Public Works Department,

Government of Assam

PREPARATION OF DPR FOR BRIDGE OVER RIVER BRAHMAPUTRA CONNECTING PANBAZAR TO NORTH GUWAHATI

ENVIRONMENTAL IMPACT ASSESSMENT(EIA) & ENVIRONMENTAL MANAGEMENT PLAN(EMP)

June, 2018

SMEC INDIA
Member of the Surbana Jureng Group

TRP Social Consultancy Pvt. Ltd.
in association with
Wolkem Consultancy Services

SURBANA JURONG

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EIA/EMP REPORT

Report Prepared under EIA Notification Dated 14/09/2006 and its subsequent Amendments ToR Letter No: SEIAA,866/2018/65/686

Project Name : *"Construction of Bridges over River Brahmaputra connecting Bharalamukh (Panbazar) to North Guwahati"*

Brief Description about Project:

The Public Works Department (PWD), Assam has decided to undertake the construction of six lane Bridge over river Brahmaputra along with approach road to connect south bank of Guwahati to North Guwahati. The entire length of proposed project is 8.658.

As, bridges are not covered under EIA Notification, 2006 and as such Environmental Clearance (EC) is not required" but an application filed by (137 of 2014) Vikrant Kumar Tongad V. DTTDC, GNCTD, and MoEF&CC and DPCC, in this regards decision from National Green Tribunal has been made. As per the judgement of NGT the case is considered as Area Development Project covered under schedule 8(b) category B of EIA Notification, 2006.

The EIA and EMP report of this project has been prepared in line with prescribed Terms of reference issued by SEIAA, Assam vide letter no. SEIAA/688/2018/65/686 dt. 2/4/2018.

Project Proponent

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National Accreditation Board for Education & Training

CERTIFICATE OF ACCREDITATION

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3	Mineral beneficiation	7	2 (b)	A
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9	Highways	34	7 (f)	B
10	Common Effluent Treatment Plants (CETPs)	36	7 (h)	B
11	Common Municipal Solid Waste Management Facility (CMSWMF)	37	7 (i)	B
12	Building and construction projects	38	8 (a)	B
13	Townships and Area development projects	39	8 (b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RA AC minutes dated Sep. 27, 2017 posted on QCI-NABET website.

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Sr. Director, NABET
Dated: Dec. 14, 2017

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List of Abbreviations

APHA	:	American Public Health Association
BOD	:	Biological Oxygen Demand
CH	:	Chainage
CO	:	Carbon Monoxide
COI	:	Corridor of Impact
EC	:	Electrical Conductivity
EIA	:	Environmental Impact Assessment
EPA	:	Environmental Protection Authority
EPC	:	Environment Protection Council
EPL	:	Environment Protection Law
PWD	:	Public Works Department
GoI	:	Government of India
HIV	:	Human Immunodeficiency Virus
IUCN	:	International Union for Conservation of Nature and Natural Resources
KLD	:	Kilo Litre Day
Km	:	Kilometre
LC	:	Least Concern
L.H. S	:	Left Hand Side
MoRTH	:	Ministry of Road Transport and Highway
NGO	:	Non-Government Organization
NGT	:	National Green Tribunal
NHAI	:	National Highway Authority of India
OFC	:	Optical Fibre Cable
PAP	:	Project Affected Persons
PIU	:	Project Implementation Unit
PM	:	Particulate Matter
PWD	:	Public Works Department
R&R	:	Rehabilitation and Resettlement
RAP	:	Resettlement Action Plan
R.H. S	:	Right Hand Side
RoW	:	Right of Way
SC	:	Supervision Consultant
SIA	:	Social Impact Assessment
TDS	:	Total Dissolved Solids
ToR	:	Term of Reference
TSS	:	Total Suspended Solids
VU	:	Vulnerable
WB	:	The World Bank
WHO	:	World Health Organization

1. INTRODUCTION

1.1 BACKGROUND

To tackle rapid urbanization and allied problems taking place in Assam State in a scientific manner, the Government of Assam planned to take up infrastructure development projects. The responsibility of such development in urban part of capital city of Assam is govern by Public Works Department (PWD) which has been designated by Government of Assam to execute one of the major project entitled "Construction of Bridge over river Brahmaputra connecting Pan Bazar- North Guwahati". The proposed project shall not only lead to the desired benefits but can also ensure that the project features under consideration are environmentally sound and sustainable. The present Environmental Impact Assessment study is the part of the DPR.

1.2 PROJECT RATIONALE

The environment has a limited carrying capacity and it can only sustain a negative impact up to a level without further degradation. Several systems, however, temporarily disturb it leading to a new balance in order to re-establish the equilibrium between human activity and nature. But sensitive systems are not so resilient to cope up with changes in physical and natural Environment, thus not only leading to negative impact on them but also, socio-economic losses may occur. Developmental projects are meant for improving the quality of life for people and growing the country's economy. For all positive impacts of the developmental projects, there may be also some significant detrimental impacts on nearby communities and natural environment. There can be direct or indirect impact on flora, fauna, water resources, land use etc. Similarly, there may be impact on properties of people, their livelihood and other social components. To account for all these issues, environmental and social impact assessment is utmost necessary. These concerns for environmental and social issues in projects have also become a part of legal requirements for obtaining financial support. Environmental considerations are therefore of prime importance in projects.

1.3 PROJECT CATEGORIZATION AS PER GOVERNMENT OF INDIA REQUIREMENTS

Bridges are not covered under EIA Notification, 2006 and as such Environmental Clearance (EC) is not required". But an application filed by (137 of 2014) Vikrant Kumar Tongad V. DTTDC, GNCTD, and MOEF&CC AND DPCC in this regards for decision from National Green Tribunal. As per the judgement of NGT the case is considered as Area Development Project covered under schedule 8(b) category B of EIA Notification, 2006.

As per EIA Notification 2006 and amendment thereafter, Environmental Clearance for 8 (b) project is required under the following conditions.

Table 1.1: Conditions of Environmental Clearance for 8 (b) project

Project	**Category with threshold limit**			**Conditions if any**
1	2	3	4	5
8 (b)	Townships and Area Development Projects	≥3,00,000 sq. mtrs of built up area or and < Covering an area ≥ 150 ha	≥1,50,000 sq. mtrs and < 3,00, 000 sq. mtrs built up area or covering an area ≥ 50 ha and < 150 ha	Note: General Condition shall not apply.

General Condition (GC)

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

The proposed project does not fall under "Category B" of 8(b) projects due to following reasons:

Total Built-up area –130400 Sqm. (13.04 ha) and
Total Cover area – 35.44 ha.

However, Form 1 and Form 1A under Category B of 8(b) has been submitted by PWD to SEAC, Assam for ToR/clarification regarding the requirement of EC. Subsequently, presentation has been made to SEAC and ToR has been issued by SEIAA, Assam vide letter no. SEIAA. 688/2018/65/686 dt. 2/4/2018. The present report prepared in the line of direction of SEIAA.

1.4 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) STUDY

The environmental assessment preparation led to identification of potential environmental hazards and their feasible remedial measures, based on which the environmental mitigation measures have been prepared.

1.4.1. Scope of EIA

The environmental impact assessment scope includes screening and scoping, identification and assessment of impacts, preparation of management plans including budget for minimisation of impacts, monitoring plan for the project and identification of project benefits.

1.4.2. Environmental Screening and Scoping

Environmental screening exercise of the project was undertaken to facilitate inputs on environmental considerations, apart from social, economic, and traffic & transport considerations. Further, screening exercise also provided scoping inputs in determining the major environmental issues and defined the scope of work for conducting environmental impact assessment. The scoping exercise defines geographical boundaries for the project road for impact assessment as well as defining the project influence area to assess the impacts due to project activities.

1.4.3. Identification & Assessment of Impact and Preparation of Management Plan

The EIA study led to identification and evaluation of potential environmental hazards, based on which the feasible remedial/ mitigation measures can be prepared.

a) Objective of the study

The major objectives of this study are:

- to establish present environmental condition along the project corridor through available data/ information supported by field studies;
- to evaluate the impacts on relevant environmental attributes due to the construction & operation of the proposed project;
- to recommend adequate mitigation measures to minimize/reduce adverse impacts and to prepare an Environmental Management Plan (EMP) for timely implementation of the mitigation measures to make the project environmentally sound and sustainable.

An Environmental Impact Assessment (EIA) study includes:

- Establishment of the present environmental scenario;
- Study of the specific activities related to the project;
- Evaluation of the probable environmental impacts;
- Recommendations of necessary environmental control measures;
- Preparation of Environmental Management Plan.

b) Scope of the Study

Environmental assessment is a detailed process, which starts from the conception of the project and continues till the operation phase. The steps for environmental assessment are therefore different at different phases. The present report details the environmental setting of the project zone, establishment of baseline data, identification of anticipated environmental impact, assessment of impacts and finally suggests appropriate mitigation measures.

The scope for the environmental impact assessment study has been decided in accordance with the EIA Notification 2006 of Ministry of Environment, Forest & Climate Change (MoEF&CC) and amendments thereafter, Guidelines and Terms of Reference (TOR) specified by MoEF&CC, Government of India.

c) Methodology for Environmental Impact Assessment (EIA)

The EIA procedure proceeded simultaneously with the DPR of the project. A reconnaissance survey of the project site was taken up to identify sensitive issues/hot spot (water bodies, forests, school & hospitals and archaeological/ historical structure). Land use was studied within 500 m and within 10 km on either side of the project road. Published secondary data was utilised to assess and collect base line data including ambient air quality, surface/ground water quality, soil quality, noise levels and Tree enumeration data within proposed RoW. Details regarding existing project area features including details of existing habitations, infrastructure (education, health and commercial), public utilities (wells, water taps, religious structures) and natural resources (river, stream, drain) were also collected.

