are lying on the high hill slopes and ridges. The area between these two road sections is mostly marshy land surrounded by inner hill basins.

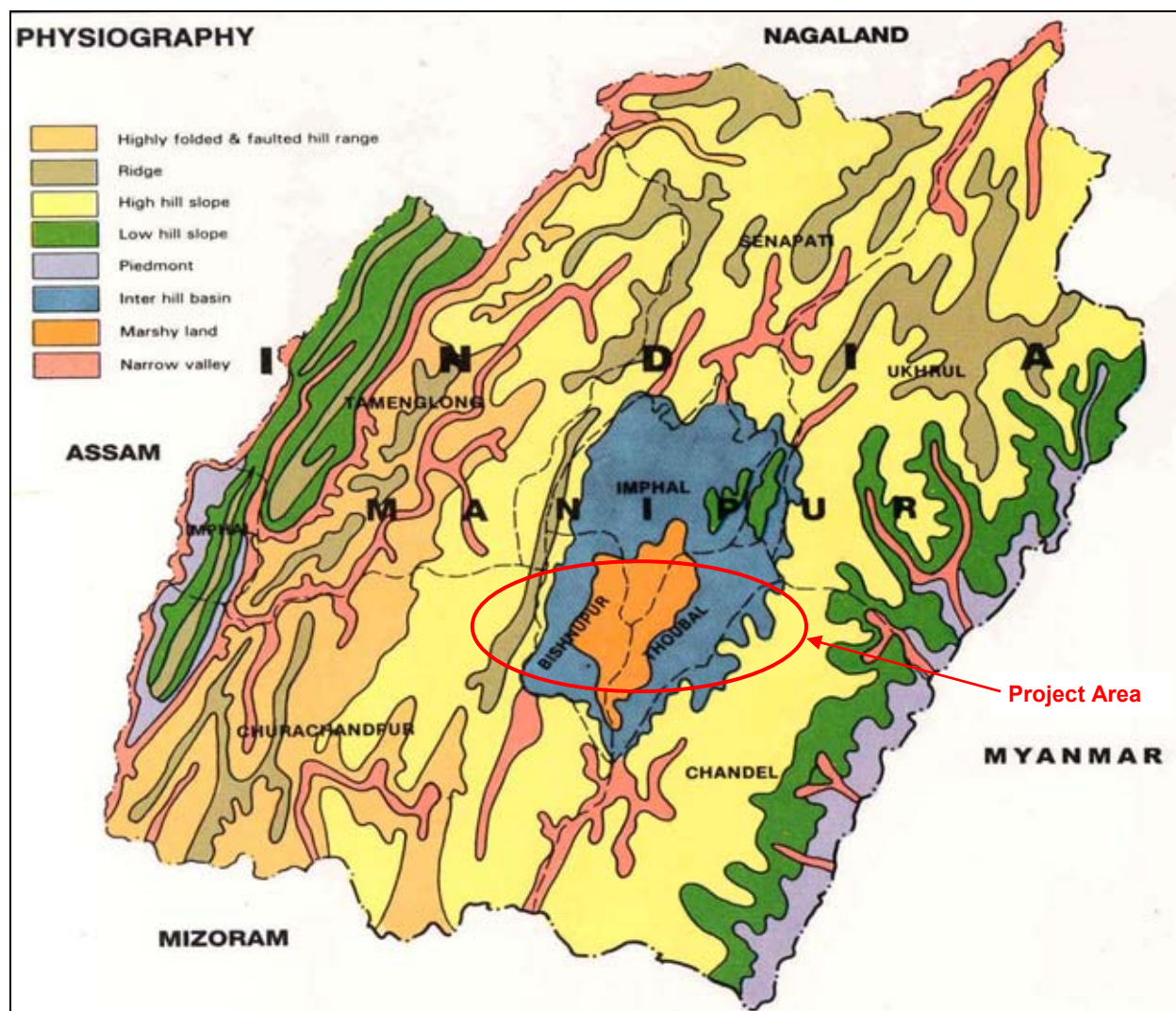


Figure 4.3: Physiographical Map of Manipur State



## 2. Climate

93. The state has subtropical temperate climate. Rainfall is relatively abundant and widespread. The rainy season starts in June with the onset of the south-west monsoon and last upto September. Intermittent rains continue even upto October along with the retreat of the monsoon. During the rainy season the rain water in the hills quickly flow down to the valley and all the rivers and small streams rises to the full brim, frequently flooding its embankments. The cold season last from the month of December to February. During the winter months light rainfall occurs under the influence of the north-east monsoon, March and October are by far the most pleasant months in the year. April and May are not hot season followed by occasional thunder storms.

94. The annual rainfall of Manipur in 2001 was to be 1769 mm as against the normal rainfall of 2000mm. The state has a salubrious climate. The summer months are never oppressive with the average maximum temperature fluctuating from 32°C to 35°C during April-June, the mercury seldom going beyond 37°C. In December-February with the start of the cold winter months the average minimum temperature fall to 6°C to 4°C.

95. The salient climatic features of the state are as fallow:

Average Annual Rainfall	-	2000 mm
Concentration of precipitation-		June to October
Humidity	-	79 to 96%
Cloudiness	-	Heavily clouded
Wind	-	Generally light except rainy season
Temperature	-	Summer      32°C to 35°C
		Winter        6°C to 4°C

## 3. Water Resources and Water Quality

96. The state has vast water resources in the form of lakes, ponds, rivers and streams, some with marshy areas. It has abundant of water potential both ground as well as surface water. Important rivers that flow through the project region are the Imphal and the Thoubal. The Thoubal river originates in the hill ranges of Ukhrul and is an important tributary of the Imphal river. On its course, it passes through Yairipok and Thoubal before joining the Imphal at Irong near Mayang Imphal. The Imphal river rises in the hills of Senapati district and flows south. During the dry seasons these rivers are lean and thin but, during the rainy monsoon periods these rivers are very wild and frequent flood occur causing widespread damage to the paddy fields, property and life. Other rivers in the region are the Wangjing, the Arong and the Sekmai. These rivers originate in the hills of Ukhrul district. Table 4.1 list out the major rivers which cross the project road. Besides these rivers there are several small streams and small ponds exist along the project road.

**Table 4.1: Major Rivers along the Project Road**

Sl. No.	River Name	Chainage (Km)	Width of the River Crossings (m)
<b>Section 1: Tupul – Bishnupur</b>			
1.	Chinicol River	48+586	Minor
<b>Section 2: Thoubal – Kasom Khullen</b>			
2.	Khoirom River	9+600	Minor
3.	Khoirom River	10+800	Minor
4.	River (Bridge)	11+300	Minor
5.	River (Bridge)	11+500	Minor
6.	River (Bridge)	15+750	Minor
7.	River (Bridge)	17+500	Minor
8.	River (Bridge)	18+350	

97. The ground water aquifers in the region occur in sediments and fractured rocks. Springs are either seasonal or perennial and are often used for irrigation and drinking purposes. There are number of hot springs in the region which are being used by the local communities for domestic and agricultural purposes and also being used by the visiting tourists.

98. The surface water quality in the region is reported to be well within the permissible limits and also found by visual identifications. There are no reports of any water born disease in the region. People are using this water for drinking purpose without any treatment.

99. In case of ground water quality, it is generally good in entire north east region. People use ground water for domestic purposes without any treatment. Overall ground water quality is acceptable.

#### **4. Air Quality**

100. The ambient air quality in the state is quite pure compared to other neighbouring states. Except few urban centres like Bishnupur and Thoubal, the ambient air quality is good. There are no major industrial activities in the State. Dust arising from unpaved surfaces, forest fire, smoke created by burning of fire woods for producing charcoal and domestic heating, and vehicular pollution are sources of air pollution in the region. Firewood burning is major contributor in the ambient pollution load. Industrial and vehicular pollution is mainly concentrated in the major commercial areas. Lack of technology and state of the art equipments are some of the factors responsible for industrial pollution.

101. Vehicular pollution is a secondary source of pollution in the state as the traffic density in the entire state is very less. Pollution from vehicles is mainly due to use of low-grade fuel, low maintenance of vehicles, and also the poor conditions of the roads. The level of pollution in rural areas is much lower than that of the urban areas. Also, the traffic flow in rural areas much less than that of the urban locations. The traffic density in the state is very low. About 30 % of the vehicles consist of two wheelers followed by cars and trucks.

102. There is no data available regarding the air quality in the project areas Bishnupur and Thoubal area. However, during the discussion with Manipur Pollution Control Board officials, it is reported that the ambient air quality in the project areas is well within permissible standards.

During the field surveys sources of any point or non-point air pollution were not observed throughout the project roads. The traffic on the roads is too low to cause any air pollution due to vehicle exhaust. There are no industries in or along the roads in project area and hence any source of atmospheric air pollution is not expected.

## 5. Noise Quality

103. Noise pollution is not a problem in the project areas. Also in future there will not be any rise in the noise levels due to proposed activities as also there are no major settlements along the proposed subproject road sections. Since the traffic flow is expected to be very low in the project road, there will not be any rise in the noise levels. However, few commercial locations i.e. Bishnupur and Thoubal small contribution to noise levels are expected, but still the ambient noise quality is expected to be well within the permissible limits.

104. During the construction period, temporary increase in the noise levels are expected due to movement of construction machineries and construction activities associated with proposed road development. Suitable measures in the form of noise barriers and timely scheduling of construction activities will minimize these affects to the greater extent.

## B. Ecological Environment

### 1. Vegetation

105. In spite of its small size, the state's vegetation is rich and varied in character. This is because of its different climatic conditions found in the state and its peculiar physiography. The forest area of the state falls into four distinct zones viz. i) Burma drainage forests, ii) Urkul pine forests, iii) forests overlooking the valley and iv) Barak drainage forests.

106. In Manipur, the forest area covers about 17219 sq.km land area which is about 78 percent of total geographical area of the state and 2.54 percent of country's forest cover. The areas under reserve forests and protected forests stood at 1467 sq.km and 4171 sq.km respectively. The remaining forest area is unclassified forests. Figure 4.4 show the distribution of forest area of Manipur. Vegetation map and Forest map of the Manipur state are presented in Figure 4.5 and Figure 4.6 respectively.

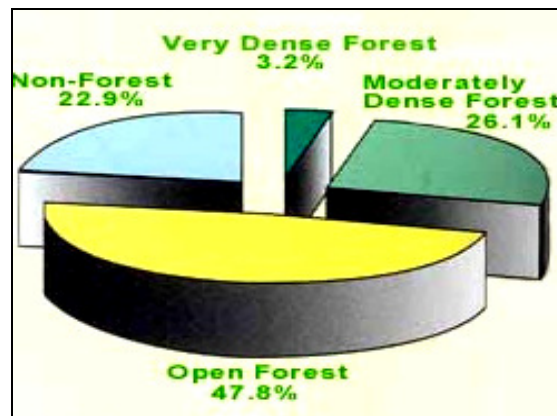


Figure 4.4: Distribution of Forests in the State

107. Blessed with an amazing variety of flora and fauna, 67% of the geographical area of Manipur is hill tract covered forests. Depending on the altitude of hill ranges, the climatic condition varies from tropical to sub-alpine. The wet forests and the pine forests occur between 900-2700 m above MSL and they together sustain a host of rare and endemic plant and animal life. Coveted the world over as some of the most beautiful and precious blooms, orchids have an aura of exotic, mysteries about them.

108. In Manipur, they are abound in their natural habitat growing in soil or on trees and shrubs speaking their beauty and colour, stunning the eye that is not used to seeing them in

such profusion. There are 500 varieties of orchids which grow in Manipur of which 472 have been identified.

109. In addition to 'Siroi Lily' which is the only terrestrial lily grown on the hill tops of Siroi hill, Ukhrul, the Hoolock Gibbon, the Sloe Loris, the Clauded Leopard, the Spotted Linshang, Mrs. Hume's Barbacked Pheasant, Blyths Tragopan, Burmese Pea-Fowl, four different species of Hornbills etc. form only a part of the rich natural fauna of Manipur. However, the most unique is the Sangai the dancing deer. The floating mass of vegetation on the Loktak Lake sustains small herds of this endemic deer which unfortunately has the dubious distinction of being the most threatened Cervid (known as Phumdi) in the World. Other mentionable fauna is Salamander known as 'Lengwa' found at the foothill of Siroi in Ukhrul.

110. The major species of vegetation available in the state include Teak, Uninhou, Khasi-pine, Dipterocarpes species, Michelia, Champa, Terminalia, species, Cedrela Toona, Schima Wallichii etc.

111. Vegetation along the project road sections Tupul to Bishnupur and Chandrakhong to Kasom Khullen, are mostly covered by the dry deciduous forest, thick grass, agriculture and current jhum as shown in the map (Figure 4.5).

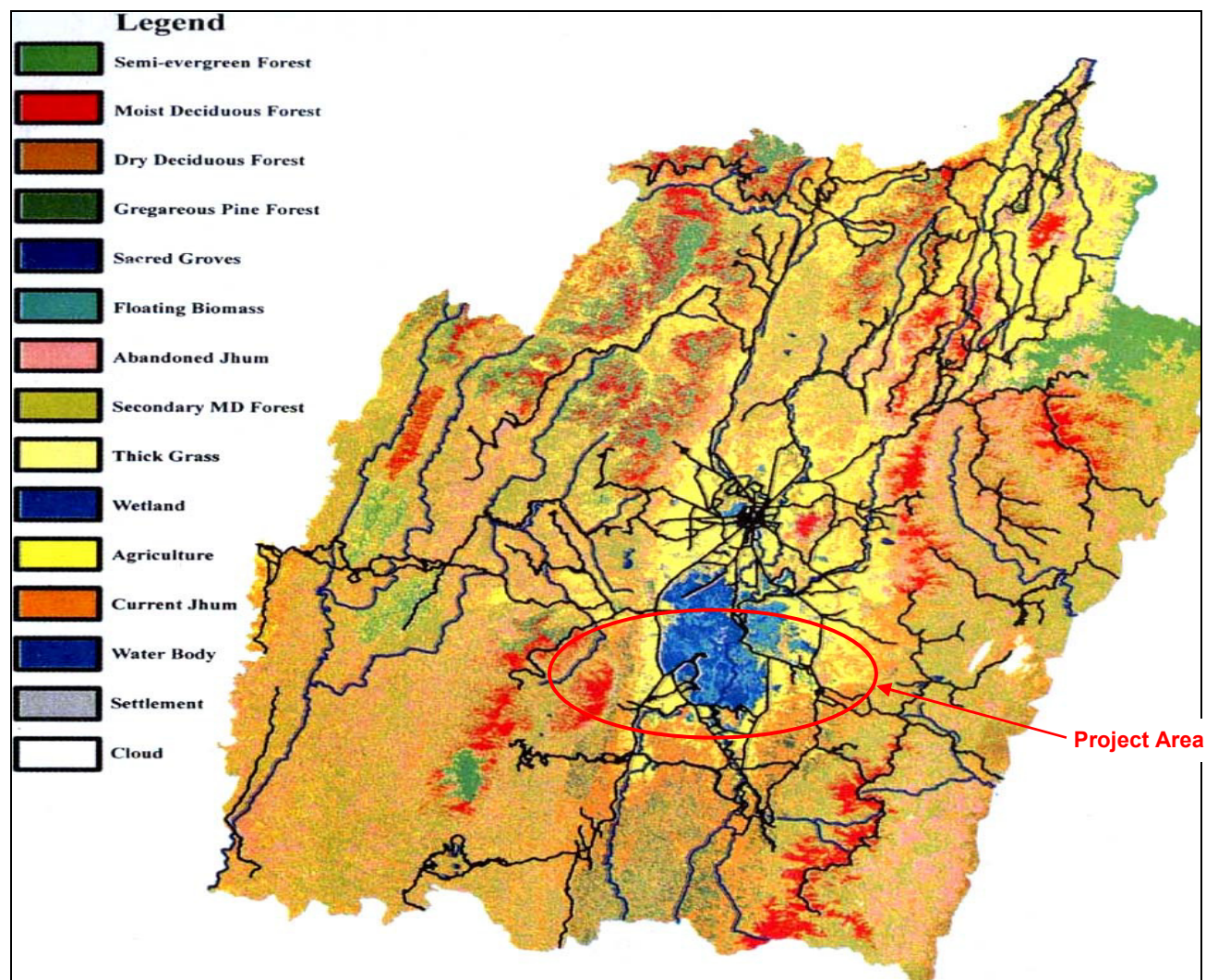
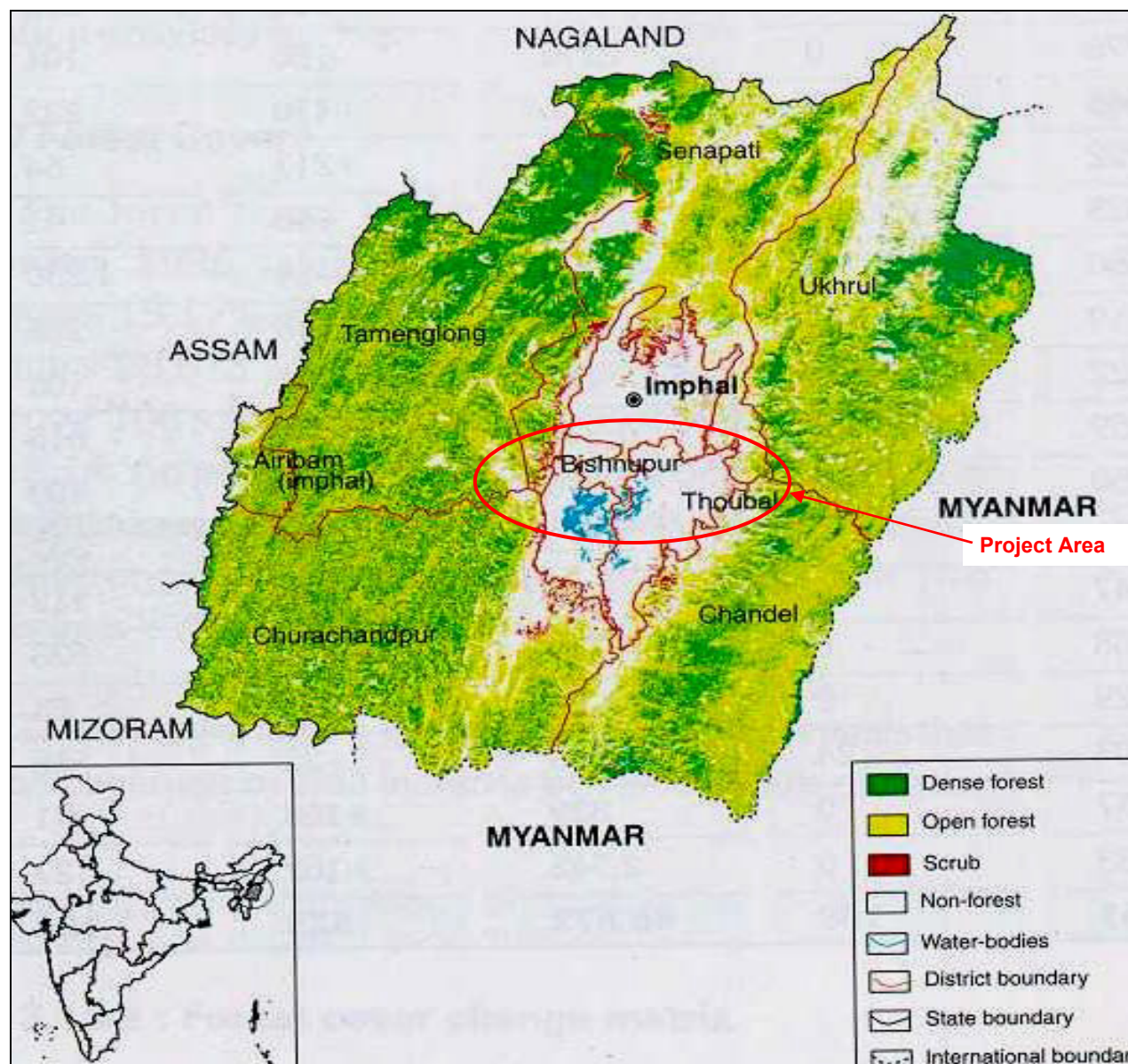


Figure 4.5: Vegetation Map of Manipur State (Source: MRSAC, Imphal)





**Figure 4.6: Forest Map of Manipur State** (Source: State of Environment Report, Manipur)

112. Forests along the project road sections Tupul to Bishnupur and Chandrakhong to Kasom Khullen, are mix of open forest, dense forests and part of non-forest areas as shown in the map (Figure 4.6).

## 2. Wildlife and Protected Area Network of Manipur

113. The State has rich wildlife and has long network of protected area. In order to protect the rich flora and fauna of Manipur from the poacher, the Government has established parks and sanctuaries. The state's protected area network comprises of five wildlife sanctuaries and two national parks. Recognizing the importance of this region as one of the hot spots, majority of the biodiversity rich areas of the state has been placed inside the protected area network system comprising mainly of the National Park and Sanctuary.

114. In the State, conservation of wildlife is carried out in two categories as ex-situ conservation and in-situ conservation.

115. **Ex-Situ Conservation:** The wildlife is located/ transported from their natural habitat to an area well protected from outside elements and preserved there. An example of this category is the Manipur Zoological Garden at Iroishemba, Orchid Preservation Centre at Khonghampat, Arboretum etc.

116. **In-Situ Conservation:** Areas having adequate natural flora and fauna are declared as National Parks and Wildlife Sanctuaries. They are known as the Protected Areas Networks (PAN). The entry of human and cattle inside the area is strictly under control. No dead, dying or diseased plants can be removed from such areas. The examples of this category are the Keibul Lamjao National Park and Yangoupokpi Lokchao Wildlife Sanctuary.

117. The details of sites are given in Table 4.2. Figure 4.7 show the protected area map of the Manipur. The total area under the protected area network is 1 percent of total geographical area of state and that of under national parks is 0.2 percent.

