

Environmental Assessment Report

Summary Initial Environmental Examination (Assam)
Project Number: 37066
June 2008

India: Rural Roads Sector II Investment Program (Project 3)

Prepared by Ministry of Rural Development for the Asian Development Bank (ADB).

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

ABBREVIATIONS

ADB	:	Asian Development Bank
ASRB	:	Assam State Road Board
BIS	:	Bureau of Indian Standards
CGN	:	Chief General Manager
CGWB	:	Central Ground Water Board
CO	:	Carbon Monoxide
COI	:	Corridor of Impact
ECoP	:	Environmental Code of Practices
EIA	:	Environmental Impact Assessment
EMAP	:	Environmental Mitigation Action Plan
EO	:	Environmental Officer
FEO	:	Field Environmental Officer
FGD	:	Focus Group Discussion
GOI	:	Government of India
GSB	:	Granular Sub Base
HA	:	Hectare
HC	:	Hydro Carbon
IA	:	Implementation Agency
IEE	:	Initial Environmental Examination
IRC	:	Indian Road Congress
LPG	:	Liquefied Petroleum Gas
MORD	:	Ministry of Rural Development
MORTH	:	Ministry of Road Transport and Highways
NAAQS	:	National Ambient Air Quality Standards
NGO	:	Non Governmental Organisation
NOx	:	Nitrogen Oxide
NRRDA	:	National Rural Roads Development Authority
PIC	:	Project Implementation Consultant
PIU	:	Project Implementation Unit
PMC	:	Project Management Consultant
PMGSY	:	Pradhan Mantri Gram Sadak Yojna
POL	:	Petroleum, Oil and Lubricants
PPTA	:	Project Preparation Technical Assistance
ROW	:	Right of Way
RPM	:	Respirable Particulate Matter
RRSII	:	Rural Roads Sector II Investment Program
SBD	:	Standard Bidding Documents
SO ₂	:	Sulphur dioxide
SPM	:	Suspended Particulate Matter
SSTA	:	Small Scale Technical Assistance
TA	:	Technical Assistance
US	:	United States
WBM	:	Water Bound Macadam

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SECTION – 0

EXECUTIVE SUMMARY

0.1 BACKGROUND OF THE PROJECT

1. The Government of India (GoI) has embarked upon a rural connectivity program to connect rural villages through metalled road. The program has been named as 'Pradhan Mantri Gram Sadak Yojana (PMGSY)'. It has been targeted that all villages up to the population of 500 will be connected by the year 2007. As a part of this program 969.85 km road length is planned to be taken up in the State of Assam with the loan assistance from the Asian Development Bank (ADB) under the Rural Roads Sector II Investment Program as Batch II. About the same length was undertaken for construction in Batch I. Construction works of Batch I are almost completed. As per the relevant policy of Asian Development Bank Initial Environmental Examination has been taken up to integrate environmental mitigation measures in the project design.

0.2 BRIEF FEATURES OF PROJECT

2. In the Batch II a total length of 969.85 km has been taken. This length comprises rural roads varying in length from 1.2 to 18.2 km. In total roads have been selected. These are located in all 26 districts of Assam. The rural road construction works will provide for 7.5 m roadway width with 3.75 m carriageway in plain terrain. The construction proposal considers a 3.75 m concrete pavement lined storm water drains for stretches passing through the habitations. In case of hilly tracks regions the roadway width will be limited to 6.0 m with 3.75 m carriageway.

3. At present rural habitations to be covered under PMGSY are connected to the nearest paved road network through unpaved tracks.

4. The available Right of Way (RoW) varies from 10 to 12 m. No land acquisition is planned. The private land owners along the proposed RoW are voluntarily parting the encroached land and in some cases parting even their private land without any compensation. The present traffic data on each of these Rural roads typically vary between 10-15 vehicles per day. The traffic largely comprises of Motor Cycles/ two wheelers, tractors, and light commercial vehicles and animal drawn carts.

0.3 INITIAL ENVIRONMENTAL EXAMINATION (IEE) STUDY IN THE PROJECT

5. This report covers the Initial Environmental Examination (IEE) of the Batch roads is as per terms of reference of Technical Support Consultants (TSC) and guidelines given by Asian Development Bank and Ministry of Environment & Forests, Govt. of India. The IEE has been included in project preparation to streamline environmental issues in project design.

6. Environmental considerations are an integral part of project preparation. The mitigation measures have been provided in IEE report for all identified adverse environmental impacts.

7. The detailed designs of this project road have been closely coordinated with the preparation of report. The IEE preparation led to the identification of potential environmental

hot spots and feasible remedial measures (including avoidance, and mitigations) which are included in the Environmental Management Plan (EMP).

0.4 TYPE OF PROJECT

8. For projects with potential to have significant adverse environmental impacts (Category A) an environmental impact assessment (EIA) is required. Category B projects are judged to have some adverse environmental impacts, but of lesser degree or significance than those for category A projects. Category B projects require an Initial Environmental Examination (IEE) 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 as is the case for this project. No endangered species of flora & fauna are reported along the rural roads selected in second annual batch. Thus the present project has been considered under category – B as per ADB definition.

9. Environmental clearance is required at the State and Central Government level for specific projects. The Government of India has issued Environmental Impact Assessment Notification 2006 as a part of Environmental (Protection) Act, 1986. As per this notification road projects have been categorised in two categories namely 'A' and 'B'. The Category 'A' projects are all NH and Category 'B' projects all State Highways. The current project will fall in Category 'B2'. The Environmental Clearance is required for only those projects which are either new in length of 30 km or more or land acquisition put together on either side of existing road is more than 20m. The present project is a rural construction in length less than 30 km and does not require any land acquisition and hence will not require Environmental Clearance. The other clearances required will be consent to operate and establish from SPCB for construction camps, permission from Ground Water Board for water withdrawal, licenses from chief controller of explosives Nagpur for storage of Fuel/HSD at construction site, licenses/permissions from labour department under labour laws. All these permissions/licenses have to be obtained by the respective contractors.

0.5 NEED FOR THE PROJECT

10. The rural road connectivity is seen as a catalyst for Rural Sector Development by promoting access to health, education facilities and as an avenue to increased economic opportunities, leading to increased agricultural income and productive employment opportunities. The Rural road development project is expected to play a dominant in the development of rural sector and ensuring sustainable poverty reduction program.

0.6 PROJECT LOCATION AND SIZE

11. All rural road projects are located in the state of Assam.

12. The total length of road under scope of work is 1000.78 km.

13. The most of rural roads are located in plain terrain barring a few in undulating terrain. The land use pattern for rural roads is predominantly agricultural barring few patches of agricultural lands & built up areas in the settlements.

0.7 DESCRIPTION OF ENVIRONMENT

0.7.1 Physical Resources

14. Determination of baseline conditions of natural and physical environmental components along project route is vital for robust impact assessment. The components of the environment for which the information has been collected are described in the following subsections.

0.7.2 Climate

15. The climate of Assam is characterized by a hot summer and well distributed rainfall during the monsoon season.

16. The main feature of the climate is long dry period average monthly temperature rising over 9.0 degree centigrade, through maximum summer temperature may even go up to 26 degree centigrade. In winter the temperature not go below 18 degree centigrade .The monsoon bring sufficient rains. The average rainfall is around 2100 mm.

0.7.3 Air Quality

17. The ambient air quality in the vicinity of Rural roads is expected to be within the limits specified in the National Ambient Air Quality Standards.

0.7.4 Noise Quality

18. Noise levels are anticipated within the stipulated limits of CPCB of rural areas.

0.7.5 Water Hydrology and Drainage

19. The entire state of Assam is drained by river Brahmaputra and its tributaries.

0.7.6 Physiography and Soils

20. The major soil types within the state can be classified into five groups namely Entisols, Molisols, Alfisols, Ultisols, and Histosols.

0.7.7 Ecological Resources

Forests

21. None of the rural roads selected passes through reserved or protected forests. .

Fauna

22. There are no endangered species of fauna reported along the rural roads. Most of the faunal species are domesticated like cattle, goats & dogs. Common birds like sparrow and crows are found.

0.7.8 Trees along the existing Road

23. The tree species that generally occur are Mango, Betal nut, Jamun, Banana crop, Tea Plantations, Coconut Palm, Bamboo trees, timber and tanm, etc.

0.7.9 Protected Monuments and Properties of Archaeological Value

24. There is no archaeological site/protected monument location that falls under the influence area of project routes.

0.7.10 Water Bodies on the Alignment

25. The water bodies have been avoided while finalising the alignment. However, road ditches are full of water during rainy season.

0.8 Environmental Impacts

0.8.1 Topography

26. During the construction of the rural roads, the topography will change due to excavation of borrow areas, cuts and fills for roads and construction of project related structures (construction camp, hot mix plant, labour camp, stock piles and etc). Provision of construction yard for material handling will also alter the existing topography. The change in topography will also be due to the probable induced developments of the project. Benefits in the form of land levelling and tree plantations in the vicinity of the project road shall enhance the local aesthetics.

0.8.2 Impact on Climate

27. Impact on the climate conditions from the proposed rural road construction will not be significant as no major deforestation and/or removal of vegetation is involved for the project.

0.8.3 Impacts on Air Quality

28. There will be rise in SPM levels during the construction activities within construction area, which shall again be within prescribed limit after the construction activities are over. Since there is very low traffic density, the post project ambient air quality is expected to be within the stipulated limits.

0.8.4 Impacts on Noise Levels

29. The impact of noise levels from the proposed project on the neighbouring communities is addressed. It has been concluded that both day time and night time equivalent noise levels are within the permissible limits right from start of project life up to the end of project life.

0.8.5 Impacts on Water Resources and Quality

30. The construction and operation of the proposed rural roads will not have any major impacts on the surface water and the ground water quality in the influence area. Contamination to water bodies may result due to spilling of construction materials, oil, grease, fuel and paint in the equipment yards and asphalt plants. This will be more prominent in case of locations where the project road crosses minor streams, canals, distributaries, etc. Mitigatory measures have been planned to avoid contamination of these water bodies.

0.8.6 Impact on Ecological Resources

31. The most of rural roads selected pass through agricultural land. There are no endangered species or rare species of flora and fauna in the project area. Hence no impact of project construction is expected on ecological resources. Due to construction of rural roads on existing alignment and adequate RoW the impact on vegetation is not anticipated.

0.8.7 Impact on Drainage Pattern

32. The proposed widening and strengthening will not alter drainage pattern of the area as adequate cross drainage structures have been planned and existing culverts along the rural roads are planned for rehabilitation.

0.8.8 Impact on Human Use Values

33. There will be no acquisition of land along the rural roads selected for . There is need to relocate 19 hand pumps as those are located in Col.

0.8.9 Loss of Private Properties

34. The loss of private properties is not anticipated as in buildup portions construction is restricted to available RoW.

0.8.10 Impact on Religious Structures

35. Religious structures (Chabutaras, temples and other religious structures) are not located within COI hence no impact is anticipated.

0.9 MITIGATION AVOIDANCE AND ENHANCEMENT MEASURES

36. The mitigatory measures have been planned for identified adverse environmental impacts. The construction workers camp will be located at least 1.5 km away from habitations. The construction camp, hot mix plants, crushers etc. will be located at 1.5 km away from habitations and in down wind directions. The location of construction workers' and construction camp will be 500m from road side ponds (if any). Adequate cross drainage structures have been planned to maintain proper cross drainage. In order to compensate negative impacts on flora due to cutting of trees the project plans compensatory plantation in the ratio of 1:3 i.e. for every to be tree cut three trees will be planted.

0.10 ENVIRONMENTAL MANAGEMENT PLAN

37. Environmental Management Plan has been prepared and is intended to become a part of the contract documents so that implementation of all the environmental measures can be ensured. The implementation actions, responsibilities and timeframes have been specified for each component and adverse impact anticipated. Separate section detail out the monitoring plan, a comprehensive monitoring system and budgetary estimates for corridor. The total cost for environmental management plan is INR 44.07 millions including cost for the monitoring of environmental indicators.

0.11 PUBLIC CONSULTATIONS

38. Public consultations were conducted at local level, institutional level and district level during the baseline data generation period. The main purpose of these consultations was to know the Community's reaction to the perceived impact of proposed project on the people at

individual and settlement level. The issues of the most concern were related to rehabilitation and resettlements and have been dealt with in short RAP. It was also felt during the public consultation process that most of the people are aware about the project but they did not appreciate environmental problems associated with road projects, however, some people were concerned about environmental issues mainly air and noise pollution. The other concerns raised at during public consultation were demand for solutions for safety problems. The issues raised by the public have been duly incorporated in project design.

0.12 FINDINGS OF THE STUDY

39. The major findings of the study are:

40. The total length in second annual batch is 969.85 km. The terrain of the proposed alignment passes through mainly plain terrain. The land use pattern of the road is predominantly agricultural barring few built up areas in the towns & villages.

41. At present the roads are existing cart tracks.

42. Based on the field survey and data available from secondary sources, it can be concluded that the project will not have significant negative environmental impacts. The issues of concern in the project are construction of road and culverts. Proper environmental management plan compliance needs to be ensured. The project falls in category B as per the ADB's guidelines.

43. EMAP included in ECOP document has been included in the current IEE. For future batches new EMAP has been included in Appendix III.

0.13 RECOMMENDATIONS

44. The IEE report has discussed the environmental issues in details and then suggested an Environmental Management plan. The plan with proper implementation monitoring schedule needs to be followed. Major recommendations in these plans are given below:

- a) An Environmental Officer should be ensured in each PIU in the team of Project Implementation Consultants (PIC).
 - b) Recommended compensatory plantation is three times the number of trees to be cut.
 - c) Air pollution and noise pollution control measures to be implemented during construction.
 - d) Water bodies will not be impacted as far as possible.
 - e) Workers camp will be located away from water bodies and will have proper water supply and sanitation facilities.
 - f) All machineries will conform to the noise and emission limits as per applicable Indian laws.
-

- g) The consultants have prepared state specific EMP and has been given in Appendix IV. It is recommended that this EMP is followed in Batch-3 and subsequent batches implementation.
- h) A standard EMP to be followed in batch-2 road has been given in Appendix-2. This EMP was part of ECOP document.

0.14 CONCLUSION

45. Based on the IEE study and surveys conducted for the Project, associated potential adverse environmental impacts can be mitigated to an acceptable level by adequate implementation of the measures as stated in the IEE Report. Adequate provisions shall be made in the Project to cover the environmental mitigation and monitoring requirements, and their associated costs as suggested in environmental budget. There is no requirement of further EIA study.

46. As already mentioned the proposed project, i.e. widening and strengthening of the road network by creating additional road capacity between different points of the road network will improve operational efficiency and can act as an effective mechanism for reducing economic of the road stretches. It may be noted that, in terms of prominent environmental impacts of road projects on air quality and noise levels, the project brings considerable improvement to possible exposure levels to population when compared with no project scenario.

47. Overall, the major social and environmental impacts associated with proposed projects are limited to the construction period and can be mitigated to an acceptable level by implementation of recommended measures and by best engineering and environmental practices.

SECTION-1

1.0 INTRODUCTION

1.1 General

1. The GOI is currently implementing the national rural roads program known as Pradhan Mantri Gram Sadak Yojna (PMGSY) in many states of India through the Ministry of Rural Development (MORD). The objective of the PMGSY is to provide all-weather road connectivity to all rural habitations with a population of more than 1000 by 2004 and habitations with more than 500 populations by 2007. The Assam Public Work Department (PWD) is the nodal department implementing PMGSY in Assam.

2. The Asian Development Bank (ADB) is providing loan under the Rural Roads Sector II Investment Project (RRSII) to support PMGSY in Assam, West Bengal and Orissa states. The ADB's loan assistance has been implemented in annual batches. First annual batch consist of 3,000 km rural roads (1000 km in each state) and was prepared under ADB's Technical Assistance. The construction work of first annual batch is nearing completion and for the second annual batch state Governments are in the process of awarding the contract. The Detailed Project Reports (DPRs) for second annual batch have been proposed the state Government. These DPRs have included an initial environmental examination in the form of checklist. The environmental assessment has to be taken up as per policy requirements of ADB. The project as per classification of ADB has been categorised as 'Category B' project and therefore requires an Initial Environmental Examination (IEE). The second batch of the RRSII is also classified as a "B" project in accordance to ADB's environmental classification. The present volume of the report covers IEE for about 969.85 km road length in the State of Assam in the second annual batch that was prepared by using the environmental checklist served as IEE. This environmental checklist is part of agreed 'Environmental Assessment Review Frame Work (EARF)'. This IEE report has been prepared by M/s Operations Research Group (P) Ltd., The Technical Support Consultants (TSC) appointed by National Rural Road Development Agency (NRRDA) under the ADB loan assurance.

1.2 Project Identification and Location

3. The Assam PWD has selected about 969.85 km of rural roads to be taken up under the second annual batch of ADB loan assistance under RRSII in Assam. The 969.85 km of roads comprises 138 different stretches spread over in 26 districts of the State. Within each district, the roads are further scattered in several blocks and sub divisions. The minimum and maximum length of the roads ranges between 1.214 and 18.184 km respectively. The list of 969.85 km roads in given in **Appendix 1** and the location map of the districts is given in **Figure 1.1**.



Fig No. – 1.1 District Map of Assam

1.3 Rural Road Construction Proposals

4. The proposal for rural road construction works typically considers a 10-12m right of way (ROW), which includes side slopes for embankment, side drains on either side of the alignment. The construction proposals are confined to the existing alignment of the unpaved tracks. Majority of these are foot/pathways traditionally used by the villagers and transformed into the present form of unpaved tracks/roads through minor construction works taken up by the communities, local bodies and State Government over the decades

1.4 Initial Environmental Examination

1.4.1 Corridor of Impact and Study Area

5. Based on the proposed cross-section, 15m (7.5m on each side of the existing alignment) has been considered as the direct area of influence or the corridor of impact (COI) for IEE. In addition, a 10 km wide corridor (5 km on each side) of the proposed alignment has been considered for assessment of the baseline environmental conditions of the region as a whole.

1.4.2 Field Visits

6. The TSC has been appointed to assist the state Government in environmental and social safeguard during the project implementation. The TSC has prepared Initial Environmental Examination Report. Although the IEE report is based on the environmental checklist that served as an IEE for each road as part of the preparation of the DPR, the field visit was also undertaken by the environmental specialist of TSC between November 2007 to March 2008. The field visit was carried out for selected roads in all districts in different stretches / locations, which broadly represent the first second batch of 969.85 km.

1.4.3 Secondary Data Collection

7. Upon the completion field appraisal, secondary environmental data pertaining to the significant environmental issues were collected from various government and non-governmental / research institutions for assessment of the baseline environment of the project locations / region as a whole.

1.4.4 Primary Data Collection

8. The primary data generation was limited to the ecological investigation of typical sensitive areas among the selected rural road construction proposals. Similarly, tree enumeration survey was also carried out in some of the selected stretches of the rural road construction proposals. The details of the investigations are included under the section 3.0 – Description of Environment.

1.5 Purpose of the Report

9. This report summarises the Initial Environmental Examination (IEE) of the second annual batch of 969.85 km of rural roads in Assam. The IEE for each road was prepared by using the environmental checklist that has been agreed under the Environmental Assessment Review Framework for the Rural Road Project. The Summary of the IEE has been prepared in accordance with the Bank's Environmental Assessment Guidelines, 2003.

SECTION- 2

2.0 DESCRIPTION OF PROJECT

2.1 Type of Project

1. The PMGSY program has mandate to provide all-weather roads to all the rural habitations within the country by year 2007. The PMGSY guidelines have the following priorities for establishing the rural connectivity.

- Unconnected habitations with population of 1000 or more
- Unconnected habitations with population of 500 to 999 or in population located in designated hilly or desert areas or with predominantly scheduled caste or scheduled tribe population, greater than 250.
- Population of 1000 or more presently connected by all-weather gravel roads.
- Population that satisfy the criteria described in category two above presently connected by all weather roads.
- Population of 1000 or more presently connected by all weather paved or WBN roads requiring rehabilitation.
- Population that satisfy the criteria described in category two above presently connected by all weather paved or WBM requiring rehabilitation

2.2 Category of Project

2. The Rural Road Development Program under the PMGSY is categorised as 'B' in accordance with the ADB's Environmental Assessment Guidelines, 2003 and Initial Environmental Examination (IEE) are to be carried out for projects under the Category B. The Category B projects are judged to have some adverse environmental impacts but of lesser degree and / or significance than Category A projects, which require detailed EIA studies.

2.3 Need for Project

3. The rural road connectivity is seen as a catalyst for rural sector development by promoting access to health, education facilities and as an avenue to increased economic opportunities, leading to increased agricultural income and productive employment opportunities. The rural road development project is expected to play a dominant role in development of rural sector and ensuring sustainable poverty reduction program.

2.4 Location and Selection Criteria of Roads for IEE

4. The second batch of 969.85 km of rural roads is spread over 11 districts. The district wise distribution of the 969.85 km roads is given in **Table 2.1**.

Table 2.1 : District wise Distribution of Rural Roads under Batch II - 969.85km

S. No.	Name of the District	Length (km)	No. of Roads	Length in km	
				Minimum	Maximum
1	Kamrup (Rural)	66.161	10	2.12	9.65
2	Sonitpur	49.776	6	5.23	13.088
3	Morigaon	37.139	5	2.132	16.974
4	Goalpara	28.518	5	2.459	8.445
5	Chirang	30.300	4	6.70	8.00
6	Karbi Anglong	40.329	3	6.956	18.184
7	Nagaon	86.015	8	5.290	15.486
8	Bongaigaon	28.618	4	1.818	14.900
9	Nalbari	32.422	8	1.754	11.049
10	Dibrugarh	30.742	5	3.231	7.982
11	Jorhat	47.595	7	46.26	10.462
12	Tinsukia	30.392	5	2.244	9.582
13	Cachar	46.340	12	1.537	9.878
14	Udalguri	21.139	2	5.881	15.258
15	Barpeta	53.941	9	1.587	10.207
16	Baksa	30.054	5	2.717	13.517
17	Dhemaji	49.537	5	4.990	17.936
18	Dhubri	35.027	4	5.200	11.775
19	Golaghat	45.892	6	1.214	10.877
20	Kokrajhar	30.984	5	1.814	9.900
21	Lakhimpur	52.680	5	5.591	12.941
22	Darrang	24.030	4	3.385	8.800
23	Sivsagar	30.221	3	3.442	5.190
24	Karimganj	17.671	3	2.907	7.500
25	Hailakandi	20.251	3	3.151	8.950
26	N C Hills	18.450	2	8.000	10.450
Total		969.85	138	1.214	18.184

5. The list of sample roads visited is given in **Table 2.2**. The list of 969.85 km roads is given in **Appendix I**.

6. The land use pattern of Assam can be broadly divided into 6 categories namely, arable land (agriculture land), Reserved Forest, Protected Forest, Orchard and plantation, scrub and Grass areas and urban areas. Based on the land use category selection of districts were first made to represent all land use categories in eastern, western, central and southern parts of the state. Further selection of individual roads within a district (project district) were made through consultations with the PIU of PWD district level. The consultants visited 3-4 representative roads in each district. The land use features of the state as a whole are given in **Figure 2.1**. The environmental features of these districts and state as a whole are given in Section 3.0 –Description of Environment.