Other data such as socio-economic data, existing flora and fauna, were collected from primary and various secondary sources. The primary and secondary data was analyzed, and project impacts were assessed on various components of environment. Finally, an environmental management plan has been prepared to mitigate the adverse impacts.

The findings of the assessment gave imperative feedback to the design team, particularly in terms of the sensitive receptor utility/facilities affected. It helped alteration in designs at possible locations and incorporate mitigation measures wherever the impacts were inevitable due to other constraints.

d) Project Benefits

The unmeasurable benefits in terms of economic, social and sustainable environmental aspects is envisaged through development of this bridge project. The project will give significant economic benefits to the State. Construction of identified project will lead to better connectivity and play a significant role in changing the socio-economic condition of the people living in the region. Installation of proper safety system through signage, barricades etc. will enhance the prosperity of the proposed project area.

The project will also generate direct and indirect employment to the local people of the State and connect South Bank to North Bank with insignificant risk. The indirect benefits include savings in vehicle operating costs, less fuel consumption and decreased cost of passenger travel.

1.5 IDENTIFICATION OF THE PROJECT AND PROJECT PROPONENT

1.5.1. Project Identification

The proposed project is located at Guwahati city, the largest city of North-East India. Guwahati, with its cardinal points as 26˚10′ North latitude and 92˚49′ East longitude is situated on the southern bank of River Brahmaputra. The city is situated on an undulating plain with varying altitudes of 49.5 m to 55.5 m above mean sea level (MSL) and is linear in settlement pattern. The city ‘s strategic location, connectivity and economic opportunities have fueled the process of urbanization to make it the biggest and the most important city of the Northeast, making it the gateway to the North-East. The alignment will connect South Bank at latitude 26°10’26.41” and longitude 91°43’44.87” and North Bank at latitude 26°11’6.52” and longitude 91°43’8.29”. The alignment connects the North Bank and South Bank of city at Bharalumukh river point near Panbazar, the central business hub of the Guwahati city. The bridge will connect with NH-31 on the northern bank of the river Brahmaputra through a six-lane road.

Alignment at South Bank

Forms Y- junction with two rotaries at Bharalumukh. The arms are designed with rotary end 30 m dia and connected by a new 3-lane road along the river bank designed as 3-lane one-way box girder bridge.

Junction 1 meets AT Road near the Bhuthnath Temple

Junction 2 meets the meets the MG Road at Sankardev Udyan park on the bank of the rivernearby Pragjyotish Cultural Complex

Alignment at North Bank

The bridge lands at North Bank at a distance of 390 m west of Aswaklanta temple at Maj Gaon.
The length of viaduct is 1165 m from, Maj Gaon landing to Abhaypur village.
From the viaduct end at Abhaypur village-1 the road meets the Abhaypur village -2 at college junction and goes towards North along the Abhaypur main road and meets NH-31 at Gauripur junction. Total length of road is 4.2 km.

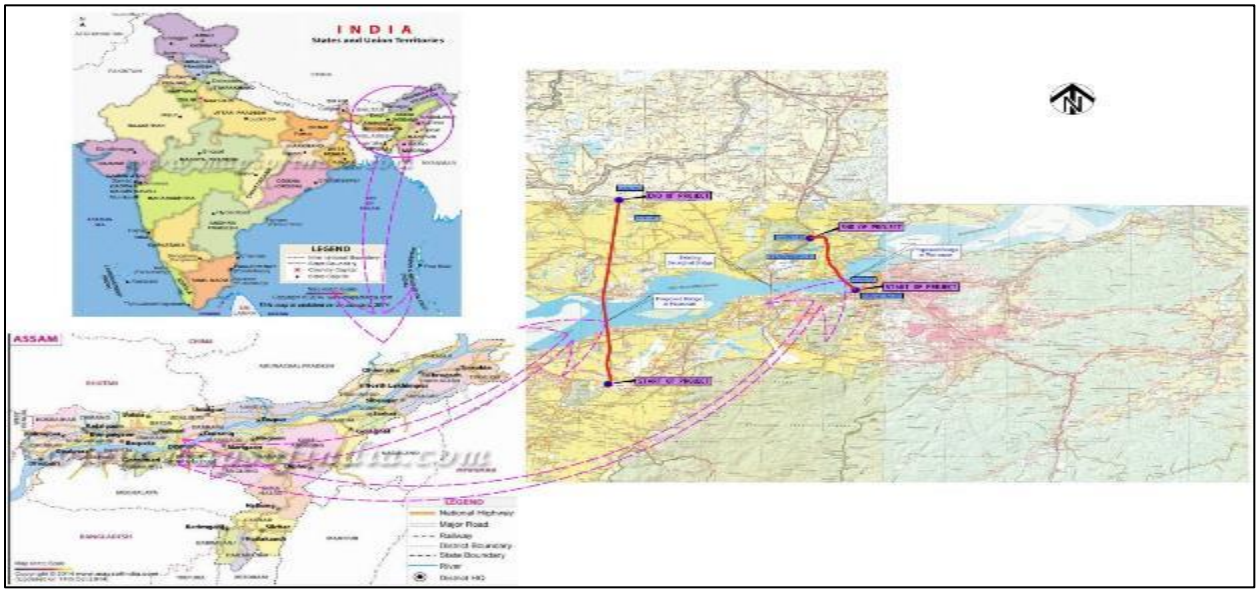


Figure 1.1: Index map

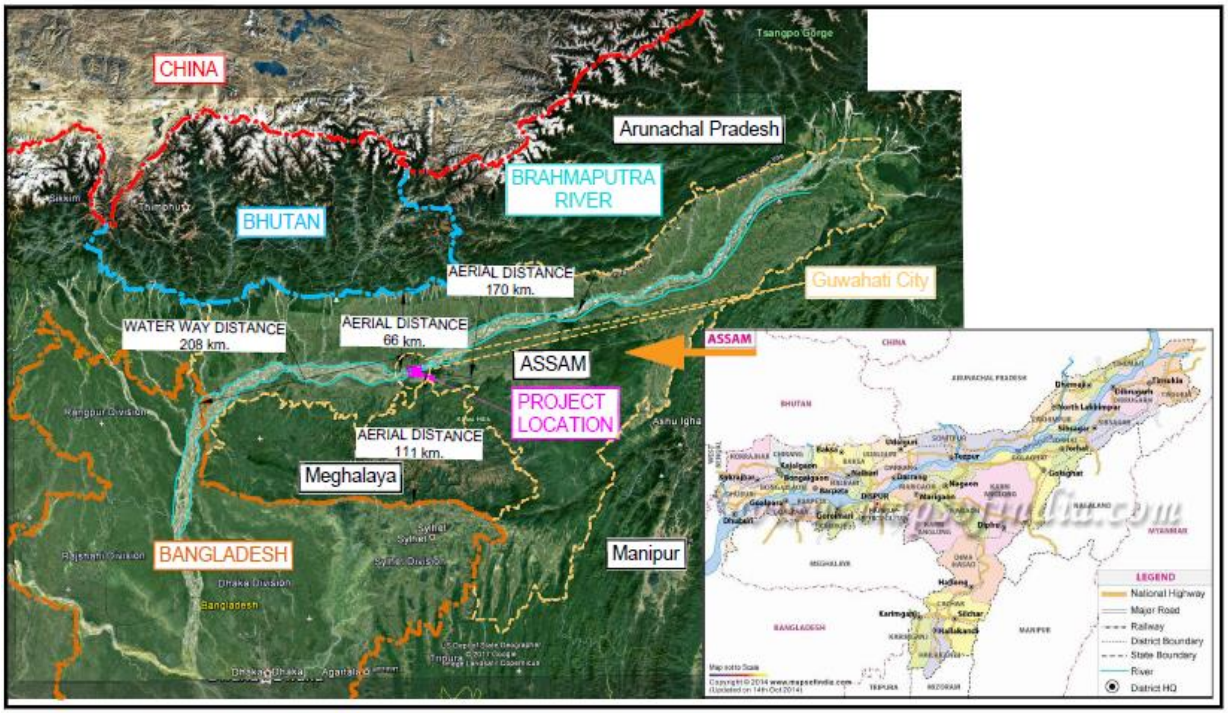


Figure 1.2: Location Map

Figure 1.3: Approved Alignment

1.5.2. Project Proponent

The Assam Public Works Department was established in the year 1880 under British Rule. At the beginning it had the responsibility for all public infrastructure development, construction and maintenance work, but, in the year 1956 the Embankment and Drainage wing came out of the parent Department and established as an independent Department. The department has undergone considerable expansion since after attainment of independence and for smooth functioning of the organization, to share the increasing work load and for providing more stress to development works, the Assam P.W.D. has been divided into two wings viz. Roads and Building wings in August 1977 and since then both the wings are functioning with their prescribed identity.

The principal function of the Public Works Department is to develop the infra-structure for transport & communications of the State. Assam P.W.D. discharges its function in construction and repair of roads, bridges, culverts in the state including construction and repair of public buildings of the state and till date it has reached a considerable height of fame and competence.

1.6 PROJECT CONSULTANT

M/s SMEC India Pvt. Ltd. (Member of the Surbana Jurong Group) has been engaged to conduct Feasibility and Detailed Project Report (DPR) for two bridges across river Brahmaputra including Environmental Assessment through its NABET accredited EIA consultant in accordance with to provide consultancy services to assist it in all aspects of study in accordance with assigned Terms of Reference (ToR) of the consultancy assignment. M/s TRP Social Consultants Pvt. Ltd. JV M/s Wolkem India Ltd. has been engaged by M/S SMEC India Pvt. Ltd. for preparation of Environmental Impact Assessment and Environmental Clearance.