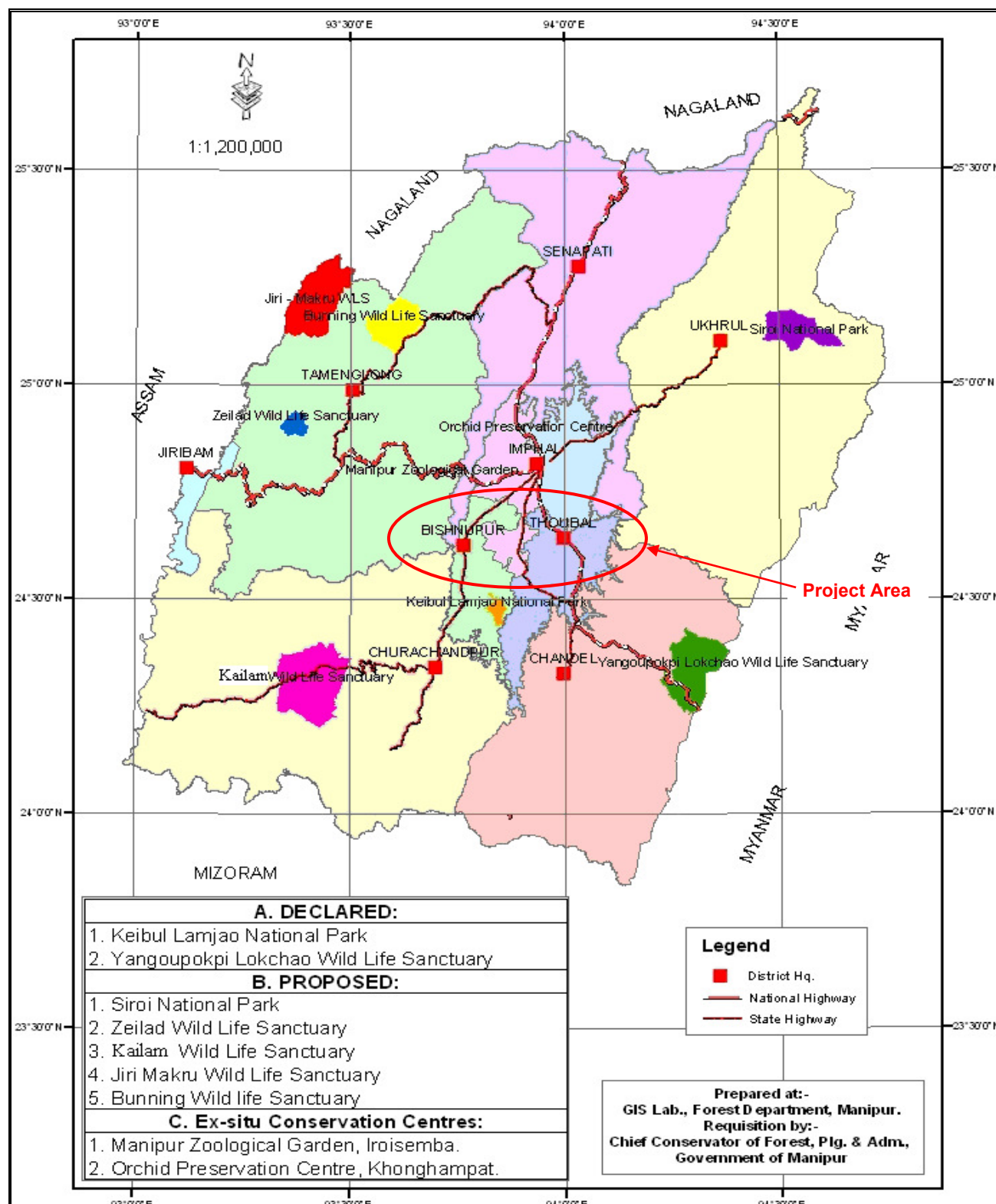
**Table 4.2: Protected Area Network in the State of Manipur**

Sl.	Protected Area	Location (District)	Area in sq.km
<b>A.</b>	<b>In-situ Conservation Sites</b>		
1	Keibul Lamjao National Park	Keibul Lamjao (Bishnupur Dist.)	40.00
2	Yangoupokpi Lokchao Wildlife Sanctuary	Lokchao (Chandel Dist.)	184.80
3	Shiroi Hill National Park	Ukhrul (Ukhrul Dist.)	41.00
4	Kailam Wildlife Sanctuary	Churachandpur Dist.	187.50
5	Jiri-Makru Wildlife Sanctuary	Tamenglong Dist.	198.00
6.	Bunning Wildlife Sanctuary	Tamenglong Dist.	115.80
7.	Zeliad Wildlife Sanctuary	Tamenglong	21.00
<b>B.</b>	<b>Ex-site Conservation Sites</b>		
1	Manipur Zoological Garden	Iroisemba, Imphal West	0.08
2	2nd Home SANGAI	Iroisemba, Imphal West	0.60
3	Orchid Preservation Centre	Khonghampat, Imphal West	0.50

Source: Statistical Booklet of Manipur Forest (2008-2009), Wildlife Wing, Forest Department, Government of Manipur

118. In the state, in spite of its rich vegetation, due to the absence of any forest worth the name within the district wild animals are not found abundantly, Deer and Jungle fowl are some of the varieties found at present occasionally along the slope of eastern hills adjoining the district. But the lakes support a variety of wild birds such as partridge, snipe, duck, geese, etc. particularly in winter months. These birds are mostly migratory in character. Some of them are seen coming from far off Siberia. With the gradual conversation of the lakes into agricultural lands these migratory birds are seen in increasingly fewer members in recent times.

119. It can be seen from the map (figure 4.7) that the project section sections Tupul to Bishnupur and Chandrakhong to Kasom Khullen, neither encroaches nor passes by any of the protected areas of Manipur. However, it passes through the stretches of reserve forests and village forests (do not have legal status) that is being managed by village management committees. Pockets of forests areas are from chainage km 3.0 to 15.0, 16.0 to 18.0, 19.0 to 31.0, 32.0 to 42.0, and 43.0 to 47.0 in section 1 and from km 28.0 to 40.0 in Section 2.



Source: Wildlife Wing, Forest Department, Government of Manipur

**Figure 4.7: Protected Area Map of Manipur State**

## C. Socio Economic Environment

### 1. Demography

120. Manipur is one of the sisters' states in north eastern state a population of 2.38 million with about more than 75 percent of the population living in the rural areas. The human population density is very less (only 107 persons/km<sup>2</sup>) compared to 149 persons/km<sup>2</sup> for the north eastern region. Sex ratio is 978 against the 936 in the region. The demographic feature of north eastern states is unique in that there are more than 29 recognized tribes, which inhabit mostly the hill areas and each with distinct culture, ethos, and traditional knowledge systems. The major minority groups in the state namely Aimol, Anal, Angami, Chiru, Chothe, Hmar, Kabui, Kacha Naga, Mizo, Mao, Lusai etc. The majority of the people survive on subsistence economy based mainly on the agriculture, supplemented with limited horticulture, animal husbandry, crafts/handloom, etc. Table 4.3 presents the demographic features of the state and the North eastern region.

**Table 4.3: Demographic Features of Manipur and North Eastern Region as per 2001 census (p)**

State	Area (sq. km)	Population			Density	Sex Ratio
		Rural	Urban	Total		
Manipur	22,327	1818,224	570,410	238,8634	107	978
NE Region	262,179	3,3008,703	5,809,395	3,904,1167	149	936
All India	3,287,263	741,660,293	285,354,954	102,701,5247	312	933

Source: 1) Census of India, 2001 (Provisional), 2) Statistical Abstract of State Governments, Directorate of Economics and Statistics, 3) Where do we stand in 2003, Meghalaya & North East and India & The World, Directorate of Economics & Statistics, Government of Meghalaya

121. The Net State Domestic Product at constant (1993-94) prices in the year 2001-02 was Rs.19350 million, with annual growth of around 6 per cent. Per capita income at constant prices in 2001-02 was Rs.7976 (against Rs.10754 for the country as a whole). Agriculture continues to be a major contributor for the economy.

122. The progress on industrial front has been constrained by many factors particularly the lack of appropriate infrastructure, lack of raw materials and trained manpower.

### 2. Land Resources

123. The area available for land utilization in the state is about 19052 sq.km out of the total geographical area of 22327 sq.km. This means about 85 percent of the area in the state is available under various land uses. Major portion of the land use is under forest cover covering about 70 percent of the land use area. About 8 percent area is under gross cropped area. Agriculture is the second major land use in area. The area under various land uses in the region is presented in the Table 4.4.



**Table 4.4: Land use pattern in North East Region (Figure in thousand hectare)**

State	Reporting area for land utilization	Forest area	Not available for cultivation	Other uncultivated land excluding fallow land	Fallow land	Gross cropped area	Net area sown	Area sown more than once	Total
Manipur	1905.2	1741.8	269.5	82.6	3.3	182	140	42	2461.2
NE Region	21754.5	13379	3296.8	1624	913.6	5448.6	3891.1	1557.5	30110.6

Source: www.neportal.org (Directorate of Economics and Statistics, NE states and NEC, Shillong).

Statistical Abstract (2001-02), Sikkim, Directorate of Economics and Statistics, NE States.

### 3. Agriculture and Forestry

124. Agriculture is the mainstay of the people. It contributes major shares in the state domestic product and provides employment to about 63 percent of total working force in state. Total net sown area is 160,000 hectares. Rice is principal food grain followed by maize and millets. An annual production of 366,000 tons of rice was registered in 2000-01. Sugarcane is another cash crop.

125. The socio-economic life of people centres on the forests. As mentioned earlier they cover about 70 per cent of the total geographic area of the state. Wide varieties of bamboos, orchids, aromatic and medicinal plants are found in the State.

### 4. Fisheries

126. Though the state has no marine fishery, it has vast inland fishery resources like ponds, tanks, natural lakes, marshy areas, swampy areas, rivers, reservoirs, submerged cropped land, paddy field etc. The largest source of fish is the Loktak Lake. The production of fish in Manipur for the year 2001-02 was estimated to be 16.5 thousands tones as against the 16.05 in thousand tons in the year 2000-01 showing an increase of 2.8 percent over the previous years.

127. The important fishes commonly found in the region's plain and river basins are *Catla catla*, *Labeo rohita*, *Labeo calbase*, *Cirrihinus mirigale*, *Clarius*, *batrachus*, *Rita rita*, *Heteropneustus fonilis*, *Notopterus nontopterus*, *N. Chitala*, *Macrobrachum rosenbergii*, *M. malconsoni*, *M. Chapral*, *Channa punetatus* *C. gaehua*, *C. striatus*.

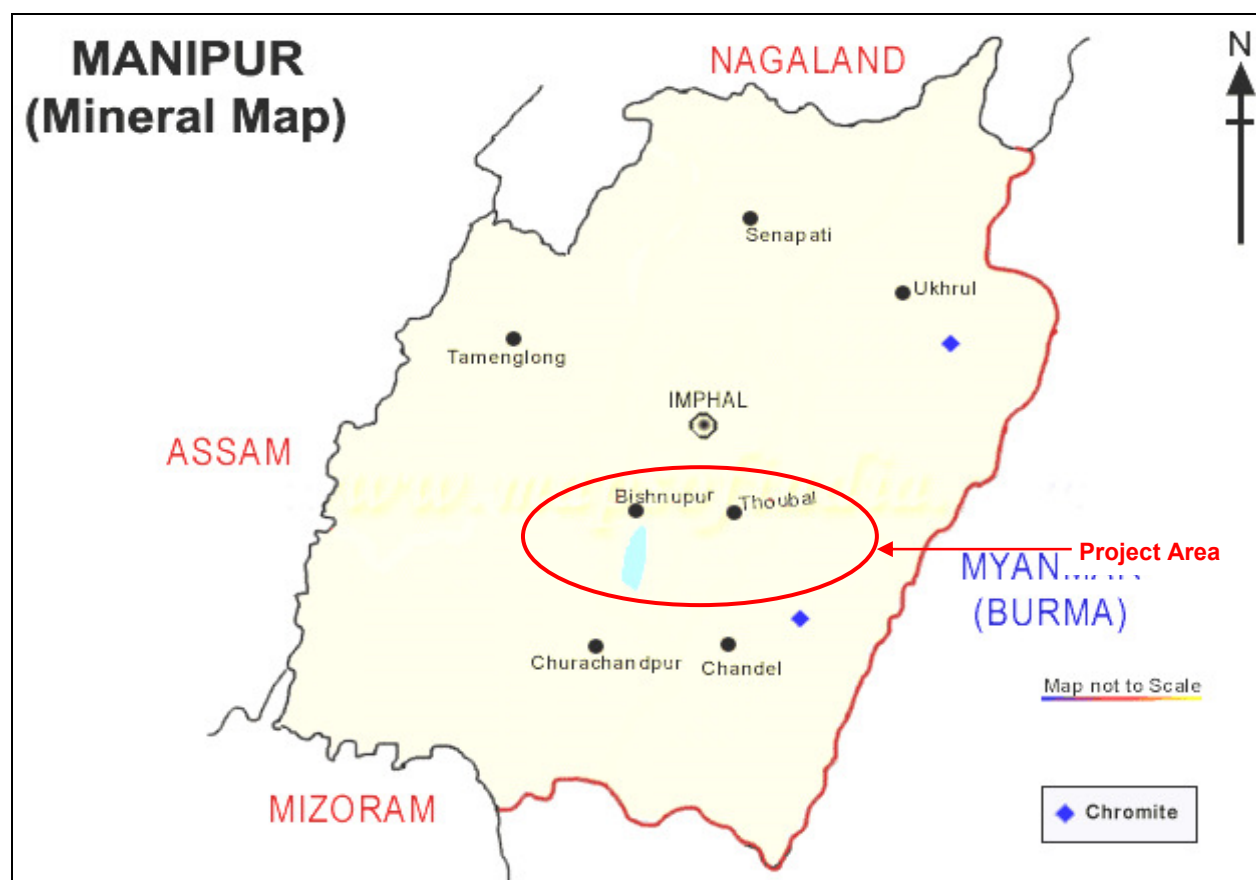
### 5. Transportation

128. Transportation system is a key factor in the socio-economic development of any state. There is practically no railway network in the state. Two rail heads – one at Dimapur in Nagaland (215 km away from Imphal) and the other at Jiribam (225 km away from Imphal) serves the state. The state has one airport at Imphal, which connects up with the rest of the country. Waterways are also not feasible. Roads, therefore, constitute the only means of transport system in the state for movement of men, materials and services within and outside the state. The total road network stands at around 7200 km, of which 2600 km are unsurfaced roads.

### 6. Mineral Resources

129. The state has endowed with mineral resources. The main mineral reserves in the state includes lime stone (14.8 thousand tons), clay (2.5 thousand tons), and chromite (0.1 thousand

tons). For exploiting the mineral resources, it is important to provide a good road and rail infrastructure. Mineral resources of the Manipur are shown in Figure 4.8.



**Figure 4.8: Mineral Area Map of Manipur State**

## **7. Industrial Situation**

130. The State is industrially backward compared to the rest of the country. There is no large scale industry. It has 1 industrial estate, 12 medium scale and 8771 small scale units (2001) giving employment to about 2 lacs people. Lack of roads, power and transport are the major constraints impeding the industrial growth.

## **8. Aesthetic and Tourism**

131. The state has immense scope for promotion of tourism. It has a salubrious climate, exotic greenery and rich flora and fauna besides the rich culture. Keibul Lamjo National Park, the only habitat of Brow Antlered Deer, on the bank of Loktak Lake (the biggest fresh water lake in north eastern India), Khongjom War Memorial are few major tourist spots in the region. During the year 2001, 409 foreign tourists and 10385 thousands of domestic tourists came to the state. The state offers unique opportunity for eco-tourism development.

## **9. Cultural Resources**

132. The state has great cultural value. Festivals and cultural activities are being celebrated throughout the year in the state. The department of arts and cultural has taken various activities like promotion of art and culture, preservation of old and historical monuments. The state has

great cultural value for Buddhism. To promote and preserve the rich cultural heritage of the state, the department has been organising a number of programmes annually.

## 10. Energy and Electric Power Potential

133. The state has an installed capacity of 117 MW of power including the power from central sector. It is just able to meet the current demand. With increase in socio-economic development, more power will be required. It is, therefore, necessary to increase power availability in the state.

## 11. International Trade & Commerce

134. The north eastern region has the potential to emerge as a strategic base for domestic and foreign investors to tap the potential of the contiguous markets of China, Myanmar, Lao PDR, Nepal, Bhutan and Tibet. This calls for converting the unauthorised trade into authorised trade, at the policy level as well as at the ground level. The BIMST-EC (Bangladesh-India-Myanmar-Sri Lanka-Thailand Economic Cooperation) initiative is creating an enabling environment for rapid economic development through identification and implementation of specific cooperation projects in the sectors of trade, investment and industry, technology, human resource development, tourism, agriculture, energy, infrastructure and transportation.

135. The various physical features along the project road are described in Table 4.5.

**Table 4.5: Physical /Sensitive Features along the project road MN-06**

Location / Chainage (Km)	Features
<b>Section 1: Tupul – Bishnupur Road</b>	
0 -1	Tupul starting points, Rolling to hilly terrain,
1-2	Hilly terrain with Landslides (geologically weak area)
3-4	Village area thin settlement
3-15	Road passes entirely through hilly terrain with pockets of forests on hillocks
13-14	Thin settlement on hillocks
15-16	Thin settlement at Thangal village
16-18	Hilly terrain with pockets of forests on hillocks
18-19	Landslide location
19-31	Project road passes through hilly terrain with pockets of forests on hillocks
22-23	Village area with thin settlement
25-26	Thin settlement location
31-32	Zoujantek village with thin settlement on hillocks
32-42	Project road passes through hilly terrain with pockets of forests on hillocks
42-43	Village area with thin settlement
43-47	Project road passes through hilly terrain with pockets of forests on hillocks
47-50	Project road passes through hilly to undulating terrain with agricultural land
49-50	Bridge over river (30 m )
51-52	Built up area of Bishnupur, residential and commercial structures both side of the

Location / Chainage (Km)	Features
	road, Bishnupur Junction at km 52
<b>Section 2: Thoubal – Kasom Khullen Road</b>	
1-2	Thoubal commercial area
2-4	Settlement continues along the road Commercial shops
4-10	Plain area with agricultural land and clusters of settlements
12-15	Residential area along the project road both side Yeripok town both side at km 92
15-20	Plain terrain with agricultural land and paddy fields
20-21	Chandrakhong village area, thin settlement
21-28	Hilly terrain with pockets of agricultural, Left river valley
28-33	Hilly terrain with pockets of forest area on hillocks both side
33-35	Thin settlement on hillocks
35-38	Hilly terrain with pockets of forest area on hillocks both side
38-39	Thin settlement on hillocks
39-41	Village area with rolling terrain Kasom Khullen village

## **V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES**

136. This chapter presents key environmental issues associated with various aspects of the proposed project. Identification and assessment of the potential environmental impacts are based on secondary information supplemented by field visits. Impacts on various environmental components have been assessed at four different stages, namely:

- the project location;
- design;
- construction; and
- operation stages.

137. A few short and long-term negative effects, mainly at the construction and operation stages, are, nonetheless, anticipated. These can be kept in check through proper planning and adopting environment friendly road construction methods and the appropriate regulatory measures.

### **A. Identification and Assessment of Impacts**

#### **1. Positive Impacts due to improvement of road section between Tupul and Kasom Khullen in the Manipur State**

138. The following are the anticipated:

- Improvement of the Tupul - Kasom Khullen section to intermediate /two lane will result in reduction in travel time and lower vehicle operating cost i.e. per kilometre vehicle operating cost from the general improvement work and an absolute saving in cost due to reduction in fuel consumption and therefore exhausts, tyre and spare parts consumption can be expected for the existing traffic.
- Better access to other parts of the state by connecting three national highways (NH-53, NH-150 and NH-39). From economic point of view, proposed road will enhance the trade and commerce between six districts as well as other neighbouring states.
- Easier access to remote villages and easier access to important religious or tourist sites.

#### **2. Adverse Environmental Impacts due to improvement of road section between Tupul and Kasom Khullen in the Manipur State**

139. The following adverse environmental impacts are expected from the improvement of Tupul-Kasom Khullen road section:

- Cutting of road side trees that falls within formation width i.e. 9.0 m may reduce the ecological balance of the area and also increase problem of soil erosion.
- Noise, air and water pollution and disposal of waste, during construction, will cause adverse impacts on local residents. These effects should, however, only be temporary/reversible.

- A number of quarries and other sources will be established. However, the operation of quarries is an independent and already regulated activity. Negative impacts on water quality of rivers in the form of silt deposition and runoff during construction are expected. However, this is short term and will be taken care by controlled construction activities.
- Improvement of road sections and construction of cross drainage structures may enhance soil erosion and reduce the micro -level ecological balance of the area. The widening will also require the cutting of a large number of trees (tentatively 4105).
- Minor impacts on noise and air quality for those now living and workings close to the project road (mainly at Bishnupur and Thoubal) will deteriorate during the construction period and afterwards during operation.

## **B. Impacts and Mitigation Measures Due to Project Location and Design**

### **1. Vegetation Clearing and Tree Felling**

140. Most of the project road section passes through hilly terrain with forests. Since, improvement work will be largely limited to the available ROW there will not be any adverse impacts due to diversion of forest land. Nonetheless, land clearing will involve cutting of a large number of trees exist within 8.7 m formation width. Problem of soil erosion is expected in some locations. To minimize loss of trees, the following mitigation measures are adopted during the detailed design and construction stage of the project:

- widening proposal will consider option with minimal tree cutting.
- identify areas prone to erosion and include land stabilization measures.
- strictly enforce the conditions put as part of the forest clearance by the State Forest Authority.
- adopting Environmental Friendly Road Construction (EFRC) methods.

141. The improvements of the proposed road will largely be confined on the existing alignment. At some locations, improvements to the geometry may involve cutting, filling, and the need to cut vegetation along most of the project road length. This will have more significant impact and this matter is discussed in the sections which follow.

142. From the field assessment it is estimated that tentatively 4105 trees (1221 on left side and 2884 on right side) may be cleared along MN-06 (Tupul – Kasom Khullen) section. These numbers will be further confirmed during the joint verification with forest department. As per compensatory afforestation, the tree plantation will be done three times of tree cutting (1:3 of tree cutting i.e. 12315 trees). At sensitive locations such as schools, colleges and hospitals along the project roads noise barrier shall need to be provided. Details of the trees to be cut are given in Table 5.1 for Section 1 and Section 2 of MN-06 subproject. Species wise detail of tree inventory is provided as Appendix 2.

**Table 5.1: Details of trees to be cleared along MN-06 Subproject Roads**

Chainage (km)	LHS	RHS
<b>Section 1: Tupul - Bishnupur</b>		
0 – 39	1298	1896
39-40	36	51

Chainage (km)	LHS	RHS
40-41	13	30
41-42	40	40
42-43	14	14
43-44	58	58
44-45	45	45
45-46	46	57
46-47	12	33
47-48	41	41
48-49	18	73
49-50	21	21
50-51	39	113
51-52	36	36
	419	612
Subtotal 1	1031	
Section 2: Thoubal - Kasom Khullen		
0-1	8	36
1-2	5	53
2-3	7	22
3-4	10	8
4-5	25	5
5-6	23	21
6-7	11	23
7-8	13	11
8-9	11	18
9-10	31	11
10-11	21	141
11-12	38	75
12-13	15	38
13-14	8	259
14-15	14	8
15-16	11	37
16-17	31	31
17-18	20	6
18-19	10	47
19-20	5	37
21-22	8	49
22-23	17	28
23-24	6	34

Chainage (km)	LHS	RHS
24-25	12	22
25-41	442	1252
	<b>802</b>	<b>2272</b>
<b>Subtotal 2</b>	<b>3074</b>	
<b>Grand total</b>	<b>4105</b>	

## 2. Borrow Pits and Quarries Operation

143. There is a need to establish construction camps and related facilities, such as borrow pits and quarries. These must be located in environmentally sound and socially safe areas. It is expected that construction materials for the road works will be mined only from approved quarries. The following criteria must be applied when locating borrow areas:

- borrow areas are not established in ecologically sensitive areas;
- villagers are consulted in regard to the design and location of all borrow areas – these should ensure the safety of local communities and, if possible, should incorporate beneficial post construction features for the villages;
- located away from the road and hill slopes as well as settlements facing the road, so as to minimise visual impacts;
- In case of reserve forest areas, construction facilities such as temporary workers camp, hot mix plants, and concrete batching plant and stone crushers should not be established in stretches that passes through reserve / protected forests. Consult forest department / village forest management committees before locating temporary project facilities such as construction camps and workers camp;
- construction camps for labourers should be located at least 500 m away from settlements;
- living accommodation and ancillary facilities should be erected and maintained to standards and scales approved by the Engineer-in-Charge; and
- toilets and urinals should be provided in accessible places away from the asphalt plant and mixing yard.