2.5 Size or Magnitude of Operation

7. The construction cost of rural roads under the second annual batch of 969.85 km is broadly estimated at Indian Rupees 5187.58 million.

2.6 Schedule for Implementation

8. The 969.85 km rural road construction works are scheduled to commence from October 2005 and expected to be complete by end 2007.

2.7 Description of Project

2.7.1 Rural Road Construction Proposals

9. The rural road construction works will provide for 7.5m roadway width with 3.75m carriageway in plain terrain. The construction proposal considers a 3.75m cement concrete pavement with lined storm water drains for stretches passing through the habitations. In case of hilly tracks / regions the roadway width will be limited to 6.0m with 3.75m carriageway. Thus 10-12 m of right of way (RoW) is required for the construction proposals.

10. The pavement design considers a base layer of variable thickness (based on design), 150 mm granular sub base (GSB), 150mm thick water bound macadam (WBM grade I & II) and finally topped with 20mm thick bituminous pavement. A typical section proposed for construction of roads is given in **Figure 2.2**. Adequate cross drainage channels across the roads are given.

Table 2.2 : List of Selected Roads Visited by TSC as part of The Preparation of This Report

Sl. No.	District	Package No.	From	To	Length (km)
1	Kamrup (Rural)	AS-11-71	Rani	Gohaihat Tiniali	5.00
2	Sonitpur	AS-22-69	Borpura Disiri	Ratuwa	8.916
3	Morigaon	AS-17-35	Lengeribori	Lalipar	2.132
4	Goalpara	AS-07-41	Ambari	Taltola	2.459
5	Chirang	AS-25-19	Bijni	Amteka	8.000
6	Karbi Anglong	AS-12-42	Kheroni	Lamsakhang	18.184
7	Nagaon	AS-19-88	Hojai market	Raikata Islampur	9.751
8	Bongaigaon	AS-02-28	Gerukabari	Kirtanpara	14.900
9	Nalbari	AS-20-50	Narikuchi	Bilpar	11.049
10	Dibrugarh	AS-06-42	NH37	Lachan Mirigaon	7.982
11	Jorhat	AS-10-50	Tiyok	Naamsisu	8.177
12	Tinsukia	AS-23-31	Bijuliban	Barhulung	9.12
13	Cachar	AS-03-53	SH Road	NH 54 via Ali Tikar	1.537
14	Udalguri	AS-26-11	Patalagaon No.1	Bhergaon TE (B K Rd)	5.881
15	Barpeta	AS-01-55	Botia	Niz Saldah	5.144
Total					118.232

11. The rural road construction works will be in conformity with the Rural Roads Manual and / or Technical Specifications for Rural Roads published by the Indian Road Congress (IRC) on behalf of Ministry of Rural, Development Government of India.

2.7.2 Present Condition

12. At present the rural habitations to be covered under PMGSY are connected to the nearest paved road network through unpaved tracks. Generally, these are the traditional

village pathways that have transformed into the present tracks or unpaved roads through minor construction works undertaken over the decades under various programs by the local bodies and State Governments. The tracks are not all weather roads have corrugations at several stretches but vehicular traffic like farm tractors; light commercial vehicles still do ply on these tracks in dry seasons.

2.7.3 Available Right of Way (RoW)

13. The existing width of tracks generally varies between 3-8m in stretches passing through agricultural lands or habitations and 8-10m in stretches through the open lands / agricultural fields. As per the information available with Assam, PWD the required RoW of 10-12m is available even in stretches passing through the agricultural lands in all the road construction proposals and no fresh land acquisition is required. The RoW has been encroached and put to agricultural use by the adjacent landowners in almost all the road construction proposals.

14. The private landowners along the proposed right of way (RoW) are voluntarily parting the encroached land and in some cases parted even their own private land without any compensation, anticipating the benefits from the road construction works. In case of construction works through the intermediate rural settlements / habitations the carriageway width is restricted to 3.75 m and a cement concrete pavement is considered in all such cases.

2.7.4 Alignment and profile

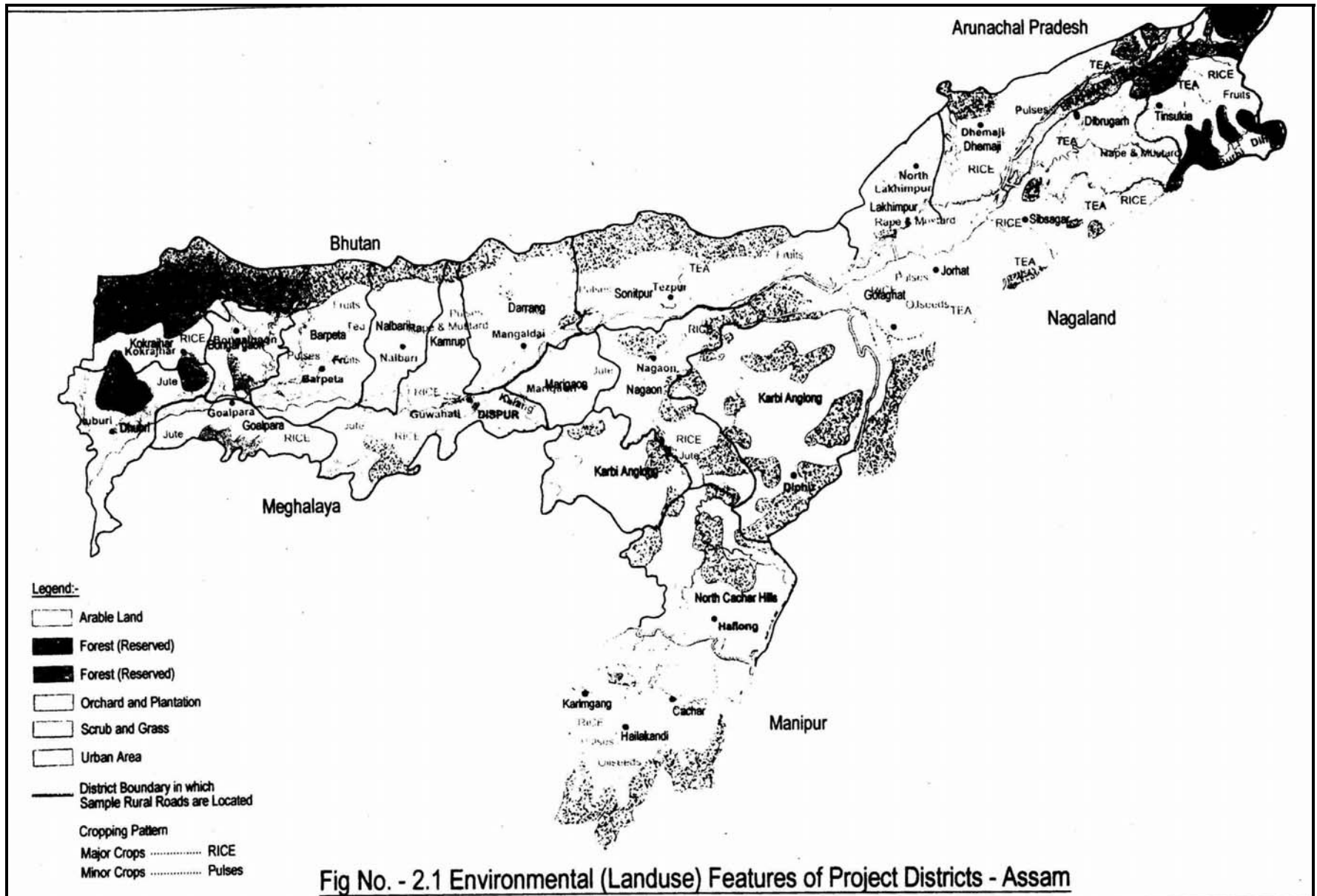
15. The construction works are to be confined to the existing alignment of the unpaved tracks. The existing horizontal and vertical alignment / profile will be generally maintained except for minor smoothing or corrections to sustain consistent design speed without causing any land acquisition requirements and thereby the possible social and/or environmental concerns.

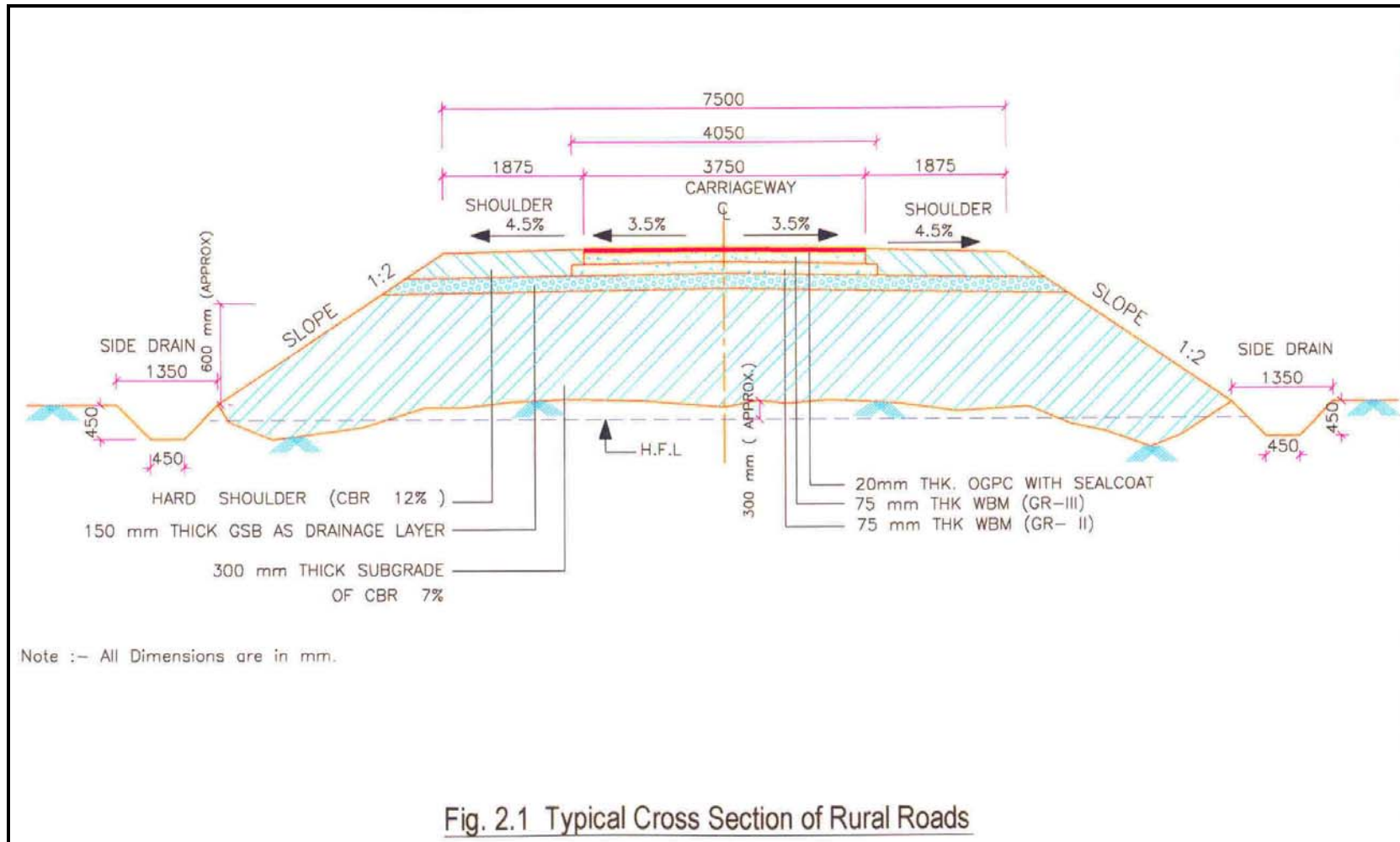
2.7.5 Traffic

16. The present traffic data on each of these rural roads typically vary between 10-20 vehicles per day on most of the rural stretches. The traffic largely comprises motor cycles/two wheelers, tractors and light commercial vehicles and animal drawn carts and bicycles.

2.7.6 Economic Assessment

17. The economic analysis carried out under the project has indicated that the rural road construction works will act as a catalyst for the rural economic growth and poverty alleviation of the community in the region.





SECTION-3

3.0 DESCRIPTION OF ENVIRONMENT

3.1 General

1. The baseline environment of the study area along with environmental profile within the corridor of impact (COI) of the project roads are given in this section.

3.2 Physical Resources

3.2.1 Geology

2. The Himalayan watershed of the Brahmaputra comprises four major physiographic units that rise progressively to the north. The lowermost ranges are called Sub-Himalayas (1000-2000m) that are mainly of tertiary sandstones and conspicuous by the presence of many raised, relatively young terraces. The Middle Himalayas (3000-5000m) are underlain by lower Gondwana (Palaeozoic) deposits comprising shales, slates and Phyllites overlain by a thick horizon of basaltic rocks. The greater Himalayas (average elevation 6000m) consist primarily of granites and gneisses. Further to the north, the trans- Himalayas of Tibet (4500m) are made of sedimentary formations of Palaeozoic to Eocene age. The Patkainagar ranges bordering the Brahmaputra valley on the east and south east (average elevation 1000 meter) consist of Tertiary formation criss-crossed by numerous faults. The highlands to the south comprising the Meghalaya Plateaus and Mikir Hills (600-1800m) are made up of gneisses and schists of Precambrian age and they form a part of the Indian Peninsular block.

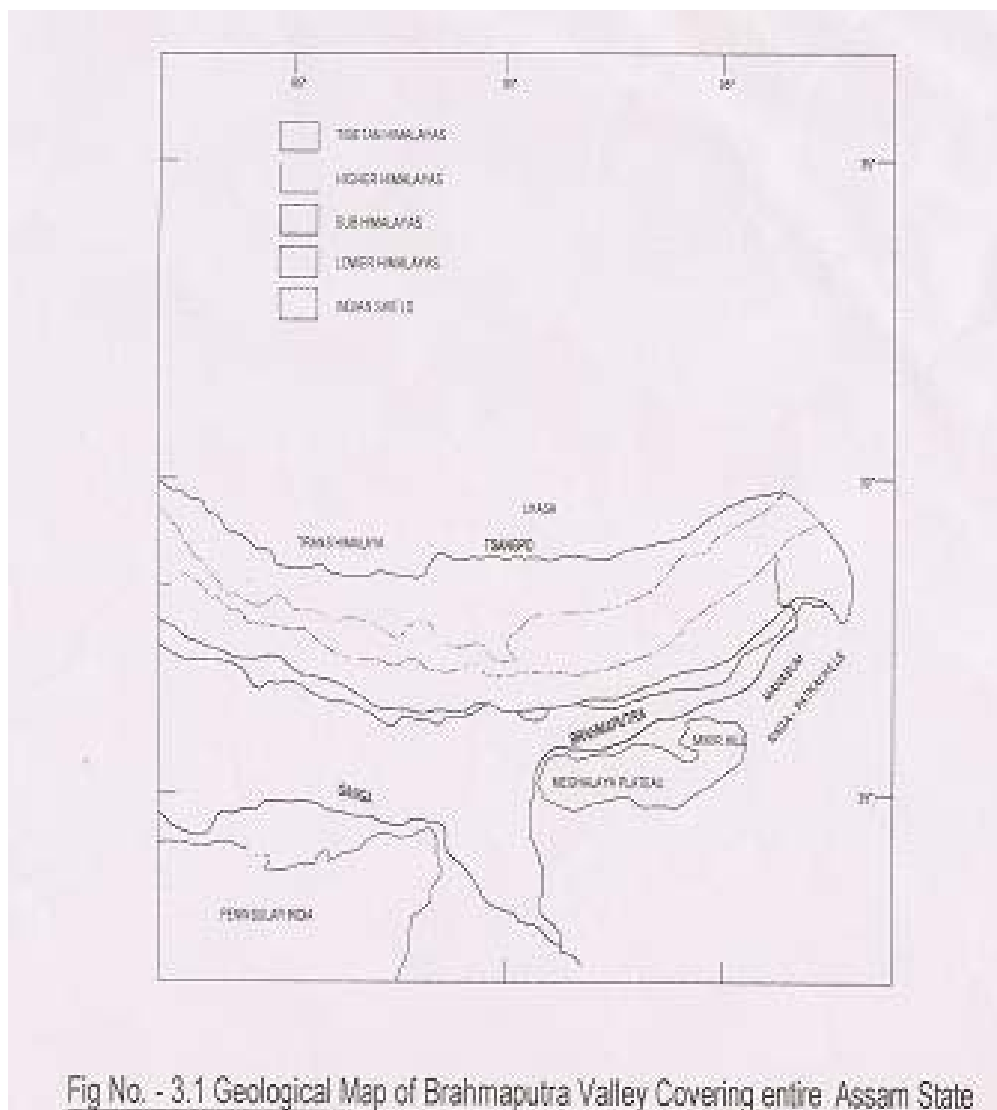
3. The Brahmaputra valley in Assam is underlain by recent alluvium approximately 200-300m thick consisting of clay, silt, sand and Pebbles.

4. The geological map of the Brahmaputra valley covering the entire Assam state / project districts is given in **Figure 3.1**

3.2.2 Earthquake Zone / Sensitivity

5. The Bureau of Indian Standards has categorised the entire India into 5 seismic zones depending upon the degree of proneness to earthquakes. The Zone I signify lesser degree while Zone V is of highest order. The entire Assam state has been placed under seismic Zone V.

6. The Brahmaputra valley and its adjoining highlands are seismically very unstable. The earthquakes of 1897 and 1950, measuring 8.7 on Richter scale are among the most severe in recorded history, and have caused extensive landslips. Rock falls on hill slope, subsidence and fissuring of ground in the valley changes in the courses and morphology of several tributary rivers.

Figure No.-3.1 Geological Map of Brahmaputra Valley Covering entire Assam State

3.2.3 Geo- Hydrology

7. The eastern part of the state comprising Tinsukia, Sibsagar, Lakhimpur, Jorhat, Dibrugarh and Dhemaji districts have a ground water potential ranging between 10 to 55 litres / sec. The Western part of the State comprising districts like Barpeta, Bongaigaon, Dhubri, Goalpara, Kamrup, Kokrajhar and Nalbari districts have ground water potential yield ranging between 10 to 40 litres/sec. The central part of the state comprising districts Darrang, Karbi Anglong, Marigaon, Nagaon, Sonitpur districts also have a ground water potential ranging between 15 to 60litre/sec. The southern part of the state comprising districts Cachar Hailakhandi Karimganj and North Cachar hills have poor ground water resources and not suitable for ground water development.

8. The hydrogeological conditions in Eastern, Central, Western and Southern part of Assam are given in **Table 3.1**.

Table 3.1 Hydrogeological conditions in Eastern, Central, Western and Southern Zone. Assam State

S.NO	ZONE	District	Ground Water Potential (Yield) Liter / Sec
1.	Western Zone of the State	Barpeta	>25
			>25
			10.20
2.		Bongaigaon	30.50
			20.30
			10.20
3.		Dhubri	<40
			25.40
			1.5
4.		Goalpara	1.4
			5.10
			25.40
			<40
5.		Kamrup	>25
			>25
			10.25
			<5
6.	Nalbari	>25	
		>25	
		10.25	
7.	Central Zone of the State	Darrang	25.40
			10.25
			5.10
8.		Morigaon	25.40
			20.40
9.		Naugaon	10.20
	0.10		
10.	Sonitpur	>42	
		42.56	
11.	Southern Zone of the State	Cachar	<10
			area not suitable for GW development
12.		Hailakandi	<10
			10.25
			<1
13.		Karimganj	<10
			10.25
			<1
14.		Eastern Zone of the State	Dhemaji
	28.42		
15.	Dibrugarh		15.25
			10.12
16.	Lakhimpur		40.70
			Hilly area
17.	Ttisukia		15.75
			<10

3.2.4 Physiographic & Relief

9. The Assam state can be divided into four distinct Physiographic divisions as under:
- ❖ Eastern plains with altitude and central plains having altitude in the rang of 600m above mean sea level
 - ❖ Cachar plains in the southern part of the state having altitude in the rang of 50m above mean sea level
 - ❖ Central and south central part of state comprising North Cachar Hills and Rengma Hills with altitudes ranging between 300-150m above mean sea level
 - ❖ Western part of state comprising North and South Brahmaputra hills. Remaining part of the state in central and eastern part of the state mainly being plains.
10. The Physiographic and landforms of the Assam is shown in **Figure 3.2**

3.2.5 Drainage

11. The entire Assam falls within the Brahmaputra river basin. The Brahmaputra River is one of the Largest Rivers in the world traversing a distance about of 3000 km through Tibet, India and Bangladesh and draining an area of nearly 580,000 sq. km. within Assam. Brahmaputra flows in a highly braided channel characterised by numerous sand bars or chars. During its course, the river receives many tributaries both from north and south. The tributaries from north are Subarnashri, Jia Bharali, Dhansiri, Puthimari, Pagladia, Manas, Champabat, Saralbhanga and sankosh. The main tributaries from south are Noa Dihing, Buridihing, Disang, Dikhow and Kopili. The nortn and south Bank Tributaries have divergent characteristics, which are given in **Table 3.2**.