1.7 POLICY LEGAL AND ADMINISTRATIVE FRAME WORK

This section presents a review of the existing institutions and legislation pertinent to this project. Regulations, relevant procedures and requirements that may directly influence the project, the competence of the concerned institutions and their ability to successfully implement the environmental management measures have been addressed. This section also outlines various aspects associated with the framework in place for environmental approval of developmental projects with reference to the central government and state government of Assam.

National Constitution of India

Article 48A and 51A of Indian Constitution: As a sequel to the UN Conference on the Human Environment (1972), Indian Parliament in 1976 amended the Constitution of India by introducing articles 48A and 51A. These articles incorporated environmental concerns into the Directive Principles of state policy and postulated as a fundamental duty of all citizens to preserve and protect the environment.

Key Environmental Laws and Legislations applicable to the Project

The principal Environmental Regulatory Agency in India is the Ministry of Environment, Forests and Climate Change (MoEF&CC). MoEF&CC formulates environmental policies and accords environmental clearance for the projects. The State Pollution Control Board (SPCB) accords No Objection Certificate (NOC), Consent to Establishment (CTE) and Consent to operation (CTO) for the projects and related activities. Following are some major regulatory requirements of the project:

The Environment (Protection) Act, 1986 and Amendments thereafter

This act was passed as an overall comprehensive act "for protection and improvement of environment". Under this act rules have been specified for discharge/emission of effluents and different standards for environmental quality. These include Ambient Noise Standard, Emission from Motor Vehicles, and Mass Emission standard for Petrol Driven Vehicles, General Effluent Standards etc. This act will be applicable during all three phases of project namely pre- construction, construction phase and operation phases.

EIA Notification, 2006 & Amendments thereafter

EIA Notification, 2006 falls under Environment (Protection) Act, 1986. Under this act any project which has probable impact on the environment is listed under 34 categories which are required to take prior environmental clearance after identifying /occupying the land for particular use.

The Environmental clearance will be taken by PWD, with the help of Design Consultant and its Environment Consultant in adherence to approved ToR issued by SEIAA, Assam.

The Water (Prevention and Control of Pollution) Act, 1974 and Amendments thereafter

This act was enacted in 1974 for the prevention and control of water pollution and for the maintaining or restoring of wholesomeness of water in the country. It resulted in the establishment of the Central and State Level Pollution Control Boards, whose responsibility includes managing of water quality and effluent standards, as well as monitoring water quality, prosecuting offenders and issuing licenses for construction and operation of any facility. This will include generation of liquid effluent during construction of road/bridges from civil engineering activities or from domestic activities in workers colony. There are specific penalties for violation, which includes imprisonment for responsible officials. This act will be applicable during implementation of project for establishments of hot mix plant, batching plant and DG set etc.

The Water (Prevention and Control of Pollution) Cess Act, 1977 and Amendments thereafter

Under Section 3: Levy and Collection of Cess there shall be levied and collected a cess for the purpose of the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974) and utilization there under. The cess under sub-section (1) shall be payable by every person extracting water from ground and using supply water. This act will be applicable during implementation of project for use of ground/supply water.

The Air (Prevention and Control of Pollution) Act, 1981 and Amendments thereafter

This act was enacted in 1981 to provide for the prevention, control and abatement of air pollution in India. It empowers Central and State Pollution Control Boards for managing air quality and emission standards, as well as monitoring air quality, prosecuting offenders and issuing licenses for construction and operation of any facility. There are specific penalties for violation, which include imprisonment for responsible officials. This act has notified National Ambient Air Quality Standard for different zones e.g. Industrial, Residential and Sensitive. Air quality during construction and operation phases will be guided by this specific Act. This act will also be applicable to the project during construction for obtaining NOC for establishment of hot mix plant, crushers, etc.

The Noise Pollution (Regulation and Control) Rules, 2000 and Amendments thereafter

The noise levels in any area shall not exceed the noise quality standards in respect of noise as specified in the schedule. The authority shall be responsible for the enforcement of noise pollution control measures and the due compliance of the noise quality standards in respect of noise. This rule will be

applicable as vehicular noise on project route during construction phase and for future vehicular noise and necessary protection measure need to be considered in design.

Forest (Conservation) Act, 1980 and Forest (Conservation) Rules 2003 and Amendments thereafter

These Act and rule are of significance in case the project corridors require acquisition of forestland as a result of the rehabilitation work proposed. In the present case the project area doesn't passes through forest area. Hence, this act is not applicable in the project. For land with roadside plantation of NH-31 at Gauripur Junction, clarification regarding requirement of forest diversion/forest clearance from concerned DFO is under process. Compensatory Afforestation plan for tree cutting involved in revenue land will be obtained from concern Forest Division after detailed tree enumeration during assessment of property for revenue land.

Solid Wastes Management Rules, 2016

The objective of the rule is management and handling of solid waste. This rule is applicable for disposal of solid waste generated during construction.

Hazardous and other Wastes (Management & Transboundary Movement) Rules, 2016

The objective of the rule is storage, handling, transportation and disposal of hazardous waste. This rule is applicable for storage and handling of hazardous waste during construction.

Construction and Demolition Waste Management Rules, 2016

The objective of the rule is management of construction and demolition waste. This rule is applicable for disposal of solid waste generated due to construction and demolition.

Batteries (Management & Handling) Amendment Rules, 2010

The objective of the rule is management and handling of used lead batteries. This rule is applicable for safe disposal of used lead batteries.

E-waste (Management) Rules, 2016

The objective of the rule is to develop effective mechanism to regulate generation, collection, storage, transport, import, export, recycling, treatment and disposal of e-wastes. This rule is applicable for handling of e-waste.

Central Motor Vehicles Act, 1988

The objective of the act is to control vehicular air and noise pollution. This act will be applicable for machinery, equipment and vehicles during construction phase.

Mines and Minerals (Regulation and Development) Act, 1957 as amended thereafter

The objective of the act is for safe and sound mining activity. This act is applicable for collection of boulder, sand and aggregates etc.

The Explosives Act 1884 & Rules 2008

The objective of the Act and rule to regulate the manufacture, possession, use, sale, transport, import and export of Explosives. This act is applicable for transporting and storing diesel, bitumen etc.

The Building and Other Construction Workers Regulation of Employment and Conditions of Service Act, 1996 and The Employment Rights (Amendment) Act 2013

The objective of the Act is for the purpose of providing immediate relief to the persons affected by accident occurring while handling any hazardous substance and for matters connected therewith or incidental thereto. This act is applicable for Engagement of Labour by contractors.

Notification for use of fly ash 1999 and Amendments thereafter

Promoting the utilization of fly ash in the manufacture of building materials and in construction activity within a specified radius of 300 kilometers from coal or lignite based thermal power plants.

The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013

In India, a new bill, Land Acquisition and Rehabilitation and Resettlement Bill has been passed by the Parliament in 2013 to repeal the Land Acquisition Act of 1894. This is the first National/ Central Law on the subject of Rehabilitation & Resettlement of families affected and displaced as a result of land acquisition. Only R&R provisions will apply when private companies purchase land for a project, and the same exceeds the area thresholds set by the State Governments for such purchase.

As per this Act, compensation will be given within a period of three months from the date of the award. Where an award has been made but the affected individuals have not accepted compensation or have not yet given up possession, and the proceedings have been pending for 5 years or more, provisions of the new law will apply. This Act stipulates mandatory consent of at least 70% of affected people for acquiring land for Public Private Partnership (PPP) projects and 80% for acquiring land for private companies. Under the new legislation, compensation for the owners of the acquired land will be four times the market value in rural areas and twice in urban areas. It also stipulates that the land cannot be vacated until the entire compensation is awarded to the affected parties.

Assam Land (Requisition and Acquisition) Act, 1964 (Act XV of 1964)

Land Acquisition have been prepared considering the state Government legislation & Acts for land acquisition Rule 5 and Section 4(1) of the Assam Land (Requisition and Acquisition) Act, 1964 (Act XV of 1964) in addition to The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013.

1.8 STRUCTURE OF EIA & EMP DOCUMENT

As per Environmental Impact Notification S.O.1533 (E), of 14th September 2006 as amended thereafter and direction of SEIAA, EIA report for Construction of Bridge over River Bramhaputra along with approach roads which leads to Gauripur Jn. of NH-31 has been structured in following chapters which is as per approved ToR.

Table 1.2: Report Structure

Chapter No.	Chapter Name	Contents
1	Introduction	This chapter includes background of the project, project rationale, project categorization as per government of India requirements, objective, scope and methodology Environmental Impact Assessment (EIA) study, project benefits, identification of the project and project proponent, project consultant, policy legal and administrative frame work and structure of EIA & EMP document.
2	Project Description	This chapter covers description of the project, such as type and need of project, project location, existing project salient features, details of the proposed improvements, typical cross sections, traffic scenario, road safety measures, etc. and different aspects which is related to environmental and resource consumption.
3	Description of Environment	This chapter describes the Baseline Environmental features in detail. It includes details about physical environmental resources viz. Physiography, Geology and Soils, Quarry Site, Borrow Area, Climatology details, status of baseline ambient air quality, noise levels, water quality, soil quality and ecological and social & economic aspects along the project road corridor.
4	Anticipated Impacts and Mitigation Measures	This chapter details out the anticipated project impacts on the environment based on baseline environmental features of the project during design, construction and operation phases and mitigation measures for all identified adverse impacts.
5	Analysis of Alternatives	This chapter elucidate details analysis about different options of alignment with considering design, environmental, social and economical aspects. The selection of final alignment with their justification is reflected in this chapter.
6	Environmental Monitoring Plan	The monitoring of VECs with effectiveness of mitigation measures (incl. measurement methodologies, frequency, location, data analysis, reporting schedules) is enriched in different sections.
7	Additional Studies	This chapter explain about Traffic and Health safety during construction as well as operational phase. The detail about Disaster and emergency preparedness plan is integral part of this chapter.
8	Project Benefits	The chapter gives an overview of improvements in the physical infrastructure, improvements in the social infrastructure, employment potential, environmental benefits along with other tangible benefits
9	Environmental Cost – Benefit Analysis	The cost of this project with reference to environmental and social concern has been analysed. The analysis of existing infrastructure and strategic benefit of this project will be part of this chapter.
10	Environmental Management Plan (EMP)	Description of the administrative aspects of ensuring that mitigative measures are implemented and their effectiveness monitored, after approval of the EIA, grievance redressal mechanism, EMP Budget is some major contents of this chapter.