144. As part of detailed engineering design and considering above criteria, possible sources of construction materials have been identified (Appendix 3).

## 3. Cultural Heritage

145. There are no adverse impacts expected on historical places/ monuments. However, there are few small shrines along the road. Care must be taken to avoid any damage to these structures. Earthworks, as associated with the road construction/ improvement works, or deriving from secondary sites such as quarries or borrow pits, may reveal sites or artifacts of cultural/ archaeological significance. In the event of such discovery, concerned authorities should be informed and the requirement to take such action should be incorporated in contract documents.

## 4. Other Impacts deriving from the Project Preliminary Planning and Design Process

146. During preliminary planning and design of this project, the Consultant should take into account the need for:



- optimum siting and control of quarries;
- reduced incidence of slope failures due to inadequate drainage;
- providing adequate culverts/ drains;
- providing side-drainage structures;
- mechanised construction methods and thereby, for example, reduced use of firewood for heating bitumen;
- maximising safety and thereby reducing traffic accidents;
- reducing travel times and, thereby, fuel consumption and emissions;
- increased accessibility for residents to education and health facilities, markets etc., and for others who might come for tourist or other purposes; and
- improving the socio-economic conditions of residents in the project areas of influence.

147. As part of the engineering works for this work, the following have been the guiding principles in determining preliminary alignments:

Environmental Issue	Measures to be taken
Alignment	Final alignment should be determined so as to minimise land take, air pollution and the impact on people and animals and to avoid unfavourable geological condition and cultural relics.
Balancing cut and fill	The design should attempt to equalise cut and fill. The centreline should be aligned so that on all slopes below 60 degrees, half cut and half fill can be achieved.
Soil erosion	Temporary and permanent drainage systems should be designed to minimise the soil erosion.
Dust and air pollution	Borrow sites, waste disposal sites and asphalt mixing sites should be identified – keeping in mind environmental issues such as dust.
Cultural heritage	Any archaeological sites identified along the alignment should be excavated prior to construction.
Wildlife Habitat	Care should be taken in preservation of wildlife and construction workers should be educated on wildlife protection.

### C. Impacts and Mitigation Measures during Construction

148. As a requirement of the Environmental Impact Assessment Notification 2006 (amended 2009), by Government of India, any development activities should not be taken in any part of country unless it has granted clearance from the Ministry of Environment and Forests, Government of India.

149. Highways are classified as one of the project, listed in said notification, which require prior environmental clearance. Highways are classified in two categories. In **Category A** include New National Highways & Expansion of National Highways greater than 30 km, involving additional right of way greater than 20m involving land acquisition and passing through more than one State. **Category B** includes All New state highway projects and State highway expansion projects in hilly terrain (above 1,000 m AMSL) and or ecologically sensitive areas. Any project or activity specified in category B will treated as category A, if located in whole or in part within 10 km from the boundary of: (i) Protected areas notified under the Wildlife

(Protection) Act 1972; ii) Critically polluted areas as identified by the Central Pollution Control Board from time to time; (iii) Eco-sensitive areas as notified under section 3 of the Environment (Protection) Act, 1986, such as, Mahabaleswar, Panchgani, Matheran, Pachmarhi, Dahanu, Doon Valley and (iv) interstate boundaries and international Boundaries. Since present subprojects do not pass through any sensitive areas, hence environmental clearance from Central / State Government is not required. However, prior to applying commencement of civil works, a number of resource-specific clearances and permits have to be obtained. Table 5.2 outlines the types of clearances and permits and the authorised bodies that issue them along with the procedures involved.

**Table 5.2: Clearances and Permits Required for MN-06**

Sl. No.	Clearance/permit	Authorised body	Procedures involved	Time involved
1	Clearance from Forest Department	Divisional Forest Office	Project proponent will submit application to the district forest office. Joint verification and enumeration of trees to be cut shall be done by division office and after approval shall be allowed to cut.	Approximately 6 months or more
2	Clearance for quarry sites	State Department of Geology and Mining, Govt. of Manipur, Imphal	Submission of application for quarry site to mining department. Department of mines and minerals after scrutiny of application and consultation with forest department and revenue department together with site verifications will give approval with specific conditions.	Takes between 3 months and six months.
3	Clearance for blasting	State Department of Geology and Mining, Govt. of Manipur, Imphal	Detailed application with blasting locations and amount of blasting shall be submitted to DoMM. Mining department may issue the conditional approval.	2 to 6 months

150. Any felling of trees requires forestry clearance and appropriate permits. The procedures necessary to obtain such permits will require liaison with local territorial forestry offices and their head office in Imphal. No clearance is required for the use of surface sand and stone from the river banks as for commercial purposes they can only be purchased in an open auction carried out by the forestry office. It is imperative that all necessary clearances and permits be obtained before commencement of work.

## **C.1 Physical Environment**

### **1. Topography, Geology and Soil**

151. During the improvement works for the road sections micro-level topography may change due to the cutting of slope, filling, the cutting of trees, construction of bridge embankments, stone quarrying, and construction of structures. With proper planning, these topographical impacts can be kept within acceptable limits and sometimes even used to enhance local aesthetics. Any negative impacts on topography (existing or new), particularly soil erosion due to a lack of drainage facilities, will be minimised with the provision of proper drainage facilities

such as culverts, causeways etc. The overall impact on topography is, therefore, anticipated to be insignificant.

152. The terrain and geological conditions of area are such that, even with reasonable care exercised during final design, during construction the interaction between proposed road features and existing land features may reveal/ result in significant land instabilities.

153. During the construction phase following restrictions should be imposed:

- existing vegetation including shrubs and grasses along the road (except within the strip directly under embankments or cuttings) should be properly maintained;
- sites for quarrying, borrowing and disposal of spoils are to be confirmed according to the applicable laws and regulations in the state and the practices followed in recent/ ongoing internationally funded road projects should be continued;
- controlled and environmentally friendly quarrying techniques should be applied to minimise erosions and landslides;
- blasting should not be carried out during busy periods; and
- cut material should be disposed of in suitable depressions;

154. It is also important to:

- maintain adequate vegetative cover above and below the road;
- maintain the natural course of water bodies (that is as far as possible) and avoid throwing debris into stream courses;
- construct proper drainage structures to avoid erosion; and
- minimise construction of hair-pin bends that are close to each other: as this often adds to instability.

155. Given the existence of flat terrain and high rainfall in almost entire project area and weak geology in some areas, it is inevitable that some sites will face problems of silt deposit and erosion, mostly debris slides.

## 2. Erosion, Silt Run-Off and Landslides

156. All hill/soil cutting areas should be revegetated as soon as construction activities are completed. At more vulnerable locations, selected bioengineering techniques should be adopted - a combination of bioengineering techniques and hard engineering solutions such as rock bolting and the provision of bank drains may be required. Solutions will, however, need to be individually tailored by the geo-technical/ environmental experts of the Supervision Consultant. Figure 5.1 shows the typical landslide on project road.



Figure 5.1: Landslide prone location along the road

157. Excavation and earthworks should be mainly undertaken during the dry season when the risks from erosion and silt run-off are least. The materials used for surface dressing will consist of aggregates and gravel, which do not contain silt. Internationally accepted best practice engineering approaches to minimise erosion risks and silt run-off will be incorporated into contract documents and monitored during construction. In order to minimise erosion, silt run off and landslides, it will also be important to:

- ensure that all embankment grades are not too steep and prone to erosion;
- waste material is not thrown into nearby rivers and cross cutting water bodies;
- temporary retention ponds, interception drains, and silt traps are installed to prevent silt laden water from entering adjacent water bodies;
- the topsoil of borrow areas is preserved and used for re-vegetation;
- borrow areas are provided with gentle side slope that are re-vegetated and connected to the nearest drainage channel to avoid the formation of cess pools during the rainy season; and
- control the disposal and ensure the vegetative stabilisation of spoil.

### **3. Climate**

158. The proposed improvement/ construction works will be localised activities and the Project will not have significant impact on climatic conditions, such as rainfall, temperature and humidity in the project area.

### **4. Surface and Ground Water, Drainage and Hydrology**

159. Given the presence of river Thoubal, Yagoi Karong and part of project road running parallel to Thoubal river, and presence small streams crossing the project road, improvement of road may result in disruptions to the natural hydrology and water mismanagement and lead to further problems of soil erosion.

160. The natural courses of Thoubal and Yagoi Karong Rivers should, therefore be maintained. Appropriate temporary diversions of water-courses will be made and brought back to their natural course as soon as works are completed on that section. No disposal of construction debris in streams and rivers is allowed.

161. Minor impacts on water resources are expected during the construction phase. The rehabilitation of existing bridges may also cause soil erosion and turbidity in downstream water bodies. To mitigate this, river-bank slope stabilities will be monitored and, if necessary, appropriate remedial measures applied throughout the construction period. Construction work at bridges during rainy season will be minimized to avoid erosion and sedimentation.

162. The likely impacts of surface water movements are changes in the natural drainage systems, downstream scour, and erosion due to constriction in flows. If suspended solid concentrations in the water are affected, this could also affect aquatic river ecology.

163. To mitigate these impacts the following should be implemented:

- chemicals and oils are stored in secure, impermeable containers, and disposed of well away from surface waters;
- no vehicle cleaning activity is allowed within 300 m of water bodies/ drains;

- construction camps are equipped with sanitary latrines that do not pollute surface waters;
- the work on bridges and culverts is limited to dry seasons, when many of the smaller streams will have low water - water diversion works can be minimised and the original course restored immediately after the work has been completed;
- drivers are made aware of diversions and other works at bridge construction sites to avoid accidents;
- drainage structures are properly designed to accommodate forecast discharges;
- side drain waters must be discharged at every available stream crossing to minimize volume and prevent erosion at discharge point;
- provide lined drainage structures;
- where an increased discharge of surface water endangers the stability of the water outlet, erosion protection measures such as bioengineering measures, ripraps, and check dams are incorporated;
- in areas with high water tables, seepage may occur and side drains and up-slope catch drains must always been lined to avoid percolation; and
- all debris and vegetation, clogging culverts are regularly cleared.

164. Ground water pollution is not envisaged in the subproject areas of Bishnupur and Kussum Khullen.

## 5. Air Quality

165. During construction air quality may be deteriorated for short periods due to (i) the exhaust emissions from the operation of construction machinery; (ii) fugitive emissions from brick, concrete, and asphalt plants; (iii) the dust generated from the haulage of materials, exposed soils and material stockpiles; (iv) cutting and filling of hill slope; (v) cleaning of the road; (vi) material loading; (vii) unloading; and (viii) blasting activities. The impact is expected to be localised, temporary and confined to construction areas.

166. Adverse impacts on air quality during construction are likely to result from three main sources; (i) emissions from construction equipment, including delivery trucks; (ii) fugitive dust from earth-moving operations and demolition; and (iii) localised increased traffic congestion in construction areas.

167. The adverse impacts on air quality during construction stage were classified in Table 5.3. There are two types of pollution, dust pollution and pollution from harmful gases.

**Table 5.3: Impact on Air Quality during Construction Stage**

Sl.	Impact	Source
1	Generation of Dust (SPM)	<ul style="list-style-type: none"> <li>• Transportation and tipping of cut material - while the former will occur over the entire stretch between the cutting location and disposal site, the latter is more location specific and more intense;</li> <li>• Blasting operations;</li> <li>• Activation of landslides and rock falls etc.;</li> <li>• Transportation of raw materials from quarries and borrow sites;</li> <li>• Stone crushing, handling and storage of aggregates in asphalt plants;</li> </ul>

Sl.	Impact	Source
		<ul style="list-style-type: none"> <li>• Site levelling, clearing of trees, laying of asphalt, construction of bridges;</li> <li>• Concrete batching plants;</li> <li>• Asphalt mix plants – due to the mixing of aggregates with bitumen; and</li> <li>• Construction of structures and allied activities</li> </ul>
2	Generation of polluting gases including SO <sub>2</sub> , NO <sub>x</sub> and HC	<ul style="list-style-type: none"> <li>• Hot mix plants;</li> <li>• Large construction equipment, trucks and asphalt producing and paving equipment;</li> <li>• The movement of heavy machinery, oil tankers etc. on steep slopes will cause much higher emissions of gases;</li> <li>• Toxic gases released through the heating process during bitumen production; and</li> <li>• Inadequate vehicle maintenance and the use of adulterated fuel in vehicles.</li> </ul>

168. On the MN-06 road sections it is expected that air quality will be affected to some minor extent by dust and particulate matters generated by construction, vehicular movements, site clearance, earth filling and material loading and unloading. The impacts are expected to be localised, temporary and confined to construction areas. Care should, however, be taken at sensitive urban locations so that harmful impacts can be minimised.

169. As it is anticipated that suspended particulate matter (SPM) levels will increase during construction, certain mitigation measures are suggested in order to bring down these levels to prescribed standards. The following actions should be implemented:

- regular check-up and maintenance of construction equipment and long idling of engines are discouraged;
- mixing plants i.e. asphalt, concrete, and bricks, should be operated within the permissible limits of CPCB, and located away from settlements;
- the contractor will submit a dust suppression and control programme to the PWD prior to construction – this plan details actions to be taken to minimise dust generation and identify equipment to be used;
- vehicles delivering loose and fine materials should be covered to reduce spills;
- controlled blasting should be carried out and such only with the prior approval of the site Engineer and, if required, PWD;
- bitumen emulsion should be used wherever feasible, and
- bitumen heaters should be used and the use of wood for fuel prohibited.

## 6. Noise Levels

170. With the exception of the Bishnupur and Thoubal urban centers, the ambient noise level along the project road is within permissible limits prescribed by CPCB. During the construction period, noise will be generated from the operation of heavy machinery, blasting works, the haulage of construction materials to the construction yard and the general activities at the yard itself. Concrete mixing and material movements will be the primary noise generating activities and will be uniformly distributed over the entire construction period. These construction activities are expected to produce noise levels in the range of 80-95 dB(A). Piling, if necessary, will also cause vibration. Noise and vibration from this source will be unavoidable but the impact

will only be temporary and affect people living or working near piling locations. In construction sites within 500 metres of a settlement, noisy operations should cease between 22:00 and 06:00 hrs. Regular maintenance of construction vehicles and machinery must also be undertaken to reduce noise. The impact and sources of noise and vibration are summarised in Table 5.4.

**Table 5.4: Likely Impact on Noise Quality in the Vicinity of Project Area**

Impact	Source
Increased Noise Levels causing discomfort to local residents, workers and local fauna	<ul style="list-style-type: none"> <li>• Mobilisation of heavy construction machinery;</li> <li>• Accelerations/decelerations/gear changes – though the extent of impact will depend on the level of congestion and smoothness of the road surface;</li> <li>• Use of blasting to cut into hill sides;</li> <li>• Excavation work for foundations and grading;</li> <li>• Construction of structures and other facilities;</li> <li>• Crushing plants, asphalt production plants; and Loading, transportation and unloading of construction materials.</li> </ul>

171. Typical noise levels associated with various construction activities and equipment are presented in Table 5.5.

**Table 5.5: Typical noise levels of principal construction equipments  
(Noise Level in db (A) at 50 Feet)**

Clearing		Structure Construction	
Bulldozer	80	Crane	75-77
Front end loader	72-84	Welding generator	71-82
Jack hammer	81-98	Concrete mixer	74-88
Crane with ball	75-87	Concrete pump	81-84
		Concrete vibrator	76
Excavation and Earth Moving		Air compressor	74-87
Bulldozer	80	Pneumatic tools	81-98
Backhoe	72-93	Bulldozer	80
Front end loader	72-84	Cement and dump trucks	83-94
Dump truck	83-94	Front end loader	72-84
Jack hammer	81-98	Dump truck	83-94
Scraper	80-93	Paver	86-88
Grading and Compaction		Landscaping and clean-up	
Grader	80-93	Bulldozer	80
Roller	73-75	Backhoe	72-93
		Truck	83-94
Paving		Front and end loader	72-84
Paver	86-88	Dump truck	83-94
Truck	83-94	Paver	86-88
Tamper	74-77	Dump truck	83-94

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



172. The noise levels indicated for various construction activities/ equipments, while far exceeding permissible standards, will occur only intermittently. Still, these extremely high sound levels present real risk to the health of workers on-site.

173. Since the anticipated post-construction volumes of traffic on the project road is expected to be low, impacts from higher noise levels will have little significance even though present noise levels in these areas are low. In these areas, the noise produced during construction will also not have a significant impact, if proper mitigation measures are taken. Mitigation measures should include:

- construction machinery should be located away from settlements;
- careful planning of machinery operation and the scheduling of such operations;
- controlled blasting should only be carried out with prior approval from the Engineer in charge;
- contractors should be required to fit noise shields on construction machinery and to provide earplugs to the operators of heavy machines;
- blasting should be conducted only during day-light hours; and
- only controlled blasting should be conducted.

## 7. Topography and Appearance

174. Construction activities of the project roads will bring permanent changes in the local-level topography and appearance of the project site. There will be loss in aesthetic beauty of the project area mainly due to the earthwork. Table 5.6 elaborates potential effects on the topography and appearance and appropriate mitigation measures.

**Table 5.6: Potential Effects on Topography by the Proposed Road Section Upgrading**

Sl.	Construction activity	Potential effect on topography and appearance	Mitigation
1	Clearing of vegetation and cutting of hillside for widening of the road	Scarring of landscape from cutting and potential landslides (short term and long term) may be caused. There may be minor permanent changes in the landscape.	Cut material should be used to widen the road or disposed off at proper disposal sites. Cut slopes should be re-vegetated immediately after widening activities.
2	Stone quarrying	Scarring of landscape and potential landslides (rock slides/falls). There may be permanent changes in the landscape.	Stone quarrying should only be undertaken in legally approved areas. Controlled and environmental friendly quarrying should be carried out to minimise landslides and erosion.
4	Earthwork from borrow areas	Scarring of landscape due to unearthing activities. Minor but permanent changes in landscape.	Borrow areas should be in legally approved locations. As soon as construction activities are complete, they should be re-vegetated and brought back as far as possible to their previous appearance.
5	Waste disposal	Disposal of cut soils and debris at improper locations such as hillside below the road will make the area look untidy and unattractive.	Cut off material should be used to widen the road or disposed of at proper disposal sites.

Sl.	Construction activity	Potential effect on topography and appearance	Mitigation
6	Establishment of labour camps	Disposal of waste and litter at improper locations and deforestation for fire-wood will make the area look dirty and unattractive.	Provision and allocation of proper waste disposal bins and sites are required. A supply of cooking gas should be provided by the contractor to eliminate the use of fire wood.

## C.2 Ecological Resources

### 1. Wildlife

175. In the project area presence of wild animals is very rare. Also, only part of project road travels through not protected areas, it will not have any impacts on movement of wild animals. Though no studies of the impacts of development activities on wildlife have been conducted in state so far, the work on this road may have low-level impacts on wildlife.

176. The improvement works to the existing alignment, usefully should involve minimal tree felling and hence cause little impact. However, some section of the project road passes through dense forests, construction work in this area may, may have impacts on presence of wildlife.

177. Some indirect ecological degradation may also occur from wildlife poaching, by construction workers and outsiders due to greater accessibility and as a result of increased local demands for food resulting from road construction activities. In order to avoid such impacts the contract document should include the following:

- project staff and work crews should not be allowed to have fire-arms and animal traps etc.;
- construction facilities such as workers camp, construction camp, hot mix plant, batching plant should be located at least 1 km away from the forest stretches; and
- employment agreements should specify heavy penalties for illegal hunting, trapping and wildlife trading – all other ancillary works should also agree not to participate in such activities.

### 2. Vegetation

178. Most of the project road (75 km) passes though the hilly terrain with pockets of forests with thin vegetation along the project road. The density of vegetation in area is very less i.e. 0.1 to 0.2. Removal of the existing vegetative cover and the uprooting of trees (about 4105 trees) is an unfortunate activity, which will reduce the ecological balance in the areas. A total of approximately 279000 sq.m. (3 m strip for entire length 93 km) of scrub and vegetation cover will probably be removed for improvement of road between Tupul and Kasom Khullen. The loss of vegetative cover will mostly be permanent and only some might be revived through mitigation efforts. Another impact from road construction activities and deriving from the quarrying, preparation and transfer of stone chips and other earthwork, is the accumulation of dust on the surrounding vegetation. This will leads to deterioration of the vegetative health, which in turn will affect the ecology as well as the aesthetic beauty of the area. Induced impacts may result from the following:

- increased forest harvesting for fire-wood, construction timber, forage, medicinal plants and other products;
- increased earth and rock extraction;
- construction crew demands for wood as a fuel and for building materials;
- construction crew demands for food and recreational hunting and fishing;

179. To minimise adverse impacts on vegetative cover the contract documents should specify that:

- all wood building material for workers' housing should be brought from outside the project area;
- workers should be supplied with non-wood fuels such as liquefied petroleum gas for the duration of the contract;
- all contract equipment and plants should be cleaned to the satisfaction of the project engineer in charge prior to their relocation to project sites;
- during site clearance, care should be taken to ensure that the minimum area of vegetation area is affected; and
- water sprinkling of trucks used as construction vehicles should be properly and regularly undertaken, so that dust deposition problem on vegetation are minimised.

## **C.2 Socio-economic Resources**

### **1. Human Use Values**

180. Field reconnaissance surveys of the project roads were conducted on October 2005 to assess the environmental and social conditions. It was noted that the relocation of structures will be required at few locations. These structures made of light materials i.e. compacted earth, timber and corrugated iron sheets. The widening options have been devised to minimise impacts of structures.

181. The survey also found that there is one temporary structure and one temple likely to be affected due to widening of road. A short resettlement plan is prepared to address this issue. The affected people will be compensated and rehabilitated as per the provisions of the Resettlement Plan.

182. There will be negligible land acquisition as the proposed widening will be accommodated within existing ROW of the road.

183. At certain locations on the road, particularly at bridge sites, traffic will be temporarily diverted from the existing carriageway while construction is in progress and temporary traffic diversions will be managed within the ROW. In other instances, traffic may have to be diverted across adjacent private land, in which case compensation will be paid for any loss of crops or the replacement of damaged structures. In other situations, most frequently not at bridge sites, for example when bitumen surfacing is in progress, it may be required to close the road temporarily. In these circumstances, adequate radio and press releases should be made beforehand and a date/time given for the re-opening.

184. Most construction will be undertaken during the dry season when few crops are planted to so that losses can be minimised.

## **2. Sensitive Location Such as School, College and Hospital along the Project Road**

185. The sensitive location such as school, college and hospital along MN-06 within 100 meter from the edge of the existing road has been identified as given in Table 4.5. Impacts on these sensitive resources are minimized by keeping alignment away from these locations to the extent possible.

## **3. Health, Safety and Hygiene for Construction Workers**

186. Construction of the roads will result in the generation of waste. In isolated places, the amount of waste generated may be greater than normal because of substandard subsoil materials, which will need to be replaced.

187. The Contractor will be required to control the construction site, keep it clean and provide facilities such as dust bins and collectors for the temporary storage of all waste. This waste should be adequately stored to avoid pollution of water supplies and water sources and to avoid dust formation. The Contractor will be responsible for the safe removal and/or storage of all waste in order to prevent environmental pollution of any type that may be harmful to people or animals.

188. All necessary safeguards should be taken to ensure safety, welfare and good health of all persons entitled to be on the sites and to ensure that works are carried out in a safe and efficient manner. All personnel working at vulnerable sites will wear safety helmets and strong footwear. It should be ensured that all workmen and staff employed on site use proper safety equipment – for example, eye protectors, ear plugs, safety helmets, the designated safety equipment when working over water - and that proper rescue equipment is available. Fire extinguishers and first-aid equipment will be kept at all sites.