Table 3.2 Characteristics of North & South Bank Brahmaputra Tributaries- Assam

S. No	Tributaries	Characteristics
1.	North Bank Tributaries	Very steep slopes and shallow braided channels for a considerable distance from the foothills and in some cases. Right up to the out fall
		Coares sandy beds and carry a heavy silt charge
		Flash floods
2.	South Bank Tributaries	Comparatively flatter grades and deep meandering channels, almost from the foothills
		Beds and banks are composed of fine alluvial soils
		Comparatively low silt charge

12. The basin map of Brahmaputra covering the entire state is shown in **Figure 3.3**.

3.2.6 Flood Prone Areas

13. The chronically flood of prone areas within the state are mainly along the river Brahmaputra from eastern to western part of the state. The incidences of annual flood in the state since 1953, is given in **Table 3.3**, the fiercest of them being the flood in 1988, in which a total of 42.23 lakh hectares of land (including 11.20 lakh hectares of crop was also damaged) affecting more then 8 million people in 8770 villages. Consultations with the state Government authorities indicate that only embankments are being constructed to combat the menace of floods. Which have only resulted riverbeds and resultant intensification of flood hazard. The chronically flood affected areas within the state are shown in **Figure 3.4**

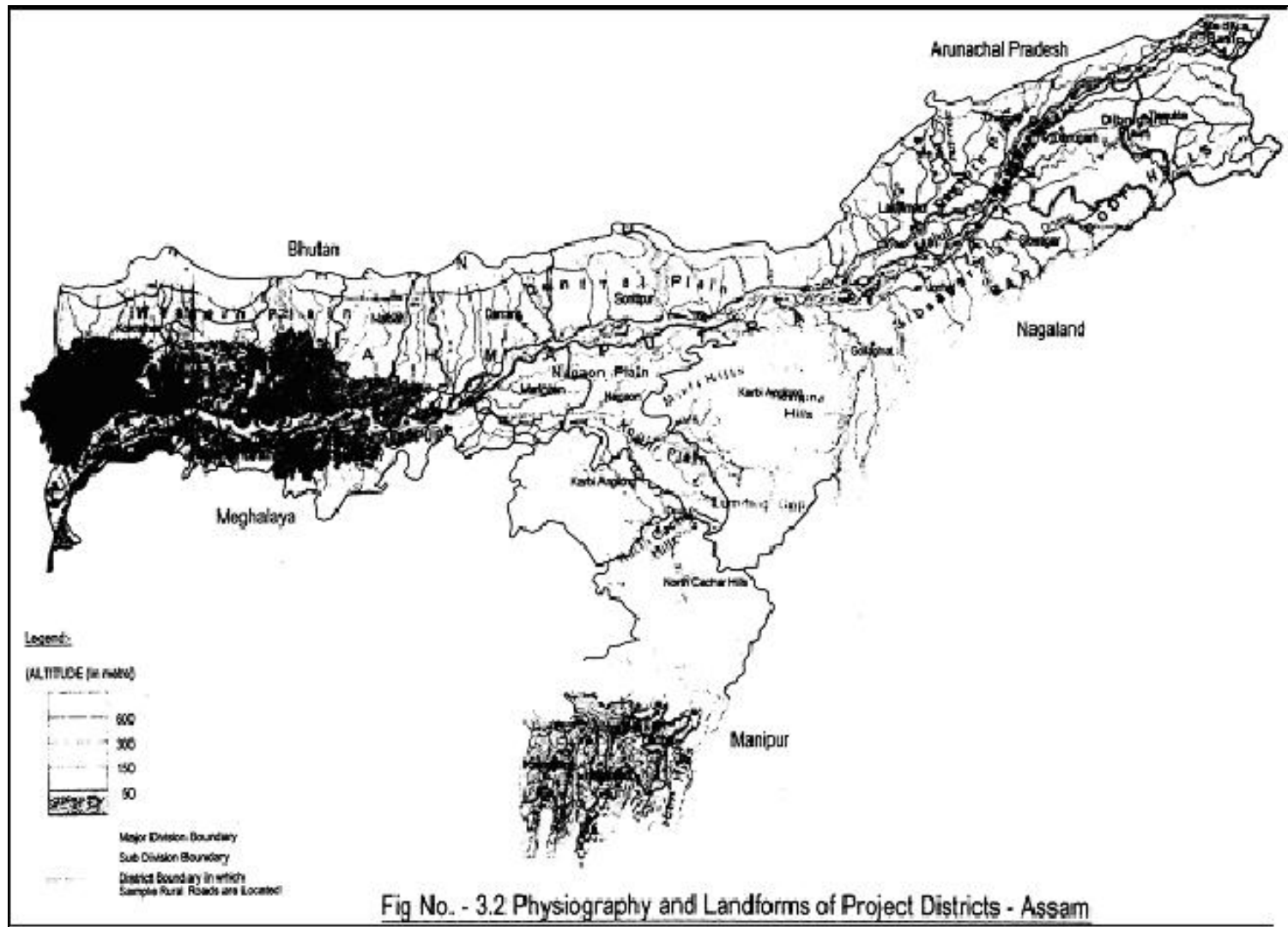
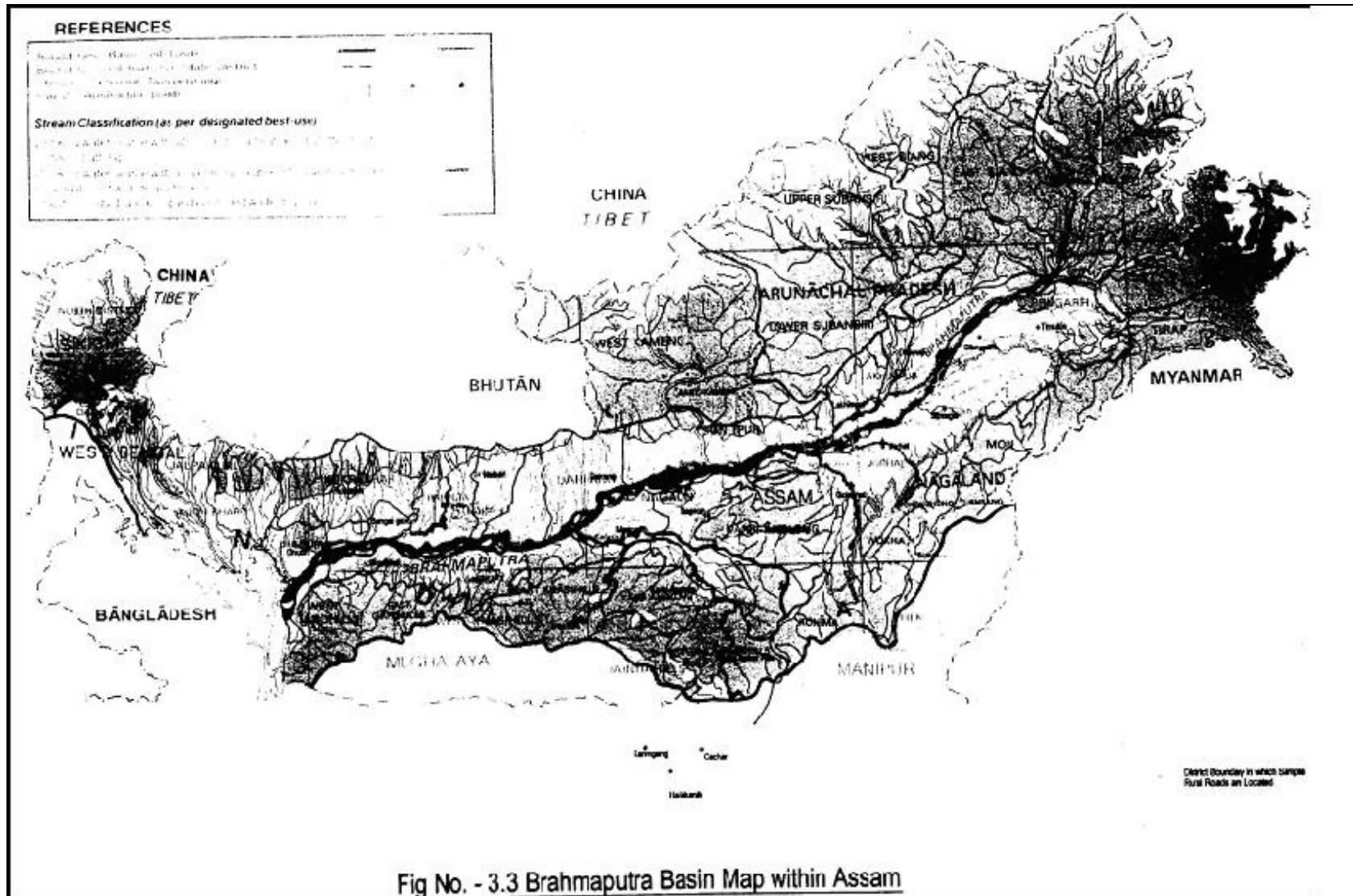


Fig No. - 3.2 Physiography and Landforms of Project Districts - Assam



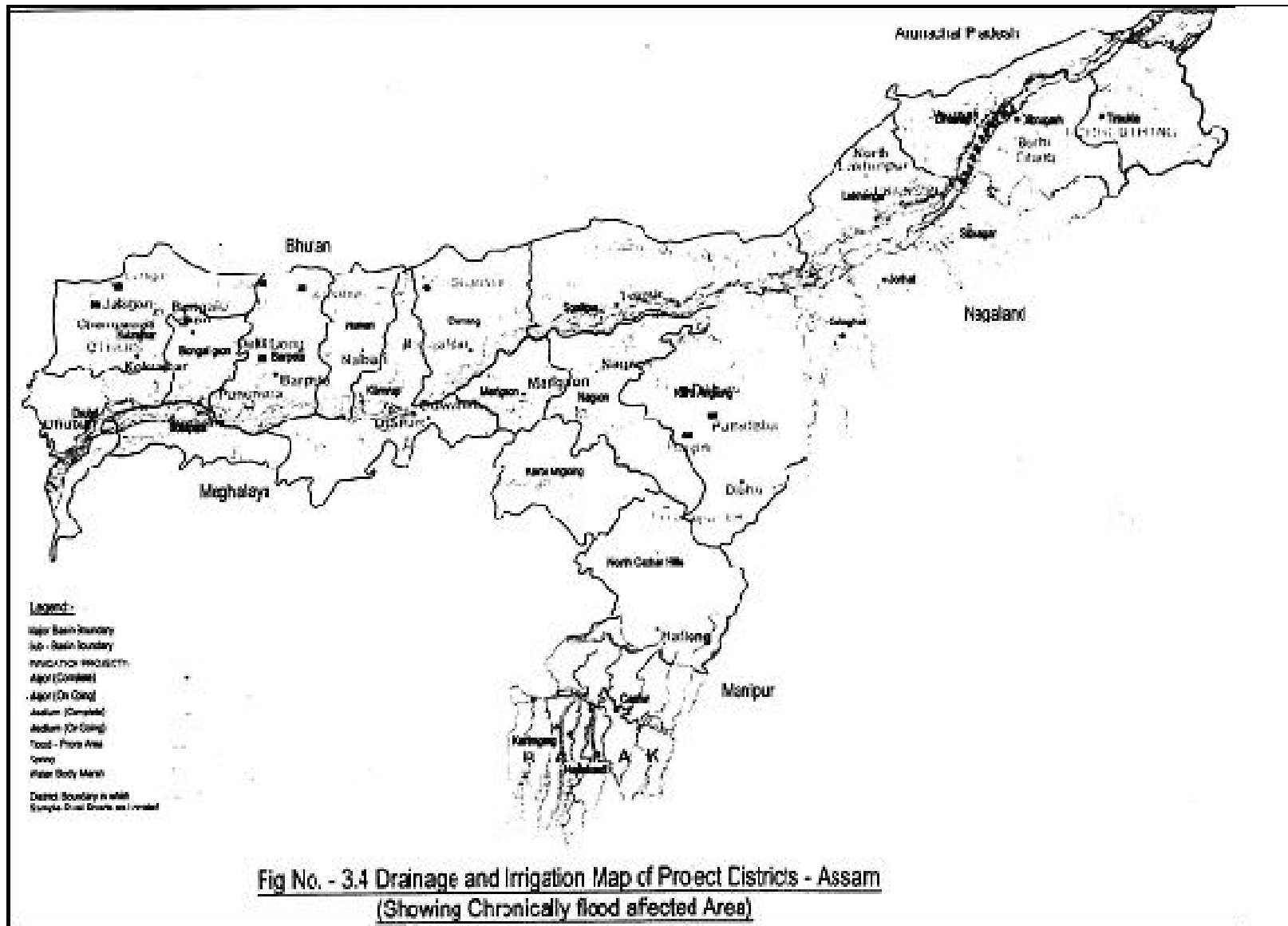
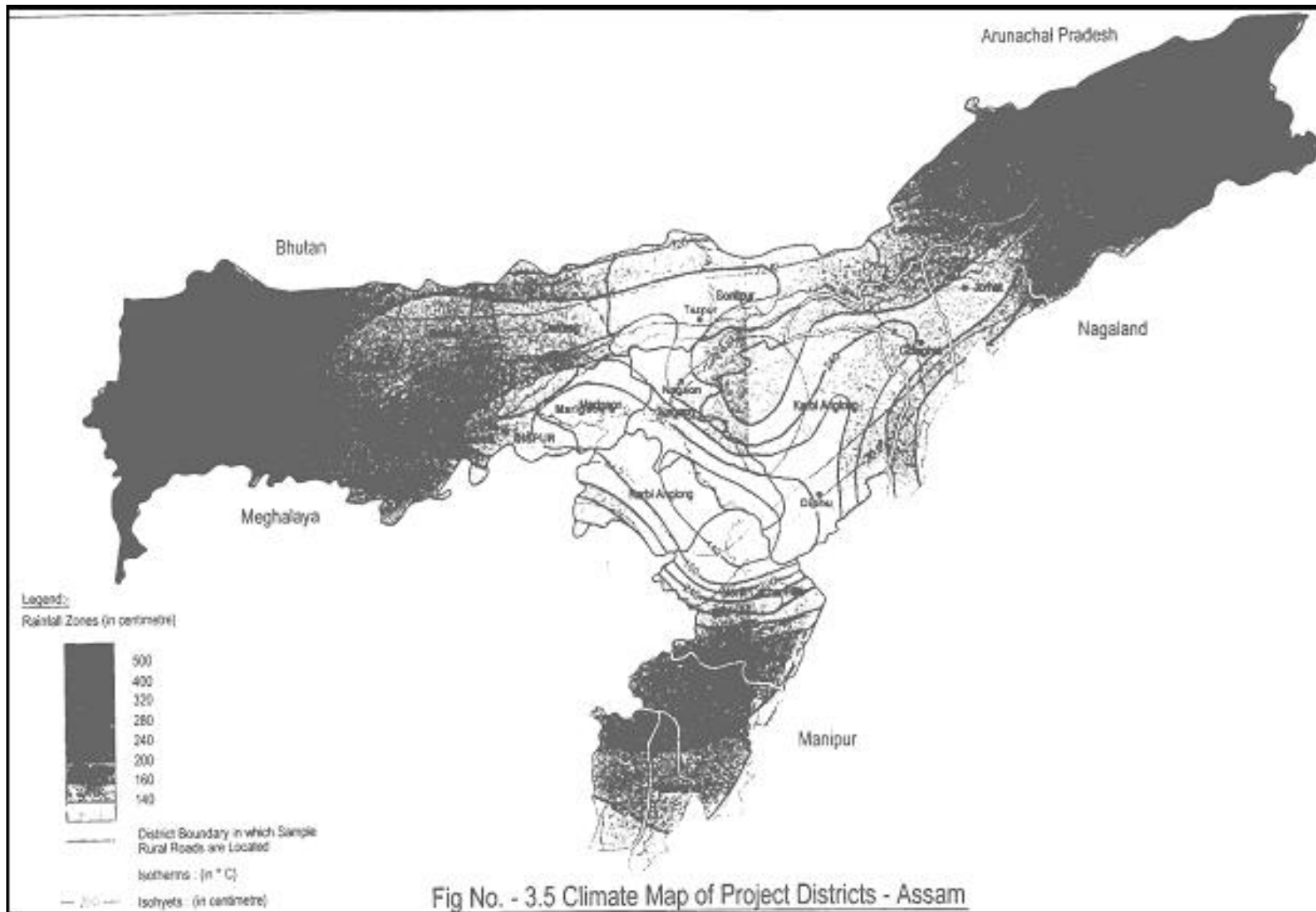


Table 3.3 : Statement Showing Annual Floods in Assam (1953-1988)

S. No	Year	Area Affected (M ha)	Crop Area Affected (M ha)	Population Affected (Million)	Total damage (in current Prices) (in crores)
1	1953	0.08	-	0.41	2.66
2	1954	3.15	0.27	1.68	15.77
3	1955	1.41	0.09	0.80	3.71
4	1956	0.06	0.08	0.56	3.26
5	1957	0.04	0.02	0.31	4.52
6	1958	1.25	0.07	0.47	2.70
7	1959	1.04	0.19	0.76	8.40
8	1960	0.47	0.22	1.32	7.76
9	1961	0.19	0.02	0.25	0.56
10	1962	1.62	0.38	1.05	20.32
11	1963	0.58	0.08	0.83	2.06
12	1964	0.76	0.15	0.77	2.46
13	1965	0.60	0.02	0.24	0.69
14	1966	1.78	0.04	4.65	22.53
15	1967	0.26	0.07	0.68	2.44
16	1968	0.41	0.13	0.92	8.36
17	1969	0.81	0.10	1.47	8.47
18	1970	0.72	0.20	1.71	10.43
19	1971	0.36	0.11	0.67	5.63
20	1972	1.10	0.38	3.20	24.15
21	1973	2.75	0.29	2.29	16.49
22	1974	1.12	0.26	2.85	19.24
23	1975	0.01	0.01	0.03	0.34
24	1976	0.57	0.11	1.46	11.98
25	1977	1.10	0.45	4.55	31.08
26	1978	0.31	0.08	0.92	4.27
27	1979	0.37	0.24	2.35	28.16
28	1980	1.16	0.29	3.36	39.80
29	1981	0.46	0.07	1.36	7.40
30	1982	0.61	0.10	1.42	21.90
31	1983	0.73	0.14	2.26	56.18
32	1984	1.52	0.49	5.68	50.82
33	1985	0.65	0.08	2.37	-
34	1986	0.43	0.32	2.35	204.59
35	1987	0.08	0.99	9.46	30.61
36	1988	4.22	0.13	12.68	708.84

3.2.7 Climate

14. Assam has four distinct seasons; winter, summer, monsoon and autumn or post monsoon. Winter is between December to end February, from March onwards the summer starts and continues end May or 1st week of June and last up to last week of September / first week of October. Much of the rainfall in June and September is associated with thunderclouds. The climatological parameters of representing the project districts / Assam are described hereunder. The climate of project districts / state is depicted in **Figure 3.5**.



15. **Temperature:** The mean minimum annual Temperature in the state varies between 9 C in Goalpara and Bongaigaon districts (western part of state) to 26 C in Dhubri and Marigaon districts (central and western part of state).

16. **Relative Humidity:** Normally, May to October months are humid and January to April are dry. The maximum relative humidity range is between 75 to 85% in morning hours and 50 to 65% in the evening hours.

17. **Rainfall:** The state received an annual average rainfall of 2125 mm rainfall. The eastern, western and southern part of state received rainfall varying between 3200 to 5000 mm whereas the central parts of the state receiving rainfall between 1400 mm to 4000 mm. The maximum rainfall is received between June and September months. on the basis of rainfall. The state can be classified into nine zones and depicted in **Figure 3.5**, which also shows the isohyets for the entire state.

3.2.8 Soil

18. The major soil types within the state can be classified into five groups namely Entisols, Mollisols, Alfisols, Ultisols, Histosols. These soil types can be further classified into several sub groups. The Entisols can be sub classified into Younger alluvium and Bhabar. The Younger alluvium can be predominantly seen along the Brahmaputra River and some sporadic patches in southern parts of state. The Mollisols can be seen in western and Northern fringes of the state. The alfisols can be seen in central parts of state.