Chapter No.	Chapter Name	Contents
11	Summary and Conclusion	This chapter summarise the project with impact, mitigation and management plan of proposed activities.
12	Disclosure of Consultants	This chapter includes the names of the consultants engaged along with nature of consultancy rendered to carry out entire EIA Study.
TOR Compliance Report		This section contains compliance of TOR

2. PROJECT DESCRIPTION

2.1 TYPE OF PROJECT

The proposed project is construction of Bridges over River Brahmaputra connecting Panbazar to North Guwahati along with its approach roads. As, bridges are not covered under EIA Notification, 2006 and as such Environmental Clearance (EC) is not required". But an application filed by (137 of 2014) Vikrant Kumar Tongad V. DTTDC, GNCTD, and MOEF&CC AND DPCC in this regards for decision from National Green Tribunal. As per the judgement of NGT the case is considered as Area Development Project covered under schedule 8(b) category B of EIA Notification, 2006.

ToR has been issued by SEIAA, Assam vide letter no. SEIAA. 688/2018/65/686 dt. 2/4/2018 under B category, category 8(b) of EIA Notification, 2006.

2.2 GENERAL

The Public Works Department (PWD) has decided to undertake the construction of six lane Bridge over river Brahmaputra along with approach road to connect south bank of Guwahati to North Guwahati. The entire length of proposed project is 8.658. There is 1.450 km south bank approach, 1.240 km main bridge over the river along with 369 m Ramp, 1.165 km (0.900km via duct and 0.265 km via duct approach) via duct and 4.070 km of approach road.

In order to access the financial and technical designing of the project M/s SMEC India Pvt. Ltd. has been entrusted by Public Works Department (PWD) to accomplish the task of carrying out the Feasibility and Detail Project Report for proposed Bridge over River Bramhaputra along with approach roads which connects at Gauripur Jn of NH-31.

The relevant codes followed for design of the proposed project are as given below:

• IRC:5-2015	Section I, General Features
• IRC:6-2014	Section II, Loads and Stresses
• IRC:112-2011	Code of practice for Concrete road bridges
• IRC:22-2008	Section IV, Composite construction for road bridges
• IRC:24	Section V, Steel Road Bridges
• IRC:78-2014	Section VII, Foundations and Substructure
• IRC:83 (Part I) 1999	Section IX (Part I), Metallic Bearings
• IRC:83 (Part II) 1999	Section IX (Part II), Elastomeric Bearings
• IRC:83 (Part III) 2002 • IRC:83 (Part IV) 2014	Section IX (Part III), POT, Pot cum PTFE, Pin and Metallic Guide Bearings. Section IX (Part IV), Spherical and Cylindrical Bearings.
• IRC:89 – 1997	Guide lines for design and construction of River Training and Control Works for Road Bridges (Ist Revision)
• IRC: SP:64-2005	Guidelines for Analysis and Design of cast in place voided slab superstructure
• IRC: SP:65-2005	Guidelines for Design and Construction of Segmental Bridges
• IRC: SP:66-2005	Guidelines for Design of Continuous Bridges
• IRC: SP:67-2005	Guidelines for use of external and un-bonded Pre-stressing tendons in bridge structures

• IRC: SP:69-2005	Guidelines and Specifications for Expansion Joints
• IS:2911 (Pt-1/Sec-2):2010	Design and construction of Pile Foundations - Bored Cast in-Situ concrete piles
• IRC SP:84-2014	Manual specification & standards for Four Lanning of Highways Through public private partnership
• IRC SP:73-2015	Manual specification & standards for two Lanning of Highways with paved shoulder

The planned project shall have many advantages for the area and region. Some of the important advantages are:

- Savings in vehicle operating costs.
- Faster, comfortable journeys.
- Safer travel.
- Benefits to trade especially in movement of perishable goods.
- Reduced maintenance costs.
- All round development of areas

2.3 OBJECTIVES

The present chapter deliberates about the technical and economic viability of the project and prepare detail project report identifying the maximum possible improvement requirements of a 6-lane Bridge over Bramhaputra River with appropriate specifications and standards.

2.4 PROJECT ROAD DESCRIPTION

Figure 2.1: Proposed Road near Bharalumukh

The project road near Bharalumukh shown in **Figure 2.1** will connect Guwahati to North Guwahati by connecting AT road on Southern Bank side of Brahmaputra River to NH-31 on Northern Bank side of Brahmaputra River with a Six-lane bridge over it, allowing the necessary waterway for inland water navigation.

The bridge will be connected to the south bank or the AT Road with the help of the approach ramps and development of the junctions has been made for facilitating the flow of traffic. The approach

road to proposed bridge at Bharalumukh location starts from AT road near Santipur Bus stop (340m to west).

Similarly, the northern bank is connected to the main bridge with the help of an approach viaduct and other structures, junction's in order to benefit the users of the bridge and the inhabitants of the nearby areas.

Proposed location of Left arm at South Bank

Proposed location of Right arm at South Bank

Proposed Center Point of Bridge Structural Part

Proposed location of Main Bridge Endpoint (Structural part) at North Guwahati

College Nagar Jn.

End of proposed project at Gauripur Jn. NH-31

2.5 TRAFFIC ROAD PROJECTIONS FOR THE PLANNED PROPOSED PROJECT

The traffic survey of the project influence area has been carried out in order to assess the present and future traffic demand of the bridge corridor and plan for funding of the project.

The Traffic Projections have been presented in the Table 2.1 below.

Table 2-1: Traffic Projections

Year	TVC-1 (Santipur)		TVC-2 (Jaiguru)		Proposed Bridge	
	Total Vehicles	Total PCUs	Total Vehicles	Total PCUs	Total Vehicles	Total PCUs
2017	51374	49641	27840	36428	22312	23430
2018	55141	53140	29900	39091	23982	25156
2019	59187	56892	32113	41950	25776	27011
2020	63535	60914	34491	45020	27705	29003
2021	68206	65226	37047	48320	29780	31144
2022	75948	72490	41299	53437	33280	34702
2023	82394	78402	44806	57877	36151	37631
2024	89396	84807	48615	62690	39272	40809
2025	97004	91747	52750	67908	42664	44258
2026	105269	99268	57241	73564	46351	48002
2027	113167	106426	61489	78792	49857	51510
2028	121665	114109	66055	84395	53630	55278
2029	130809	122357	70963	90400	57690	59323
2030	140646	131210	76238	96835	62058	63666
2031	151231	140714	81907	103733	66758	68329
2032	160822	149406	86964	109760	70989	72496
2033	171025	158643	92335	116142	75490	76920
2034	181883	168459	98043	122902	80278	81618
2035	193436	178892	104107	130061	85372	86606
2036	205728	189981	110550	137645	90791	91903
2037	214336	197760	115137	143241	94618	95724

2038	223307	205864	119916	149068	98609	99705
2039	232658	214305	124896	155134	102769	103853
2040	242405	223098	130085	161450	107105	108175
2041	252565	232258	135491	168025	111627	112679
2042	260136	239237	139658	173426	115013	116190
2043	267934	246427	143953	179003	118503	119811
2044	275966	253834	148381	184760	122098	123546
2045	284239	261464	152946	190703	125803	127398
2046	292761	269323	157652	196840	129621	131371
2047	301539	277420	162504	203175	133554	135468
2048	310580	285760	167505	209716	137608	139694
2049	319893	294352	172661	216469	141784	144052
2050	329486	303202	177977	223442	146088	148548
2051	339366	312319	183456	230640	150522	153184
2052	349543	321711	189105	238073	155092	157966

The boat ferry count has been carried out to reflect the need of this project and role in improvement of socio economic condition of this area.

Table 2-2: Boat Ferry Count

Survey Location	Directions	Two-wheeler	Cycle	Passenger
Fancy Bazar Ghat	Towards Fancy Bazar	251	94	1611
	From Fancy Bazar	223	95	1649
Pan Bazar Ghat	Towards Pan Bazar	217	104	1522
	From Pan Bazar	208	119	1544
Kuruwa Ghat	Towards Kuruwa	83	47	715
	From MadapKhanda	117	63	781

Figure 2.2: Traffic Survey Locations

2.6 ABUTTING LAND USE AND BUILT-UP AREAS

Existing abutting Land use along the project road is predominantly agricultural on both the sides. There are very few villages existing along the project road and the details of the same are given in Table 2.2.

Table 2-3: List of villages along the Project Corridor

S.no	Existing Chainage		Length(M)	Name of village	Remarks
	From	To			
1	-0.600	0.850	1.450	Guwahati Sahar	River Bank fly over and its approach
2	-0.039	0.330	0.369	Brahmaputra River	East Side of Ramp of extradosed bridge
3	-0.039	0.330	0.369		West Side of Ramp of extradosed bridge
4	0.330	1.570	1.240		Extradosed Main Bridge
5	1.570	2.340	0.770	North Guwahati	
6	2.340	5.100	2.760	Abhayapur	
7	5.100	5.900	0.800	Gouripur	
8	5.900	5.920	0.020	Jhalla	
9	5.920	6.800	0.880	Sila	
Total length			**8.658**		

2.7 TERRAIN

Topographic survey along the approved alignment has been carried out with the help of Total Station and the topographic data have been obtained. The reference bench mark of RL50.755m for establishing the levels at various places on the alignment is the GTS bench mark inside the office complex of CWC at Kachhary Ghat, Guwahati.