189. The construction camps are anticipated to house up to 300 people for three years. With this concentration of people, the potential for the transmission of diseases and illnesses will increase. The main health and safety risks during construction will arise from:

- inadequate sanitation facilities in worker camps;
- introduction of sexually transmitted, and other diseases, by immigrant workers; and
- outbreaks of malaria, typhoid, cholera etc. amongst the labour force.

190. The following actions will be undertaken at construction camps and stipulated in construction contracts:

- submit and obtain approval for a health and safety plan prior to the commencement of work;
- provision of adequate health care facilities; and
- workers will be required to undergo pre-employment medical screening and treatment (if required) and periodic health checks thereafter.

191. The project will support a public health education programme for workers and villagers covering road safety, malaria, hygiene, and sexually transmitted diseases. The district health departments will be enjoined to participate in monitoring and education of communities and workers affected by the project.

#### **4. Nuisance to nearby Properties**

192. Nuisance to nearby properties is likely to result from:

- noise and vibration from mechanical devices and construction plant;
- dust during quarrying, construction and the trafficking of new surfaces prior to sealing;
- gaseous emissions from heavy equipment; and
- fumes from asphalt boiling sites.

193. Much of the project road pass through rural areas and presently air/dust pollution is not a major issue. Nonetheless, there will be regular watering of the road surfaces or the application of emulsion coats near villages, where dust is a nuisance. Noise generating equipment such as power generators and concrete mixers will be kept away from populated/ commercial areas. Provisions will be incorporated into the contractor's contract to require the use of dust suppression measures.

#### **5. Interference with Utilities and Traffic**

194. On the project road, utilities interfere with the ROW at few locations that will have to be moved prior to construction. This should not be a major problem.

195. Traffic may experience minor delays when diverted around active construction areas, but will be more severely hampered at the locations where temporary road closures are necessary. Such hazard points will have proper signs indicating the nature of the problem envisaged.

#### **6. Community Impacts**

196. There will be minor widening work on entire road length - in which case the resettlement problem will be minor.

197. Construction camps may put stress on local resources and the infrastructure in nearby communities resulting to people raising grievances. This sometimes leads to aggression between residents and migrant workers. To prevent such problems, the contractor should provide the construction camps with facilities such as health care clinics, places of worship, and occasional entertainment. The use of local labourers during the construction will be promoted to minimise these problems.

#### **7. Quality of Life**

198. The impact of the improvements of project road on the socio-economic environment will be significantly beneficial. Improved access and reduced travel times and costs will be major stimuli to economic growth, particularly in rural areas. Better access of agricultural goods to market will be important and a major contributor to poverty reduction.

199. Increased labour mobility will occur. This has both positive and negative impacts. Increased access is a two-way phenomenon, and the corollary to increased access to the project areas is increased access for the residents of these areas to more urban life-styles. Out-migration may result. There is also the likelihood of the relocation of homes and businesses to new road-side locations.

200. During construction, benefits to local people can be maximised if the contractor recruits construction workers locally regardless of gender. Where possible, he/she should also not discriminate in the employment of women.

## **8. Construction Materials**

201. The use of proper sources for stone and aggregates has become a major issue in most states. Historically, stone has been collected from the roadside or from shallow surface workings. Small quarries on steep slopes are often enlarged by blasting or excavation at the base. This is dangerous and can cause slope failures. Roadside stone collection continues in some districts despite its proven negative impacts on road safety and stability. Sand and gravel are often obtained from river deposits. Jurisdiction over stone and aggregates is shared between the Geological Survey of India and the State Forest Department. The Geological Survey of India issues licences for major mineral developments while the Forest Department issues permits for stone quarrying and for sand and gravel extraction. This is largely because these are mostly found on forest lands. Roadside quarrying is officially discouraged, but unofficially continues, invariably by petty contractors.

202. Road maintenance, repair and new construction will continue to cause large demands for construction materials. There is a clear need for a better materials supply policy in each district to minimise environmental impacts of small-scale, poorly managed operations and improve the quality and reliability of supply. In some districts, it may be appropriate to develop centralised quarries, if an operator can be attracted. In any case, pre-designation of sources would give contractors a level playing field for bidding and minimise incentives for environmentally damaging cost cutting.

203. As a prior requirement of projects, every quarry and borrow area should be subjected to a site specific environmental investigation, work according to an approved plan; and should be left in a safe condition or restored to a productive land use. Subject to these conditions, obtaining construction materials for projects will not cause unacceptable impacts.

204. Quarry and borrow pits may be filled with rejected construction waste and afterwards should be given a vegetative cover. If this is not possible, then the excavated slopes will be filled in such a way that they resemble an original ground surface.

### **205. Mitigation for Quarries**

- aggregates will be sourced only from licensed quarry sites that comply with environmental and other applicable regulations;
- occupational safety procedures/practices for the work force will be adhered to in all quarries;
- quarry and crushing units will be provided with adequate dust suppression measures; and
- regular monitoring of the quarries by concerned authorities to ensure compliance with environmental management and monitoring measures.

### **206. Mitigation of Borrow Areas**

- prior approval will be obtained from concerned authorities and all local environmental regulations be complied with;

- within all identified borrow areas, the actual extent of area to be excavated will be demarcated with signs and access to the operational area controlled;
- borrow pit plant and machinery will conform to EPA noise emission regulations;
- protective gear will be provided to the workforce exposed to noise levels beyond threshold limits and there should be proper rotation of such personnel; and
- all operation areas will be water sprinkled to control dust levels to national ambient air quality standards.

207. The project will require large amounts of bitumen or bitumen emulsion usually stored in drums. These empty bitumen drums are generally recycled as steel sheeting, or used in road construction as parapets or for bank stabilisation. When supplied and used in this manner, bitumen is not regarded as a significant environmental hazard.

208. The project will require the import, transport and use of fuel and oils. Minor diesel spills are common in region, especially around fuel stations. The project provides an opportunity to assist the PWD and contractors in improving fuel handling practices so as to minimise future fuel spillage.

#### **D. Impacts and Mitigation Measures during Operation**

##### **1. Noise Vibration, Air Pollution, Runoff, Spoils of Hazardous Materials**

209. The current low traffic flows along the project road is expected to increase because of improved economic activities associated with better access. The larger numbers of vehicles will be an additional source of noise and gaseous emissions. Repairs to culverts and new drainage work will eliminate/reduce the soil erosion problems presently caused by poor cross drainage. Also, the situation will remain good because road sections pass through open areas and road side trees and plants have the capacity to absorb gaseous as well as noise pollutants. Bioengineering techniques may also help to absorb pollution.

210. The project road is linked to national highways (NH-53, NH-150 and NH-39) which carry a variety of goods and materials in the state. With the road improvements including safety measures, it is envisaged that overall road safety will improve resulting to reduced risk of accidental spillages.

211. Stone and sand quarries and water sources along the Project road are provided in the Appendix 3.

##### **2. Land Use and Settlements**

212. The likely impacts on land use and settlement patterns are limited. Improved access will lead to increased migration, but this will occur gradually and over a prolonged period. There will be time for new residential areas to be established. There will be a need to control ribbon development.

##### **3. Social Impacts**

213. Specific benefits to local people will include:

- easier communication;
- easier access to markets (both internally and regionally) with savings in travel times and costs;



- enhanced market efficiency through better distribution and accelerated deliveries etc.;
- improved access to health, education and other social services;
- employment generation;
- improved technical skills; and
- enhanced economic activity.

214. Likely adverse social impacts will include:

- increased chances of exposure to communicable diseases, particularly during construction;
- influxes of new settlers leading to increased pressure on natural resources causing hardship to local communities relying on local/forest resources; and
- rural-to-urban migration causing labour shortages in the depleted rural areas and other negative impacts in the urban areas.

#### **E. Potential Environmental Enhancement/Protection Measures**

215. Appendix 10 of this IEE Report presents good environmental management practices and guide documents in the following aspects of road construction:

- Plant Management
- Campsite Management
- Debris Disposal Management
- Borrow Area Management
- Quarry Area Management.

## VI. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

216. In accordance with the ADB's environmental safeguards policy, public consultation were held as part of IEE study with beneficiaries, local /government officials, community leaders, NGO's, and other stakeholders in corridor of impact. Brief description of the project and its activities were presented, preliminary environmental screening results were discussed, and comments were solicited and noted to be considered in the engineering design and preparation of mitigation measures. The State PWD also took the opportunity to foster co-operation among officers of PWD, forest department, the community and the stakeholders to achieve a cordial working relationship for smooth implementation of the project.

217. The official consultation with the stakeholders was carried out during project preparation (first week of June 2005) and detailed design (November 2007) at respective offices in state head quarter Imphal. Various officials consulted include Conservator of Forest, Wildlife Warden, Loktal Development Authority, Environmental Officer from pollution control board, statistical officer etc. The various issues discussed are:

- Statistics of forests cover in the State and its legal status i.e. Reserved, Protected, Unclassed;
- Requirements of Forest Department to carryout project activities within forest areas;
- Flora and Fauna and endangered species in the State;
- Scope of the proposed road development, IEE and likely impacts on flora & fauna;
- Major threats to flora & fauna in the state;
- Procedure to get clearance from forest department and NOC from pollution control board;
- Environmental Quality parameters i.e. Air, Water, Noise quality in the State and major sources of pollution;
- Instructional capacity of state authorities in pollution control and environmental management;
- Socio-economic conditions and likely impacts on due to proposed road improvement;

218. The list of officials / people contacted along with the venue, issues raised, date of consultation is presented on Appendix 4.

219. Details of the consultations through focus group discussions were carried out as detailed in Table 6.1.

**Table 6.1: Peoples' Perception about Environment Degradation**

Date	Venue / Place	Participants	Remarks
23rd October 2005	Village – Mayang Imphal Village – Thoubal Village – Chandrakhong	Total – 23 participants Local villagers, affected persons, shop owners, farmers, forest guards, community leaders,	Two to three persons were interviewed from each village to have representative sample
24th October 2005	Village – Tupul Village – Thangal Village – Zouzangtek Village – Bishnupur		

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

221. In order to document likely impacts on affected persons, an interview survey has been carried out. A sample of PAPs was selected and interviewed through a designed questionnaire (Appendix 5). Precaution has been exercised during the survey to ensure that the sample interviewed is truly representative of the affected groups and the questions are worded so as not to generate a bias response. Figure 6.1 shows one such interview survey.



Figure 6.1: View of Pubic Consultation with PAPs road

222. It is envisaged from the interview survey that there is increased environmental awareness among the people. It can also be seen from the table that more than 55 percent of the persons are in the opinion that environmental conditions of the area is good. About 60 percent of people are agreed that the quality of air, water and noise in the area is good; whereas, about 30 percent responded feel that the environmental quality is being deteriorated. Poor road condition and vehicular emissions are the major sources they feel responsible for this. In case of presence of archaeological, historical and cultural sites, the respondent has mixed opinion. There is no major history of natural disasters. About 65 percent of respondent indicated presence of rare species in the forests of the region. Overall, the general environmental conditions in the region are good and people have increased environmental awareness. Table 6.2 shows the result of public opinion survey carried out in the region.

**Table 6.2: Peoples' Perception about Environment Degradation**

Sl. No.	Question asked about	No. of people interviewed	Positive response (%)	Negative response (%)	No response (%)
1.	Water quality of rivers, ponds, wells, and canals	23	57	43	0
2.	Noise quality of the area	23	61	30	9
3.	Air quality of the area	23	61	30	4
4.	Archaeological sites	23	52	30	13
5.	Natural disaster	23	22	61	13
6.	Rare species of animals and birds	23	65	22	9
7.	Cultural sites i.e. market, melas	23	57	26	13
<i>Note: Positive response shows that the overall environmental scenario in the area is good and wise versa</i>					

223. The IEE report will be disclosed in MDONER, PWD and ADB websites. The full reports will also be available to interested parties on request from office of PWD, Manipur.

## VII. GRIEVANCE AND REDRESS MECHANISM

224. 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.

225. 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.

226. **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:

- a) Initial grievance sheet (including the description of the grievance) with an acknowledgement of receipt given to the complainant when the complaint is registered;
- b) Grievance monitoring sheet with actions taken (investigation, corrective measures);
- c) Closure sheet, one copy of which will be handed to the complainant after he/she has agreed to the resolution and signed-off.

227. 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.

228. **Second Tier of GRM.** The Resettlement 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)<sup>4</sup>. The GRC will be established before commencement of site works. A

---

<sup>4</sup> 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

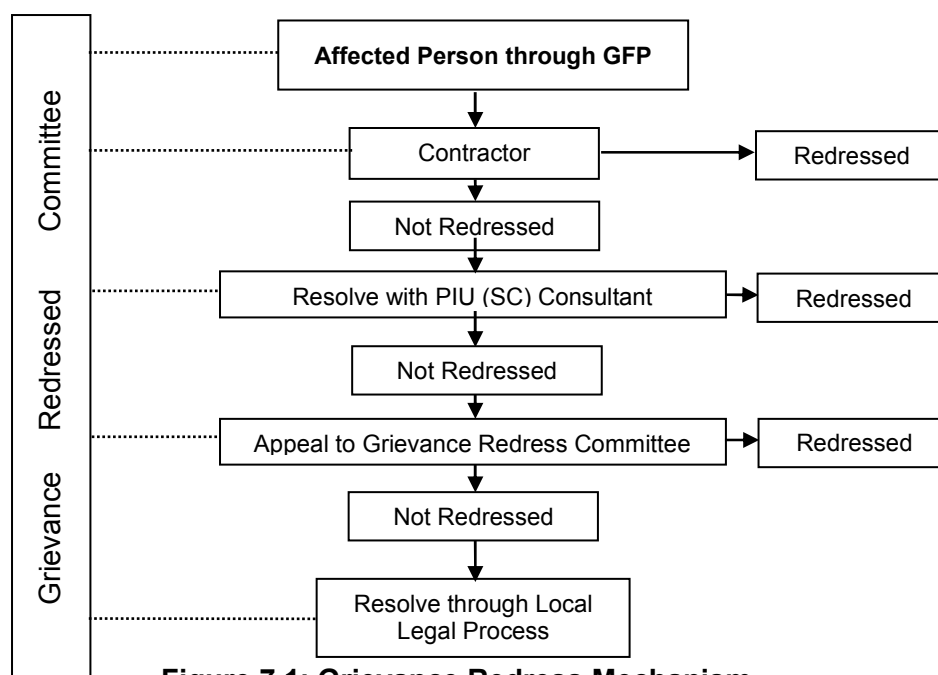
hearing will be called with the GRC, if necessary, where the affected person can present his/her concern/issues. The process will facilitate resolution through mediation. The local GRC will meet as necessary when there are grievances to be addressed. The GRC will suggest corrective measures at the field 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.

229. 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.<sup>1</sup>

230. **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.

231. 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).

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



**Figure 7.1: Grievance Redress Mechanism**

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.

## **VIII. ENVIRONMENTAL MANAGEMENT PLAN**

233. This Environmental Management Plan (EMP) consist of a set of mitigation, monitoring and institutional measures to avoid, minimize and mitigate adverse environmental impacts and enhance positive impacts.

234. The major components of the EMP are the mitigation of potentially adverse impacts, monitoring of EMP implementation during project implementation and operation; and institutional arrangements to implement the EMP.

### **A. Summary of Impacts**

235. Following are anticipated potential adverse environmental impacts:

- Impacts on surrounding area due to tree cutting for the proposed widening;
- Impacts on cultural properties and common property resources for the proposed widening;
- Temporary impact on land and air environment due to locating construction camp;
- Temporary impact on land, air and water environment due to establishing and operating construction plants (Hot Mix Plant and Diesel Generator [DG] sets);
- Impact on biophysical environment due to quarry operation;
- Impact on air quality, water quality, drainage, road users due to construction activities of project road ;
- Impact on land and water environment due to disposal of waste materials; and
- Impact on occupational health and safety due to all onsite and offsite construction works.

### **B. Mitigation Measures**

236. The identified environmental issues and suggested mitigation measures with institutional arrangements for implementation, supervision and monitoring have been provided in matrix format in Appendix 6. These mitigation measures will be implemented as applicable for tranche 2 subproject in Manipur i.e. MN-06. The specific impacts and mitigation measures to be implemented particularly during the construction phase of MN-06 subprojects are presented in following sections.

#### **1. Compensatory tree plantation**

237. As per compensatory afforestation, the tree plantation will be done three times of tree cutting (1:3 of tree cutting). A total of 21315 trees will be planted as part of compensatory afforestation as detailed in Table 8.1.

**Table 8.1: Section-wise details of Compensatory Afforestation**

Subproject	From	To	Tranche	Length (km)	Tree to be cut in the project road (tentative)	Proposed tree to be planted in the project area in consultation with Forest Dept. (1:3 of tree cutting)
MN.06 (Section 1)	Tupul	Bishnupur	2	52.0	1031	3093
MN.06 (Section 2)	Thoubal	Kasom Khullen	2	41.2	3074	9222
<b>Total</b>				<b>93.2</b>	<b>4105</b>	<b>12315</b>

## **2. Slope Protections and Bioengineering Measures**

238. Slope protection measures such as retaining walls and bio-engineering measures are suitable for slope protection in hill roads. The following items have been suggested as bio-engineering measures for slope protection in hill roads.

- (i) Turning of slopes through rough grassing
- (ii) Tree plantation along the hill section (slopes) of the Project road to control the soil erosion.

239. The above items as bio-engineering measures have been incorporated in EMP budget.

## **3. Enhancement of Cultural Properties**

240. The cultural properties will be enhanced during construction phase of the project road. Following items can be considered for enhancement of cultural properties.

- Provision and erection of cement concrete, standard sitting benches including clearing of the area around the benches.
- Boundary fencing with barbed wire fencing of approved make and specification including provision and erection of struts.

241. The specific cultural properties for enhancement will be identified by Contractor and Engineer jointly. The Contractor will take the approval before execution of the work.

## **4. Excavated Road Side Debris and its disposal**

242. The provision has been made in cost estimate to use the roadway excavated materials as necessary for the construction of road, which are as follows.

- For all types of soil, such as ordinary rock, hard rock and
- Excavation from drain and foundation of other structures.

243. As per above description, the Contractor will use the excavated road side material for construction of road. The unsuitable material will be disposed properly. The Contractor will not dispose the excavated unsuitable material generated from hill section to other side (valley side) of the project road. Proper disposal plan will be prepared by the Contractor to dispose the unsuitable material generated from hill cutting/ road excavation.

## **5. Water Bodies to be Protected**



244. The surface water bodies in the project road require protection during construction phase of the project road. The Contractor shall not disturb/ pollute the surface water due to construction activities of the project road. The Contractor will be responsible to protect the surface water and extra payment for the same will not be given.

## **6. Re-development of Borrow Area**

245. The items for redevelopment of borrow area such as preservation of top soil and re-application of stored top soil has been considered in proposed EMP cost. The Contractor will re-develop the borrow areas before closing of same. The estimated quantities for preservation and re-application of the top soil has been considered for redevelopment of borrow area.

### **C. Environmental Monitoring**

246. Environmental monitoring is an essential tool for environmental management as it provides the basic information for rational management decisions. To ensure the effective implementation of mitigation measures and environmental management plan during construction and operation phase of the up gradation of project road, it is essential that an effective Environmental Monitoring Plan be designed and followed. Monitoring will be undertaken on selected parameters of air, water, noise, soil and performance monitoring on tree plantation as mentioned in Appendix 7. The stipulated standards for various environmental attributes (water, air and noise) are given in Appendix 11.

### **D. Institutional Requirements**

247. 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 key players are involved in EMP implementation during construction stage:

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

248. There is a need to establish Environmental and Social Management Unit (ESMU) within the PIU. Since it is not envisage 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.

249. 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.

250. 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.

251. 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:

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

252. 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.

253. 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:

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

254. The responsibilities of ESO of Contractor will include the following:

- Directly reporting to the Project Manager of the Contractor;
- Discussing various environmental issues and environmental mitigation, enhancement and monitoring actions with all concerned directly or indirectly;
- Preparing Contractor's EMP, traffic management plan and safety plan as part of their Work Program;

- Ensuring contractor's compliance with the EMP stipulations and conditions of statutory bodies;
- Assisting his project manager to ensure environmentally sound and safe construction practices;
- Assisting his project manager to ensure the timely procurement of materials that are included in the Bill of Quantities relating to environmental mitigation and enhancement measures;
- Conducting periodic environmental and safety training for contractor's engineers, supervisors and workers;
- Preparing a registers for material sources, labour, pollution monitoring results, public complaint and as may be directed by the Engineer;
- Assisting the PIU on various environmental monitoring and control activities including pollution monitoring; and
- Preparing and submitting monthly reports to SC on status of implementation safeguard measures.

255. 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. The requirements of various statutory permits and clearances are mentioned in Table 5.2. 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 Imphal by PIU, once most of the staff has been mobilized. The training program is included in Appendix 8.

#### **E. Proposed Environmental Budget**

256. The proposed EMP budget is **Rupees 7,240,775 (or USD134,088)**. The environmental budget including cost of environmental training is summarised in Table 8.2 and details are provided in Appendix 9.

**Table 8.2: Summary EMP Budget**

<b>Sl. No.</b>	<b>Item</b>	<b>Amount in INR</b>
A.	Tree Plantation	4741275
B.	Environmental Monitoring	214500
C.	Bioengineering measures for slope protection	2080000
D.	Enhancement of cultural properties	130000
E.	Environmental Training	75000
<b>Total in INR</b>		<b>72,40,775</b>
<b>Total in USD</b>		<b>134,088</b>

## IX. CONCLUSION AND RECOMMENDATION

257. The proposed improvement works for tranche 2 subproject in Manipur i.e. MN-06 (Tupul-Kasom Khullen) has been categorized as environmental Category 'B' project based on environmental screening and assessment of likely impacts. The initial environmental examination ascertains that it 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 easy to mitigate.

258. The proposed road section does not pass through or located nearby any national park, wildlife sanctuary. However the road passes through hilly terrain and reserve forests areas for most of the section. Since the proposed improvement work is restricted within available ROW, no additional forest land required. No archaeological/ protected monument is located in the project vicinity. The land use pattern around the alignment is predominantly agricultural / open land.

259. The significant adverse impacts of the road section upgrading are:

- Impacts on surrounding area due to tree cutting (about 4105) for the proposed widening;
- Impacts on soil erosion and landslides;
- Impacts on cultural properties and common property resources for the proposed widening;
- Temporary impact on land and air environment due to locating construction camp;
- Temporary impact on land, air and water environment due to establishing and operating construction plants (Hot Mix Plant and Diesel Generator [DG] sets);
- Impact on biophysical environment due to quarry operation;
- Impact on air quality, water quality, drainage, road users due to construction activities of project road;
- Impact on land and water environment due to disposal of waste materials; and
- Impact on occupational health and safety due to all onsite and offsite construction works.

260. Stakeholder and public consultations were undertaken and in general, the subproject received immense support from local people. The local people appreciated that besides providing an all-weather efficient connectivity to large rural populations and improving the traffic scenario in the region, it will bear out several other socio-economic positive benefits.