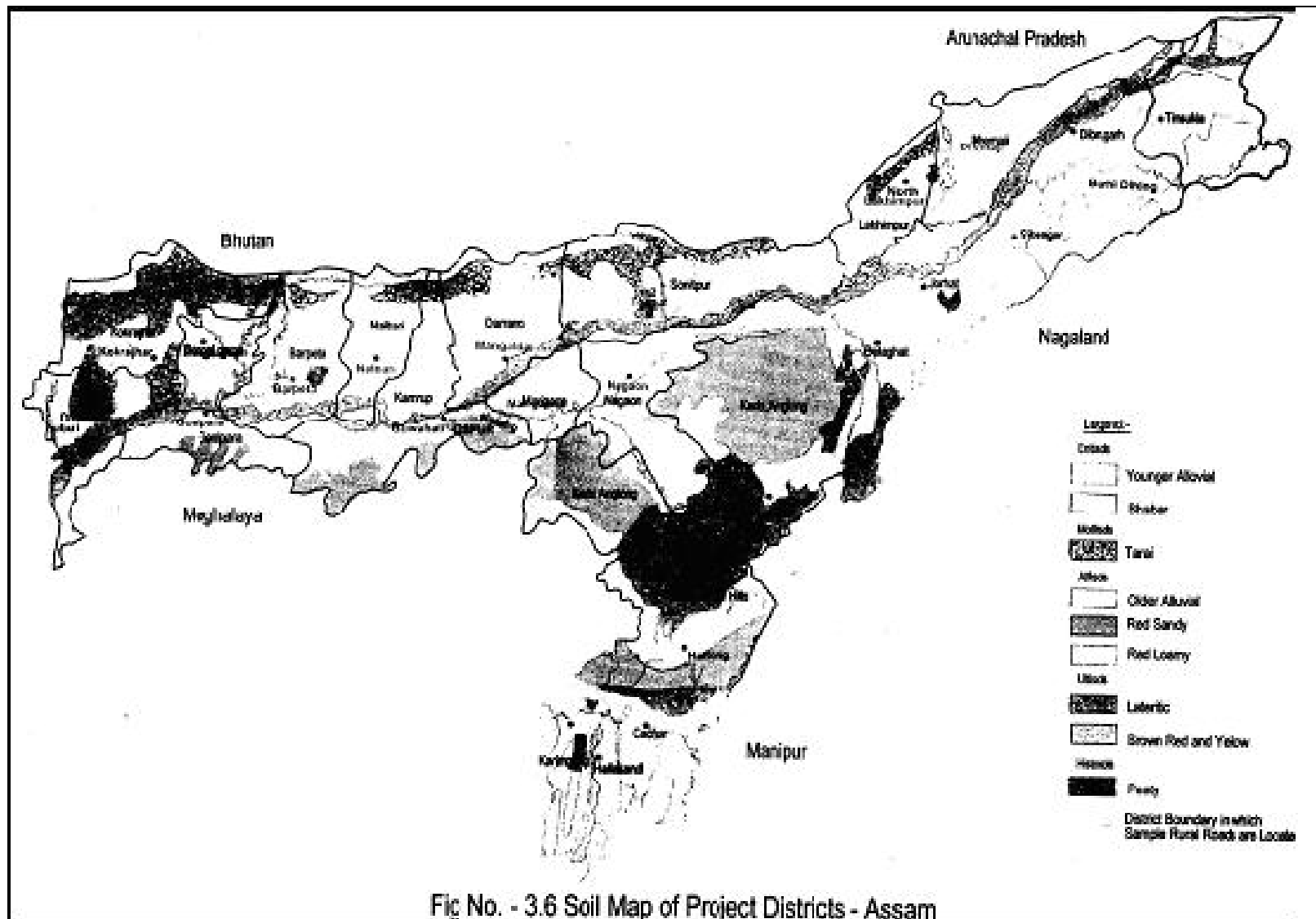
19. The soil type prevalent across the project districts / state are given in **Figure: 3.6**

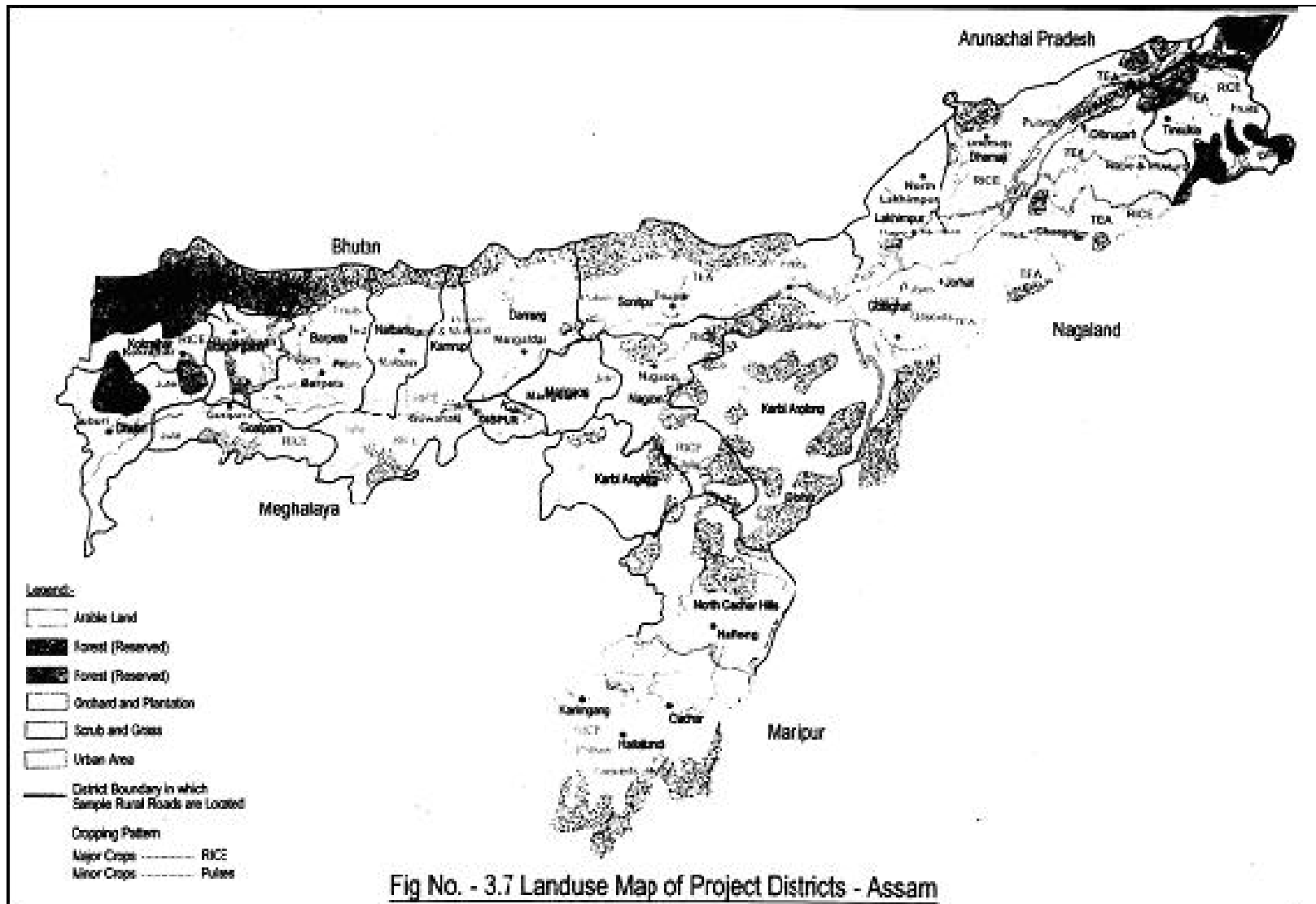
3.2.9 Land Use

20. The distribution of land utilisation within the entire can be broadly divided into 6 categories namely, arable land (agriculture land), Reserved Forest, Orchard and Plantation, Scrub and Grass area and urban areas. The land use pattern of the state based on these categories is given in **Figure 3.7** and the extent of the area under each category is given in **Table 3.4**.

Table 3.4 Land Use Details of Brahmaputra Basin - Assam

S. No	Land Use Categories	Area (000 ha)
1	Gross Area	7.64.00
2	Areas under forest	1814.00
3	Areas not available for Cultivation	2364.00
4	Culturable areas	2886.00
5	Uncultivated culturable area	965.00
6	Net area shown	1921.00
7	Area shown more then one	364.00
8	Total cropped area	2285.00
9	Net area irrigated	566.00
10	Gross area irrigation	566.00
11	Percentage of net area sown irrigated to culturable area	66.56
12	Percentage of net area irrigated to culturable area	19.61
13	Percentage of net area irrigated to net area sown	29.46





3.2.10 Water Quality

21. As mentioned under section 3.2.5, the entire state is within the Brahmaputra basin. The Brahmaputra River is one of the largest rivers in the world traversing a distance an area of nearly 580,000 sq. km. Within, Brahmaputra flows in a highly braided channel characterised by numerous sand bars or chars. During its course, the river receives many tributaries both from north and south. The tributaries from north are Subarnashri, Saralbhanga and Sankosh. The main tributaries from south are Noa Dihing, Buribihing, Disang, Dikhow, and Kopili. The Brahmaputra has also flowing through North Bengal like Teesta, Jaldhaka, Torsa, Kalijani and Raidok

22. The State Pollution Control Boards of Assam, Nagaland and Sikkim at 31 locations are doing the water quality monitoring of River Brahmaputra and its several tributaries in the basin. The tributary streams covered under the monitoring programme are Dhansiri, Teesta, Subansiri, Burhidihing, Digboi, Disang, Jhanji, Bhogdoi, Mora Bharali, Borak, Bharalu, Deepar Bill, Dickchu, Maney Khola and Ranichu. The published data of water quality by CPCB has been reformed. The data has been published in CPCB Publication titled as "Status of water quality in India – 2004", published in the year 2006. The water quality of River Brahmaputra indicates that mean pts value and conductivity are satisfying the water quality criteria for various uses. Dissolved oxygen is observed in the range of 1.1 to 9.4 mg/l. The BOD value ranges from 0.1 -413 mg/l. The highest value of 4.3 mg/l is observed at Dibrugarh. The count of Faecal Coliform (FC) ranges from 300 to 2,40,000 MPN/100ml, whereas Total Coliform (TC) ranges from 360- 2,40,000 MPN/100 ml. The TC is not meeting the water quality criteria at all the locations in monitoring programme.

23. The water quality of River Dhansiri is conforming to water quality criteria with respect to pH, DO conductivity.

24. The water quality of River Brahmaputra, its major tributaries assessed at 8 different stretches are given in **Table 3.5**. The details of the river stretches along with water quality sampling stations are given in **Appendix 2**.

3.2.11 Ambient Air Quality

25. The Central Pollution Control Board and state pollution Control Board maintain database on the ambient air quality of the state. However, such database is limited to major cities and some selected industrial areas. No secondary data is available for the project districts particularly representing the rural areas. Along the proposed road improvement proposal, neither there is any industrial activity nor significant vehicular contributing to air pollution. Therefore the ambient air quality is expected to be within the National Ambient Air Quality Standards (NAAQS) for all parameters¹² excepting the dust or the particulate matter. The occasional vehicular movement on the unpaved roads lead to concentration of both the Suspended particulate matter (SPM) and Respirable Particulate matter (RPM<10 um) beyond the limits of the NAAQS.

Table 3.5 Water quality along various Stretches of River Brahmaputra & its Tributaries

S. NO	Parameters	Stretch I		Stretch II		Stretch III		Stretch IV		Stretch V		Stretch VI		Stretch VII		Stretch VIII	
		Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
1	Physical Parameter																
a)	Temp (C)	12 11	222	15 28	23 04	12 29	238	18 30	238	16 30	235	18 32	251	18 30	244	17 27	219
b)	Turbidity (NTU)	21 160	409	69 230	70 68	24 113	49 56	76 955	408	15 210	507	41 726	3107	28 139	27 72	2.5-154.4	64.9
2	Mineral Indicator																
a)	Physical Parameter	75 91	794	61 82	7 51	72 88	7 7	72 85	78	62 82	75	68 84	7.5	70 89	7.99	75 8.2	7.9
b)	Conductivity (umhos /cm)	60 275	136 2	75 215	124 0	99 260	1381	61 230	1456	55 250	1238	38 600	1827	50 430	182.8	59 - 350	112
c)	Chloride (mg / l)	4 32	10 5	4 16	8 2	422	82	4 32	101	4 66	10.1	2 58	1843	6 36	12.8	6 16	9.83
d)	Total Alkalinity (mg / l)	36 116	65 1	36 94	68 9	30 270	74 36	48 126	817	24 245	677	16 240	766	20 248	95.2	30 124	50.33
e)	Total Hardness (mg / l)	30 110	60 9	34 108	61 6	40 90	62 1	42 120	727	18 118	54 4	16 138	5235	14.242	83.93	20- 88	37.83
f)	Calcium (mg / l)	20 68	40 4	18 60	41 6	22 78	45 3	28 74	495	10 64	32 19	6 94	332	8 .192	5479	Dec-62	27.83
g)	Magnesium (mg / l)	4 66	21 8	16954 00	19 9	4 34	16 8	10 48	232	4 76	21 99	2 50	19.1	4 106	29.1	26-Apr	10
h)	Sulphate (mg / l)	2 47	14 9	4 42	20 34	6 325	19 62	21 35	1848	12 84	20 8	15 46	152	10 33	12.4	2 - 21.6	9 5
i)	Nitrate (mg / l)	001 018	00 8	002 02	0 09	002 068	0 13	001 04	0 08	001 18	0 17	002 034	0.1	001 06	0 09	002 0.08	0.06
j)	Total Dissolved Solids (mg / l)	46 414	109 46	64 326	127 18	76 4	148 33	82 324	152	42 34	1331	25 560	1551	35 548	159.5	42- 270	91.85
3	Indicators of Organic Pollutants																
a)	BOD (mg / l)	02 24	0 94	03 36	1 23	02 38	1 29	02 52	123	02 72	1.73	02 21	330	01 54	0.79	0.1 - 2.4	1.33
b)	COD (mg / l)	32 273	10 12	14 368	11 84	32 160	7 84	24 351	11.5	16 432	14	32 688	181	0.8 272	7 79	32 -25.6	9.72
c)	TKN (mg / l)	06 25	1 30	06 76	1 95	06 24	1 23	08 22	1.35	03 42	1.41	008 .73	192	0.3 - 4.9	1.27	03- 20.3	3.99
d)	DO (mg / l)	68 115	9 1	54 117	8 1	58 115	8 4	52 108	724	39 132	6 78	0 110	635	4.3- 10.6	7.64	6.8-10.8	8.67
4	Bacteriological indicators																
a)	Total Coliform Coun (MPN / 100)		26467		80422		26908		46355		65854		2E+05		28890		48270
b)	Fecal Coliform Coun (MPN / 100)		6310		31639		46376		15480		18453		1E+05		4477		37080

3.2.12 Ambient Noise Quality

26. Similar to the database on air quality, the Central Pollution Control Board and State Pollution Control Board does maintain a data bases on ambient noise levels for major cities and some selected industries areas. No secondary data is available for the project districts particularly representing the rural areas.

27. Along the proposed road improvement proposals, neither there is any industrial activity nor significant vehicular traffic contributing to ambient noise levels. The occasional vehicular movement on the unpaved road contribute to increased noise level over short duration limited to daytime. The existing roads do not appear to have vehicular traffic in the night time. Therefore the ambient noise levels are expected to be within the National Ambient Noise Standards.

3.3 Ecological Resources

3.3.1 Terrestrial Flora

28. During the field investigations, the most dominant terrestrial flora within the project districts were was recorded. The dominant flora comprised generally the trees planted along side of the rural project roads, particularly the stretches along agricultural land. Many of these are planted by the adjacent landowners and often perceived, as a fence to their respective lands. Some of these trees are to be felled during the clearing up operations for road construction. The common tree observed of the road improvement proposals are presented in **Table 3.6**.

Table 3.6 List of Most Common Trees of Project Districts – Assam State

S. No	Botanical Names	Local Names
1	Mangitera Indica Linn	Mango Orchards / Trees
2	Tectitona Grandis	
3	Tamarindus Indica	
4	Areca Catechu Linn	(Betal - nut palm)
5	Syzyginm Cumini (Linn)	Jamun Trees
6	-	Sugarcane Crop
7	-	Banana Crop
8	-	Tea Plantations
9	Cocos Nucitera Linn	Coconut Palm
10	Bombay Cieba	Bamboo Trees
11	Acacia Catechu	Timber & Tanin
12	Acacia Nilotica	Medicine
13	Acacia Auriculiformis	Timber & Saponin
14	Aegi mermelos	Fruits & Medicine
15	Alstonia scholaris	Medicine
16	Azadirachta Indica	Timber Medicine
17	Bombay Cieba	Ornamental & Fibre
18	Boswellia Serratta	Timber
19	Diospyros Malaberica	Fruits

29. As a case study, tree enumeration in the required RoW of 12 m was undertaken in 10 rural roads improvement proposals. Although, none of these stretches pass though any forest land / area but still has trees which might require felling during clearing up operations

and construction of rural roads. The tree enumeration survey indicates that the selected 10 rural road construction (within the RoW) have trees ranging between 5-10 trees per km. The actual number of trees which require felling can only be determined after marking of the improved alignment on ground

30. The clearance of the vegetation and felling of the road improvement is an environmental concern. Although most of the trees within the RoW do not have ecological and / or significant economic values but provide a serene landscape to the road users.

3.3.2 Fauna

31. The occurrence of wild life species threatened or endangered has not been reported within the corridor of impact of the road construction proposals selected.

3.4 Quality of Life Values

3.4.1 Archaeological / Historical Monuments

32. Although, Assam is known to have several archaeological and historical / protected monuments spread all over the state, none of them are situated within 5 km on each side from the rural roads of 969.85 km road construction proposals.

3.4.2 Temples / Shrines / Idols / Statues

33. The corridor of impact (Col) or the direct influence area of the 969.85 km rural roads in second annual batch under the ADB loan program have no shrines, idols, tombs, and roadside small temples which might be impacted or require relocation due to road construction works.

SECTION- 4

POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1 INTRODUCTION

1. This Section identifies and assesses the probable impacts on different environmental parameters due to planning, construction and the operation of the proposed development of rural roads. After studying the existing baseline environmental scenario, initial field visits/surveys, reviewing the process and related statutory norms, the major impacts can be identified and assessed during the design, construction and the operation phases. Potential positive impacts or improvements are also reviewed.

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

- i) Planning and Design
- ii) Construction
- iii) Operation

3. Planning and Design covers the construction details, materials of construction etc. that ultimately decides the impact during later phases. Most of the impacts are during construction and operation phase. While some of the construction phase impacts are temporary, some are permanent. The permanent impacts would be positive in nature such as increase in business & employment opportunities, reduction in accidents, and comfort in journey. Though project road are only small rural roads not a national highway thus negative impact such as risk of HIV/AIDS and human trafficking will be negligible, however these negative impacts would be during construction phase only.

4. Other important criterion for identification of impact is the identification of the Corridor of Impact. For present IEE study, a Corridor of Impact (Col) of 15 m width of road alignment has been considered.

5. Environmental parameters are broadly classified into three groups.

- i) Physical Environment
- ii) Biological Environment
- iii) Human Environment

6. Physical environment includes water resources, water quality, air quality, noise and land environment, Biological environment includes, flora, fauna and plantations.

7. Human environment includes the social environment rehabilitation, employment, agriculture, housing, culture, etc. Social impacts such as Poverty impacts, involuntary resettlement, HIV/ AIDs, trafficking of women and Children have also been covered in detail in the Social Impact Assessment Report.

4.1.1 Approach to Mitigation Measures

8. The Environmental Management Plan (EMP) is the key to ensure that the environmental quality of the zone under impact does not deteriorate beyond the expected level due to the project. As discussed in the previous chapters, the road design, construction and operation activities can have various levels of environmental impacts. The Environmental Management Plan (EMP) covers all aspects of the design, construction and operation phases related to environment. The Environmental Management Plan (EMP) needs to be implemented right from the inception and should continue throughout. The

EMP can be divided into three phases - (a) Design phase (b) Construction phase and (c) Operational phase.

4.2 IMPACT AND MITIGATION DURING DESIGN STAGE

4.2.1 Impacts

9. The major impact associated with Design or Pre-construction phase deals with loss of land, properties and livelihood due to acquisition of properties. The design of alignment also decides the acquiring or impacting water bodies, forest, cultural sites etc. In the design phase these issues along with environmental and social studies, are integrated to minimise the impact in the project no land acquisition and property acquisition is planned. Besides the impact on environment and social factors, there should also be consideration for legal issues so that the project can be operated with ease.

4.2.2 Mitigation Measures

10. In case of present rural, the major issue at design stage has been the land availability on the existing can't tracks. While finalizing alignments and deciding on corridor of impact, these data will be considered and design has tried to minimize the impact on environment.

Table 4.1: Design Phase Mitigation Measures – General

Impacts	Mitigation Measures
Land Acquisition	Alignment design avoids land acquisition
Removal of Trees	Alignment design to reduce the number and Compensatory plantation.
Impact on public utilities e.g. community wells etc.	Alignment design to consider. In case of removal alternate arrangement to be done before.
Borrow pits	Locations to be selected considering minimum loss of productive land and redevelopment
Environmental Specifications for Contractors	Environmental qualifications specification shall be included in pre-qualification packages for the contractors

11. These mitigation measures have been considered during finalising the road design. The widening is being carried out in available RoW and is concentric in nature in most portion of each rural road. This will save trees and utilities.

12. **Table 4.2** shows some special mitigation measures adopted in project design to avoid damage to public properties and livelihood.

Table 4.2: Mitigation Measures in Project Road Design

Impacts	Mitigation Measures
Removal of Trees	Compensatory plantation of triple the number of trees to be cut will be carried out.
Impact on public utilities e.g. community wells etc.	In case of removal alternate arrangement will be done before. Social Impact Assessment will consider these issues.
Borrow Pits and queries	These have been identified and the required measures will be carried out.

13. No acquisition of land has been planned for the project route.

4.3 PRE CONSTRUCTION & CONSTRUCTION STAGES

4.3.1 Impacts

14. As discussed in Section -3 ambient air quality is anticipated to be within the ambient air quality standards at rural roads. However, air quality is one of the most important parameters to be impacted during construction phase.

15. Impacts on air quality during construction are due to generation of dust due to earth moving activities on roadside, generation of dust due to excavation and handling of construction materials and vehicle movements. Emission of gaseous pollutants like sulphur dioxide, nitrogen oxides, hydrocarbon, particulates, carbon monoxide etc. from heavy vehicles are also important sources.

16. Gaseous emission from Asphalt mixing plant is another important source of pollution. The larger sized plant can have serious impact. Dust is produced due to handling of aggregates. Smoke and soot, consisting carcinogenic materials are generated due to partial combustion of mixtures. Heating of bitumen also releases toxic gases.

17. However, the mitigation measures and special attention at the sensitive spots can reduce the impact substantially. Observing environmental regulations regarding use of vehicles, crusher plants and asphalt mixing plants will also mitigate the air pollution within acceptable limits. Impact on air quality during construction phase is temporary and site specific. Thus it is difficult to quantify on an objective level. Overall, impact will not be significant if proper mitigation measures are implemented.

4.3.2 Mitigation Measures

18. The proposed rural road construction will reduce dust generation due to vehicle movement as paved surface will be created.

19. The asphalt plants, crushers and the batching plants will be sited at least 1.5 km away in the downwind direction from the nearest human settlement.

20. Authorised quarries shall only be used and therefore emissions from the crusher and vibrating screen at the stone quarries shall not exceed the emission standards set by Central Pollution Control Board.

21. All precautions to reduce the level of dust emissions from the hot mix plants, crushers and batching plants and other transportation of materials will be taken up in line with SPCBs and MoEF requirements. Vehicles delivering loose and fine materials like sand and fine aggregates shall be covered to reduce spills on haul roads. Water will be sprayed on earthworks, temporary haulages and detour roads on a regular basis. During and after compaction of the sub-grade, water will be sprayed at regular intervals to prevent dust generation. The hot mix plant will be fitted with dust extraction units.

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

- ❖ An adequate cyclone/scrubber to control emissions from the stack of hot mix plants will need to be provided in the event of the emissions exceeding the SPCB norms.
- ❖ The contractor shall obtain a No Objection Certificate (NOC) from SPCBs prior to the location and operation of plant to ensure the efficacy of the mitigation measures. All vehicles, equipment and machinery used for construction will be regularly maintained and monitored to ensure that the pollution emission levels conform to the SPCB, CPCB and MoEF norms.