Some of the important levels as obtained from the Topographic Survey have been presented below.

- The HFL at the gauge site is 51.46m above MSL.
- The AT road Level on the Southern Bank is RL 51.559m (GPS 1).
- The NH-31 Road Level near Gauripur Junction is RL 56.861 (GPS 19).
- The Rail Level at the ROB Location is RL 51.690m.
- VUP1 Ground Level RL 51.754m.
- VUP2 Ground Level RL 50.683.

2.8 RIGHT OF WAY

The right of way along the project stretch varies widely and about 14m to 16m with Carriageway Width of 5 m and 1- 2.5m Earthen shoulder in North bank of proposed project. However, in South Bank it is about 10-15m (as per site) with paved shoulder. The proposed RoW is 80m. Based on the survey conducted and information on ROW, the land required for widening of the existing road and acquisition to provide 80m ROW include agricultural, barren / fallow lands governmental and other lands under private ownership in north bank. However, for approach road in south bank, mostly government land is required.

2.9 ALIGNMENT DESIGN

Under the gamut of the project, various engineering surveys and investigations have been carried out. As part of the scope of Feasibility Study, the analysis of these surveys has been carried out to

develop and recommend the various design alternatives. Preliminary designs and cost estimation of these alternatives is done. Thereafter economic and financial analysis of the various alternatives is carried out to arrive at the best techno-economic solution.

2.9.1. Design Parameters

Following parameters are adopted while fixing the alignments of the approach road.

- Efforts have been made to facilitate easy movement of most of the traffic from Southern Guwahati to northern Guwahati.
- Best possible Highway Geometric Standards have been applied to ensure the comfort of road users & utilize the road up to its full working efficiency.
- Right of Way (ROW) has been proposed keeping in mind the requirement for further future development to cater to the escalation in traffic.
- Utilization of existing road/ROW (if existing) has been highly considered while fixing Proposed Right of Way (PROW) by fully utilising the Existing Right of Way (EROW) in order to minimise the Land Acquisition & length of diversion road.
- By utilising the Existing ROW, consideration has been made to minimize the impact of existing structures/Buildings, industries, religious structures etc. to the extent feasible.

2.9.2. Design standards

The design of the road geometry for the assigned project will cover the following main principles, which form the basis of desirable standard of highway design:

- Road safety and smooth flow of traffic will be of prime concern in the design. The selection of optimum design standards reduces the possibility of undesirability of the facility to be provided.
- Both horizontal and vertical geometry will be according due importance as per selected standards. It will not be compromised unless it becomes formidable to accept for the particular situation or due to site constraints.
- Consistent Design will be adopted and abrupt changes in the design speed to be avoided to ensure the comfort & safety of users.
- The proposed design will minimise the total transportation cost, including initial construction costs, costs for the maintenance of the facility and the costs borne by the road users.

“Desirable” standards will be adopted and “Minimum” standards will be allowed only where serious restrictions are imposed by technical or economic considerations. Further amended standards may be adopted if applying “Desirable / minimum” standard leads to increase in cost or not suitable to site conditions.

2.9.3. Description of Alignment

Improvement proposals for alignment are proposed based on objectives outlined in Terms of Reference (ToR). As mentioned in TOR main objective of proposed project is improvement of safety feature of the alignment, capacity augmentation and improvement within proposed ROW (80m) as far as possible.

The alignment starts from Bharalumukh at South Bank and will end at existing Gauripur junction to join NH-31 on North Bank. Total length of of the proposed project including a Six-Lane bridge is 8.658 km.

South Bank

The approach road connecting to proposed bridge at Pan Bazar starts from AT road, 340m to west from Santipur Bus stop.

i) A rotary has been proposed at 435m from Sonaram School compound to the west for smooth entry of traffic to the proposed Bridge. The rotary has a radius of 30m and the approach road ramp (inverted Y-shaped) connecting to the Main Bridge has a radius of 170.00 m. This will facilitate easy movement of traffic from AT road / MG road travelling to North Guwahati.

ii) There is another rotary proposed at a distance of about 1200m from first rotary near Pragjyothi Cultural Complex on MG road. This will allow traffic coming from North Guwahati to South Guwahati to enter MG road / AT road. This rotary has a radius of 30m and the approach road ramp (inverted Y-shaped) has a radius of 170.00m.

Both the rotaries are connected for through movement of traffic from AT road to MG road with an elevated one-way corridor on the River bank. A Y-junction has also been proposed to be developed near Bharalumukh Bus stop for providing access to existing AT road. One Minor bridge over Bharalumukh Nala is proposed to be constructed on the ramp. The existing bridge on the MG road will be taken up repair and retrofitting. It may be noted here that the proposed alignment is not affecting Sonaram High School and its ground. The connecting road on the river bank will be above the park area and hence will not disturb the park area. The entry to the rotary is on the land where the office of The Director of Surveys, Assam is located at present. Since this is a government building the same may be relocated to a suitable place. By this unnecessary delay for the Land acquisition will be prevented. South bank alignment and location map has been shown in Figure 2.3 below.

Figure 2.3: South Bank Alignment

North Bank

The major portion of proposed alignment i.e. (5.230km) is on North Bank including North approach of proposed Six-lane Bridge.

After touching the North bank of Brahmaputra, the main bridge is connected to a viaduct of length 1.165km crossing villages such as Ghora Jan, State Highway 2- Barpeta-Hajo Guwahati Road. After the end of the viaduct the road goes via Abhaypur, college Nagar, Gauripur and after Gauripur Bottling plant road crosses the railway tracks and then joins nearby the existing Gauripur junction with NH-31.

Mostly habitated built-up area is near the North Bank. Efforts have been made to minimize the acquisition of buildings, important industries, factories like Gauripur Bottling plant, HPPL etc. Chainages of these locations are given in Table below. Alignment and location map are as shown in Figure 2.4 below.

Table 2-4: Alignment Details

S. No.	Items	Details
1.	Total Length	8658m
2.	Speed	100 Kmph (Main Bridge), 40 Kmph (Approach Ramps- Southern Bank), 60 Kmph (Southern Bank Road), 10 Kmph (At Rotaries) & 65-100 Kmph at Northern Guwahati Road
3.	R.O.W	80m
4.	Min curve radius(m)	170.00m (Ramps) & 250m (Approach Road)
5.	Max curve radius(m)	1500m
6.	Max. S.E	5%
7.	Length of Six Lane Bridge (approx.)	1240m
8.	Length of Each Ramp on South Bank (approx.)	369m
9.	Length of flyover on South River Bank (approx.)	1450m
10.	Length of viaduct on North Bank (approx.)	900m
11.	Length of North viaduct approach (approx.)	265m
12.	North Viaduct approach to End of Project road meeting with NH-31	4065m
13.	Nos of VUP	1 (Ch.4+060)
14.	Nos of Minor Bridge	1 (Ch.5+498)
15.	Nos of ROB	1 (Ch.6+641)

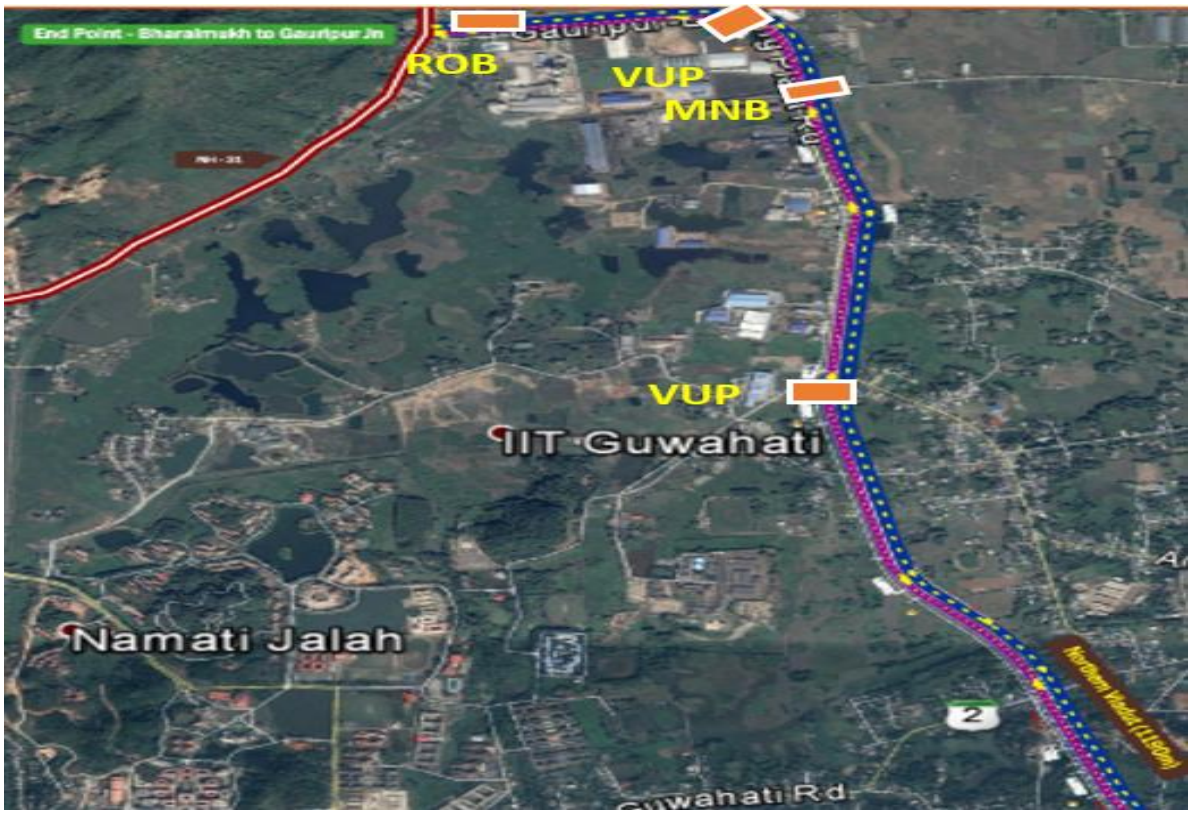


Figure 2.4: North Bank Alignment

2.9.4. TCS schedule

Different TCS of proposed alignment has been designed and the same is presented in below table and figures: -