261. 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

**Country/Project Title:** INDIA: North Eastern State Roads Investment Program

**Sector Division:** South Asia Transport and Communication Division (SATC)

**Road Section:** MN-06: Tupul – Kasom Khullen Road section in the State of Manipur– 93.1 km

Screening questions	Yes	No	Remarks
<b>A. Project siting</b>			
<ul style="list-style-type: none"> <li>Is the project area adjacent to or within any of the following environmentally sensitive areas?</li> </ul>			
<ul style="list-style-type: none"> <li>Cultural heritage site</li> </ul>		X	
<ul style="list-style-type: none"> <li>Protected area</li> </ul>		X	Sections of project road passing through the reserved forest area of Temenglong, Bishnupur and Ukhrul forest divisions. However no forest land acquisition is envisaged. A detail assessment and specific mitigation measures with respect to flora and fauna shall be implemented to control the adverse impacts.
<ul style="list-style-type: none"> <li>Wetland</li> </ul>		X	
<ul style="list-style-type: none"> <li>Mangrove</li> </ul>		X	
<ul style="list-style-type: none"> <li>Estuarine</li> </ul>		X	
<ul style="list-style-type: none"> <li>Buffer zone of protected area</li> </ul>		X	
<ul style="list-style-type: none"> <li>Special area for protecting biodiversity</li> </ul>		X	
<b>B. Potential environmental impacts</b>			
<ul style="list-style-type: none"> <li>Will the project cause...</li> </ul>			
<ul style="list-style-type: none"> <li>Encroachment on historical/cultural areas; disfiguration of landscape by road embankments, cuts, fills, and quarries?</li> </ul>	X		The topography of project road is hilly in Tupul to Bishnupur and Chandrakhong to Kasom Khullen sections and plain terrain in remaining sections. Hilly sections are vulnerable to landslide. Impacts of landscape by road embankments, cuts and fills are anticipated. Proper management plan for will be required during construction to sustain the quarries.
<ul style="list-style-type: none"> <li>Encroachment on precious ecology (e.g. Sensitive or protected areas)?</li> </ul>		X	
<ul style="list-style-type: none"> <li>Alteration of surface water hydrology of waterways crossed by roads, resulting in increased sediment in streams affected by increased soil erosion at construction site?</li> </ul>	X		Project road passes though number of water bodies and streams are running parallel to road in most of the road length. Controlled construction activities will ensure sediment discharge into streams to the extent.

Screening questions	Yes	No	Remarks
<ul style="list-style-type: none"> <li>Deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction?</li> </ul>	X		<p>During construction period suitable mitigation measures will be required to control the silt runoff.</p> <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>
<ul style="list-style-type: none"> <li>Increased local air pollution due to rock crushing, cutting and filling works, and chemicals from asphalt processing?</li> </ul>	X		With appropriate mitigation measures and use of most modern environment friendly equipments/machineries air pollution shall be reduced to permissible levels.
<ul style="list-style-type: none"> <li>risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation during project construction and operation?</li> </ul>	X		Possible but will be reduced with appropriate mitigation measures.
<ul style="list-style-type: none"> <li>Noise and vibration due to blasting and other civil works?</li> </ul>	X		Short term minor impact may occur during construction period. Suitable mitigation measures will be required to minimize the adverse effects.
<ul style="list-style-type: none"> <li>Dislocation or involuntary resettlement of people</li> </ul>		X	This will be updated in Social Report.
<ul style="list-style-type: none"> <li>dislocation and compulsory resettlement of people living in right-of-way?</li> </ul>	X		This will be updated in Social Report.
<ul style="list-style-type: none"> <li>disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?</li> </ul>		X	
<ul style="list-style-type: none"> <li>Other social concerns relating to inconveniences in living conditions in the project areas that may trigger cases of upper respiratory problems and stress?</li> </ul>		X	Imposing of appropriate mitigation measures in contract agreement to keep the air pollution within permissible levels will keep a check on this problem.
<ul style="list-style-type: none"> <li>Hazardous driving conditions where construction interferes with pre-existing roads?</li> </ul>		X	To minimise the impact suitable traffic management plan will be required.
<ul style="list-style-type: none"> <li>Poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases from workers to local populations?</li> </ul>	X		<p>Proper provisions for sanitation, health care and solid waste disposal facilities will be available in the contract documents to avoid such possibility.</p> <p>Workers will be made aware about communicable diseases.</p>
<ul style="list-style-type: none"> <li>Creation of temporary breeding habitats for mosquito vectors of disease?</li> </ul>		X	
<ul style="list-style-type: none"> <li>Accident risks associated with increased vehicular traffic, leading to accidental spills of toxic materials and loss of life?</li> </ul>		X	Adoption of suitable traffic signage system at sensitive places will reduce such possibility.
<ul style="list-style-type: none"> <li>Increased noise and air pollution resulting from traffic volume?</li> </ul>		X	<p>Due to improvement in Riding Quality &amp; Comfort in driving due to unidirectional traffic such pollution will be reduced.</p> <p>Mitigation measures along with monitoring plan will be required.</p>

Screening questions	Yes	No	Remarks
<ul style="list-style-type: none"> <li>Increased risk of water pollution from oil, grease and fuel spills, and other materials from vehicles using the road?</li> </ul>	X		Controlled construction activities and proper drainage system will reduce this possibility.
<ul style="list-style-type: none"> <li>social conflicts if workers from other regions or countries are hired?</li> </ul>	X		Possible. Adequate measures will be adopted in contractor's specification to ensure maximum participation of local labours for construction activities.
<ul style="list-style-type: none"> <li>large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?</li> </ul>		X	Possible.
<ul style="list-style-type: none"> <li>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?</li> </ul>		X	Possible but controlled handling of explosives and construction material will avoid this risk.
<ul style="list-style-type: none"> <li>community safety risks due to both accidental and natural causes, especially where the structural elements or components of the 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.</li> </ul>		X	Possible. Adequate health and safety measures would be included to minimize community safety risks.

Climate Change and Disaster Risk Questions The following questions are not for environmental categorization. They are included in this checklist to help identify potential climate and disaster risks.	Yes	No	REMARKS
<ul style="list-style-type: none"> <li>Is the Project area subject to hazards such as earthquakes, floods, landslides, tropical cyclone winds, storm surges, tsunami or volcanic eruptions and climate changes (see Appendix I)</li> </ul>	X		Project is vulnerable to heavy rainfall and landslides.
<ul style="list-style-type: none"> <li>Could changes in temperature, precipitation, or extreme events patterns over the Project lifespan affect technical or financial sustainability (e.g., increased erosion or landslides could increase maintenance costs, permafrost melting or increased soil moisture content could affect sub0-grade).</li> </ul>	X		Likely. Increase in rainfall will reduce lifespan of the project as this is a landslide prone area.
<ul style="list-style-type: none"> <li>Are there any demographic or socio-economic aspects of the Project area that are already vulnerable (eg., high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?</li> </ul>		X	
<ul style="list-style-type: none"> <li>Could the Project potentially increase the climate or disaster vulnerability of the surrounding area (e.g., by encouraging settlement in areas that will be more affected by floods in the future, or encouraging settlement in earthquake zones)?</li> </ul>		X	

### Appendix 2: Species wise details of trees along the subproject roads

#### Number, Location, and Type of Trees to be affected along MN-06: Tupul – Kasom Khullen subproject

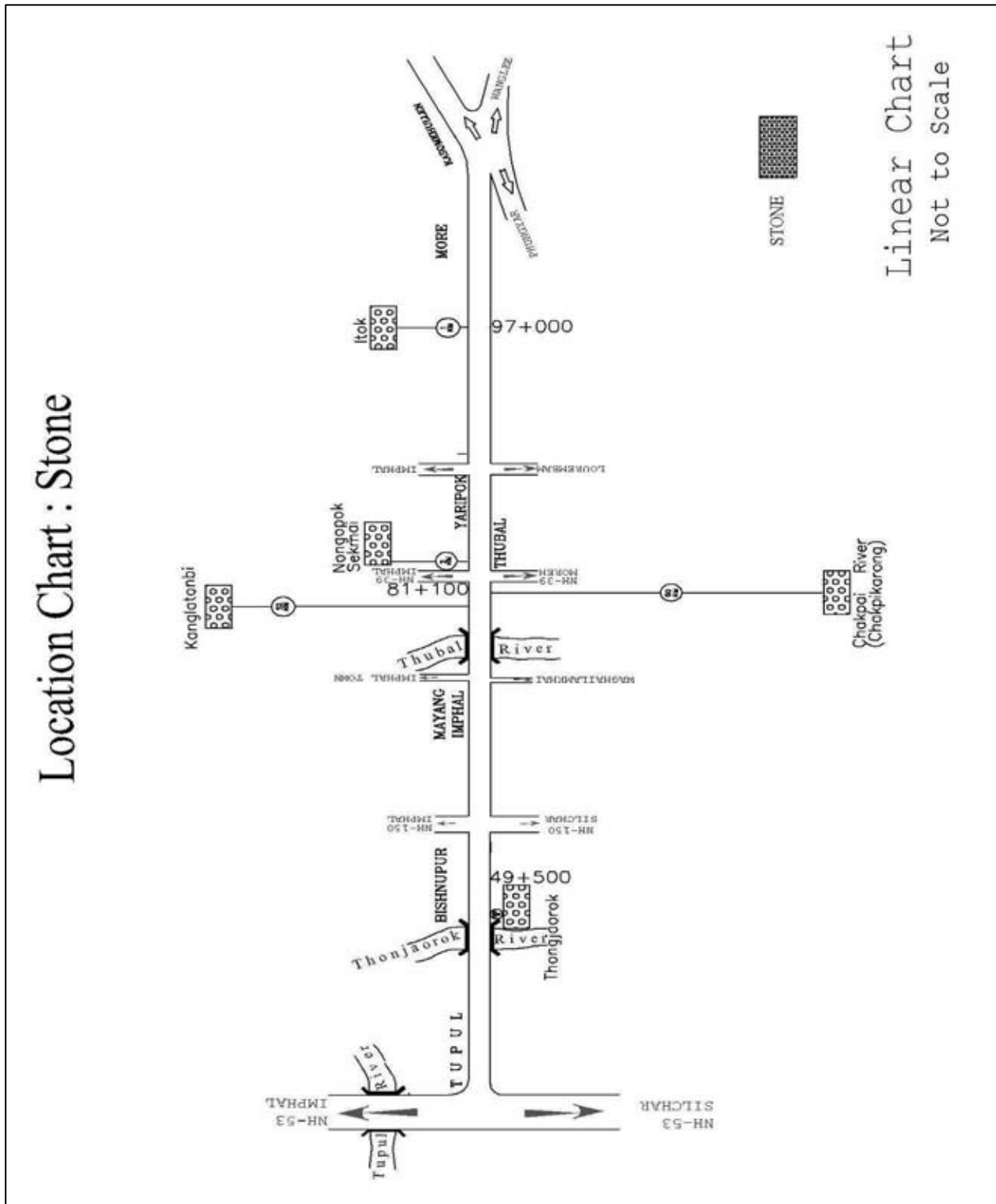
Chainage (km)	LHS	RHS
<b>Section 1: Tupul – Bishnupur</b>		
0.0 – 39.35	1298 (mix species)	1896 (mix species)
39.350-40.000	HRT-9,TZP-2,LNG-13,HUD-4,CHNTR-2,TMK-5 TRN-1	HRT-9,TZP-2,LNG-13,HUD-4,CHNTR-2,TMK-5,TRN-1,ASBNG-6,HTO-7,KUR-1,TKT-1
40-41	UTH-2,LNG-5,UMB-2,TZP-2,HNG-2	UTH-2,LNG-5,UMB-2,TZP-2,HNG-2,MKTB-3,SRS-1,HTP-3,KKMB-2,TUM-6,HRT-2
41-42	BAM-4,PRG-9,HRT-9,LNG-1,TRN-7,TUM-4,HUD-1,HTP-1,UNG-3,THB-1	BAM-4,PRG-9,HRT-9,LNG-1,TRN-7,TUM-4,HUD-1,HTP-1,UNG-3,THB-1
42-43	HTP-3,NAK-1,BAM-2,TUM-4,HRT-1,UNG-1,HRT-2	HTP-3,NAK-1,BAM-2,TUM-4,HRT-1,UNG-1,HRT-2
43-44	HTP-2,UCH-3,PRG-28,HRT-2,TRN-2,NAK-1,UNG-11,TUM-5,KHK-1,JAM-3	HTP-2,UCH-3,PRG-28,HRT-2,TRN-2,NAK-1,UNG-11,TUM-5,KHK-1,JAM-3
44-45	UCJ-36,HRT-1,NSK-1,CHF-1,YGK-1,BAM-4,HKR-1	UCJ-36,HRT-1,NSK-1,CHF-1,YGK-1,BAM-4,HKR-1
45-46	UCH-9,WNG-3,UNG-7,BAM-9,PRG-8,TRN-3,YGK-3,HBI-1,HRT-1,KUR-2	UCH-9,NSK-11,WNG-3,UNG-7,BAM-9,PRG-8,TRN-3,YGK-3,HBI-1,HRT-1,KUR-2
46-47	NSK-1,TRN-3,TUM-1,HRT-1,HTP-2,UNG-3,HNG-1	THB-1,YGK-1,UCH-19,NSK-1,TRN-3,TUM-1,HRT-1,HTP-2,UNG-3,HNG-1
47-48	KHK-2,TUM-12,BPL-2,JAM-3,NSK-1,HNG-1,YGK-4,TRN-4,BAN-7,HRT-1,UCH-4	KHK-2,TUM-12,BPL-2,JAM-3,NSK-1,HNG-1,YGK-4,TRN-4,BAN-7,HRT-1,UCH-4
48-49	GLM-2,HTP-2,TUM-2,CHNTR-4,TRN-6,ASBNG-1,THB-1	BAM-1,JAM-2,TKT-39,UNG-1,YGK-9,BPL-1,WNG-1,UCH-1,GLM-2,HTP-2,TUM-2,CHNTR-4,TRN-6,ASBNG-1,THB-1
49-50	TUM-4,NSK-7,TRM-3,NEM-1,BAM-1,PUN-1,YGK-2,KNG-2	TUM-4,NSK-7,TRM-3,NEM-1,BAM-1,PUN-1,YGK-2,KNG-2
50-51	HBI-1,KNG-3,HNG-4,YGK-17,HNO-8,MKTB-1,THB-1,TZP-1,KHK-1,CHF-1,JAM-1	LHO-2,KOB-1,TUM-1,TRN-3,GLM-18,BAM-24,NSK-2,NEM-23,HBI-1,KNG-3,HNG-4,YGK-17,HNO-8,MKTB-1,THB-1,TZP-1,KHK-1,CHF-1,JAM-1
51-52	TRN-8,NSK-4,GLM-4,YGK-5,KNG-1,HNG-3,KOB-2,BAM-1,TZP-1,TKT-7	TRN-8,NSK-4,GLM-4,YGK-5,KNG-1,HNG-3,KOB-2,BAM-1,TZP-1,TKT-7
<b>Section 2: Thoubal - Kasom Khullen</b>		
0-1	TRN-5,TUM-1,NSK-1,KUR-1	TRN-4,BAM-1,NAK-2,HNG-1,CHF-1,HNO-2,GLM-6,BPL-17,KUR-1,KNG-1
1-2	KNG-2,GLM-1,NEM-1,NSK-1,	TUM-2,BAM-9,TRN-10,HKR-1,HNG-3,HNO-1,LAB-2,JAM-1,KUR-2,MNG-1,NSK-14,KNG-1,GLM-3,THB-1,NEM-2
2-3	GLM-1,NSK-2,NEM-3,HNG-1	TUM-3,GLM-6,NEM-1,TRN-3,NSK-7,KNG-1,NAK-1



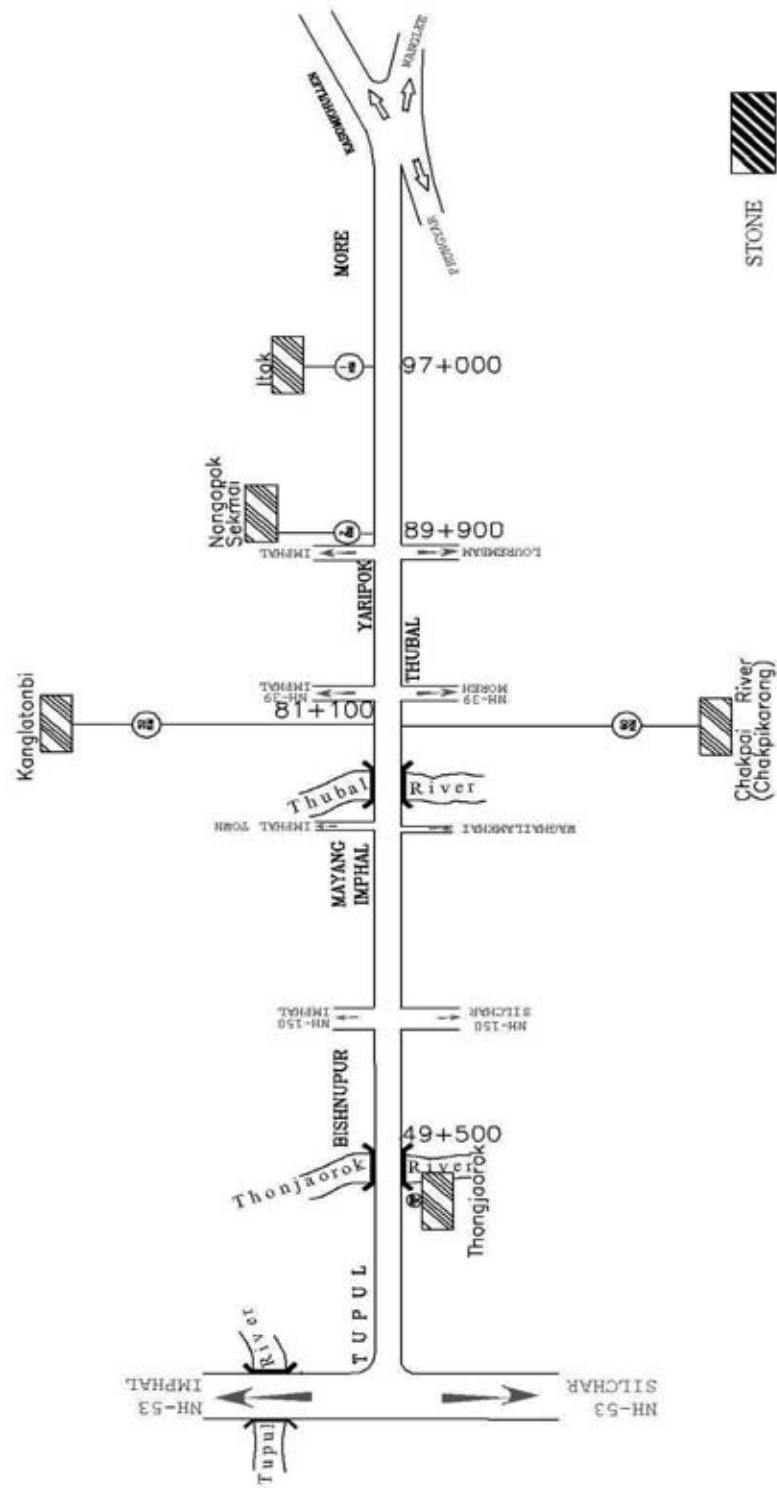
Chainage (km)	LHS	RHS
3-4	GLM-1,NSK-2,NAK-1,YGK-1,THB-1,TRN-1,NEM-2,PGD-1	TRN-5,TUM-1,NSK-1,KUR-1,
4-5	TRN-9,KOB-9,BAM-2,GLM-1,HNO-1,BOR-2,BAM-1	KNG-2,GLM-1,NEM-1,NSK-1
5-6	GLM-14,NSK-2,NAK-1,YGK-1,THB-1,TRN-1,NEM-2,PGD-1	GLM-1,NSK-2,NEM-3,HNG-1,BOR-6,TRN-2,KUR-1,KNG-5
6-7	GLM-5,KHK-2,BPL-1,BAM-1,KUR-2	GLM-14,NSK-2,NAK-1,YGK-1,THB-1,TRN-1,NEM-2,PGD-1
7-8	KNG-1,KHK4,HNG-1,TRN-3,YGK-1,KUR-3	GLM-5,KHK-2,BPL-1,BAM-1,KUR-2,
8-9	GLM-1,KUR-2,BAM-3,HNG-4,KHK-1	KNG-1,KHK4,HNG-1,TRN-3,YGK-1,KUR-3,NAK1,GLM-4
9-10	KHK-1,TRN-2,KNG-2,GLM-4,KOB-3,HNG-1,PGD-1,NSK-16,UNG-1	GLM-1,KUR-2,BAM-3,HNG-4,KHK-1
10-11	KNG-2,GLM-16,NSK-1,BOR-1,TKT-1	KHK-1,TRN-2,KNG-2,GLM-4,KOB-3,HNG-1,PGD-1,NSK-126,UNG-1
11-12	TRN-2,YGK-1,UCH-2,TUM-2,NSK-31	KNG-2,GLM-16,NSK-44,TUM-2,TRN-4,NEM-2,YGK-1,HNO-1,KOB-1,BOR-1,TKT-1
12-13	KHK-1,BOR-1,TRN-1,NSK-12	TRN-2,YGK-1,UCH-2,TUM-2,NSK-31
13-14	NSK-4,GLM-1,TRN-1,BPL-2	KHK-1,BOR-1,TRN-1,NSK-256
14-15	TUM-5,PGD-1,JAM-4,LAB-2,UNG-2	NSK-4,GLM-1,TRN-1,BPL-2
15-16	GLM-1,KUR-2,BAM-3,HNG-4,KHK-1	TUM-5,PGD-1,JAM-4,LAB-2,NAK-3,UCH-11,NSK-9,UNG-2
16-17	KHK-1,TRN-2,KNG-2,GLM-4,KOB-3,HNG-1,PGD-1,NSK-16,UNG-1	UCH-11,NSK-7,YGK-7,UNG-1,KHK-1,JAM-1,HRT-3
17-18	KNG-2,GLM-1,NSK-4,TUM-2,TRN-4,NEM-2,YGK-1,HNO-1,KOB-1,BOR-1,TKT-1	UCH-2,HRT-3,HNG-1
18-19	TRN-2,YGK-1,UCH-2,TUM-2,NSK-3	JAM-1,UNG-2,CHF-1,PGD-2,HYM-2,HRT-3,YGK-1,ASBNG-1,HNG-12,TRM-22
19-20	KHK-1,BOR-1,TRN-1,NSK-2	HYM-2,KHK-1,NAK-1,KHK-1,TRN-10,KOB-2,YGK-2,TUM-3,UCH-15
21-22	NSK-4,GLM-1,TRN-1,BPL-2	UCH-14,ASBNG-5,HRT-8,TRN-12,NAK-1,UNG-3,YGK-2,NSK-4
22-23	TUM-2,PGD-1,JAM-4,LAB-2,NAK-3,UCH-2,NSK-1,UNG-2	HRT-2,NEM-4,UCH-9,NSK-2,TRN-1,TUM-3,ASBNG-1,UNG-1,CHNTR-1,KHK-1,HNO-1,LNG-1,HTP-1
23-24	UCH-2,HRT-3,HNG-1	HTP-4,UCH-10,TRN-1,HYN-3,NSK-5,UNG-1,YGK-3,ASBNG-2,HNO-5
24-25	JAM-1,UNG-2,CHF-1,PGD-2,HYM-2,ASBNG-1,HNG-1,TRM-2	KUR-1,TRN-2,UNG-1,UCH-7,NSK-2,HBI-1,KHK-2,BAM-2,NEM-1,HRT-3
25-41	442 (mix species)	1252 (mix species)
<b>Total</b>	<b>1221</b>	<b>2884</b>
<b>Total on both Side</b>		<b>4105</b>