- ❖ A vehicle maintenance schedule prepared by the contractor and approved by the Engineer shall be adhered to. Contractor will take necessary consent from state pollution control board for location of hot mix plants.

4.4 IMPACTS DURING OPERATION STAGE

4.4.1 Impacts

23. During operation phase major impact can result from vehicular pollution. These pollutants include sulphur dioxide, nitrogen oxides, particulates, lead, carbon monoxide, hydrocarbon etc. Some secondary pollutants like ozone, Peroxyacetyl nitrate (PAN) etc. are formed depending upon meteorological factors, topography, etc. Dust is another important air pollutant that is generated due to bad maintenance of road, accumulation of wastes on roads etc. Impact during operation phase is continuous and to some extent unavoidable.

24. The impact on ambient air quality will be insignificant during operation because numbers of vehicles in a day are expected to be 10-15. Due to creation of paved surface dust generation will also be minimised.

25. In India emission regulations are being made more stringent day by day. Already lead has been abolished from petrol in all metropolitan cities and is expected to be abolished from the entire country very soon. Indian emission standards are now following to meet Bharat II norms and if there is effective enforcement there should be reduction, in impacts as these standards take effect over time. By the time construction will be over Bharat III stage emission norms will be applicable. The present air quality is below permissible limit of CPCB.

4.4.2 Mitigation Measures

26. Compensatory plantation to be taken up will also screen the dust and other emissions.

4.5 WATER RESOURCES

4.5.1 Impacts and Mitigation Measures during Pre-Construction Stage

a) Impacts

27. To facilitate the cross-drainage at the drains and streams, various cross drainage (CD) structures are proposed, including improvements in the existing structures. The road side ponds and other water bodies have not been noticed. There are road side ditches. The water table along the road is 3 - 5 m below ground. Due to the high water table along the corridor, wells and tube wells are mostly the sources of potable and irrigation water. The typical impacts on water resources during the construction of a road are summarised in **Table - 4.5**.

Table –4.5: Impacts on Water Resources Due To Construction Activities

Impacts Due To Construction	Indicators
Alteration of drainage, run off, flooding	No. of cross drainage channels
Depletion of Ground Water recharge	Area rendered impervious
Use of Water Supply for Construction	Quantum of water used
Contamination from fuel and lubricants	Nature and quantum of contaminants

Impacts Due To Construction	Indicators
Contamination from improper sanitation and Waste Disposal in Construction Camps	Area of camp / disposal site and proximity to water bodies / channels

Alteration of Drainage

28. Impacts of road construction in the proposed project will be due to construction of cross drainage structures at Nallas, etc. Alteration of drainage can lead to soil erosion of adjacent areas. However, as mostly CD works are done in summer when the water levels are low, the impacts due to alteration of drainage can be minimised effectively by planning construction only in the dry season. In the CD works mostly culverts are to be constructed therefore no major impacts on drainage are anticipated.

b) Mitigation Measures

29. No drainage modification of surface flow of rivers is envisaged and no mitigation is required.

4.6 IMPACTS AND MITIGATION MEASURES DURING OPERATION STAGE

a) Impacts

30. One of the potential impacts of road construction is the increased surface run off. The construction of road in the project area will increase surface runoff due to paved impervious surface of main carriageway.

31. Impacts due to surface runoff include increased soil erosion and local flooding or water logging. However, the rural roads have been designed with side drains to take care of runoff, therefore, this runoff shall be drained to the nearest cross drainage structure. The engineering design includes design of cross drainage structures, which shall take care of the extra flow.

b) Mitigation Measures

32. To maintain an efficient storm water flow, the roadside ditches will be cleaned regularly at least once every year prior to the monsoons. The waste collected will be disposed off at locations identified during construction phase.

4.7 INCREASED SEDIMENT AND DEGRADATION OF WATER QUALITY

4.7.1 Impacts and Mitigation Measures During Pre-construction and Construction Stage

a) Impacts

33. The degradation of water quality can occur during construction stage from increased sediment load into watercourses near the construction site. This may be aggravated by removal of trees and consequent increase in soil erosion. As soil in the study area is alluvial-clayey loam type with a low silt composition, the impacts due to the increased sediment load will be insignificant.

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

b) Mitigation Measures

Design Stage

35. To ensure efficient cross-drainage and to prevent water logging along the sides, adequately sized and adequate numbers of cross-drainage structures have been provided. Along the settlements, as part of the engineering design, provision has been made for drainage along the sides of main carriageway.

Construction Stage

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

37. All necessary precautions such as proper drainage and height of road will be maintained to construct temporary or permanent devices to prevent inundation. Temporary drains for collection and disposal of runoff into natural drainage system will be constructed. The contractor will take all the necessary measures such as proper drainage to prevent temporary or permanent flooding of the work site or any adjacent area.

4.7.2 Flood Hazard

38. The extent of impact due to the streams/local rivers may damage the pavement and washing away of road sections of levels of carriageway is not kept above HFL. Further such eventuality will not occur as design takes care of this aspect by providing carriageway level 1metre above HFL. Further adequately sized drain on either side of rural roads portions will be part of good engineering practice. Adequate numbers culverts have been planned to avoid flooding of road surface. It is expected that overall the rural roads will not be subjected to flooding.

4.8 CUMULATIVE IMPACTS- NATURAL AND BIO-PHYSICAL ENVIRONMENT

4.8.1 Impacts on Air Quality

a) Pre Construction and Construction Stage

39. The area will be impacted to some extent by air pollution during construction stage only. Construction stage impacts will be of short term and may have adverse impacts on the construction workers as well as on the settlements adjacent to the alignment, especially those in the downwind direction. During pre-construction stage impacts will be due to establishment of construction camp, site clearance and due to construction vehicle movements. It is anticipated that these impacts will be limited within 500m on either side of project road and 500m radius around construction camp. It is anticipated that these impacts will be limited within 1.0 km radius around construction camp.

b) During Operation Stage

40. During operation stage impact on air quality will be due to increased number of vehicles and vehicular pollution. But air quality impacts are not expected to be significant as vehicular movement is not much.

4.8.2 Mitigation Measures

b) During Construction

41. To mitigate air quality impacts during construction, there will be regular water spray at construction site. All vehicles and machinery will be maintained. There will be regular environmental monitoring and remedial actions will be taken in the event of AAQ violation.

At locations of air sensitive receptors the construction activities will be closely monitored by the supervision consultant.

b) During Operation

42. During operation regular monitoring is planned. The compensatory plantation will alleviate the impacts to a great extent.

4.9 LAND/PHYSIOGRAPHY

43. The impact of road construction on physiography is a function of the terrain of the area. It is most drastically altered where hilly terrain or where extensive cut-and-fill operations are involved. In present case project road is already existing and is being widened therefore no change in physiography is expected after project implementation.

4.10 SEISMICITY

44. The entire project corridor falls in Zone V with a seismic coefficient of 0.05. Hence the area is relatively stable. No blasting is envisaged at the construction site. Therefore there will be no significant impacts in ground vibration due to construction.

4.11 LOSS OF PRODUCTIVE SOIL

4.11.1 Impacts and Mitigation during Pre-Construction Stage

a) Impacts

45. Loss of productive soil, albeit during the construction stage only, is envisaged at locations of workers camps, stockyards, storage, godowns etc. (for the duration of construction) if these are located on fertile areas. The EMP can ensure that no productive areas are used for these purposes and avoid adverse impact. In any case, though it would be a direct impact, it would be reversible as the soil can be stockpiled and replaced after the construction is complete and the worker camps etc are closed.

b) Mitigation Measures

46. In the selection of borrow areas for the project, productive agricultural areas have been avoided for borrowing of materials. The workers camps, stockyard, storage and godowns will not be established at agricultural land. In case productive areas are taken for borrow areas, stock yards, storage or workers' camp, the post construction rehabilitation will be ensured.

4.11.2 Impacts and Mitigation During Construction Stage

a) Impacts

47. Soils both within and outside the RoW may be negatively impacted due to the proposed project. The loss of productive topsoil due to road construction is a direct adverse long-term impact. The project road alignment in most of its part will utilise land available in existing RoW hence will not involve loss of much productive soil. In addition to this there will be temporary impact on productive soil at diversions and labour camp due to leasing of land for construction period. The top soil from productive areas will be either utilised in side slopes/shoulder dressing or will be stored outside and will be spread back during rehabilitation.

b) Mitigation Measures

48. Given the practical experience there may be temporary requirement of productively agricultural areas for construction camps, all areas of cutting, borrow areas and etc. in productive lands and all areas to be permanently covered, the top soil will be stripped to a specified depth of 150 mm and stored in stockpiles of height not exceeding

2m. Stockpiles would be covered with tarpaulin to prevent runoff and leaching of nutrients. The stockpiling will be done in slopes of 2:1, to reduce surface runoff and enhance percolation through the mass of stored soil. Since topsoil will be in substantial quantities it is suggested that it will be stored in stockpiles at each km within the RoW.

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

- Covering all disturbed areas including for the redevelopment of borrow areas;
- Top dressing of the road embankments and fill slopes;
- Filling up of tree pits, proposed as part of compensatory afforestation; and

50. To prevent any compaction of soil in the adjoining productive lands, the movement of construction vehicles, machinery and equipment will be restricted to RoW.

4.12 SOIL EROSION

4.12.1 Impacts and Mitigation Measures during Pre-Construction Stage

a) Impacts

51. The soil in the study area is alluvial-clayey loam. Erosion will be exacerbated if the vegetation is removed from the sides since roots are known to hold soil together. This will however be for the duration until the compensatory afforestation and roadside turfing have matured. In stretches where raised carriageway has been planned, slope protection measures are required.

52. To prevent the eroded material from entering the watercourse, silt fencing and/or sand bags can be provided at the end of ditches or cascade arrangements can be provided at the end of ditches as they enter the watercourse. While the former requires frequent cleaning to prevent built-up, the voids in the cascade will be filled up by eroded material and eventually vegetation will be established there.

53. No soil erosion is envisaged when the road is in operation as all the slopes and embankments of the project road shall be stabilised through sound engineering techniques and checks will be made that the works have been carried out to the required standard.

54. Soil erosion results in the loss of soil cover, slope stability and addition of sediment loading to drainage channels. The problem of soil erosion is likely to be more pronounced during the construction stage along bridge-end fills, over steep banks and embankment slopes.

b) Mitigation Measures

55. The slope of the road embankment has been fixed at 1:2, which is stable and reduces the possibilities of slope failures. This protection will mainly be provided at approaches of major and minor bridges. The slope protection will be done in accordance with recommended practice. For treatment of embankment slopes for erosion control, IRC: 56-1974. All the culverts to be constructed as cross drainage structures, the slopes will be protected by turfing with grasses and shrubs.

56. To check the slope stabilisation of the borrow pits adjacent to the embankment, the depth of the pit will be so regulated that the bottom edge of pit shall not intersect the imaginary line of slope 1:4 drawn from the top edge of the nearest embankment. To avoid embankment slippage and erosion, borrow pits shall not be dug continuously.

4.12.2 Impacts and Mitigation Measures during Construction Stage

a) Impacts

57. Impacts in the construction stage due to soil erosion are mainly at the construction sites of approaches of bridges and culverts and along the edges of the diversion channels.

58. Severe erosion of earth slopes is usually caused by a concentration of storm water flowing from the roadway section or from the area at the top of cut slopes down unprotected embankments or other slopes. Preventing concentration of water in these critical areas is essential. Rainfall on cut and fill slopes will cause erosion to varying degrees, depending on the intensity of rainfall, the type of soil, the degree of slope, the length of the exposed surface, the climatic exposure, and the effectiveness of the vegetative or other protective cover.

b) Mitigation

59. Channels, ditches, berms, or shoulder dikes for diverting water to satisfactory outfalls should be constructed at appropriate locations early in the construction of the project.

60. Benches or terraces, enclosed drainage systems, or the mulching or covering of the soil with various materials may be required to reduce slope erosion due to rainfall especially while constructing embankments.

4.13 COMPACTION OF SOIL

4.13.1 Impacts and Mitigation during Pre-Construction Stage

a) Impacts

Preconstruction Stage

61. Compaction of Soil will occur in the pre-construction stage (particularly during site clearance stage) due to movement of heavy machinery and vehicles. Similarly, compaction will take place during setting up of construction camps and stockyards. However, this is a short duration impact. Appropriate mitigation measures have been given in section 4.13.4.

4.13.2 Construction Stage

62. Compaction occurs beyond the carriageway and within the vegetated area of the RoW by the movement of vehicles and heavy machinery. Movement of vehicles during road construction is the major cause of soil compaction. This impact is direct and will be the maximum in the RoW. It is necessary to ensure that there is no adverse impact of soil compaction in areas other than the RoW, where vegetation can grow and rain infiltration will take place.

4.13.3 Operation Stage

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

b) Mitigation

4.13.4 Preconstruction and Construction Stage

64. Vehicles and machinery will be kept within ROW to minimise the adverse impacts during pre- construction and construction. In case the machineries are needed to be placed / installed outside the RoW they shall be done on barren or unused land. At construction camp vehicles/machineries will be parked at designated location.

4.13.5 Operation Stage

65. During operation stage no impacts are anticipated as pavement itself is a function of completed base and sub-base.

4.14 CONTAMINATION OF SOIL

a) Impacts

4.14.1 Pre-Construction Stage

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

4.14.2 Construction Stage

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

b) Mitigation Measures

68. At various construction sites, the vehicles and equipment will be maintained and refuelled in such a fashion that oil/diesel spillage does not contaminate the soil. It will be ensured that the fuel storage and refuelling sites are kept away from drainage channels and important water bodies.

4.15 CONSUMPTION OF CONSTRUCTION MATERIAL

69. The construction of the rural roads envisages the use of significant quantities of the earth, stone and grit and sand along with bitumen.

70. The excavation of quarries and borrow pits used for obtaining rocks, soil and aggregate materials for road construction can cause direct and indirect long-term adverse impacts on the environment. Significant quantities of materials will be required from quarry and borrow areas for the project road.

71. The impacts of Quarrying operations could be significant at various stages of road construction. Quarrying and crushing could have an impact especially on the air quality of the area especially the area downwind to the quarry. The impacts are as described below.

4.15.1 Impacts and Mitigation Measures during Pre Construction Stage

a) Impacts

72. The design team has identified some of the quarries close to project road. The bulk of the materials needed for the construction of the embankments may be procured from these quarries or any other suitable quarry as desired by the TSC/PIC.

73. As these quarries are already in operation with the requisite environmental clearances and redevelopment plans, no major impacts, which arise in making new quarries operational, are likely.

b) Mitigation Measures

74. As part of the project preparation process, an evaluation of existing quarries in the project influence area has been carried out and the status in terms of the suitability of the quarry material and their adequacy for construction purposes have been assessed.

75. The mitigation measures for depletion of natural resources have been considered to be there as Assam State Government Mining Department is issuing licenses of quarries considering all future planning and other development activities.

4.15.2 Impacts and Mitigation Measures during Construction Stage

a) Impacts

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

77. Though the quarry materials are to be transported over long distances to the construction sites, almost all the quarries identified have proper access roads, therefore, no major impacts during the haulage of materials is envisaged.

78. The impacts of crusher goes up to a distance of at least 1km and mainly results in dust generation. In addition to this there is change in physiography of the site due to storage of crushed and uncrushed material at site.

c) Mitigation Measures

79. If the contractors decide to use quarries not in the recommended list, they would require obtaining clearance from mines department and State Pollution Control Board. The EMPs has incorporated requirements that the contractor will have to fulfil before materials can be procured from quarries and crushers. These include verification of availability, currently valid permissions from regulators for both operations. To offset any possibility of spillage of quarry materials due to transport proper precautionary measures such as the covering of vehicles with tarpaulin shall be carried out. Further, it will be ensured that water sprinkling arrangement at crusher belt is working.

80. The Assam PWD in association with the Assam Pollution Control Board shall carry out the monitoring of the rehabilitation of the quarries so as to ensure that the rehabilitation plan has been carried out as laid down in the conditions of state pollution board clearance. This can be done effectively by PWD by empanelling quarries having environmental compliances and in future contracts conditions is put that construction material should be procured from empanelled quarries only. Further, new lease or license to quarry owner shall be given by the mining department only on satisfactory certificate from SPCB.

4.16 BORROW PITS

4.16.1 Impacts and Mitigation Measures during Pre Construction Stage

a) Impacts

81. Borrowing is to be carried out in accordance to the guidelines laid out in IRC-10-1961. Also, productive agricultural areas have been avoided for borrowing. However, the borrow area pits, if not treated properly after the borrowing is complete, can form stagnant pools and pose health hazards to prevent which redevelopment of borrow areas need to be worked out.

b) Mitigation Measures

82. No borrow area shall be opened without permission of the Supervision Consultant. The borrowing shall not be carried out in cultivable lands.

83. Location of source of supply of material for embankment or sub-grade and the procedure for excavation or transport of material shall be in compliance with the environmental requirements of the MoEF, MoRTH and as specified in IRC: 10-1961.

84. Redevelopment of the identified borrows areas will be worked out, as part of the project will be implemented to mitigate the impacts. These redevelopments will be in the form of fresh water fish ponds, levelled agriculture fields, plantation of trees, etc.

4.16.2 Impacts and Mitigation Measures during Construction Stage

a) Impacts

85. Cartage of the borrow materials to the construction sites is of significance, as almost all such areas are accessible through dirt tracks only and therefore, spillage and compaction of soil along these tracks will be a significant impact.

86. Rehabilitation of borrows areas from which earth has been excavated, is a potential problem, which needs to be addressed. In addition to visual blight, safety issues shall also be considered.

b) Mitigation Measures

87. To avoid any embankment slippage's, the borrow areas will not be dug continuously. In case borrow areas other than specified is selected, the size and shape of borrows pits will be decided by the Supervision Consultant. Borrowing of earth shall be carried out at locations recommended as per IRC: 10-1961 relevant MoRTH clauses whose salient features are described below:

88. **Non-Cultivable lands:** Borrowing of earth will be carried out upto a depth of 1.0 m from the existing ground level. Borrowing of earth shall not be done continuously. Small drains shall be cut through the ridges, if necessary, to facilitate drainage. Borrow pits shall have slopes not steeper than 1 vertical to 4 horizontal.

89. **Public or private agricultural lands:** Borrowing of earth shall not be carried out on productive lands. However, in the event of borrowing from productive lands, topsoil shall be preserved in stockpiles. A 150mm layer of the top soil shall be stripped off from the area designated for borrowing and it shall be stored in stock piles in a designated area for height not exceeding 2m and side slopes not steeper than 1:2. At such locations, the depth of borrow pits shall not exceed 45 cm and it may be dug out to a depth of not more than 30 cm after stripping the 15 cm top soil aside.

90. **Borrow pits on the riverside:** The borrow pit should be located not less than 15m from the toe of the bank, distance depending on the magnitude and duration of flood to be withstood.

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

92. The contractor shall evolve site-specific redevelopment plans for each borrows area location, which shall be implemented after the approval of the Supervision Consultant.

4.17 NOISE

93. Road noise depends on factors such as traffic intensity, the type and condition of the vehicles plying on the road, acceleration/deceleration/gear changes by the vehicles depending on the level of congestion and smoothness of road surface (IRC: 104-1988).

94. The baseline noise levels monitored at various locations along the project road indicate baseline levels below the permissible limits of CPCB. Noise levels will increase significantly during construction phase due to movement of construction machinery and due to movement of vehicles during operation.

95. As per the experience of consultants the noise levels at construction camp and construction site go upto 85 dB(A). But these will be intermittent in nature and during operation of heavy machinery/DG set at site and construction camp.

4.17.1 Impacts and Mitigation during Pre-Construction Stage

a) Impacts

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

b) Mitigation Measures

97. The baseline monitoring indicates the noise levels below permissible limits of CPCB along the existing road. However plantations will be made as precautionary measures.

4.17.2 Impacts and Mitigation Measures during Construction Stage

a) Impacts

98. Due to the various construction activities, there will be temporary noise impacts in the immediate vicinity of the project corridor. The construction activities will include the excavation for foundations and grading of the site and the construction of structures and facilities. Crushing plants, asphalt production plants, movement of heavy vehicles, loading, transportation and unloading of construction materials produce significant noise during construction stage.

99. Though the noise levels presented for the various construction activities far exceed the permissible standards, it is important to note that the construction noise is generally intermittent and depends on the type of operation, location and function of the equipment.

Noise shall be mitigated at source wherever possible and mitigation measures as to regulate the timings of construction. The mitigatory measures will include no construction activity at night in habitations, personal protected equipment to workers, etc.

b) Mitigation Measures

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

101. In construction sites within 250m of the nearest habitation, noisy construction work such as concrete mixing, batching will be stopped during the night time between 10:00 p.m. and 6:00 a.m. No noisy construction activities will be permitted around the silence zones, a distance of 100m from the sensitive receptors as hospitals, educational institutions etc. Portable noise barriers will be installed at such locations. To protect construction workers from severe noise impacts, noise standards of industrial enterprises will be strictly enforced, and workers shall be provided with Personal Protective Equipment (PPE) such as earplugs. The construction camp will be located at least 1.5 km downwind direction of habitation.

102. Monitoring shall be taken up at few locations of the alignment in addition to noise sensitive receptors where noise barriers have been provided, so as to ascertain any requirement for the provision of additional measures for the mitigation of ill effects due to increased noise resulting from the operation of the project.

4.17.3 Noise Impacts during Operation

a) Impact

103. The impacts due to noise during operations will be due to increased vehicular activity. This will be due to increase in vehicular flow. During operation the noise levels are not expected to go beyond CPCB limits. Since increase in vehicle numbers is not expected to be significant, therefore, expected noise levels are not likely to exceed CPCB standards.

b) Mitigation Measures During Operations Phase

104. During operation phase noise impacts will be mitigated to great extent through plantation.

4.18 FLORA

4.18.1 Roadside Plantations

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

106. To prevent single-vehicle collision with the roadside trees, trees very close to the road need to be cleared. Roadside trees are safety hazards, particularly those trees with strong and rigid stems. Some trees are safety hazards because they preclude clear sight distances. Some trees (such as Tamarinds indicia) have a propensity to overturn when old and are potential safety hazards depending upon age and decay condition.