South Bank Road

Table 2-5: TCS Schedule – South Bank Road

Chainage		Length in Meter	TCS	Remarks
From	To			
-600	-508	92	6A	Approach of Flyover
-508	688	1196	9	One Way Flyover on River Bank
688	850	162	6A	Approach of Flyover

Ramp west/East

Table 2-6: TCS Schedule- Ramp West/ East

• Chainage		Length in Meter	TCS	Remarks
From	To			
-39	330	369	3	Viaduct

Main Bridge & North Guwahati

Table 2-7: TCS Schedule- Main Bridge & North Guwahati

Chainage		Length in Meter	TCS	Remarks
From	To			
330	1570	1240	4	Main Bridge
1570	2470	900	3	Viaduct
2470	2735	265	5	Viaduct Approach
2735	3580	845	1	New Construction with Service Road (Rural section)
3580	4640	1060	6	VUP Approach
4640	6200	1560	2	Reconstruction & Concentric Widening in Urban section with Service Road
6200	6800	600	8	ROB Approach

2.9.5. TCS Drawing

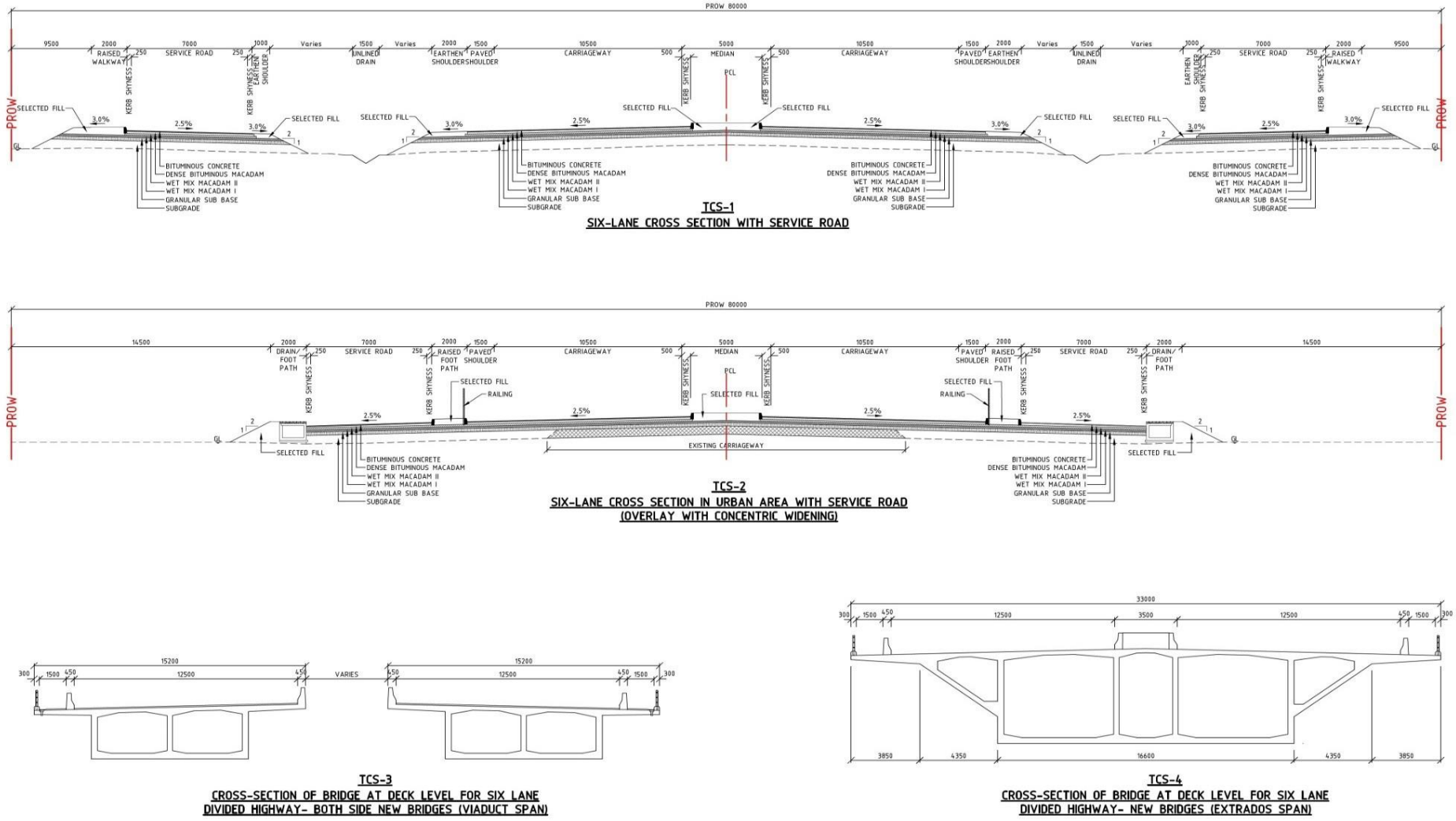


Figure 2.5: TCS Drawing - I

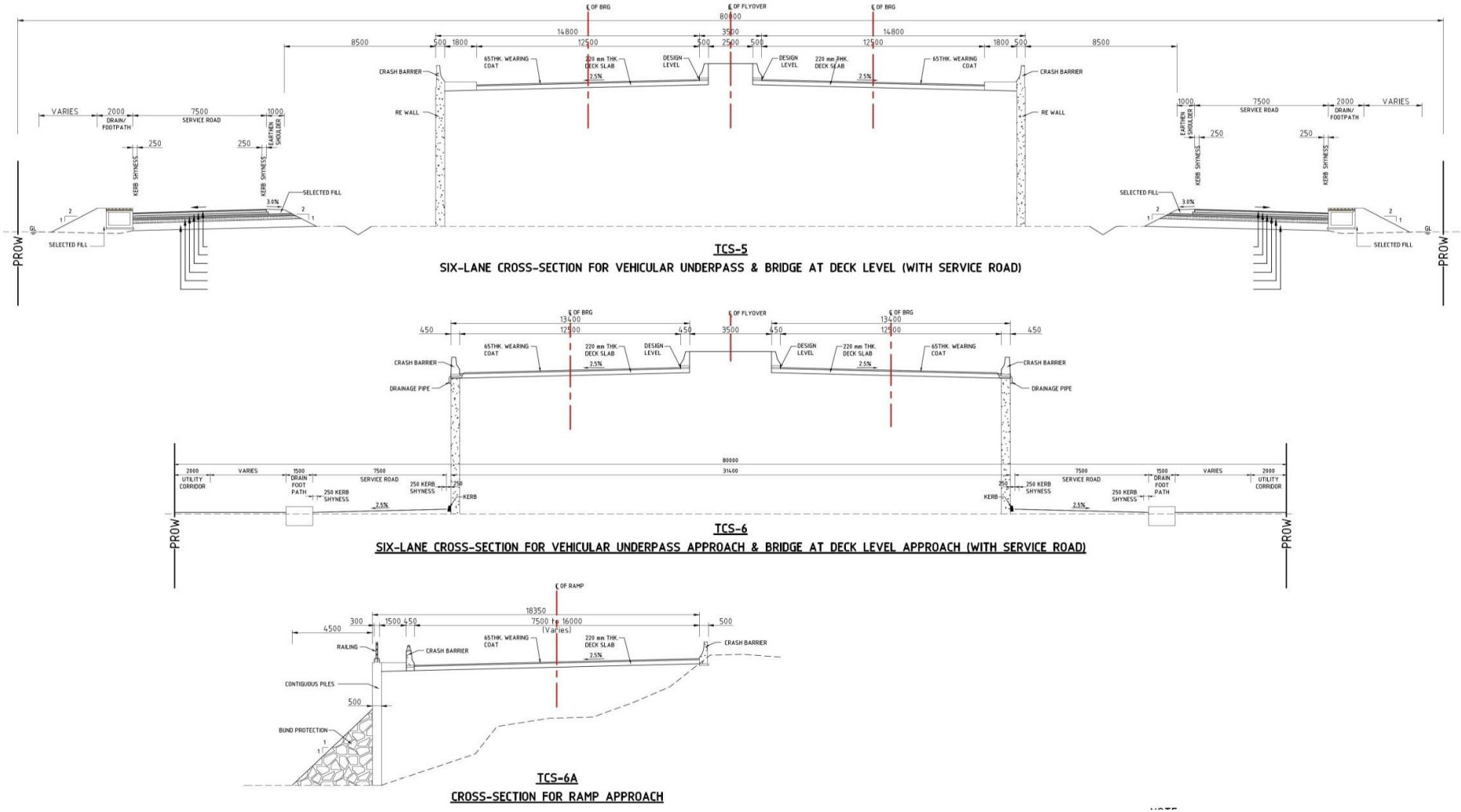
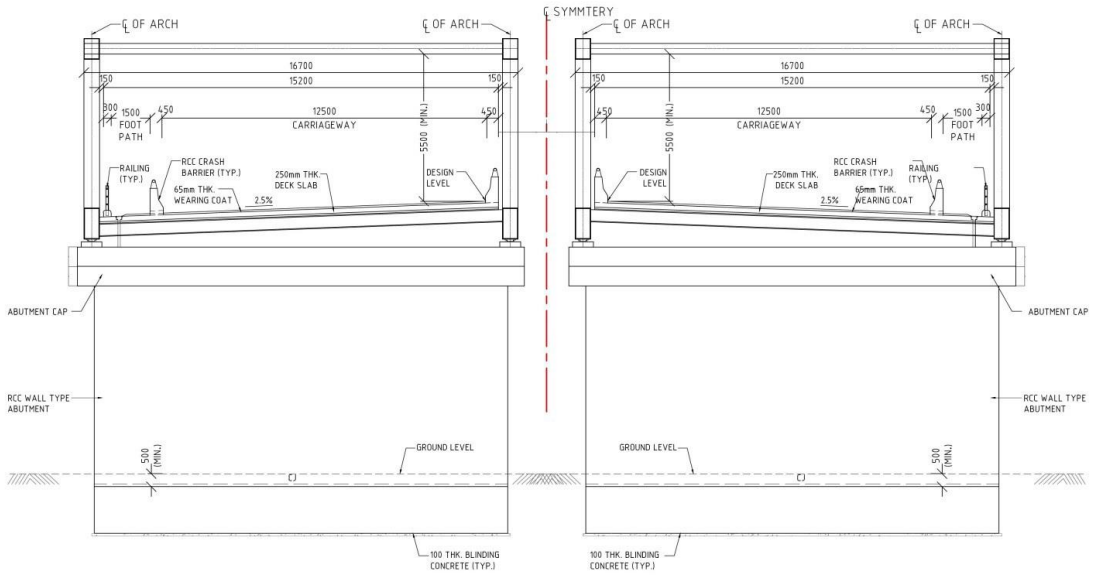
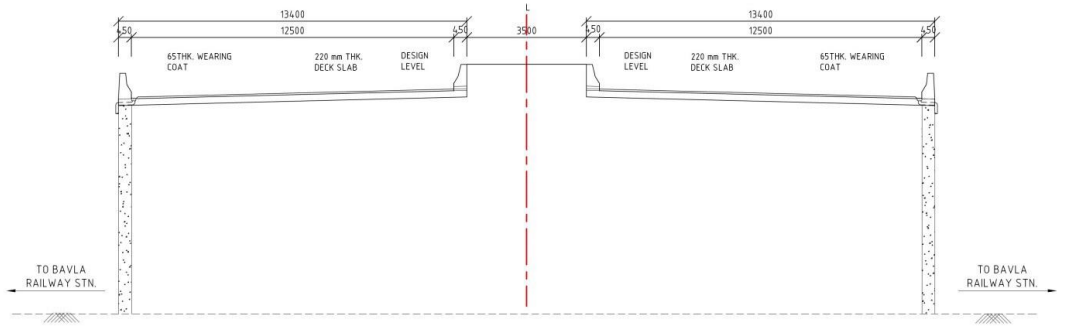