Abbreviated Form	Full form	Abbreviated Form	Full form
NSK	Nasik	THB	Theibong
HNO	Heinou	PRG	Pareng
HNG	Heining	YGK	Yongchak
HBG	Heibong	LHU	Leihau
HRT	Heirit	GLM	Gulmohar
HTP	Heitup	KUR	Kurao
HBI	Heibi	PGD	Pungdom
HKR	Heikru	UCH	Uchan
HKG	Heikreng	WNG	Wang
HTO	Heitroi	HYM	Heiyem
TZP	Tezpatta	LAB	Laba
HRG	Heirikokthong	CHNTR	Chingthrow
KHK	Khok	TMK	Tamuk
TRN	Tairen	MNG	Mange
TUM	Tumitla	MRB	Marbieoo
UTH	Uthambal	URM	Ureirom
SGK	Singkap	SRS	Siris
UNG	Uyung	ASBNG	Ashiheibong
KNG	Khongnang	UMB	Umanbi
BOR	Boroi	MKTB	Mukthubi
BAM	Bamboo	KKMB	Kokhumbi
JAM	Jam	NAK	Nakupi
TKT	Teak	PUN	Punthong
LNG	Lengchi	LHO	Leihao
BPL	Baraplei	KOB	Kobila
NEM	Neem	TRA	Tera
HUD	Huiden		

### Appendix 3: Location Map of Borrow Areas, Stone & Sand Quarries and Water Sources

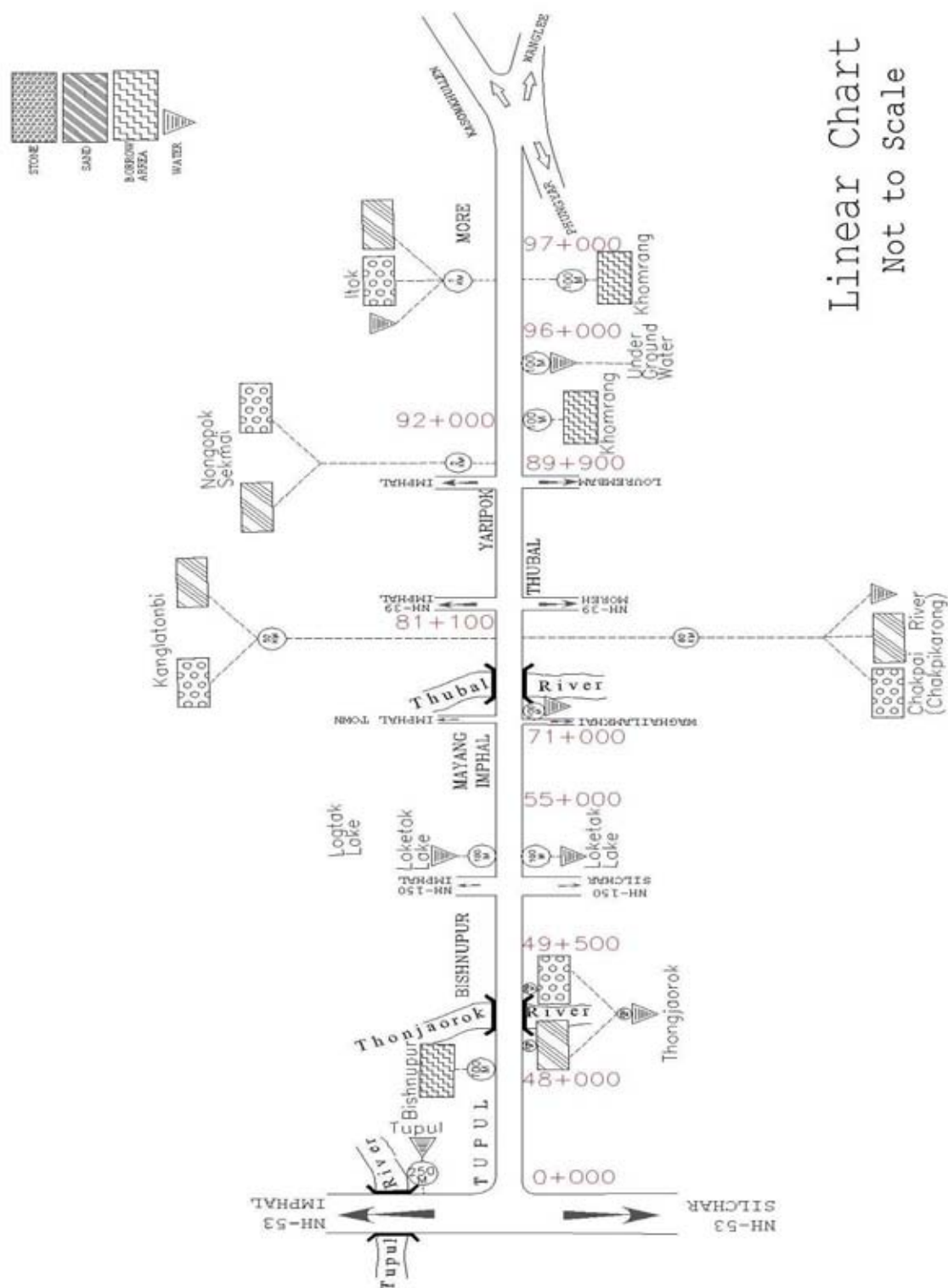


# Location Chart : Sand



Linear Chart  
Not to Scale

## Location Chart For Various Construction Material



**Appendix 4: List of Officials Consulted & Issues Discussed During Field Visit**

Sl. No.	Name of Official Consulted	Department	Issue discussed	Date
1	Mr. Kameshwar Singh	Extension officer, Social Welfare Department, Govt. of Manipur, Imphal	Social development activities in the State, active NGO's	8th June 2005
2	Ms. Peijonma Kauei	Dy. Director, Directorate of Economics & Statistics, Govt. of Manipur, Imphal	Socio-economic Statistics of the State, Major factors responsible for economic growth, Mineral resources, Cloud Bursting in the region in common phenomenon	8th June 2005
3	Dr. Khaijalayan	Member Secretary, Manipur State Pollution Control Board, Imphal	Environmental quality in state, Major sources of Air, Water, Noise and Soil Pollution, Facilities available at SPCB for monitoring of environmental quality	8th June 2005
4	Mr. N. Menecatamsi	Senior Engineer, Manipur State Pollution Control Board, Imphal	Air Quality, Water Quality, Environmental Issues in Imphal and other cities, Institutional capacity	8th June 2005
5	Mr. S. Singsit	Add. Principal Chief Conservator of Forests (Wildlife), Office of PCCF, Govt. of Manipur, Imphal	Status of Wildlife in State, Scope of IEE, Impacts on forests & wildlife, Mitigation options, Environmental friendly forest activities, Wildlife conservation programs	8th June 2005
6	Mr. K. Thanbon Singh	Chief Conservator of Forests, Office of PCCF, Govt. of Manipur, Imphal	Wildlife in state, Impacts on forests & wildlife, Mitigation options	8th June 2005
7	Mr. Jagdishor Singh	Divisional Forest Officer, Working Plan Division-I, PCCF Office, Imphal	Wildlife & Forest Resources details, Wildlife map & flora & fauna statistics	8th June 2005
8	Mr. N. Sobhachandra Singh	Ass. Conservator of Forests, Office of PCCF, Imphal	Wildlife & forest resources, Environmental Impacts & Mitigation measures, Scope of IEE	8th June 2005
9	Chinpal Raunier	Consultant (GDS), ADB TA Preparation of Northeastern States Trade and Investment Creation	Potential of trade & economy in the North Eastern Region, Impacts of road sector on trade & economy, factors affecting trade & economy	6th May 2005
10	Mr. Madhusudan Mitra	Consultant (GDS), ADB TA Preparation of Northeastern States Trade and Investment Creation	Potential of trade & economy in the North Eastern Region, Impacts of road sector on trade & economy, factors affecting trade & economy	6th May 2005

11	Mr. Kh. Temba Singh	(Nodal Officer) Superintending Engineer, National Highways Circle, PWD, Manipur	General discussion about Project road and likely benefits and impacts.	26 Nov. 2007
12	Mr. Joy Kumar	In-charge, PIU, PWD, Manipur	General discussion about Project road and likely benefits and impacts	26 Nov. 2007
13.	Mr. Gojendro Singh	Project Director, Loktak Development Authority	Availability of map of the Loktak Lake The Activities being taken near Lake by local community and LDA Study and Approval required for the Project road passing through Loktak Lake.	27 Nov. 2007
14	Mr. K. Angami	Special Secretary Forest & Environment		27 Nov. 2007
15	Mr. D. C. Karnatak, IFS	Chief Conservator of Forests, Imphal, Manipur	The Forest Clearance required for the Project road of length 73 km, which is passing through Reserve Forest. Availability of Wild life Sanctuary/ National Park with 10 km of Project road	29 Nov. 2007

### Photographs Record of Stakeholders' Consultation





## Appendix 5: Questionnaire Used for Community Consultation

### ENVIRONMENTAL SURVEY

#### Practical View of the Community about Environmental Scenario

- | Km:  | From-  | To- | Team No- |
|------|--|-----|----------|
| Q.1- | What do you think about the quality of water from ponds, wells, rivers or canal in your area?<br>Good<br>Satisfactory<br>Polluted  |     |          |
| Q.2- | If the quality of water is polluted /poor then in your opinion what are its reasons?<br><br>Ingress of industrial effluent in the source<br>Sewage leakage/discharge in the source<br>Animal water holes<br>Rain water storage<br>Others, please specify |     |          |
| Q.3- | Is the noise level in your area disturbing / irritating?<br>Yes<br>No  |     |          |
| Q.4- | If the Noise level is disturbing / irritating then in your opinion, it is due to<br>Vicinity of industry<br>Vehicular Traffic<br>Construction work<br>Work shop / scooter repair shop<br>Aviation zone<br>Others, please specify                         |     |          |
| Q.5- | How, in your opinion, the noise level can be brought to satisfactory level in your area.   |     |          |
| Q.6- | Is the quality of air, which you breath is healthy and clean<br>Yes<br>No  |     |          |
| Q.7- | If not, then what are the reasons ?<br>Due to vehicular pollution<br>Due to Industrial pollution<br>Due to poor sanitation<br>Due to tanneries in the vicinity<br>Due to domestic smoke<br>Others , please specify                                       |     |          |

Q.8- Are there any places of Archeological / historical importance in your vicinity, if yes, please give details

Q.9- Is there any previous history of natural disaster viz. Floods, Drought, earthquake etc. in your area, if so give details with year of occurrence and damage.

	Location:	Year:
Flood	Yes / No	
Drought	Yes / No	
Earthquake	Yes / No	

Q.10- Are any rare species of Birds, Animals etc. visiting your area during winter, if so please give details and locations

Name of the Species	Location
---------------------	----------

Q.11- Do you have any market place, melas etc. in your areas and it is likely to be affected by proposed expansion of road, if yes then which site do you suggest for relocation the markets.

Q.12- Do you have any suggestion to improve the Environment w.r.t. Air, Water and Noise in your area.

Particular	Name	Sign/Date
Recorder		
Scrutinizer		

**Appendix 6 : Environmental Management Plan (EMP) Matrix**

S.No.	Environmental Issue	Location/sources	Mitigation Measures	Mitigation Cost (INR)	Implementing Agency	Supervising & Monitoring Agency
<b>PRE-CONSTRUCTION PHASE</b>						
1	Obtainment of appropriate NOC/permits (Delays in processing permits causing further delay in initiation of project construction)	All along project road and critical areas	<ul style="list-style-type: none"> <li>Processing of NOC/permits on a timely basis.</li> </ul>	Project Cost	PIU	PIU
2	Involuntary resettlement or land acquisition	All along project road	<ul style="list-style-type: none"> <li>Compensation paid for temporary/ permanent loss of productive land as per entitlement framework and its process</li> </ul>	Project Cost	Revenue Dept. / PIU	PIU
3	Tree cutting	Cutting of about 4105 <sup>5</sup> nos. trees during site clearance	<ul style="list-style-type: none"> <li>Restricting tree cutting within construction limit</li> <li>Avoiding tree cutting at ancillary sites</li> <li>Providing and maintaining compensatory plantation of 12315 trees i.e. three times of cutting.</li> </ul>	47,41,275	Forest Dept. / PIU	PIU
4	Removal of utilities	Work site clearance	<ul style="list-style-type: none"> <li>Necessary planning and coordination with concerned authority and local body</li> <li>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.</li> </ul>	Project Cost	Concerned utility agencies / PIU	SC/ PIU
5	Religious places	Work site	<ul style="list-style-type: none"> <li>Suitable mitigation measures are incorporated in resettlement plan.</li> </ul>	130,000	PIU	SC / PIU

<sup>5</sup> These numbers shall be confirmed after counting and marking of trees during joint inspection with forest department officials.

S.No.	Environmental Issue	Location/sources	Mitigation Measures	Mitigation Cost (INR)	Implementing Agency	Supervising & Monitoring Agency
<b>CONSTRUCTION PHASE</b>						
1	Air Pollution	Construction plants, equipment and vehicles	Refer <b>Appendix 10-A</b> and <b>Appendix 10-B</b>	Project Cost	Contractor	SC/PIU
		Temporary diversion	<ul style="list-style-type: none"> <li>• Maintaining diversion and detour for road traffic in good shape and traffic regulated.</li> <li>• Regular sprinkling of water, as necessary.</li> </ul>	Project Cost	Contractor	SC/PIU
		Dust during earth works or from spoil dumps	<ul style="list-style-type: none"> <li>• Maintaining adequate moisture at surface of any earthwork layer completed or non-completed unless and until base course is applied, to avoid dust emission.</li> <li>• Stockpiling spoil at designated areas and at least 5 m away from traffic lane.</li> <li>• Refer <b>Appendix 10-C</b></li> </ul>	Project Cost	Contractor	SC/PIU
		Borrow pits and haul road	Refer <b>Appendix 10-D</b>	Project Cost	Contractor	SC/PIU
		Storage of construction materials	<ul style="list-style-type: none"> <li>• Sprinkling of water as necessary.</li> </ul>	Project Cost	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"> <li>• Constructing and maintaining diversion channel, sedimentation basin, dykes, etc. as may be required to temporarily channelise water flow of streams / river</li> <li>• Storage of construction material and excavated soil above high flood level</li> </ul>	Project Cost	Contractor	SC/PIU
		Construction vehicles	<ul style="list-style-type: none"> <li>• Strictly avoiding cleaning / washing of construction vehicle in any water body</li> </ul>	Project Cost	Contractor	SC/PIU

S.No.	Environmental Issue	Location/sources	Mitigation Measures	Mitigation Cost (INR)	Implementing Agency	Supervising & Monitoring Agency
		Soil erosion from construction site	<ul style="list-style-type: none"> <li>• Proper planning of site clearing and grubbing so as not to keep the cleared site before working for long duration.</li> <li>• 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</li> </ul>	Project Cost	Contractor	SC/PIU
		Seepage from Construction Debris	<ul style="list-style-type: none"> <li>• Refer <b>Appendix 10-C</b></li> </ul>	Project Cost		
		Construction camp and workers' camp	<ul style="list-style-type: none"> <li>• Refer <b>Appendix 10-B</b></li> </ul>	Project Cost	Contractor	SC/PIU
3	Ground water Pollution	Wastewater logging	<ul style="list-style-type: none"> <li>• 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.</li> </ul>	Project Cost	Contractor	SC/PIU
		Borrow pit excavation	<ul style="list-style-type: none"> <li>• Excavation of borrow pit should not touch the aquifer</li> </ul>	Project Cost	Contractor	SC/PIU
		Human wastes and wastewater at construction camp	<ul style="list-style-type: none"> <li>• Providing septic tanks for treating sewage from toilets before discharging through soak pits</li> <li>• Locating soak pits at least 50m from any ground water sources</li> <li>• Decanting and or controlled disposal of oil and grease as collected at collection tanks of maintenance yard and chemical storage areas</li> <li>• Refer <b>Appendix 10-B</b></li> </ul>	Project Cost	Contractor	SC/PIU

S.No.	Environmental Issue	Location/sources	Mitigation Measures	Mitigation Cost (INR)	Implementing Agency	Supervising & Monitoring Agency
4	Noise Pollution and Vibration	Vehicles and Construction machinery	<ul style="list-style-type: none"> <li>• <b>Site Controls:</b> Stationary equipment will be placed along un-inhabited stretches as per distance requirements computed above as far as practicable to minimize objectionable noise impacts.</li> <li>• <b>Scheduling of Project Activities:</b> 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.</li> <li>• <b>Protection devices</b> (ear plugs or ear muffs) will be provided to the workers operating in the vicinity of high noise generating machines.</li> <li>• Construction equipment and machinery should be fitted with silencers and maintained properly.</li> <li>• Source-control through proper maintenance of all equipment.</li> <li>• Use of properly designed engine enclosures and intake silencers.</li> <li>• Noise measurements should be carried out along the road to ensure the effectiveness of mitigation measures.</li> <li>• Vehicles and equipment used should conform to the prescribed noise pollution norms.</li> <li>• Movements of heavy construction vehicles and equipment near public properties will be restricted.</li> <li>• 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 <b>Appendix 10-B</b>.</li> <li>• Refer <b>Appendix 10-E</b> for identification, and operation of quarry areas and adopting controlled blasting.</li> </ul>		Contractor	SC/PIU

S.No.	Environmental Issue	Location/sources	Mitigation Measures	Mitigation Cost (INR)	Implementing Agency	Supervising & Monitoring Agency
5	Land Pollution	Spillage from plant and equipment at construction camp	<ul style="list-style-type: none"> <li>• Providing impervious platform and oil and grease trap for collection of spillage from construction equipment vehicle maintenance platform</li> <li>• Collection oil and lubes drips in container during repairing construction equipment vehicles</li> <li>• Providing impervious platform and collection tank for spillage of liquid fuel and lubes at storage area</li> <li>• Providing bulk bituminous storage tank instead of drums for storage of bitumen and bitumen emulsion</li> <li>• Providing impervious base at bitumen and emulsion storage area and regular clearing of any bitumen spillage for controlled disposal</li> <li>• Reusing bitumen spillage</li> <li>• 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)</li> <li>• Refer <b>Appendix 10-A and 10-B</b></li> </ul>	Project Cost	Contractor	SC/PIU
		Domestic solid waste and liquid waste generated at camp	<ul style="list-style-type: none"> <li>• Collecting kitchen waste at separate bins and disposing of in a pit at designated area/s</li> <li>• Collecting plastics in separate bins and disposing in deep trench at designated area/s covering with soil</li> <li>• Collecting cottons, clothes etc. at separate bins and burning in a pit (with sand bed)</li> </ul>	Project Cost	Contractor	SC/PIU
		Borrow pits	<ul style="list-style-type: none"> <li>• Controlled operation and redevelopment of borrow pits to avoid water logging and land contamination</li> </ul>	Project Cost	Contractor	SC/PIU

S.No.	Environmental Issue	Location/sources	Mitigation Measures	Mitigation Cost (INR)	Implementing Agency	Supervising & Monitoring Agency
6	Loss of topsoil	All construction sites	<ul style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>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.</li> <li>It shall be ensured by the contractor that the topsoil will not be unnecessarily trafficked either before stripping or when in stockpiles.</li> <li>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.</li> </ul>	20,80,000	Contractor	SC/PIU
7	Compaction of soil	All construction sites	<ul style="list-style-type: none"> <li>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.</li> </ul>	Project Cost	Contractor	SC/PIU
8	Ecology	Site clearance	<ul style="list-style-type: none"> <li>Restricting tree cutting within corridor of impact</li> </ul>	Project Cost	Contractor	SC/PIU



S.No.	Environmental Issue	Location/sources	Mitigation Measures	Mitigation Cost (INR)	Implementing Agency	Supervising & Monitoring Agency
		Ancillary sites	<ul style="list-style-type: none"> <li>Minimizing tree cutting and vegetation clearance during site selection</li> <li>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 quarry and 500 m for borrow areas</li> <li>Preservation of trees of ecological, socio-cultural importance</li> <li>Providing cooking at camp for discouraging and prohibiting use of fire-wood i.e. cutting of trees by the workers.</li> </ul>	Project Cost	Contractor	SC/PIU
9	Occupational health and safety of workers	Construction camp	<ul style="list-style-type: none"> <li>Water supply, sanitation, drainage and medical health facilities at campsite</li> <li>Providing and using PPEs</li> <li>Using working reverse horn for all construction equipment and vehicles</li> <li>Providing earth link circuit breaker (ELCB) for all electrical connections</li> <li>Maintaining first aid at construction sites</li> <li>Maintaining emergency response system</li> <li>Refer <b>Appendix 10-B</b></li> </ul>	Project Cost	Contractor	SC/PIU
10	Accidents and safety	Construction sites	<ul style="list-style-type: none"> <li>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.</li> <li>Providing adequate light at construction zone if working during night time is permitted by the Engineer</li> <li>Conducting induction and periodic training for all workers and supervisors</li> </ul>	75,000	Contractor	SC/PIU

S.No.	Environmental Issue	Location/sources	Mitigation Measures	Mitigation Cost (INR)	Implementing Agency	Supervising & Monitoring Agency
		Construction camp	<ul style="list-style-type: none"> <li>Conducting periodic mock drilling on critical accident prone activities</li> <li>Conducting periodic training for all personnel working at plant site</li> </ul>		Contractor	SC/PIU
<b>OPERATION PHASE</b>						
1	Air Pollution	Vehicular gaseous emission	<ul style="list-style-type: none"> <li>Periodicals monitoring of air pollutants and if values exceed the standard limits, suitable mitigation measures to be taken.</li> </ul>	Project Cost	PIU	SPCB and Traffic Police
2	Noise Pollution	Vehicular	<ul style="list-style-type: none"> <li>Periodical monitoring of noise level will be carried out. If values exceed the standard limits, suitable measures will be taken.</li> <li>Providing and maintaining signage on noise regulation at silence zones</li> </ul>	Project Cost	PIU	SPCB
3	Road Safety	Traffic and Vehicles	Maintenance of standard Highway Safety Signage and Traffic Management.	Project Cost	PIU	PIU and Traffic Police
		Lighting	Maintenance of road / flyover lighting.	Project Cost	PIU	PIU/Traffic police
4	Tree plantation	-	Roadside tree plantation three times of cutting	Project Cost	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"> <li>Contingency plans to be in place for cleaning up of spills of oil, fuel and toxic chemicals.</li> <li>Spill of oil, fuel and automobile servicing units without adequate preventive systems in place to be discouraged.</li> </ul>	Project Cost	PIU	PIU
6	Soil Erosion and Sedimentation		<ul style="list-style-type: none"> <li>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</li> </ul>	Project Cost	PIU	PIU
7	Maintenance of drainage system	-	<ul style="list-style-type: none"> <li>The drains will be periodically cleared to maintain storm water flow.</li> <li>Road drains will be cleared of debris before onset of every monsoon.</li> </ul>	Project Cost	PIU	PIU