107. All trees that are safety hazards need to be cleared. To ease construction of the embankment for the widened road formation and, to permit construction of adequate

roadside drainage structure, trees located within the clear zone need to be removed. Trees need to be cleared to facilitate construction of traffic detours.

108. The impact on roadside trees and plantation is described in the following sections.

4.18.2 Impacts and Mitigation Measures During Pre Construction Stage

a) Impacts

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

110. This negative implication needs to be taken into consideration by compensating with new plantation along the RoW of the project road.

111. The micro-ecosystems supported by the roadside trees are also a point of environmental concern. The removal of roadside trees will not only leads to erosion, and depletion of the ground water table, but also to the loss of the micro-ecosystems developed on the roadside. No impact is expected on forest as no acquisition of forest land is planned. The tree cutting in forest will not be done.

b) Mitigation Measures

112. The loss of trees is being compensated in accordance to the principles laid out in the Forest (Conservation) Act, 1980. The forest area lost due to widening will be compensated through compensatory forestation. Trees earmarked for felling will be removed only with prior approval of the District Forest Officer. The tree plantation cleared will be replaced and compensated prior to the commencement of construction. The monitoring and maintenance of plantation will be carried out by forest dept. necessary funds will be deposited by PWD, Assam in lieu of this assignment.

4.18.3 Impacts and Mitigation Measures during Construction Stage

a) Impacts

113. Accidental cutting of roadside trees may occur during the construction stage. It can also occur due to negligence from the construction crew. Therefore, it is essential that all trees that are to be felled be clearly marked. No other trees should be cut on site. Cutting of trees for fuel by workers, especially near their camps is also a concern, therefore adequate training of the workers, and availability of fuel are to be ensured by contractual obligations.

114. As the project road passes through protected forests, the impacts during construction could include use of forest wood for cooking of food by the construction workers. Mitigatory measures of these impacts have been given in EMP.

b) Mitigation

115. Apart from trees earmarked for felling, no additional tree within or outside the RoW will be carried out. No tree will be removed in the zone of construction (apart from those trees earmarked for felling) without the prior approval of the Department of Forests, through the Supervision Consultant. Construction vehicles, machinery and equipment will move or be stationed in the designated area only to prevent compaction of vegetation.

116. In order to minimise impacts the construction activities will be limited during daytime only. In order to discourage the use of firewood for cooking the contractor shall provide supplies of LPG/Kerosene free to the workforce at the worker camps.

4.18.4 Impacts and Mitigation Measures During Operation Stage

a) Impacts

117. The impacts on flora during the operation stage can occur due to accidental collision of vehicles. Though improved safety on the project road is an objective of the project, the increased speed will mean that collisions will be more damaging to the flora than before. Moreover, increased pollutant concentrations on roadsides will mean harsher conditions for the newly planted roadside trees. Improved access to reserve along the project road can also make them vulnerable to illegal logging.

b) Mitigation Measures

118. The tree plantation survival rate should be monitored carefully in initial three years. The minimum survival rate has been recommended as 75%. There is expected to positive impact on flora due to compensatory plantation. In order to prevent encroachment on the RoW, the plantation would be taken up in vacant spaces available. Monitoring will be taken up after each 5 years from the planting of roadside trees. It is planned to plant three trees for every tree to be cut.

4.19 FAUNA

4.19.1 Impacts and Mitigation measures During Construction

a) Impacts

119. There is no presence of wild life along the selected rural roads. However common domestic animals may be affected during the construction.

b) Mitigation

120. All construction activities will be carried out in such a fashion that damage and disruption to fauna will be minimum. The construction workers will be given instructions and trained to conserve/protect natural resources and fauna.

4.20 HUMAN USE VALUES

4.20.1 Impacts and Mitigation Measures Due to Land Acquisition

a) Impacts

121. There will be no land acquisition for project road widening. However, at some locations land will be taken through involuntary donations.

4.20.2 Loss of Private Properties

122. No loss of private properties is anticipated as road construction in habitations will be limited within available RoW.

b) Mitigation

123. Since no loss of private properties is anticipated therefore no mitigation measures are warranted.

4.21 CHANGES IN LAND USE

a) Impacts

124. Since the existing cart tracks, poorly maintained roads are to be improved/constructed change in land use is not expected.

125. Reduced transportation costs and availability of high-speed transportation facilities for raw materials and products will be the most important advantage of the proposed construction of rural roads.

b) Mitigation

126. No mitigation measures are warranted as no change in land use along proposed rural roads is anticipated.

e) Exploitation of Resource Base

i) Impacts

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

128. Development of such vital infrastructure will lead to over exploitation of the environmental resources (e.g. too much groundwater pumping, indiscriminate wastewater disposal, etc.). While the medium term impacts may not be large enough to be noticed, the long-term implications of such depletion are potentially disastrous.

ii) Mitigation

129. Proper planning and use of licensed quarries will avoid impacts on natural resource base.

4.22 SAFETY

130. The concern for safety stems from the proposals for faster vehicular movement along the highways. Though speedy travel is one of the objectives of the project, it also increases the intensity of loss in case of an accident. The project design takes care of safety measures for road users. Safety of pedestrians as well as of the vehicles plying on the road is given highest importance and adequate measures have been incorporated in the design of the alignment.

131. Construction activities cause hindrance to traffic movement. Traffic management plans shall be prepared. Signboards indicating construction sites on the road and flags shall be erected. All the signboards giving caution, barricades for diverting the traffic shall be as per MoRTH specifications.

4.23 ARCHAEOLOGICAL/PROTECTED MONUMENTS AND OTHER CULTURAL PROPERTIES

132. There is no archaeological/ cultural property in the influence area of Rural roads selected for second annual batch.

Other Cultural Properties

(a) Construction Stage

133. Construction Stage, which involves not only the actual road construction process, but also allied activities such as movement of road machinery, hauls vehicles etc as well. These heavy vehicles need a belt of about 2m on the roadside for movement. Also, mixing

etc activities need space along the road edge. Heavy and big machinery is not expected to be used in rural road construction. The movement is expected to within the RoW. Hence no impact is envisaged.

134. The contractor shall keep a watch for any artefacts such as fabrics, coins, artefacts, structures, or other archaeological relics. If there are discovered, the construction works will be stopped pending directions from the Assam state Archaeology Directorate who will be informed promptly. At these chance find locations, the contractor shall take reasonable precaution to prevent his workmen or any other persons from removing and damaging any such article or thing and shall, immediately upon discovery thereof and before removal acquaint the PIC/PIU of such discovery and carry out IA's instructions for dealing with the same, pending which all work shall be stopped 100m all directions from the discovery site.

135. The PIC/PIU shall seek direction from the Directorate of Archaeology, Assam before instructing the Contractor to recommence work on the site. Archaeologists will supervise the excavation to avoid any damage to the relics.

4.24 SOCIAL IMPACTS

136. Significant negative social impacts in project are not anticipated. The rural roads are expected to have significant positive impact which will be assessed and monitored as per the approved CPF document for the project.

SECTION - 5

5.0 INSTITUTIONAL REQUIREMENTS & ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN

5.1 General

1. The findings from assessment of the potential environmental impacts shows that the environmental impacts of Batch 2 rural roads are similar with environmental impacts identified in the standard Environmental Management Plan (EMP) described in the ECOP. This EMP has been attached as Appendix III. Therefore, the standard EMP as part of the ECOP has been attached in the bidding document for Batch 2 Project. The environmental management plan from this study, attached in Appendix-IV will be used as an inputs for revising the standard EMP of ECOP. The revision of the EMP includes implementation actions, responsibilities and timeframes specified for each component and an adverse impact. The revision of the EMP will be carried out separately, and when the revised EMP is approved, it will be implemented for the next batch of the Project.

5.2 Implementation of EMP at the Project level

2. The Assam PWD through its PMU is responsible to implement the overall EMP. However, during the construction stage, the contractors are responsible to mitigate all environmental impacts related with the construction activities. In this context, the EMP has been included into the Bidding Documents (BD) of all the construction packages so that it serves as a condition of contract for adopting the Environmental Code of Practices (ECoP) by the prospective contractor (s). The implementation of the EMP and/or ECoP by the contractor (s) is to be supervised by Construction Supervision Consultant in close consultation with the Project Implementation Unit (PIU) of the Assam PWD and the Project Implementation Consultant (PIC).

5.3 Implementation of Environmental Monitoring at the Project level

3. The PIU with assistance from PIC will undertake suitable environmental monitoring during the construction and right after the completion of the construction activities.

5.4 Institutional Requirements For Overall Implementation of EMP

5.4.1 Institutional Requirements – Construction Stage

4. The second annual batch of 969.85 km will be packaged into several construction contract packages (district wise) by the Project Implementation Unit (PIUs) of Assam PWD. In order to support PIUs and Assam PWD, on technical matter NRRDA has appointed Technical Support Consultants (TSC). The technical support consultant has environmental expert in their team. The environmental expert of TSC will continue to periodically review the environmental safeguard compliances at site as well as through report and documentation submitted by Assam PWD. The project Implementation Consultant (PIC) on behalf of PIU will continue to supervise

the construction works and will act as Construction Supervision Consultants (CSC). The five PICs has one Environmental Officer (EO) in their team. The contractor shall engaged the Field Environmental Officer (FEO), who will be responsible in implementing EMP.

5. The institutional requirement for the implementation of Environmental Management Plan (EMP) is given in **Figure 5.1**. The roles and responsibilities for implementation of EMP during the construction stage are described herein.

6. The EO will be responsible to ensure adherence and implementation of EMAP at all stages of works by the contractor. The EO, if found warranting may also conduct field tests, independent of the contractor to determine the effectiveness of EMAP under approval of PIC/PIU.

7. The broad duties / responsibilities of the Environmental Officer will continue to include

- ❖ Review of project design and specifications to ensure their adequacy and suitability with respect to the implementation of EMAP and or ECoP
- ❖ Collection and dissemination of relevant environmental documents including amendments to environmental protection acts issued by the various agencies, namely, ADB, Government of India / State and local bodies;
- ❖ Interact with the counterpart of the Contractor(s), review work progress/plans and ensure implementation of the EMAP;
- ❖ Co-ordination with the NGOs, community groups and Government departments on environmental issues, provide clarifications/ and obtain clearances during project implementation if any, as required from the regulatory authorities and/or submitting periodic compliance reports as required by the State Authorities;
- ❖ Monitoring sensitive environmental attributes during construction to ensure that the suggested mitigation measures in the EMAP are implemented;
- ❖ Documentation of the environmental management/monitoring activities for the regular project implementation progress report; and
- ❖ Conducting environmental training/awareness programmes for the contractors, the project implementation personnel and the communities.

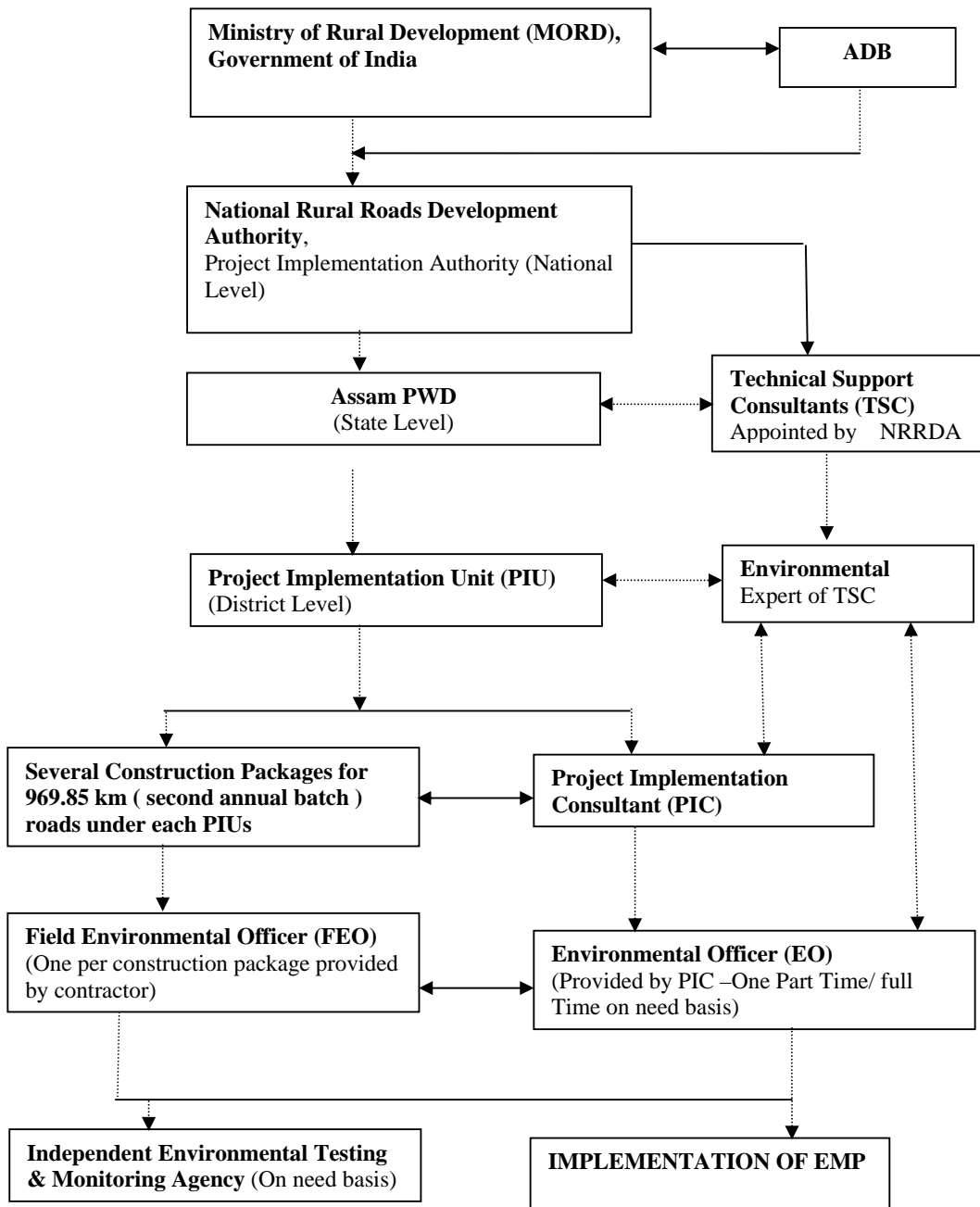


Figure-5.1: Institutional Requirements for Implementation of EMP

5.4.2 Institutional Requirements – Operation Stage

8. No institutional requirements for the environmental management and monitoring of EMP are required for the operation stage of the rural roads.

5.5 EMP Cost Estimate

9. A cost provision of US\$ 1.0 million (equivalent Indian Rupees: 44.07 million about 1%of total project cost) has been earmarked for the environmental mitigation measures for the 969.85 km second annual batch of rural roads.

SECTION - 6

PUBLIC CONSULTATIONS AND INFORMATION DISCLOSURES

6.1 INTRODUCTION

1. The rural project comprising of 969.85 km rural roads is likely to affect the communities residing around the corridor of impact and their activities. Moreover successful implementation of the project requires co-ordinated efforts of various stakeholders at different levels. Hence, consultation at different levels was used as a tool to inform and educate stakeholders about the proposed action both before and after the development decisions were made. Public consultation was useful for gathering environmental data, understanding likely impacts and community's needs and preferences.

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

3. The public consultation was carried out between November 2007 to March 2008 as part of the field works

6.2 OBJECTIVES

4. The main objective of the consultation process was to minimise negative impacts of the project and to maximise the benefits of the project. Other objectives of the consultation process were the following:

- To promote public awareness about the proposed project especially amongst the potentially impacted communities/individuals;
- To educate the communities/individuals close to project roads about the proposed course of action and the project alternatives;
- To solicit the views of communities/individuals residing near rural roads proposed for construction on environmental and social problems;
- To gather inputs from the affected communities/individuals in crucial decisions regarding mitigation of the identified environmental and social issues;
- To stimulate community self evaluation and analysis; and
- To ensure lessening of public resistance to change by providing them a platform in the decision making process

6.3 METHODOLOGY ADOPTED FOR PUBLIC CONSULTATIONS

6.3.1 Stages and Levels of Consultation

5. Public consultation was conducted both at screening stage as well as IEE stage. Consultations conducted at screening stage played an important role in scoping the level and extent of consultation to be taken in the project preparation stage.

Public consultations have been held at three levels as follows:

- **Local level** (village level/Block level) villagers through which roads are passing.
- **District level** consultations involving District Magistrates, revenue department, PIU officials, local forest department; and
- **Institutional level** consultations with State Forestry Department and State Pollution Control Board.

Tools for Consultation

6. Public Consultation was done using various tools including, discussion with village panchayats, government officials and other stakeholders.

(i) Formal/Informal discussion

7. During the transect walk, consultations were held with the panchayat officials and villagers. Also during the reconnaissance survey and site visits, discussions were carried out informally drawing people into dialogue to obtain an overview of likely impacts and concerns of the community. Consultation was held at several locations along the rural roads alignment covering areas where public activity was intense and close to proposed alignment covering Owners of houses located close to rural roads.

8. A checklist of questions was kept ready and responses were elicited from people and guidelines were issued to field assistants for the purpose. The FGDs were held at Barpeta, Bongaigaon, Morigaon, Nalbari and Udalguri.

(iii) Institutional Level / Stake Holders Consultative Workshop

9. The institutional level consultations were held with representatives of institutions having stakes in implementation of the project. The institutions contacted included state forest department, State Pollution Control Board etc.

10. In addition to the official listed above the officials from other departments were also contacted on several occasions. The contacted officials included Tehsildars, NGOs, industry department and respective – district magistrate Offices.

6.3.2 Contents

11. The consultation with institutional officials focussed on the following issues.
- Project description: - Need for the construction of rural roads and benefits of the project.
 - Social and environmental assessment processes vis-à-vis- GOI and the multilateral funding agency requirements.
 - The extent / nature of negative social and environmental impact and the need for rehabilitation and resettlement in the project. Avoidance and mitigation aspects in the project.
 - People's participation in planning, implementation and Monitoring & Evaluation Stage.

6.3.3 Public Hearing, Schedule IV, under EIA notification of MoEF

12. The implementation of second annual batch of rural road projects does not require public hearing in the light of revised EIA Notification in the year 2006.

6.3.4 Issues Raised and Community Perception

13. Some of the general issues raised during the different consultation sessions can be summed up as follows.

Water Logging and Drainage

14. Participants had a fear construction of rural roads with new alignment may alter natural drainage pattern in the area and may cause flooding and water logging in the agriculture fields if adequate cross drainage structures are not provided.

Loss of Livelihood and Income Restoration Options

15. This issue was raised by maximum number of villagers, as loss of fertile land will deteriorate their income sources.

Road Safety

16. Safety issues were paramount in all the consultation sessions. Woman participants raised the issue of their children's safety.

Land Acquisition

17. People were concerned about the land requirements of the project and impact on their agriculture land. They were also of the view that community should be consulted before the road designs are finalised.

Loss of Idols/Shrines

18. Participants showed resistance for shifting of idols, burial grounds and other religious structures at certain locations.

Loss of Trees Due to Road Construction

19. Respondents were of the opinion that trees cutting should be avoided or else minimised. For trees to be cut compensatory plantation should be done. Some villagers expected additional plantation should be done. Recommended tree species for plantation were other local varieties.

Impacts on Health

20. Separate consultation sessions were organised by social team to identify issues pertaining to health specifically for sexually transmitted diseases (STDs). Settlements along the rural roads were reported to be getting exposed to such diseases as there are no long distance users on the project roads.

Employment during Construction

21. The locals demanded that locals should be given preference in employment during project implementation.

Perceptions and Expectations

22. Perceptions and expectations of the community recorded during the consultation sessions can be broadly listed as:

- The public and the PAPs appreciate the rural road construction.
- Community and large appreciated overall benefits to the community resulting from project development;
- Aware of the increased access, less travel time in commuting after project implementation;
- Expect better management of traffic and necessary noise barriers at educational and health facilities during construction;

Addressal of Issues

23. The project has tried its best to address all the issues raised during consultations under the Constraints of suitability from engineering point of view. Some of the provisions made under the project to address the issues and concerns of the community are given in **Table 6.1**.

Table 6.1: Addressal of General Issues and Concerns under the Project

Issue/Concern	Addressal under the project
Water Logging and Drainage	Adequate cross drainage structures have been planned
Road Safety	Adequate safely signage's planned all along the rural road.
Land acquisition and Mode of compensation	The proposed RoW is 12m along the rural road. No land acquisition is planned in project road.
Loss of roadside idols/shrines	Idols and shrines will be relocated to the other nearby places with consultation and proper rituals
Loss of trees	Compensatory afforestation would be done at the ratio of three trees for each tree to be cut.
Increased pollution levels	Pollution levels are not crossing the prescribed limits of CPCB and planned plantation will screen the emission.
Utilities and basic infrastructure	All the utilities, electric poles, telephone lines, wells, tubewells etc. to be impacted will be relocated under the project cost.
Employment of locals during construction	Locals will be given preference for employment during the project implementation

24. The issues raised and their incorporation in the design has been explained in **Table 6.2**.

Table 6.2: Summarisation of Issues and Findings at Various Locations

Location	Issues	Participants Comments and Suggestions	Mitigation Measures and Action Plan
Barpeta, Bongaigaon, Morigaon, Sonitpur, Nalbari and Udalguri	<ul style="list-style-type: none"> • Peoples Perception about the Project • Air, Water Quality • Noise level • Water Source • Health and Environment • Road Alignment 	<ul style="list-style-type: none"> • The Villagers are in favour of the Project as they see a job opportunity and faster transport. • Air and Water especially drinking water qualities are not polluted. • Primary water sources are hand pump and open well and these should be relocated first if affected. • No construction activity will be taken in the night in built up area. • Affected water sources will be relocated first and then there will be dismantling of the existing sources. • The villagers required proper traffic control at the road junctions to prevent accidents. • Villagers are sound in health 	<ul style="list-style-type: none"> • Safety measures will be provided. Adequate signages will be provided. • No construction activity planned during night time at habitation. • Water Resources will be relocated first before dismantling the existing ones. • Road alignment is planned during transect walk. • Locals will be given preference in employment during construction.