Figure 2.6: TCS Drawing - II



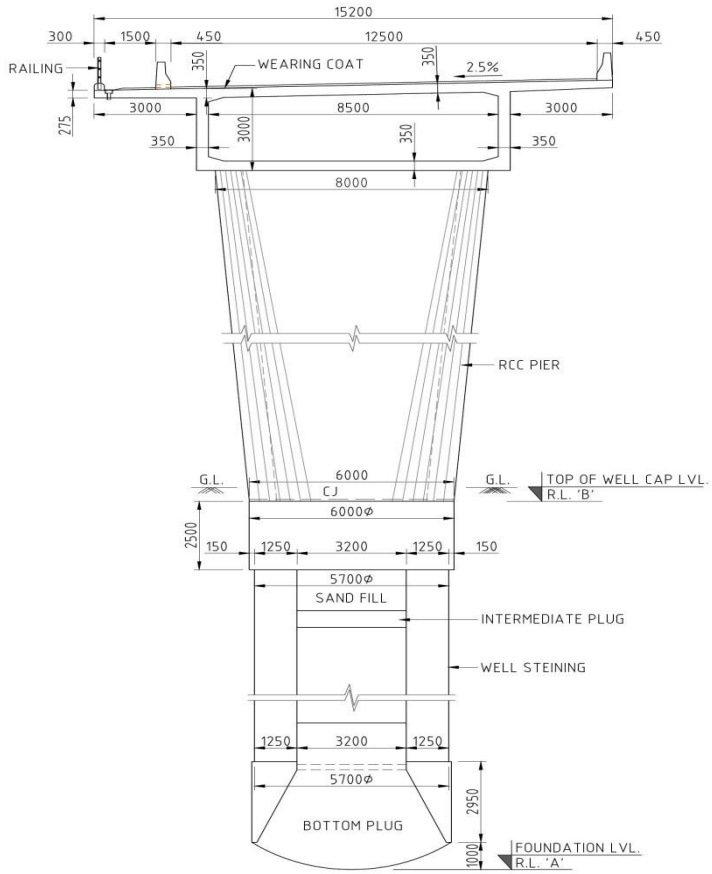
TCS-7
SIX-LANE CROSS-SECTION FOR ROB



TCS-8
SIX-LANE CROSS-SECTION FOR ROB APPROACH

NOTE:-
1. ALL DIMENSIONS ARE IN MM UN

Figure 2.7: TCS Drawing - III



TCS-9
ONE-WAY FLYOVER ON RIVER BANK ROAD

Figure 2.8: TCS Drawing IV

2.9.6. Service Roads/Slip Road

Service Roads will be provided at following chainage locations:

Table 2-8: Service Road Details

Sl. No.	Design Chainage Length (Km)			
	From (Km)	To (Km)	Length (m)	Side (m)
1	1+600	6+420	4820	LHS
2	1+600	6+130	4530	RHS

2.9.7. Design of Intersection & Junctions

INTERSECTIONS AND GRADE SEPARATORS

(a) At Grade Intersection

At grade intersections shall be provided at the intersection of service roads and all intersecting roads at locations as specified in plan.

(b) Grade Separated Structures

Following grade separated structures shall be provided:

Table 2-9: Grade Separated Structure Details

Proposed Ch. (km)	Structure Type	Location Name
1+600	Viaduct	Maj Gaon village
2+350	Viaduct	Ghoramara Village Road
4+060	VUP	Collage nagar Junction
6+641	ROB	Near Gouripur- Junction

Minor Bridge at chainage 5+498

RoB at Chainage 6+641

2.9.8. Utility Diversion

- General

Two-Meter-wide strip of land at the extreme edge of row are kept on accommodating utilities, both over as well as underground. Provision as per IRC: 98 shall be followed. Utility duct in the form of 600

mm diameter NP-4 Pipe across the project road at a spacing of 1 km shall be provided for crossing of underground utilities.

- Utility Relocation Proposal

Various types of existing utility falling in the project corridor need to be relocated are listed as below: -

Table 2-10: Utility List – North Guwahati

North Guwahati												
SL. No.	DESIGN CHAINAGE		ELECTRICAL POLE (EP)		TRANSFORMER (TF)		TELEPHONE POLE (TP)		OPTICAL FIBRE CABLE (OFC)		WATER TAP HAND PUMP	
	FROM	TO	LHS	RHS	LHS	RHS	LHS	RHS	LHS	RHS	LHS	RHS
1	0+000	1+000	0	0	0	0	0	0	0	0	0	0
2	1+000	2+000	3	0	0	0	2	0	0	0	0	0
3	2+000	3+000	5	3	0	0	0	1	0	0	0	0
4	3+000	4+000	3	2	0	1	0	0	0	0	0	0
5	4+000	5+000	46	44	1	2	0	0	2	2	1	0
6	5+000	6+000	58	11	8	2	0	0	5	1	0	0
7	6+000	7+000	36	1	2	0	0	0	5	0	0	0
	TOTAL		151	61	11	5	2	1	12	3	1	0

Table 2-11: Utility List- South Bank Road

South Bank Road												
SL. No.	DESIGN CHAINAGE		ELECTRICAL POLE (EP)		TRANSFARMER (TF)		TELEPHONE POLE (TP)		OPTICAL FIBRE CABLE (OFC)		WATER TAP HAND PUMP	
	FROM	TO	LHS	RHS	LHS	RHS	LHS	RHS	LHS	RHS	LHS	RHS
1	-1+150.5	0+000	1	0	0	0	0	0	0	0	0	0
2	0+000	1+000	0	2	0	0	0	0	0	0	0	0
3	1+000	1+247.897	0	0	0	0	0	0	0	0	0	0
	TOTAL		1	2	0	0	0	0	0	0	0	0

2.9.9. Project Facilities

This includes information regarding location and size of the facilities.

a. Bus Bays / Bus Shelters (Nos.)