### Appendix 7 : Environmental Monitoring Plan

Environmental Component	Project Stage	MONITORING						RESPONSIBILITY		
		Parameters	Measurement Method	Standards	Location and Frequency	Duration	Cost (INR)	Implementation	Supervision	
Air Quality	Construction Stage	SPM	At suitable locations as and when required and as instructed by SC (for 3 years)	Readings to be taken at 15 seconds interval for 15 minutes every hour and then Leq should be estimated.	12,000	Continuous 24 hours/ or for 1 full working day	96,000	Contractor through approved monitoring agency	SC, PIU	
		RPM								
	SO <sub>2</sub>									
	NO <sub>x</sub>									
	CO									
		SPM, RSPM, SO <sub>2</sub> , NO <sub>x</sub> , CO	Half-yearly for first two years	Continuou s 24 hours/ or for 1 full working day	Project Cost	Continuous 24 hours/ or for 1 full working day		Contractor through approved monitoring agency	SC, PIU	
	Operation Stage	SPM, RSPM, SO <sub>2</sub> , NO <sub>x</sub> , CO, HC	For three years	-	Project cost	Continuous 24 hours/ or for 1 full working day	Project Cost	PIU through approved monitoring agency	PIU	

Environmental Component	Project Stage	MONITORING						RESPONSIBILITY	
		Parameters	Measurement Method	Standards	Location and Frequency	Duration	Cost (INR)	Implementation	Supervision
Water Quality	Construction stage (surface water)	pH, temperature, turbidity, DO, BOD, COD, TDS, 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 (Refer <b>Appendix 11-A</b> )	At suitable locations as and when required and as instructed by SC (for 3 years)	-	84,000	Contractor through approved monitoring agency	SC, PIU
	Construction stage (ground water)	All parameters of drinking water		IS: 10500, 1991 (Refer <b>Appendix 11-A</b> )	At suitable locations as and when required and as instructed by SC (for 3 years)		22,500	Contractor through approved monitoring agency	SC, PIU
	Operation Stage (surface water)	pH, temperature, turbidity, DO, BOD, COD, TDS, 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	half yearly for two years	-	Project Cost	PIU through approved monitoring agency	PIU

Environmental Component	Project Stage	MONITORING						RESPONSIBILITY	
		Parameters	Measurement Method	Standards	Location and Frequency	Duration	Cost (INR)	Implementation	Supervision
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 (Refer <b>Appendix 11-C</b> )	At suitable locations as and when required and as instructed by SC (for 3 years)	Readings to be taken at 15 seconds interval for 15 minutes every hour and then Leq should be estimated.	12,000	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 (Refer <b>Appendix 11-C</b> )	Half-yearly for first two years	Continuous 24 hours/ or for 1 full working day	Project Cost	PIU through approved monitoring agency	PIU

### Appendix 8: Details of Environmental Training Program

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

**Appendix 9: Proposed Environmental Management Plan (EMP) Cost**

SL. NO.	ITEM DESCRIPTION	QUANTITY	UNIT	RATE (Rs.)	AMOUNT (Rs.)	RESPONSIBILITY
A	Tree Plantation					
A.1	Plantation of trees (Compensatory plantation i.e. Three times of total tree cut along road side) by road side in 0.6 m dia hole 1 m deep dug in the ground, mixing the soil with decayed farm yard sludge manual, planting the saplings, backfilling the trenches, watering and maintaining plants for one year.	12315	No.	285	3,509,775	PIU through Forest Department
A.2	Providing bamboo tree guard of height 1.2 meters above ground and 0.20 meter below ground for all trees other than bamboo tree.	12315	No.	100	1,231,500	
B	Environmental Monitoring					
B.1	Ambient air quality monitoring as per <b>Appendix 7</b> (2 location in the interval of 3 months for 3 Years)	24	No.	4000	96,000	PIU through Approved Monitoring Agency
B.2	Ambient noise level monitoring as per <b>Appendix 7</b> (2 location in the interval of 3 months for 3 Years)	24	No.	500	12,000	
B.3	Water quality monitoring of surface water as per <b>Appendix 7</b> (2 location in the interval of 3 months for 3 Years)	24	No.	3500	84,000	
B.4	Water quality monitoring of drinking water from construction camp as per <b>Appendix 7</b> (1 location in the interval of 6 months for 3 Years)	6	No.	3750	22,500	
C	Bioengineering measures for slope protection					
C.1	Trufing of Slopes through rough grassing and its maintenance for a period of one year including watering and mulching.	20000	sq.m	104	2,080,000	Contractor through BOQ
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.	20	No.	1000	20,000	
D.2	Boundary fencing with barbed wire fencing of approved make and specification including provision and erection of struts.	200	Rm.	550	110,000	

E	<b>Environmental Training</b>					
E.1	Training at site as per <b>Appendix 8.</b>	1	Lump Sum	75000	75,000	PIU through Supervision Consultant
		<b>Grand Total (Rupees)</b>			<b>7,240,775</b>	



## **Appendix 10: General Guidelines for Environmental Management**

### **A. PLANT MANAGEMENT (Hot-Mix, Crushing and Batching)**

#### **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  
Installed Capacity (tph):

Date:  
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:

Site plan showing wind direction, haul road and other environmental features.

Certified that the furnished information is correct and all relevant information as required is attached.

Contractor:

## **B. 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.

### **Siting, Establishing, Operation and Closure of Construction Camp**

#### **1. 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**

#### **2. 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.

### **3. 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 on site 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.

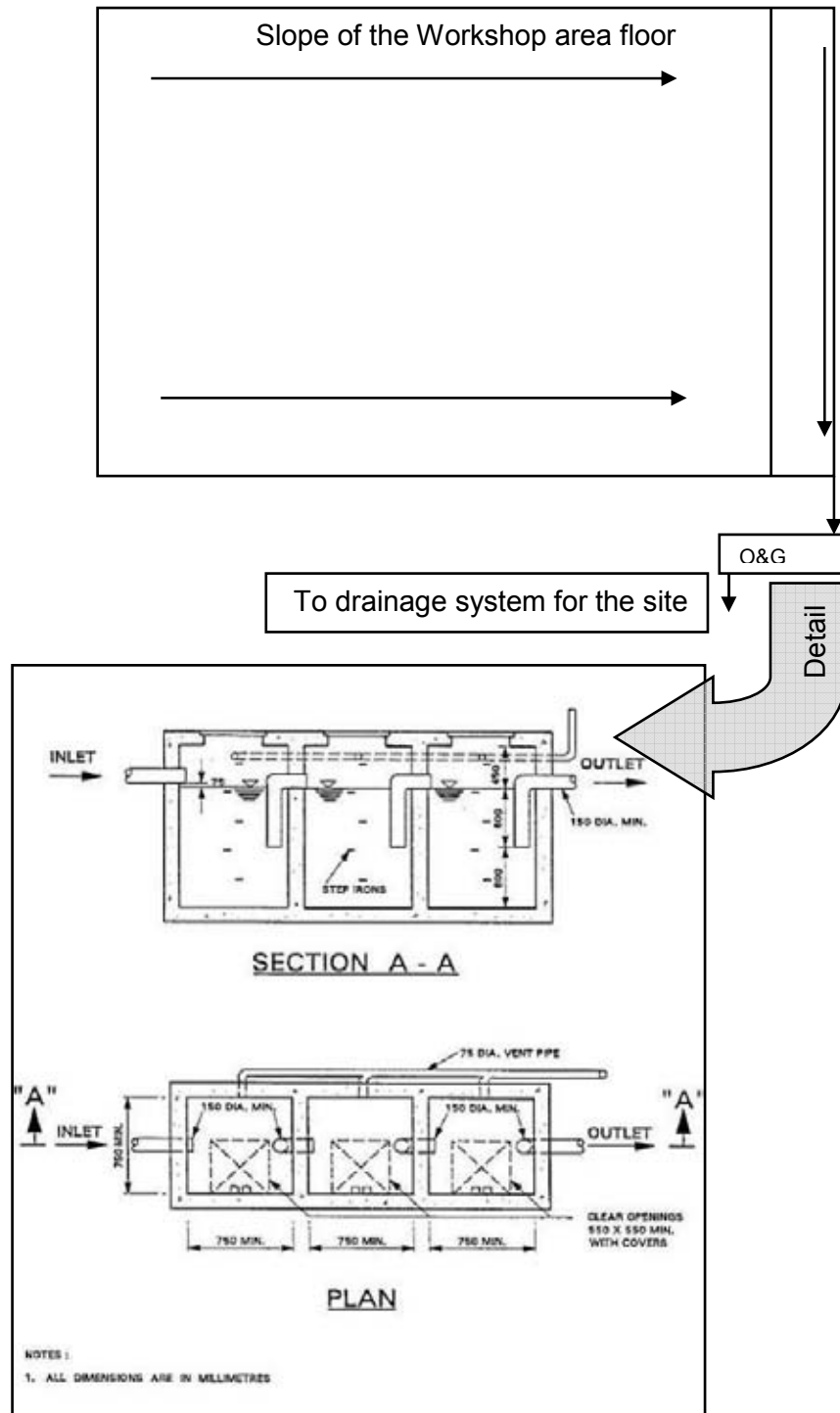
### **Mitigation Measures**

#### **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.

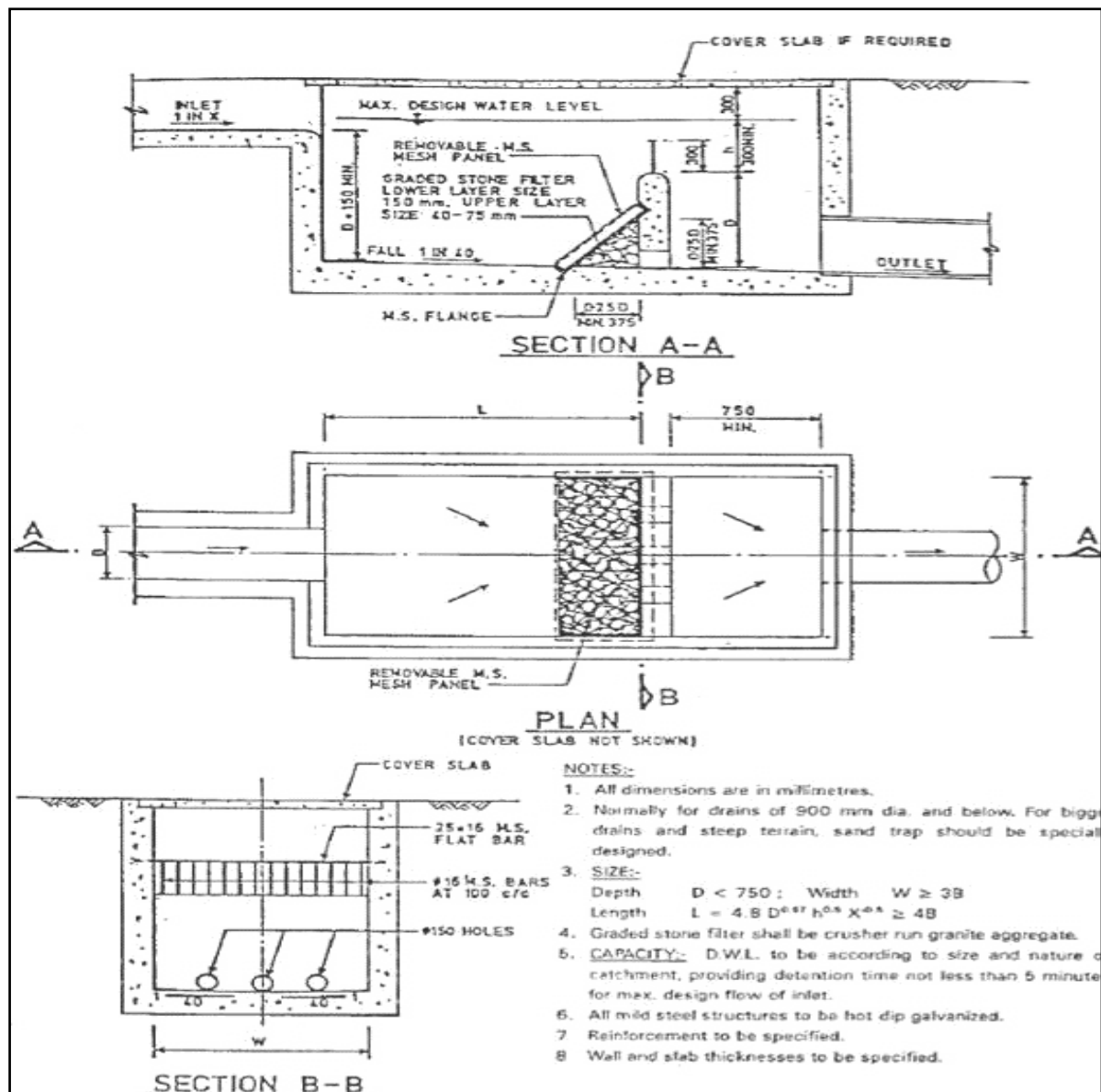
#### **2. Workshop and Maintenance areas**

- 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.
- 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.



**Figure A: Workshop Area Pollution Control**

- 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 B: 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.

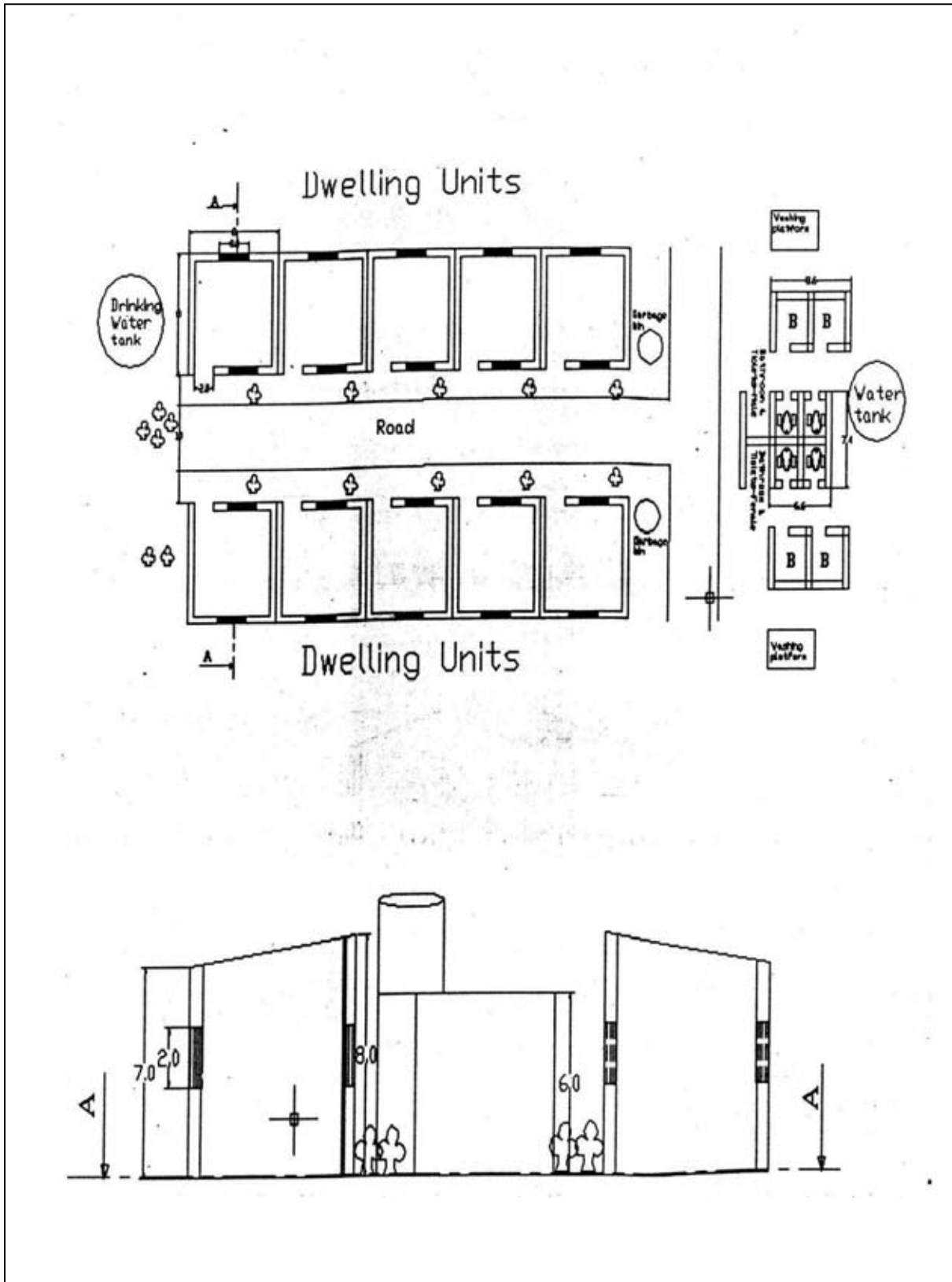
### **Mitigation Measures**

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:

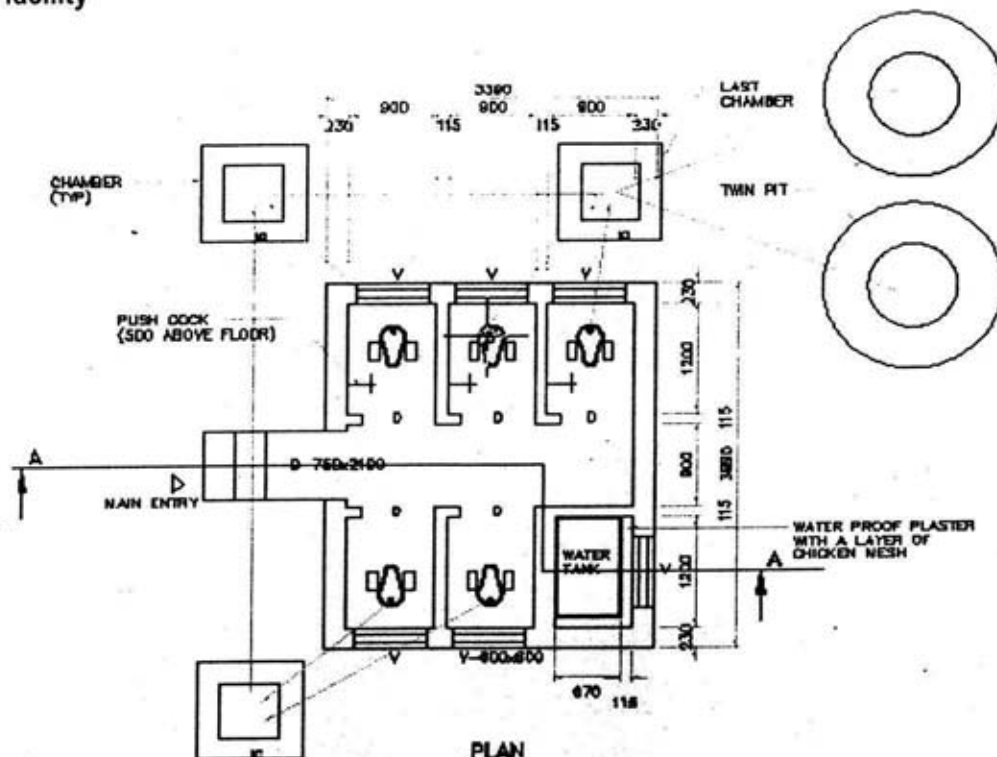
- The contractor shall provide free-of-charge temporary accommodation to all the labour employed for the project. The accommodation includes separate cooking place, bathing, washing and lavatory facilities. At least, one toilet will be provided for every 35 people and one urinal will be provided for 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.



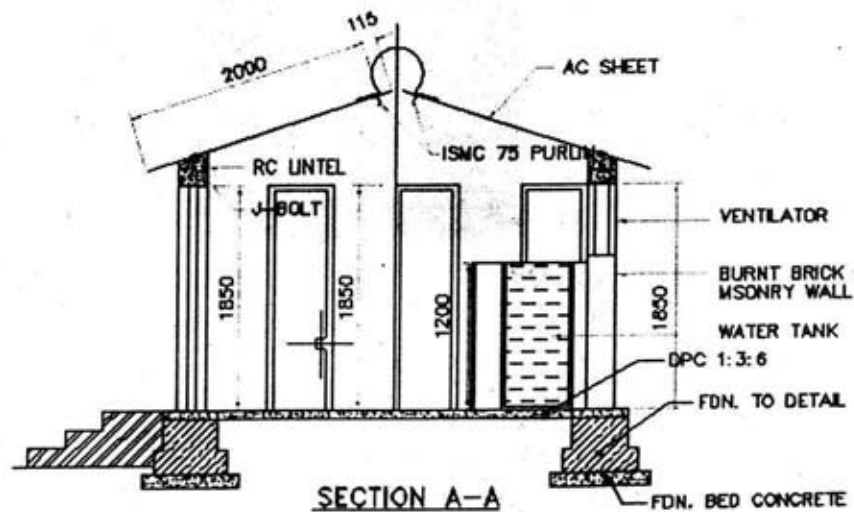
**Figure 3: TYPICAL DRAWING OF WORKERS' CAMP SANITARY FACILITY**



## Sanitary facility

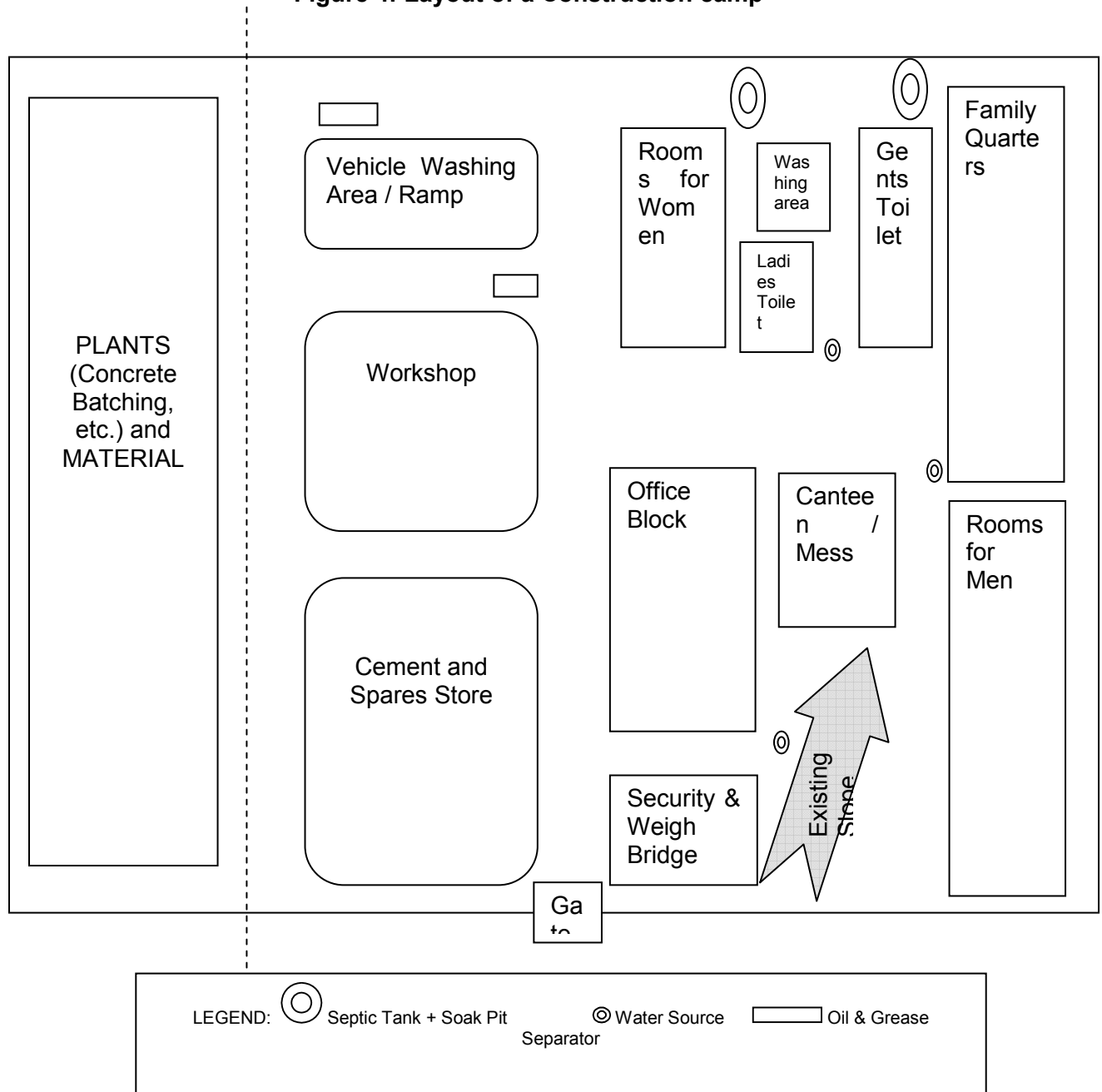


**PLAN**  
 SIZE OF EACH TOILET BOOTH : 1050x1200  
 (TYPICAL WITH 8 WC ENCLOSURE FOR SCHOOLS, SHOPPING AREAS)

**NOTES:**

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

**Figure 4: Layout of a Construction camp**



## **C. DEBRIS DISPOSAL**

### **Purpose**

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

### **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.

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

## D. BORROW AREA MANAGEMENT

### Purpose

Borrow areas are generally required to provide material for road construction sites, can have significant adverse environmental effects, especially on ecologically sensitive areas. Borrow areas can become environmental hotspots and can significantly affect the visual appearance of an area. Special mitigation and management measures are often required to avoid or minimise the environmental and social impacts of borrow areas.