SECTION - 7

FINDINGS AND RECOMMENDATIONS

7.0 FINDINGS AND RECOMMENDATIONS

1. The findings and recommendations of the IEE for the rural road construction works are summarized hereunder:
2. The IEE for 969.85 km of rural roads, which represent the second annual batch was prepared by using the environmental checklist in compliance with the agreed Environmental Assessment Review Framework (EARF) of the Rural Road Project.
3. The potential impacts have been screened in accordance with the Environmental Assessment Guidelines, 2003 of ADB and required adequate mitigation measures have been suggested and have been reflected in the environmental management plan (EMP).
4. The anticipated environmental impacts are largely generic in nature and can be mitigated by adopting suitable mitigation measures.
5. The Institutional Requirements for implementation of mitigation measures has been identified along with a frequency for monitoring of EMP. A cost provision of US\$ 1.0 million has been made for implementation of EMP for the second annual batch of 969.85 km.
6. The TSC shall prepare quarterly progress report on environmental compliances. This will help in effective implementation of EMP.
7. The IEE also indicate that rural road construction works does not warrant further EIA study for subsequent rural road construction works in Assam.
8. Based on the environmental checklist that served as IEE and the field work to verify the environmental checklist, the proposed revision of EMP for Assam state has been prepared and attached in Appendix III. It is recommended that the revised EMP given in the Appendix III might be used for the follow up batch. A separate process to revise and to approve the use of the revision of EMP will be undertaken.

CHAPTER- 8

CONCLUSION

8.1 CONCLUSION

1. Based on the review on environmental checklist for each road as part of the DPR and verification through field visit as part of the preparation of this IEE report, it shows that associated potential environmental impacts of this project are insignificant, and temporary, which mostly occurred only during the construction stage. All the potential environmental impacts can be mitigated to an acceptable level by adequate implementation of the measures as stated in the EMP.
2. As already mentioned the proposed project, i.e. widening and strengthening of the road network by creating additional road capacity between different points of the road network will improve operational efficiency and can act as an effective mechanism for reducing economic and environmental costs of the road stretches. The project brings considerable improvement to possible exposure levels to population when compared with no project scenario.
3. Overall, the major social and environmental impacts associated with proposed projects are limited to the construction period and can be mitigated to an acceptable level by implementation of recommended measures and by best engineering and environmental practices.

Appendix I

List of Rural Roads Under Second Annual Batch of ADB Loan Assistance – Assam

Sl No.	Name of the District	Package No	Road Name	Road Length (km)
1	Kamrup (Rural)	AS-11-67	Jiakur-Bortari	2.120
		AS-11-68	Bagals	5.278
		AS-11-69	Salochuti- Badlapathar	9.355
		AS-11-70	Baruapathar No.2-Malibaripathar No.1	4.908
		AS-11-71	Rani-Gohaihat Tiniali	5.000
		AS-11-72	Silobari-Bondapara	9.450
		AS-11-73	Bhukradia-Nagarbera	9.650
		AS-11-74	Purangaon-Kacharipam	7.538
		AS-11-75	Mandira N.C- Mandirapathar N.C	7.862
		AS-11-76	Majirgaon-Kahikuchi	5.000
Total Road Length : 66.161 km				
2	Sonitpur	AS-22-65	Thelamara-Missamari	5.230
		AS-22-66	Morangaon-Nasbor	10.160
		AS-22-67	107th km of NH52-Mitham Bengali	13.088
		AS-22-68	Rongapara-Urahiloga	5.324
		AS-22-69	Chariali- Balipukhuri Borpura Disiri-Ratuwa	7.058 8.916
Total Road Length : 49.776 km				
3	Morigaon	AS-17-34	Bhurbondha Mikirgaon-Ghumatigaon	16.974
		AS-17-35	Lengeribori-Lalipar	2.132
			Taptola-Rowmari	3.264
		AS-17-36	Bahakajari-GarmariGarjan	4.139
AS-17-37	Baghjap-Amlighat	10.630		
Total Road Length : 37.139km				
4	Goalpara	AS-07-38	NH37- Ambari Part III	6.892
		AS-07-39	Mahajanpara-Simlitola	5.872
		AS-07-40	Nayapara-Kailasatra	8.445
		AS-07-41	Ambari -Taltola	2.459
		AS-07-42	Nidanpur-Besorkona	4.850
Total Road Length : 28.518 km				
5	Chirang	AS-25-17	NH31CPatiladoha- Kachubill	7.600
		AS-25-18	Ulubari-Lakhijhora	8.000
		AS-25-19	Bijni-Amteka	8.000
		AS-25-20	Borobazar-Khunkarajhora	6.700
Total Road Length : 30.300km				
6	Karbi-Anglong	AS-12-40	SH33-Kherbari	6.956
		AS-12-41	5th km of DS road -Anjokpani	15.189
		AS-12-42	Kheroni-Lamsakhang	18.184
Total Road Length : 40.329 km				
7	Nagaon	AS-19-87	Amtola-Bakulguri	15.180
			Kachua tiniali- Bakulguri	9.917
		AS-19-88	Doboka market -Jamunamukh	15.486
			Hojai market - Mubarakbasti	8.888
			Hojai market – Raikata Islampur	9.751
			Pub Jamunagaon-Paschim Rowarpar	10.916
		AS-19-89	Paschim SingimariPart III- Pub Saoloni PartI Madhatari-Barbhakati	10.587 5.290
Total Road Length : 86.015km				
8	Bongaigaon	AS-02-27	Dumerguri-I (starting from Latabari) to Latabari I	5.900
		AS-02-28	Gerukabari- Kirtanpara	14.900
		AS-02-29	Talguri to Basugaon	1.818
		AS-02-30	Simlabari II to Santoshpur-II	6.000
Total Road Length : 28.618km				

Sl No.	Name of the District	Package No	Road Name	Road Length (km)
9	Nalbari	AS-20-50	Narikuchi-Bilpar	11.049
			Jalkhana and Nathkuchi to Nannatary	2.221
		AS-20-51	Dolagaon to Bhurkuchi	4.147
			Bamunbari Bhurkuchi- Bamunbari Nathkuchi No.II	6.034
			09-N-59 - Sariahtoli	1.754
		AS-20-52	Sandheli-Nij Pakowa	2.376
			Balitora No.3 - Balitari	1.827
No4 Helesa- Kenduba	3.014			
Total Road Length : 32.422 km				
10	Dibrugarh	AS-06-42	NH37(Tiloi)-NH37 (Sipon)	7.458
			NH37 – Lachan Mirigaon	7.982
			Binoigutia-Bhugmur	3.231
		AS-06-43	Nilomoni-Dhowapathar	6.984
			Kachalupathar-Betoni	5.087
Total Road Length : 30.742km				
11	Jorhat	AS-10-49	Kharikatia-Gajpuria	10.462
			LBN Road	6.848
			Bhagyalakshi-Garhali	4.626
		AS-10-50	Nowboisa-Napamuwa	4.983
			Tiyok-Naamsisu	8.177
			Chenijan-Jogibheta	7.526
			Ailamukhiya-Kathiaboria	4.973
Total Road Length : 47.595km				
12	Tinsukia	AS-23-30	Daimukhuia to Dighaltarang	9.582
		AS-23-31	Bijuliban to Barhulung	9.120
			Pengree to Philobari	2.244
		AS-23-32	Margherita to Mirika Majuli	2.446
AS-23-33	Makumali to Duarmora	7.000		
Total Road Length=30.392 Km				
13	Cachar	AS-03-53	SH Road to NH 54 via Ali Tikar	1.537
			Boaljur to Atalikandi	2.928
			Chencoorie Road to Elgin	4.280
			Srikona to Mahanpur	2.999
		AS-03-54	Itakhola to Masughat	2.250
			Gorerbond to Barampur	3.236
			NH 54 near Block HQ to PDP via Jugia Basti	4.989
		AS-03-55	NH-54 at Nutanbazar to Derby TE Factory via Panivora	3.052
			SMD Road to Hathikhai via Haidar Bazar	2.599
			NH 53 to Sribar Lakhipur Road	4.536
			Shadirkhai Khelma II to Haritkar I	9.878
Amraghat to Chekarcham Bhubankhal Nagakhal	4.056			
Total Road Length 46.340Km				
14	Udalguri	AS-26-11	Jamuguri Amba Gaon, Borigaon to Santipur	15.258
			Patalagaon No.1-Bhergaon TE (B K Road)	5.881
Total Road Length 21.139 Km				
15	Barpeta	AS-01-55	Botia to Niz Saldah	5.144
			Naligaon to Kawamari Karaguri Reserve Road	3.636
			Mandia Gaon to Digirpam	1.587
		AS-01-56	Kalgachia to Kamarpara	7.503
			Kalgachia to Nadiapara	5.693
		AS-01-57	Rampur to Takaimari	10.207
			Meda to Uttar Verbari	4.034
		AS-01-58	Borvitha to Sewrachora Gaon	8.117
Bunialguri to Digjani	8.020			
Total Road Length =53.941				

Sl No.	Name of the District	Package No	Road Name	Road Length (km)
16	Baksa	AS-24-13	Katajhar Pathar to Kahitema Pathar	13.517
		AS-24-14	Behangapur Road	2.717
			Bishnupur to Chandanpur	2.842
			Kumarikata to Kauli2	5.652
			Tebitola Kauli to Narayanpur	5.326
Total Road Length=30.054 Km				
17	Dhemaji	AS-04-45	Dirpal NL GR to Jayrampur Via Nalbari	17.936
			Moinapara Mahari Camp Tiniali	5.514
		AS-04-46	Sreepani Lilokh Halokani	10.803
			Laloong Tiniali to Kherokoni	4.990
			Barmuria Muktiar Via Peernikakubari	10.294
Total Length=49.537 Km				
18	Dhubri	AS-05-39	NH-31 at Halakura to Sagolia Boxirhat	11.775
		AS-05-40	Bisondoi to Paglahat	5.200
		AS-05-41	Nayerlga Gauranghat to Gutipar Part IV	9.060
		AS-05-42	Mayerchar Part VII to Nayerlga IV	9.037
Total Length=35.072Km				
19	Golaghat	AS-08-49	Golaghat Merapani to Amguri	1.214
			Chinatoli to PHG Path	10.877
			Nagpur to Tonajan Missing	8.067
		AS-08-50	Borghoria to Borpathar	9.327
			Dergaon Town to Jaraguri	8.599
			Golaigaon to Barpathar	7.808
Total Length=45.892Km				
20	Kokrajhar	AS-14-34	Gosaigaon to Sapkata	8.520
		AS-14-35	Gakulkata to Jaraguri	4.750
		AS-14-36	Chandamari to Banglabari Bagicha	6.000
		AS-14-37	Borkanda Sapatgram to Chithilagram	1.814
		AS-14-38	Kachugaon to Samkosh	9.900
Total Length=30.984Km				
21	Lakhimpur	AS-15-45	Sissapothar Dhundabari Via Naharani Road	12.757
			Bihpuria to Bodati via Morcha Pathar	12.941
		AS-15-46	Bishnupur Dhekiajuli Kavhajuli to NH 52 at Laluk	11.698
		AS-15-47	Karunabari to Kehotoli Road	5.591
			Kumpang Hatiey Mara No. 2 Gaon via Bharatchu Gaon Road	9.693
Total Length=52.680Km				
22	Darang	AS-16-33	Dumunichowki to Khatarra	7.845
			Baneikuchi to Pathorighat	3.385
		AS-16-34	Kanmuji to NH 52	8.800
			Kachamari Sonari to Rohinikash	4.000
Total Length=24.030Km				
23	Sivasagar	AS-21-61	Dishanmukh Ali to NH 37	7.169
			514th Km of NH 37 to 520 km of NH 37	5.190
			Madhuri Gohaigaon to Bor Ali	3.442
Total Length=30.221Km				
24	Karimganj	AS-13-26	Dullavcherra to Katlichrra via Vetarbond	7.500
		AS-13-27	Kalkalimkh to Pachhim Deffola via Adam Tila	2.907
			Patharkandi to Kazirbazar	7.264
Total Length=17.671Km				
25	Hailakandi	AS-09-17	Block Boundary to Paikan Borbond Road	8.950
		AS-09-18	T 5 to Algapur Part 5	8.150
			03 T4 to Block Boundary	3.151
Total Length=20.251Km				
26	N C Hills	AS-18-22	Nobladisa to Simnthuilong Road vis Haja diza digerkho	8.000
		AS-18-23	Gunjung to Maibong	10.450
Total Length =18.450 km				
Grand Total: No. of Roads 138, Length of Roads 969.85 Km				

Appendix - 2

Table 1: Stretches of River Brahmaputra and its Tributaries

S. No.	Stretches	Locations
On Brahmaputra River		
1	Stretch - I	River Dibang at Karimgaon in Arunachal Pradesh to Brahmaputra at Maijan in Assam
2	Stretch - II	Brahmaputra after Maijan to Brahmaputra at Tezpur
3	Stretch - III	Brahmaputra after Tezpur to Brahmaputra at Pandu
4	Stretch - IV	Brahmaputra after Pandu to Brahmaputra at Dhubri
On Tributaries of Brahmaputra		
5	Stretch - V	River Buridihing at Margherita (Tinsukia District) to river Jia Bharati at BH-52 Crossing (Sonitpur)
6	Stretch - VI	River Kolong-Kopili at Hatiamukh (Morigaon District) to river Bharalu near Pragjyotish College, Guwahati (Kamrup District)
7	Stretch - VII	River Pagladia at NH-31 crossing upto river Sankosh at NH-31 crossing (Dhubri District)
8	Stretch - VIII	River Teesta near Sevak Bazar and river Teesta at Jalpaiguri (West Bengal)

Table 2 Stretch wise Classification of Monitoring Stations Brahmaputra and its Tributaries

S. No.	Stretches	Locations	Remarks
Monitoring stations on the mainstream			
1	Stretch - I	<ul style="list-style-type: none"> - River Dibang at Karimgaon (Lohit District) - River Dihang at Pasighat (Siang District, Arunachal Pradesh) - River Lohit at Saikhowghat (Tinsukia District) - River Brahmaputra at Maijan (Dibrugarh District) 	The three independent streams, Dibang, Dihang (Siang) and Lohit together and the combined flow makes the river Brahmaputra. The Maijanghat stations are the nearest place after combination of the three streams mentioned above. So, the physico-chemical characteristics of this stretch will reveal the independent water quality of the three concerned streams and also the water quality of the river Brahmaputra after the aforesaid combination.
2	Stretch - II	<ul style="list-style-type: none"> - Brahmaputra at Minatighat (Jorhat District) - Brahmaputra at Kherghat - Brahmaputra at Gomirighat (Golaghat District) - Brahmaputra at Tezpur (Sonitpur District) 	This stretch is the middle part of the river Brahmaputra in Assam
3	Stretch - III	<ul style="list-style-type: none"> - Brahmaputra at Chandrapur (Kamrup District) - Brahmaputra at Amingaon (Kamrup District) - Brahmaputra at Pandu 	In this stretch, the stations are located at up stream and down stream of the Guwahati city, which is the largest and most populous city in N.E. region of India. Study of this stretch is supported to reveal the influence of Guwahati city on the main river.
4	Stretch - IV	<ul style="list-style-type: none"> - Brahmaputra at Goalpara (Goalpara District) - Brahmaputra at Jogighopa (Bongaigaon District) - Brahmaputra at Dhubri (Dhubri District) 	This is the last stretch of the river Brahmaputra in India before entering Bangladesh. Study of this stretch would reveal the water quality of the river after covering the earlier stretches.

S. No.	Stretches	Locations	Remarks
5	Stretch -V	<ul style="list-style-type: none"> - River Buridihing at Margherita (Tinsukia District) - River Buridihing at Khowang (Dibrugarh District) - River Disang at Godamghat (Sapekhati, Sibsagar Dist.) - River Disang at Disangmukh (Sibsagar District) - River Subansiri at erukamukh (Lakhimpur District) - River Dikhow at Dikhowmukh (Sibsagar District) - River Jhanji before confluence with Brahmaputra (Jorhat District) - River Bhogdoi at Gelabil (Jorhat District) - River Dhansiri at Golaghat (Golaghta District) - River Dhansiri at Nikorighat (Golaghat District) - River Jia-Bharali at NH-52 Crossing (Sonitpur) 	<p>The tributaries of this stretch meets the river Brahmaputra in the stretch II</p> <ul style="list-style-type: none"> - The Margherita sampling point of river Buridihing is situated in upstream of Khowang sampling point of the same river. - River Disang at Godamighat is situated in the upstream of Disangmukh - River Dhansiri near Dimapur, which situated in the upstream of Golaghat, which is again in the upstream of Nikorighat.
6	Stretch -VI	<ul style="list-style-type: none"> - River Kolong-Kopili at Hatiamukh - River Kolong Kapili at Chandrapur - River Digaru at Barnighat - River Bharalu near Pragyotish College at Guwahati 	<p>The tributaries of this stretch meets the river Brahmaputra in the stretch III</p> <ul style="list-style-type: none"> - The sampling station of river Kolong Kapili at Hatiamukh is situated in the upstream of the Chandrapur - River Bharalu is the only river flowing through the middle of the whole city of Guwahati.
7	Stretch -VII	<ul style="list-style-type: none"> - River Pagladia at NH-31 crossing - River Manas at NH-31 crossing - River Krishnai Dudhnai at Damoni - River Tunia Champabati at Chapar - River Sankosh at NH-31 crossing 	<p>The tributaries of this stretch meet the main river channel in the stretch IV, which is also the last stretch of the tributaries flowing through Assam.</p>
8	Stretch - VIII	<ul style="list-style-type: none"> - River Teesta at Jalpaiguri - Teesta at Sikkim 	<p>Tributary Teesta originates in the Himalayan range and meets the river Brahmaputra in Bangladesh after crossing Sikkim and North of West Bengal.</p>

Appendix III- Recommended EMAP for Batch III and Onwards

TABLE -1: ENVIRONMENTAL MANAGEMENT ACTION PLAN FOR PRE-CONSTRUCTION AND CONSTRUCTION PHASES

Project Action/Environmental Attributes	Mitigation Measures	Location	Time Frame	Cost	Implementing / Responsible Organization
A Pre Construction Phase					
Finalization of alignment	<ul style="list-style-type: none"> The right of way (RoW) to be finalized to minimize social impacts, minimum acquisition of agricultural land, forest areas, avoidance of temples, burial grounds etc to the extent possible (Ref strip plans and design report) 	All through the alignment of each rural road	Pre Construction Phase	Part of Project Cost	Project Preparation Consultant
Land acquisition	<ul style="list-style-type: none"> Land acquisition, compensation packages, resettlement and rehabilitation, poverty alleviation programs for affected people and all other related issues are addressed in Social Impacts and Resettlement & Rehabilitation report 	All through the alignment of each rural road	Pre Construction Phase	Land to be made available by the state Government	PIU, Govt. of Assam, NGOs and other agencies recommended in RAP report Environmental officer under the PIC will also coordinate and ensure implementation
Setting out and clearing RoW	<ul style="list-style-type: none"> Trees' falling within RoW and other vegetative cover are to be removed except those, clearance on both sides of proposed median edge. Compensatory plantations within proposed vegetation strip of RoW to be undertaken by Forest Department on behalf of Assam PWD. Re-plantation at rate of 3 for every tree 	All through the Rural roads excepting in stretches of habitations	Pre Construction Phase	Necessary cost provisions has been made. All other costs are included	PIC, PIU, Forest Department NGOs shifting of utilities shall be carried out by respective governmental bodies at cost to be reimbursed by

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Project Action/Environmental Attributes	Mitigation Measures	Location	Time Frame	Cost	Implementing / Responsible Organization
	<p>removed is to be commenced just after disturbance due to construction is stopped and NOT after completion of project.</p> <ul style="list-style-type: none"> • The species shall be endemic and very similar to the trees, which have been removed unless they are inappropriate for valid reasons. • List of species for both roadside and median and may be finalized in consultation with Forest Department, Govt. of Assam. • Small temples, shrines particularly those which are beneath trees & often are worship places are to be transplanted to adjacent areas outside RoW in close consultation with local community leaders. If required, the Department of Archeology, Govt. of Assam may be consulted to transplant such structures on cost basis and such services could be utilized if found warranted. • During RoW clearing operations, any treasure trove, slabs with epigraphical evidence or edicts, sculptural or any material are found and appear to have historical importance, it should be brought to the notice of Department of Archeology, Govt. of Assam. • All public utilities like power transmission cables, telephone cables, water/sewerage lines, drains, tube wells etc falling within RoW to be relocated to services corridor within RoW or outside as the case may. Public utilities will be generally shifted by respective agencies like Electricity board, telecom dept., public health 			under project cost.	<p>project, implementing agency. Environmental officer under the PIC will coordinate and ensure implementation. To increase survival rate of new saplings, a core Tree Management Committee is to be created to ensure complete retrieval of vegetative cover and timely replacement of perished plantations. The TMC is to be represented by project implementation Unit (PIU) of Assam PWD, officials of Forest Department, Contractor and local NGOs and coordinated by Environmental</p>

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Project Action/Environmental Attributes	Mitigation Measures	Location	Time Frame	Cost	Implementing / Responsible Organization
	dept. etc and all such costs are to be reimbursed from project cost.				officer of Construction Supervision Consultant for specific package.
Forest Areas (In case applicable)	<ul style="list-style-type: none"> • In case, the road construction requires diversion of forest land for non forest uses i.e. project development, The extent of forest area to be diverted and other documentation as per the guidelines is to be submitted to Forest department for seeking forest clearances and costs for afforestation is to be deposited with Forest department. The costs to cover for maintenance and upkeep to plants for atleast THREE years include replanting of perished ones. This situation is not likely in second annual batch of roads. • As a compensatory measure, plantation is to be undertaken in degraded forests to the extent of TWICE The are to be diverted as per the norms stipulated by Government of India/State Government. • The compensatory afforestation shall be undertaken by Assam forest Department in accordance with the provisions of State Forest Act and the guidelines from Ministry of Environment & Forests, Government of India. • Afforestation will be carried out in degraded forests as close as to forest area, which has been diverted. The selection of species, timing and extent and implementation schedule shall 	All through the alignment of rural roads	Pre construction phase	Necessary cost provisions has been made.	<p>Project Design Consultant/PIU / TSC, Forest Department</p> <p>Environmental Officer under the PIC Supervision Consultancy package will coordinate and ensure implementation</p>

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Project Action/Environmental Attributes	Mitigation Measures	Location	Time Frame	Cost	Implementing / Responsible Organization
	<p>be decided by Forest department.</p> <ul style="list-style-type: none"> Through this, twice the extent of forestland diverted will be compensated by afforestation. More often compensatory afforestation is carried for diversion of forest areas, which is practically have no vegetative cover and thus development projects also contribute to increase in green cover. 				
Diversion of traffic	<ul style="list-style-type: none"> Appropriate traffic diversion schemes shall be implemented so as to avoid inconvenience due to project operations to present road users, particularly during nighttime. Proper diversion schemes will ensure smooth traffic flow minimizes accidents, traffic snarl ups, and commotion. The diversion signs should be bold and clearly visible particularly at night. 	All through the alignment of rural roads (in specific stretches as per progress of construction work)	Construction Phase	Borne by Contractor	Diversion schemes shall be prepared by Contractor and approved by PIC/PIU/ TSC of Assam PWD
Construction Camp Sites	<ul style="list-style-type: none"> The construction campsites shall be away from any local human settlements and preferably located on lands, which are not productive barren/waste lands presently. The camps shall have adequate water supply, sanitation and all requisite infrastructure facilities. This would minimize dependence of construction personnel on outside resources, presently being used by local populace and minimize undesirable social friction thereof. The camps shall be located at a minimum 1.5 km from forest land/areas to deter the construction labor in trespassing. The camps shall have septic tank/soak pit 	As determined by contractor under approval of PIC/PIU/ TSC	Pre construction & Construction Phase	Borne by contractor	<p>All facilities are to planned and implemented by contractor under approval by PIC/PIU/ TSC</p> <p>Environmental officer and other team members of PIC will monitor and ensure appropriate implementation</p>

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Project Action/Environmental Attributes	Mitigation Measures	Location	Time Frame	Cost	Implementing / Responsible Organization
	<p>of adequate capacity so that it can function properly for the entire duration of its use.</p> <ul style="list-style-type: none"> • All construction camps shall have rationing facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. • The construction camps shall have health care facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. • The camps shall have septic tank/soak pit of adequate capacity so that it can function properly for the entire duration of its use. • All construction camps shall have rationing facilities particularly for kerosene/LPG so that dependence on firewood for cooking is avoided completely to the extent possible. • The construction camps shall have health care facilities for adults, pregnant women and children. • All construction personnel shall be subjected to routine vaccinations and other preventive/healthcare measures. • The construction camps shall have in house community/common entertainment facilities. Dependence of local entertainment outlets by construction camps should be discouraged /prohibited to the extent possible. 				
Haul roads	<ul style="list-style-type: none"> • Existing tracks / roads are to be used for hauling of materials to extent possible. • The alignment of haul roads (in case of 	As determined by contractor under approval of PIC /	Construction Phasse	Borne by Contractor	The planning, design and construction/upgrad

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Project Action/Environmental Attributes	Mitigation Measures	Location	Time Frame	Cost	Implementing / Responsible Organization
	<p>new ones transportation link shall be finalized to avoid agricultural lands to the extent possible. In unavoidable circumstances, suitable compensation may be paid to people whose land will be temporarily acquired for the duration of operations. The compensation shall cover for loss of income for the duration of acquisition and land restoration.</p> <ul style="list-style-type: none"> • Prior to construction of roads, topsoil shall be preserved or atleast shall be used for any other useful purposes like using in turfing of embankment rather than allowing its loss by construction activities. • Water tankers with suitable sprinkling system are to be deployed along haul roads. Water may be sprinkled for atleast 3 times per day all along the route to suppress the airborne dust due to the vehicular movement particularly on unpaved roads. • The vehicles deployed for material transportation shall be spillage proof to avoid or minimize the spillage of the material during transportation. In any case, the transportation links are to be inspected atleast twice daily to clear accidental spillage, if any. • The borrow and material dumping sites must be access controlled to keep away unauthorized entry of people, grazing cattle and any other stray animals. 	PIU/ TSC			<p>ation of existing roads to be used as haulage roads are responsibilities of contractor under approval of PIC / PIU</p> <p>Environmental officer and other team members of PIC will monitor and ensure appropriate implementation</p> <p>Environmental officer will coordinate with the villagers to ensure that their interests are protected and no social resentment sets in.</p>
Quarries	<ul style="list-style-type: none"> • Material, particularly aggregates shall be sourced only from licensed quarries. 	As determined by contractor under	Construction Phase	Borne by Contractor	The selection of quarries and

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Project Action/Environmental Attributes	Mitigation Measures	Location	Time Frame	Cost	Implementing / Responsible Organization
	<ul style="list-style-type: none"> A list of such quarries is available from Department of mines & Geology, Govt. of Assam. All such quarries shall have occupational safety procedures/practices in place and regular inspection shall be carried to ensure compliance. Large material draws should not be a cause for neglect of safety procedures which is otherwise common. 	approval of PIC / PIU			material selection will be the responsibility of contractor under approval of PIC /PIU/TSC Environmental officer and other team members of PIC will monitor and ensure appropriate implementation of mitigation actions.
Work sites	<ul style="list-style-type: none"> All personnel in work sites shall have protective gears like helmets, boots etc. so that injuries to personnel are minimized. Children and pregnant women shall not be allowed to work under any circumstances. No personnel shall be allowed to work at site for more than 10 hours per day (8 hour makes one work shift). Personnel who are likely to exposed to noise levels beyond stipulated limits shall be provided with protective gears like ear plugs etc and regularly rotated. Regular water sprinkling of water shall be ensured so that dust levels are kept to minimum. 	As determined by contractor under approval of PIC /PIU	Construction Phase	Borne by Contractor	All facilities are to planned and implemented by contractor under approval by PIC / PIU / TSC Environmental officer and other team members of PIC will monitor and ensure appropriate implementation.
Construction Equipment Vehicles	<ul style="list-style-type: none"> All equipment / vehicles deployed for construction activities shall be regularly maintained and not older than 5 years. 	As determined by contractor under approval of PIC	Construction Phase	Borne by Contractor	Contractor is responsible for ensuring provision

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Project Action/Environmental Attributes	Mitigation Measures	Location	Time Frame	Cost	Implementing / Responsible Organization
	<ul style="list-style-type: none"> • Vehicles/equipment shall be regularly subjected for emission tests and shall have valid POLLUTION UNDER CONTROL certificates. Revalidation of certificates shall be done once in a month. • All vehicles deployed for material movement shall be spill proof to the extent possible. • In any case all material movement routes shall be inspected daily twice to clear off any accidental spills. 	/PIU			<p>of facilities under approval by PIC / PIU</p> <p>Environmental officer and other team members of PIC will monitor and ensure appropriate implementation</p> <p>Environmental officer will regularly interact with the local people who are likely to be affected to ensure that their interests are protected and no social resentment sets in.</p>
Water resources & Drainage channels	<ul style="list-style-type: none"> • The rural road construction will also require construction of several cross drainage structures, minor and major bridges to facilitate development in accordance with design requirements and standards. • Most water bodies across roads are non-perennial and drain storm water only for few weeks during monsoon season. • Impacts arising out of construction of 	At all locations of CD structures along the rural roads	Construction Phase	To be borne by contractor	The planning, and construction / upgradation of existing/new cross drainage structures roads are responsibilities of contractor under approval by PIC

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Project Action/Environmental Attributes	Mitigation Measures	Location	Time Frame	Cost	Implementing / Responsible Organization
	<p>drainage structures is not likely to impact drainage pattern since under the road design, pattern of flow and discharge capacities of all drainage structures are reviewed and designed to negate any heading up or flooding problems.</p> <ul style="list-style-type: none"> • Impacts on water quality are not significant or either negligible since construction activities to be scheduled to complete during dry months of year. • Adequate precaution is to be taken to prevent oil/lubricant/hydrocarbon contamination of channel beds. Spillage if any, shall be immediately cleared with utmost caution to leave no traces. • Channel beds are to be cleaned up (50 m u/s & 50 m d/s sides of water courses) and restored to its previous state after completion of construction but prior to onset of monsoon. 				<p>/PIU/ TSC</p> <p>Environmental officer and other team members of PIC will monitor and ensure appropriate implementation</p>
Borrow areas	<ul style="list-style-type: none"> • Borrow areas identified / suggested during project preparation are to be investigated for presence of ecologically sensitive areas if any and cleared thereof. • Within these locations, the actual extent of area/zones to be excavated areas is to be demarcated with signboards. All such operational areas are to be access controlled particularly for locals and for grazing cattle. • Through this project, the borrow areas / pits may be converted into surface / ponds wherever possible, as a derivative of development. Some of the ponds could serve as 	As determined by contractor under approval of PIC / PIU	Construction Phase	To be borne by Contractor	Sourcing of borrowing materials and all related activities like planning & deployment of the most optimum, number of vehicles without disregarding the existing users in case of existing linkages and

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Project Action/Environmental Attributes	Mitigation Measures	Location	Time Frame	Cost	Implementing / Responsible Organization
	<p>source of water for agriculture, a practice prevalent in Assam.</p> <ul style="list-style-type: none"> The top soil recovered from newly acquired land areas for road construction is preserved and used for turfing of embankment(s) of project highway As per the current regulations, use of fly ash is mandatory for all construction works within a radius of 100 km from any thermal power plant. Therefore, fly ash shall be used in all road construction works, which are within the 100 km from thermal power stations. A list of lthermal power stations within Assam is given in Table 4.1 Section 4.0 of IEE. The Rural Road manual specifies design and construction procedures for construction of fly ash embankments. 				<p>construction / upgradation of existing / new haulage roads under approval by PIC /PIU. Environmenatal officer and other team members of PIC will monitor and ensure appropriate implementation</p>
Air Quality	<ul style="list-style-type: none"> All operational areas under the road construction works are to be regularly monitored (atleast ONCE in a season) for air quality parameters such as SPM, RPM, SO2, NOx, HC, CO etc. This will ensure identification of operations/areas of concern with regard to air pollution. Operational areas include, work sites, haulage roads, hot mix plants, quarries, borrow sites, human settlement etc. mitigation measures such water sprinkling for dust suppression, permitting construction equipment/vehicles having POLLUTION UNDER CONTROL certificates will reduce work area 	All operational areas as determined by PIC /PIU	Construction phase	Necessary cost provisions have been made	Contractor is responsible for ensuring a occupationally healthy environment for all personnel irrespective of category under approval of PIC /PIU/TSC Environmental officer and other team members of

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Project Action/Environmental Attributes	Mitigation Measures	Location	Time Frame	Cost	Implementing / Responsible Organization
	<p>concentration of air pollutants like RPM, SO₂, N Ox, HC, CO etc. does not exceed permissible limits and therefore does not contribute to build up of pollutants</p>				<p>PIC will monitor and ensure appropriate implementation Environmental officer shall requisition services of private / governmental agencies for undertaking periodic environmental monitoring if necessary to ensure compliance of contractor in this regard.</p>
<p>Soil erosion and conservation</p>	<ul style="list-style-type: none"> • Along rural roads the widening activities will raise, extend and enlarge existing roadway / tracks all along the alignment therefore mitigation measures to contain erosion and drainage problems are essential along RoW • Measures to ensure embankment stabilization including selection of less erodable material, good compaction, revegetation, placement of gabions or any suitable measures around bridges and culverts etc. (in case required) are included in technical specification and contract documents. The engineering measures for countering soil erosion, slope 	<p>At all sections of road construction involving embankment section.</p>	<p>Construction phase</p>	<p>Forms part of project cost</p>	<p>Erosion Control/embankment protection measures in accordance with the DPR and/or as governed by local site conditions shall be prepared by contractor under approval of PIC /PIU</p>

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Project Action/Environmental Attributes	Mitigation Measures	Location	Time Frame	Cost	Implementing / Responsible Organization
	<p>protection, drainage wherever required considered for project highway and detailed project report.</p> <ul style="list-style-type: none"> • Many of impacts on soil due to road construction can be significantly mitigated by some of the following measures <ul style="list-style-type: none"> a) Minimizing area of ground clearance only to the extent required. b) Balancing the filling and cutting of earth to the extent possible. c) Avoiding creation of cut slopes and embankment which are of an angle greater than natural angle of repose for locally available soil type. d) Replanting disturbed area(s) immediately after disturbance due to construction has stopped and NOT after construction has been completed. 				<p>Environmental officer and other team members of PIC will monitor and ensure appropriate implementation.</p> <p>Environmental officer may consult with the regional forest officers of Forest Department, Govt. of Assam in selecting endemic species, which also can serve engineering functions.</p>
Archeological monuments/ruins/religious structures/temples	<ul style="list-style-type: none"> • Strict adherence of mitigative measures such as controlled movement of men and material particularly heavy vehicles/construction equipment, avoiding/minimizing activities which produce vibrations, use of vibration dampners ;if vibrations are unavoidable, prohibiting unauthorized movement of construction personnel / labour near ruins etc. are to be enforced to prevent any direct / indirect damage to temple environs due to project development. • All construction activities of rural roads are to be carried out with utmost care. In case any 	All through the alignment of rural road	Pre construction and construction phase	To be borne by contractor	Contractor is responsible for ensuring a noise/vibration free environment especially in such stretches. Appropriate measures as stipulated in DPR and / or governed by local site

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Project Action/Environmental Attributes	Mitigation Measures	Location	Time Frame	Cost	Implementing / Responsible Organization
	<p>slabs with epigraphical evidence or edicts, sculptural, historical remains or any other materials pertaining to archeological / historical importance, Department of Archeology, Govt. of Assam should be immediately informed and all activities in and around such stretches site is cleared by Department of Archeology.</p> <ul style="list-style-type: none"> • Any coins, artefacts or any other chance find will be notified by the contractor. The work will be stopped and instruction will be taken from archeological department. • Number of small temples / and idols falling within RoW are to be transplanted / relocated to suitable places acceptable to local community. Interactions with local community leaders are to be initiated well in advance and necessary measures required for relocation of structures to complete satisfaction of local community. Governmental agencies such as Department of Archeology, Government of Assam will also be contacted in case assistance required. 				<p>conditions are to be implemented by contractor under approval of PIC / PIU</p> <p>Environmental officer and other team members of PIC will monitor and ensure appropriate implementation.</p>
Hot Mix Plants	<ul style="list-style-type: none"> • Hot mix plants shall be at least 1.5 km away from any human settlements and preferably located on leeward side. • Hot mix plants / sites shall be located on barren / uncultivable lands. Diversion of cultivable/agricultural lands, even preferred by local people for economic gain shall not be allowed unless otherwise warranted by specific local conditions. 	As determined by contractor under approval of PIC /PIU	Construction phase	To be borne by contractor	Contractor is responsible for ensuring a occupationally healthy and hazard free environment for all personnel irrespective of category and also for communities in

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Project Action/Environmental Attributes	Mitigation Measures	Location	Time Frame	Cost	Implementing / Responsible Organization
					and around operational areas under approval of PIC /PIU. Environmental officer and other team members of PIC will monitor and ensure appropriate implementation. Environmental officer shall requisition services of private /Governmental agencies for undertaking periodic environmental monitoring if necessary to ensure compliance of contractor in this regard.
Loss of Fertile soil	<ul style="list-style-type: none"> Clearing operations within RoW and at all places of operational areas like borrow areas, work areas, labour camps, construction of new/upgradation of existing to new haulage roads, hot mix plants, storage areas etc. shall consider preservation of fertile soil. 	All through the RoW of roads and at Borrow areas	Pre construction and construction phase	To be borne by contractor	Contractor is responsible for ensuring a proper utilization of fertile soil under approval of PIC /PIU

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Project Action/Environmental Attributes	Mitigation Measures	Location	Time Frame	Cost	Implementing / Responsible Organization
	<ul style="list-style-type: none"> As a first option, topsoil should be restored to its initial place after the specific activity is completed for which the area was vacated, or for enriching some other place like embankment slopes for turfing/erosion protective measure. The topsoil can also be used for supporting re-plantation activities within RoW/median. 				Environmental officer shall requisition services of private / governmental agencies for undertaking periodic monitoring if necessary to ensure compliance of contractor in this regard.
Accidental risks from blasting along road way and in quarries	<ul style="list-style-type: none"> All hazardous operations like blasting, deep excavations shall be access controlled for nearby local people/onlookers. Adequate caution regarding blasting shall be notified for people living by if any well in advance. The blasting operations if required shall be carried out in lean traffic hours with adequate precautionary signs for existing traffic particularly for slow moving traffic to prevent any accidents / injuries due to operations. 	All selected stretches of alignment / RoW where rocks are encountered, (anticipated rarely)	Construction phase	Forms part of project cost To be borne by contractor	Contractor is responsible for ensuring a occupationally healthy and hazard free environment for all personnel irrespective of category and also for communities in and around all operational areas under approval of PIC /PIU Environmental officer and other team members of PIU will monitor and ensure

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Project Action/Environmental Attributes	Mitigation Measures	Location	Time Frame	Cost	Implementing / Responsible Organization
					appropriate implementation
Location of campsites, storage depots	<ul style="list-style-type: none"> • The location of campsites, storage depots shall preferably on unproductive/barren lands, away from forest areas (minimum 1.5 km). • Use of agricultural/ cultivable lands shall not be allowed under any circumstances. • All fuel loading, unloading, storage areas shall be spill proof, leakage proof and carried out on paved areas. • The sites shall have suitable system to drain storm water, sanitary facilities and shall not contaminate any near by water courses / drains. • The site shall also have a system for handling any emergency situation like fire, explosion etc. 				
Storage of hazardous materials	<ul style="list-style-type: none"> • All areas intended for storage of hazardous materials shall be quarantined and provided with adequate facilities to combat emergency situations. • The personnel in charge of such areas shall be properly trained, licensed and with sufficient experience. • The areas shall be access controlled and entry shall be allowed only under authorization. 	As determined by contractor under approval of PIC /PIU	Construction Phase	To be borne by Contractor	Contractor is responsible for ensuring a occupationally healthy and hazard free environment for all personnel irrespective of category and also for communities in and around all operational areas under approval of PIC /PIU

Table -2: Environmental Monitoring Control Matrix – Construction Phase

S. No.	Environmental Attributes / Project Actions	Mitigation measures (for detail description refer to EMAP Table 5.1- under section 5.0 of IEE)	Monitoring Frequency			
			Daily	Weekly	Quartely	Monthly
1	Setting out and clearing RoW	Archeological evidence / idols / tombs if noticed /found –inform Archeological Department	✓			
2	Relocation of Utilities	Ensure complete restoration without impacting existing users	✓			
3	Traffic Diversions & Sign Boards	Diversions to be smooth sign boards in place, clear & bold particularly in night & cause least inconvenience to road users	✓			
4	Borrow Areas	Seek prior approval from local environmental regulatory agencies and compliance at all stages of operations. After borrowing ensure re-vegetation, drainage, erosion protection as per EMAP	✓		✓	
5	Quarries	Compliance of local environmental regulations in project specific quarries and at all stages of operations		✓		
6	Haul roads	Avoid agricultural lands, finalization of compensation for land owners, regular inspection to check inconvenience to locals, spillage, dust levels /watering frequency, noise level. Restoration after ;operations with wearing course and handing over road to local community	✓			

S. No.	Environmental Attributes / Project Actions	Mitigation measures (for detail description refer to EMAP Table 5.1- under section 5.0 of IEE)	Monitoring Frequency			
			Daily	Weekly	Quarterly	Monthly
7	Work sites	Comply with local Environmental regulations for air quality, Noise, occupational hazard & safety procedures at all stages work	✓			
8	Ground water level in and around construction tube wells	Bore wells shall be away from human settlements determine sustainable yield restrict withdrawal of water within yield recommended for region. Monitor depth of water below ground level in wells in and around construction tube wells before start and after completion of water withdrawal for the day		✓		
9	Construction Equipment / Vehicles	Ensure vehicles are regularly maintained have pollution under control certificates revalidated every month			✓	✓
10	Air quality at all operational areas under project	Record SPM, RPM, CO, HC, Nox, SO2 levels for 24 hourly in 8 hr. shifts as per methods / procedures recommended by Central / State pollution Control Board			✓	✓
11	Noise at all operational areas	Record noise levels at every 5 minutes for 24 hours (both day time & night time)			✓	
12	Vibration near temples, Mosque & any other similar religious structure	Restricted movement of work force, equipment and activities. Also record vibration levels during a typical working shift from a specialized agency before the start,	✓	✓		

S. No.	Environmental Attributes / Project Actions	Mitigation measures (for detail description refer to EMAP Table 5.1- under section 5.0 of IEE)	Monitoring Frequency			
			Daily	Weekly	Quartely	Monthly
		during and after completion of operations				
13	Top soil from land clearing operations	Preserve and restore the topsoil. If can not be used for restoration, divert for other applications like re-vegetation, embankment turfing and alike	As and when the situation arises			
14	Hot Mix Plants	Located at least 1.5 km from settlements, barren land and not agricultural lands. Monitor air quality, waste discharge and noise levels regularly as mentioned under Sl. No. 10,11 above. Ensure all operations comply with local environmental regulations	✓	✓		
15	POL (liquid and solid waste) / Hazardous Storage Areas	POL storage areas have impervious lining, containment ditches, oil & grease traps as per EMAP. Regular inspection & maintenance. Comply all local environmental regulations	✓	✓		
16	Soil erosion and conservation	Borrow areas shall have gentle slopes connected to near by natural water bodies, re-vegetated		✓		
17	Channel / River beds	Ensure most activities are scheduled for dry months reshaping of channel bed after completion of construction		✓		
18	Archeological monuments /ruins / religious structures / temples	Archeological evidence / idols /tombs if noticed / found-inform Archeological Department. Temples	As and when the situation arises			

S. No.	Environmental Attributes / Project Actions	Mitigation measures (for detail description refer to EMAP Table 5.1- under section 5.0 of IEE)	Monitoring Frequency			
			Daily	Weekly	Quarterly	Monthly
		within RoW are relocated in consultation with community leaders. Coordinate with Social team.				
19	Water Supply Sanitation & Health at camp sites	Adequate water supply as per norms septic tanks and soak away pits. Kerosene and LPG supply, health care facilities vaccination for work force camps		✓		
20	Construction of Noise Barriers	Consult affected parties like hospitals, educational institutions for eliciting opinion during constructing barriers	As and when the situation arises			