### Scope

These guidelines for borrow areas cover:

- statutory approvals
- environmental and social impacts of borrow areas
- selection of borrow areas
- operation of borrow areas
- rehabilitation of borrow areas

The guidelines seek to ensure that Contractors:

- comply with the regulatory requirements in force at the time
- reasonably manage any impacts
- reinstate and rehabilitate the land appropriately
- consult with affected communities

### Impacts

**Some of the potential impacts of borrow areas are:**

- trucks transporting materials to the site causing air pollution, and noise and vibrations
- ponds of stagnant water forming in excavated areas giving rise to the breeding of mosquitoes and the spreading of malaria and other mosquito-borne diseases
- natural beauty of the landscape being affected by excavations and the removal of vegetation
- natural drainage systems in the area being affected by excavations
- agriculture land and productive soils being lost, especially in paddy field areas

Borrow areas are not generally specified in Contract documents but rather it is generally the responsibility of Contractors to identify borrow areas and obtain the necessary consent from land owner and approval from SC.

In IRC: 10 and Clause 305.2.2.2 of MoRTH Specification, exclusive guideline has been given for borrow areas located alongside the road and only some of the requirements have been indicated for borrow areas located outside the road land. Following guideline is proposed to supplement the existing stipulation in IRC: 10 and Clause 305.2.2.2 of MoRTH Specification for Roads and Bridge Works:

**Location**

- Identify areas having present land use as barren land, riverside land. Otherwise, un-irrigated agriculture land or land without vegetation and tree cover;
- Prefer borrow areas on bed of irrigation water storage tank;
- Prefer areas of highland with respect to surroundings;
- Avoid locating borrow area close to any road (maintain atleast 30 m distance from ROW and 10 m from toe of embankment, whichever is higher);
- Should be at least 1.5 km away from inhabited areas;
- Maintain a distance of about 1.5km from ecologically sensitive area i.e. Reserve Forest, Protected Forest, Sanctuary, wetland etc.;
- Maintain a distance of about 1.5 km from school, hospital and any archaeological sites;
- Having adequate approach road with minimum length of earthen road;
- Ensure that unsuitable soft rock is not prominent within the proposed depth of excavation which will render rehabilitation difficult;
- Depth of excavation should be decided based on natural ground level of the land and the surroundings, and rehabilitation plan. In case higher depth of excavation is agreed with backfilling by unsuitable excavated soil (from roadway), then filling should be adequately compacted except topsoil which is to be spread on topmost layer (for at least 20cm thick).

**Operation**

- Controlled operation as per agreed / approved plan;
- Preservation of topsoil at designated areas e.g. corners of the area etc.;
- Maintain necessary buffer zone in all directions and go for vertical cut within this area. Final cut slope should be maintained within the buffer zone;

- Step-wise excavation if borrow area is located on inclined area having more than 2% slope;
- Restricting excavation up to 2m for each stages of operation if allowed depth is more;
- Avoid cutting of any tree of girth size > 30cm<sup>6</sup>. if any tree cutting is inevitable, prior permission (written) from the competent authority should be taken and compensatory plantation has to be raised.

### Rehabilitation

- Prior approval of Rehabilitation Plan considering terrain, land use and local need;
- Restricting operation as agreed by landowner and approved by the Engineer;
- Rehabilitation within agreed timeframe and before taking over;
- Integrate debris disposal and borrow area redevelopment.

### Management Procedure

The important aspects of this procedure are:

- The first and foremost thing is to have tentative estimate of borrow material requirement chainage-wise. For this, BoQ quantity for earth work, which is given as total quantity for the entire package/milestone, has to be distributed chainage-wise. The requirement of borrow material chainage-wise then has to be estimated based on the suitability of roadway excavation material for reuse and BoQ.
- Contractor to site borrow areas fulfilling environmental requirements and obtaining one time approval of the Engineer both on quality as well as environmental consideration thereby integrating environmental safeguard measures into day-to-day activities;
- Contractor to submit environmental information in prescribed format for obtaining Engineer's approval, as given in the following format (**Borrow Area Identification**). The format has been so designed that it stipulates the requirements as well as what is actual for each borrow areas and could be easily understood by any person, whoever in-charge of identifying borrow areas;
- Contractor to submit Borrow Area Layout Plan as attachment to the format showing the land use of the proposed and surrounding area along with the presence of other environmental features such as water bodies, forests, settlement, temple and any sensitive receptor i.e. health and educational institution, roads etc. within a radius of 1.5km area from the boundary of the borrow area;
- Contractor to prepare and submit Block Contour Map of each borrow area (especially which are located close to road and on undulating terrain) for deciding on operation and redevelopment plan;
- Contractor to prepare Operation Plan and submit as attachment to the format including cross sections on both directions (x,y) mentioning natural ground level, depth of topsoil (if any), total depth of excavation, cut side slope and bed slope;
- Contractor to prepare Redevelopment Plan and submit as attachment to the format include cross sections on both directions (x,y) mentioning natural ground level, excavated profile, finished profile after redevelopment etc.;

---

<sup>6</sup> Plant having girth size more than 30cm is considered as tree.

- Contractor to maintain Borrow Material Register;
- Periodic joint inspections of each borrow area until rehabilitation is complete as agreed and approved.
- The checklist for periodic inspection is given in this appendix.

### BORROW AREAS IDENTIFICATION

Construction Stage Report: One Time

Date:

Location of Borrow Area (Ch. & Offset):

Revenue Survey No.:

Sl. No.	Item / Requirement	Details as per Actual (to be filled by Contractor & checked by Engineer)
1	Date of Borrow Area planned to be operational	
2	Current Land use (preference to barren land, riverside land, otherwise, un-irrigated agriculture land or land without tree cover)	
3	Size (Sq.m) and area (m x m) of Borrow Area	
4	Proposed maximum depth of pit in m (IRC 10 & Clause 305.2.2 of MoRTH Spec.)	
5	Details of riverside borrow area (inner edge should not be less than 10m from the toe of the bank and bottom of pit should not cut the imaginary line of 1:4 from embankment top)	
6	Borrow area in cultivable land (should be avoided or restricted to total depth of 45cm including preservation of 15cm topsoil)	
7	Quantity Available (Cum)	
8	Quantity of top soil to be removed (Sq.m & depth in cm)	
9	Details of preservation (storage) and management (re-use / re-laid) of top soil	
10	Width of Haul road (m)	
11	Total Length of Haul Road (km)	
12	Length of Non-metal Haul Road (should be as minimum as possible)	
13	No of settlements within 200 m of Non-metal Haul Road (should be as minimum as possible)	
14	Distance from settlement (should be minimum 1500 m)	
15	Should be away from water bodies. Give details of water bodies within 250 m.	
16	Details of water sources for dust suppression	
17	Quantity of water required for dust suppression i.e. sprinkling at borrow area and on haul road (Cum)	
18	Availability of water required for dust suppression (Cum)	
19	Details of ecologically sensitive area i.e. RF, PF, Sanctuary etc. within 1500m (should be nil)	
20	Details of school, hospital and any archaeological sites within 1500m (should be nil)	



Sl. No.	Item / Requirement	Details as per Actual (to be filled by Contractor & checked by Engineer)
21	Distance from nearby road embankment, fence line / boundary (should be minimum 30m from ROW and 10m from toe of embankment, whichever is higher)	
22	No of Trees with girth more than 0.3 m (No tree should be affected)	

**Documents to be attached:**

- 1) Site plan and layout plan of borrow area;
- 2) Proposed borrow area operation and redevelopment plan;
- 3) Written consent from competent authority for use of water for dust suppression
- 4) Written consent of landowner on agreed operation and redevelopment plan

Certified that the furnished information is correct and all relevant information as required is attached

Contractor's Representative:

**CHECKLIST FOR MONITORING BORROW AREA OPERATION & MANAGEMENT**

Attributes	Requirements
Access road	✓ Only approved access road shall be used
Top soil preservation	✓ Top soil, if any, shall be stripped and stored at corners of the area before start of excavation for material collection; ✓ Top soil should be re-used / re-laid as per agreed plan
Depth of excavation	✓ For cultivable (agriculture) land, total depth of excavation should be limited to 45 cm including top 15 cm for top soil preservation; ✓ For riverside borrow area, the depth of excavation shall be so regulated that the inner edge of any borrow pit should not be less than 10m from the toe of the bank and bottom of pit should not cut the imaginary line of 1:4 from embankment top; ✓ If borrow area is located within 1500 m of towns or villages, they should not exceed 30 cm in depth and should be properly drained; ✓ Borrow areas close to ROW should be rectangular in shape with one side parallel to center line of the road and depth should be so regulated that it should not cut an imaginary line having slope of 1 in 4 projected from the edge of the final section of the embankment.
Damage to surrounding land	✓ Movement of man & machinery should be regulated to avoid damage to surrounding land.
Drainage control	✓ The surface drainage in and around the area should be merged with surrounding drainage; ✓ No water stagnation shall occur.
Dust suppression	✓ Water should be sprayed on <i>kutchha</i> (earthen) haul road twice in a day or as may be required to avoid dust generation during transportation of material; ✓ Depending on moisture content, 0.5 to 1.5% water may be added to excavated soil before loading during dry weather to avoid fugitive dust emission.

Attributes	Requirements
Covering material transport vehicle	✓ Material transport vehicle shall be provided with tarpaulin cover
Personal Protective Equipment	✓ Workers should be provided with helmet, gumboot and air mask and their use should be strictly enforced.
Redevelopment	✓ The area should be redeveloped within agreed timeframe on completion of material collection as per agreed rehabilitation plan.

## E. QUARRY AREA MANAGEMENT

### Purpose

Quarries generally required to provide material for road construction sites, can have significant adverse environmental effects, especially on ecologically sensitive areas. Quarries can become environmental hotspots and can significantly affect the visual appearance of an area. Special mitigation and management measures are often required to avoid or minimise the environmental and social impacts of quarries.

### Scope

**These guidelines for quarries cover:**

- statutory approvals
- environmental and social impacts of quarries
- selection of quarries
- operation of quarries
- rehabilitation of quarries

**The guidelines seek to ensure that Contractors<sup>7</sup>:**

- comply with the regulatory requirements in force at the time
- reasonably manage any impacts
- reinstate and rehabilitate the land appropriately
- consult with affected communities

### Impacts

**Some of the potential impacts of quarries are:**

- rock blasting causing air pollution, and noise and vibrations
- trucks transporting materials to the site causing air pollution, and noise and vibrations
- ponds of stagnant water forming in excavated areas giving rise to the breeding of mosquitoes and the spreading of malaria and other mosquito-borne diseases
- natural beauty of the landscape being affected by excavations and the removal of vegetation
- natural drainage systems in the area being affected by excavations

**The procedure for identification and finalization of quarry site/s shall be as given below:**

- Estimating the quantity of quarry material to be collected from each quarry area
- Only licensed quarry will be used

<sup>7</sup> The EMP stipulations will be applicable even if contract use existing licensed quarry. In case contractor use the existing licensed quarry a copy of the quarry license and lease / sub-lease agreement should be submitted to the Project Proponent. Contractor shall submit a plan delineating how he shall comply with requirements stipulated in this plan and elsewhere in the EMP on quarrying activity.

- New quarry will be at least 1.5 km away from the settlement, forest and other ecologically sensitive areas
- Away from water body
- Contractor shall identify alternative quarry sites along the whole corridor based on required quantity and environmental consideration as given in the following prescribed format of **Quarry source identification**.
- Contractor shall submit to the Engineer the detailed information / documents as prescribed in the format;
- Engineer shall undertake site inspection of alternate quarry sites and convey to Contractor on accepting a particular quarry site on environmental consideration;
- Contractor shall then take apply and obtain Quarry Lease Deed / License from the Department of Mines and Geology and provide copy of the same to the Engineer prior to operation;
- Contractor shall estimate water requirement for dust suppression at quarry sites during operation and for water spraying on *kutch*a (non-metal) haul road and ensure availability water by identifying sources and obtaining necessary permission;
- Contractor shall prepare quarry sites operation and redevelopment plan considering surrounding land uses, local needs and agreement with the landowner;
- Only licensed blaster i.e. short-firer certificate holder will be responsible for quarry blasting
- Permits for transportation, storage and use of explosive, as will be required, shall be obtained from the Controller of Explosive;
- Whenever so advised by the Engineer, controlled blasting e.g. using less charge, restricting depth and dia or drill holes, cut-off blasting etc., shall be undertaken.
- Quarry operation will be undertaken in stages with adequate benching

**The procedure for environmentally sound operation and management of quarry sites is given below:**

- Estimating the quantity of quarry material to be collected from each quarry area;
- Demarcating the entire quarry area by fencing and putting red-flag poles;
- Providing adequate metallic access road;
- Preserving topsoil from the quarry compound, if any, by stripping and stacking aside separately at corners;
- Carrying out blasting as per agreed operational plan complying with the requirements of MoRTH Specification (Clause 302 & 303) and Ministry of Environment & Forests (MoEF) as given below;
- Maintaining a **Quarry Material Collection Register** on daily material collection for each of the quarry area, which shall be produced to Engineer's representative as and when requested;
- Redeveloping the area within 2 months (or as will be agreed upon) of completion of quarry material collection;

### **Use of Explosive for Blasting**

#### **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, transport, storage, handling and use of explosives shall be strictly followed.

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, dimension and notes.

The magazine for the storage of explosives shall be built as per national / international standards 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 displayed in the lobby of the magazine:

- A copy of the relevant rules regarding safe storage in English, Portuguese and in the language with which the workers concerned are familiar.
- A statement of up-to-date stock in the magazine.
- A certificate showing the last date of testing of the lightning conductor.
- A notice that smoking is strictly prohibited.

All explosives shall be stored in a secure manner in compliance with all laws and ordinances, and all such storage places shall be clearly marked. Where no local laws or ordinances apply, 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. 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 the 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.

### **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 safety 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.

### **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.

### **Blasting Operations**

The blasting shall be carried out during fixed 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. All the charges shall be prepared by the man in charge only.

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 operations.

Red danger flags shall be displayed prominently in all directions during the blasting operations. The flags shall be planted 200m and 500m from the blasting site in all directions for blasting at work site and quarry, respectively. 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.

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 in. The powder 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 such size that the cartridge can easily go down. The holes shall be cleared of all debris and explosive 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 recognised 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 blasting site.

### **Misfire**

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

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.

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. Should it not blast the old charge, the procedure shall be repeated till the old charge is blasted.

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.

### **Account**

A careful and day to day account of the explosive shall be maintained by the Contractor in an approved register and manner which shall be open to inspection by the Engineer at all times.

During quarry operation, periodic joint inspection should be carried out by the Contractor and Engineer's representatives.

A typical checklist for the same is given here.

### QUARRY SOURCE IDENTIFICATION

Construction Stage Report: One Time

Supervision Consultant:

Contractor:

Date:

Contract Package:

Location of Quarry (Ch. & Offset):

Sl. No.	Item / Requirement	Details as per Actual
1	Present land use (bare land with no prominent vegetation is preferred)	
2	Predominant wind direction	
3	Size and area of Quarry (m xm & Sq.m)	
4	Quantity Available (Cum)	
5	Quantity proposed to be collected (Cum)	
6	No of Trees with girth more than 0.3 m	
7	No Settlement within 1500 m of Quarry	
8	No water body within 1500 m of Quarry	
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)	
12	No of Settlements within 200m of Non-metal Haul Road (should be as minimum as possible)	
13	Quantity of water required for dust suppression i.e. sprinkling at borrow area and on non-metal haul road (Cum)	
14	Details of Water sources for dust suppression	
15	Availability of water required for dust suppression (Cum)	

#### Documents to be attached:

- 1) Site plan and layout plan of quarry site
- 2) Proposed quarry site operation and redevelopment plan
- 3) Written consent / lease agreement with the Department of Mines & Geology
- 4) Written consent from competent authority for use of water for dust suppression

Certified that the furnished information is correct and all relevant information as required is attached

Contractor's Representative:

### Details to be inspected for Monitoring Quarry Area Operation & Management

Attributes	Requirements
Access road	✓ Only approved access road shall be used
Top soil preservation	<ul style="list-style-type: none"> <li>✓ Top soil, if any, should be stripped and stored at designated area before start of quarry material collection;</li> <li>✓ Top soil should be re-used / re-laid as per agreed plan</li> </ul>
Controlled blasting & safety	<ul style="list-style-type: none"> <li>✓ Storage of explosive magazine as per threshold quantity with all the safety measures;</li> <li>✓ Handling of explosive by licensed blaster only;</li> <li>✓ Use low intensity explosive;</li> <li>✓ Check unfired explosive, if any, before drilling;</li> <li>✓ Carryout blasting at lean time only;</li> <li>✓ Cordoned the area within 500m radius with flagmen having whistle for signaling preparedness;</li> <li>✓ Using properly designed audio visual signal system i.e. siren and flagmen for blasting;</li> <li>✓ Keep ready an emergency vehicle near blasting area with first aid facility and with active emergency response system.</li> </ul>
Damage to surrounding land	✓ Movement of man & machinery should be regulated to avoid damage to surrounding land.
Drainage control	✓ The surface drainage in and around the area should be merged with surrounding drainage;
Dust control	<ul style="list-style-type: none"> <li>✓ Haul road should be made metallic;</li> <li>✓ Suitable dust arrester for drilling;</li> <li>✓ Water spraying at quarry complex, if required.</li> </ul>
Covering material transport vehicle	✓ Material transport vehicle should be provided with tail board, and cover
Personal Protective Equipment	✓ Workers shall be provided with helmet, safety shoes, ear muffler and air musk and their use should be strictly enforced.
Redevelopment	✓ The area should be redeveloped within two months (or as agreed) on completion of material collection as per agreed plan.

## Appendix 11: National Standards for Water, Air and Noise Levels

### A. Indian Standard Drinking Water Specification: IS 10500:1991

Sl. No.	Substance/ Characteristic	Desirable Limit	Permissible limit	Remarks
1	Colour, Hazen units, Max	5	25	Extended to 25 if toxic substance are not suspected in absence of alternate sources
2	Odour	Unobjectionable		a) Test cold and when heated b) Test at several dilution
3	Taste	Agreeable		Test to be conducted only after safety has been established
4	Turbidity NTU, Max	5	10	
5	pH value	6.5 to 8.5	No relaxation	
6	Total Hardness (as CaCO <sub>3</sub> mg/lit)	600	600	
7	Iron (as Fe mg/lit, Max	0.3	1.0	
8	Chlorides (as Cl mg/lit Max	250	1000	
9	Residual Free Chlorine, mg/lit Max	0.2		To be applicable only when water is chlorinated. Treated at consumer end. When protection against viral infection is required, it should be Min 0.5 mg/lit
10	Dissolved Solids mg/l, Max	500	2000	
11	Calcium (as Ca) mg/l, Max	75	200	
12	Copper (as Cu) mg/l, Max	0.05	1.5	
13	Manganese (Mn) mg/l Max	0.1	0.3	
14	Sulphate (As SO <sub>4</sub> ), Max	200	400	May be extended up to 400 provided (as Mg) does not exceed 30
15	Nitrate (as NO <sub>3</sub> ) mg/l, Max	45	100	
16	Fluoride (as F) mg/l, Max	1.0	1.5	
17	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH) mg/l Max	0.001	0.002	
18	Arsenic (as As mg/l	0.05	No relaxation	To be tested when pollution is suspected
19	Lead (as Pb) mg/l	0.05	No relaxation	
20	Anionic Detergents (as MBAS) mg/l	0.2	1.0	
21	Chromium (as Cr) mg/l	0.05	1.0	To be tested when pollution is suspected
22	Mineral Oil mg/l	0.01	0.03	
23	Alkalinity mg/l	200	600	
24	Total Coliform	95% of the sample should not contain coliform in 100 ml. 10 coliform /100 ml		



**B. National Ambient Air Quality Standards (MoEF, 2009)**

Pollutant	Time Weighted Average	Concentration in Ambient air ( $\mu\text{g}/\text{m}^3$ )	
		Industrial, Residential, Rural and Other Areas	Ecologically Sensitive Areas
Sulphur Dioxide ( $\text{SO}_2$ )	Annual Average*	50	20
	24 hr**	80	80
Oxides of Nitrogen (as $\text{NO}_2$ )	Annual Average *	40	30
	24 hr**	80	80
Particulate Matter: $\text{PM}_{10}$ ( $<10 \mu\text{m}$ )	Annual Average *	60	60
	24 hr**	100	100
Particulate Matter: $\text{PM}_{2.5}$ ( $<2.5 \mu\text{m}$ )	Annual Average *	40	40
	24 hr**	60	60
Lead	Annual Average *	0.5	0.5
	24 hr**	1.0	1.0
Carbon monoxide $\text{mg}/\text{m}^3$	8 hr	2.0	2.0
	1 hr	4.0	4.0

\* Annual Arithmetic mean of minimum 104 measurement in a year taken for a week 24 hourly at uniform interval.

\*\* 24 hourly or 8 hourly or 1 hourly monitored values should meet 98 percent of the time in a year

Source: MoEF notification Central Pollution Control Board (1997) National Ambient Air Quality Monitoring Series, NAQMS/a/1996-97.

**C. National Ambient Noise Level Standards**

Area Code	Category	Limits in Decibels (dB A)	
		Day Time	Night Time
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silence Zones	50	40

Note: (1) Daytime: 6 AM to 9 P.M., Night-time 9 PM to 6 AM;

(2) Silence zone is an area up to 100 m around premises as hospitals, educational institutions and courts.

Source: Central Pollution Control Board, New Delhi