Bus bay/ Bus Shelters are proposed at following locations: -

Table 2-12: Proposed Bus Bay Locations

Sl. No.	Design Chainage (Km)		Bus Bay/Bus Shelters	Remarks
	LHS	RHS		
1	1+650	1+650	Bus Stop	Bus Stop Near Junction point on Maj gaon
2	2+300	2+300	Bus Stop	At Barpeta - Hajo Road
3	3+900	-	Bus Stop	At College Nagar Junction

	-	4+200		
4	4+750	4+750	Bus Stop	At Rha Dhala Village
5	5+750	5+750	Bus Stop	At Gouripur - Rangmahal Road

b. Pedestrian Facilities

Footpaths (Sidewalks) are provided at following location:

Walkways

Table 2-13: Proposed Walkways

Chainage		**Length in Meter**
From	**To**	
2735	3580	845

Drain

The drain facility along the proposed project road is presented at following chainage: -

Table 2-14: Proposed Drains

Chainage		**Length in Meter**
From	**To**	
2470	2735	265
3580	4655	1075
4655	5330	675
5330	6400	1070

Footpath

The footpath for pedestrian along the proposed project is proposed at following chainage:-

Table 2-15: Proposed Footpath

Chainage		**Length in Meter**
From	**To**	
-600	-508	92
-508	688	1196
688	850	162
-39	330	369
330	1570	1240
1570	2470	900
6400	6805	405

2.10 CULVERTS

Four culverts exist along the project road, their summary and details are given below in **Table 2.16.**

Table 2-16: Summary of Culverts

Type of Culvert	Number of Culverts	Type
RCC	4	

The indicative Chainages of these culverts are given below in **Table 2.17**.

Table 2-17: Details of Proposed Culverts

SL. No.	Design Chainage	Stream	Nos	Total Width	Type of culvert
1	2+080	Local Nallah	1	23 m	
2	3+500	Local Nallah	1	54.4m	
3	4+330	Local Nallah	1	54.4m	
4	5+780	Local Nallah	1	54.4m	

2.11 ROAD SAFETY FOR THE PROJECT ROAD

Road Safety Audit

Objectives

The objective of the road safety audit is to

- Minimise the risk and severity of road accidents that might be affected by the road project at the site or nearby network.
- Minimize the need for remedial work after construction.
- Reduce the whole-life costs of the project
- Improve the awareness of the safe design practices by all of those involved in the planning, design, construction and maintenance of roads.

Table 2-18: Road Safety Audit

Contents	Items	Proposed Action Aspects
Aspects to be checked	Safety and operational implications of proposed alignment and junction strategy with particular references to expected road users and vehicle types likely to use the road.	As per standard
	Width options considered for various sections.	As per standard
	Departures from standards and action taken.	No departure.
	Provision for pedestrians, cyclists and intermediate transport	Grade separated pedestrian crossing has been proposed at suitable locations. Service road is provided at all built up locations. and 1.5m paved is provided all through for NMT.
	Safety implications of the scheme beyond its physical limits i.e. How the scheme fits into its environs and road hierarchy.	Discussed in detail in subsequent paragraph specific problems and action taken.
General	Departures from standards	No Departure.
	Cross-sectional variation	No Variation.
	Drainage	As per standard.
	Climatic conditions	No effect.
	Landscaping	As required.
	Services apparatus	Provided with rest areas.
	Lay-byes	Provided as per standard practice.
	Footpaths	Provided in urban areas with service road.

	Pedestrian crossings	Grade separated pedestrian crossing has been proposed at suitable locations.
	Access	Free access with suitable design.
	Future widening	Provision made for future widening.
	Staging of contracts	Design Stage.
	Adjacent development	Taken care of, Monitoring during maintenance stage.
Local Alignment	Visibility	Acceleration and deceleration lane for local traffic, merging and de-merging with the highway, has been provided. Sight distance has been checked and found ok.
	New / Existing road interface	All local roads will be designed for 200m length for smooth connectivity with highway.
	Safety Aids on High embankments	For high embankments Metal Beam Crash Barrier along with delineators is provided.
Junctions	Minimize potential conflicts	All major junctions are grade separated, minimizing the conflict points.
	Layout	As per IRC guidelines
	Visibility	All junctions are designed as per IRC guidelines and visibility at approaches to junctions is to the standards.
Non-motorized road users Provision	Adjacent land	For uninterrupted traffic movement, adjacent l and (Within ROW) will be cleared.
	Pedestrians	Grade separated pedestrian crossing has been proposed at suitable locations in built up areas.
	Cyclists	Service Road is provided at all built up locations. And 1.5m paved shoulder is provided all through for NMT.
	Non-motorized vehicles	
Signs and Lighting	Lighting	All junctions in urban area will be illuminated.
	Signs I Markings	Signage and Road markings have been provided as specified in relevant IRC codes.

2.12 PAVEMENT DESIGN FOR MAIN CARRIAGEWAY& SERVICE ROAD

As per IRC: 37-2012, the pavement design engineer has to estimate the cumulative number of standard axles to be carried by the pavement during the design life. To do this the following calculations need to be done:

- Traffic intensity in terms of commercial vehicles per day;
- Traffic growth rate;
- Design life;
- Vehicle damage factor (VDF);
- CBR % for subgrade soil; and

- Cumulative MSA (CMSA) for the design period.

2.13 LEAD DETAILS

For construction of proposed bridge along with approach road, it is estimated that following quantity of material will be required.

Table 2-19: Required material for proposed project

S. No	Items	Unit	Quantity	Remarks
1	Steel	MT	26,731	As per details
2	Cement	MT	98,705	As per details
3	Aggregate	Cum	434,694	As per details
4	Sand	Cum	104,710	As per details
5	Water	KL	40,205,393	As per details
6	Bitumen	MT	6,026	As per details
7	Earth	Cum	756,845	2.02, 2.05, 6.03b RE, 6.21 VC, 6.21 ROB, 7.21, 10.06 ii, 10.10
8	Styed Cable	MT	1,265	7.36
9	Strands	MT	2,323	7.09, 6.09, 6.09VC
10	Bow Steel Girder	MT	907	6.25

Table 2-20: Accepted Norms for suitability of aggregates

S.No	Test	Specification
1	Aggregate Impact Value	Not more than 30% for non- bituminous work and 27% & 24% for DBM and BC work respectively
2	Los Angeles Abrasion value	Max. 40% for non- bituminous work and 35% & 30% for DBM and BC work respectively
3	Combined Flakiness and elongation	Not more than 30%

2.13.1. Sand

Approximately 104710 cum sand is available along the project road. Good quality sand can be extracted from Hahim and Barnadi which total lead distance is 78.70 and 77.20 respectively.

2.13.2. Bitumen

Approximately 6026 MT of Bitumen shall be required for the planned project. Bitumen can be procured from the nearby of project area depending upon the availability.

2.13.3. Cement

Cement to be used in the construction work shall be any of the following types with the prior approval of the Engineer:

- Ordinary Portland cement, 33 Grade, conforming to IS: 269
- Rapid Hardening Portland Cement, conforming to IS: 8041
- Ordinary Portland cement, 43 Grade, conforming to IS: 8112
- Ordinary Portland cement, 53 Grade, conforming to IS: 12269
- Sulphate Resistance Cement, Conforming to IS: 12330

The chloride content in cement shall in no case exceed 0.05 percent by mass of cement. Also, total sulphur content calculated as sulphuric anhydride (SO_3) shall in no case exceed 2.5 percent and 3.0

percent when tri-calcium aluminates percent by mass is upto 5 or greater than 5 respectively. Good quality Cement is locally available.

2.13.4. Steel

Approximately 26,731 MT of Steel shall be required for the planned project. For plain and reinforced concrete (PCC and RCC) or pre-stressed concrete (PSC) works, the reinforcement/un-tensioned steel as the case may be consists of the following grades of reinforcing bars as shown in following Table 2.21.

Table 2-21: Strength of Steel

Grade Designation	Bar Type conforming to governing IS Specification	Characteristic Strength f_y (MP_a)	Elastic Modulus GP_a
S 240	IS:432 Part I, Mild Steel Bar	240	200
S 415	IS:1786 High Yield Strength Deformed Bars (HYSD)	415	200

2.13.5. Water

Water demand during construction period is enumerated in **Table 2.22** as follows:

Table 2-22: Requirement of Water

S.No.	Purpose	Demand (KLD)
1.	Drinking Water	3
2.	Water for daily needs	12
3.	Water for compaction	10
Water Requirement in KLD for Domestic uses		**25 KLD**
Water Requirement for Construction Purpose (in liters)		**40,205,393**

2.13.6. Man Power Requirement

For construction of the project road, about 150 workers including management and supervisory staff shall be deployed. Most of the workers shall come from local area.

2.13.7. Project Implementation Schedule

The construction of the project road shall be completed within 48 months from the date of start of construction.

2.14 PROJECT COST

The total project cost is calculated based on the quantity of individual item multiplied by the rate for this item and summing up the cost of all the items. The bill wise total project cost is estimated **about 1925 Crores** which is tabulated in **Table 2.23** as under.

Table 2.23: Abstract of Cost Estimates

ABSTRACT OF COST		
Bill No.	**Description**	**Amount (Rs.)**
1	Site Clearance and Dismantling	6,993,173
2	Earth Work	189,043,472
3	Sub-Base, Base-Courses	257,859,730
4	Bituminous Pavement Courses	351,524,957
5	Cross Drainage Works	44,942,499
6	Rob, Vup, Minor Bridge & Re Wall	799,610,668

7	Bridge on Brahmaputra@ Pan Bazaar	9,651,416,387
8	Traffic Signages, Road Marking & Appurtenances	39,396,511
9	Drainage and Protection Works	87,196,226
10	Miscellaneous Works	234,557,112
11	Toll Plaza	112,630,000
	Civil Cost (A)	**11,775,170,735**
12	Design & Pmc Charges @ (Design 2% + Pmc 2%) 4% On (A)	471,006,829
13	Administrative Charges +Pmu@ 2.0%On (A)	235,503,415
14	Quality Control Charges @ 0.5%On (A)	58,875,854
15	Road Safety Audit Charges @ 0.05%On (A)	5,887,585
16	Utility Shifting 2% On Base Cost (A)	235,503,415
17	Land Acquisition Cost	1,000,000,000
18	Rehabilitation & Resettlementcost	1,050,000,000
19	Environmental Budget On (A)	117,751,707
20	Contingencies @ 3% On (A)	353,255,122
21	Taxes On (A,12)	1,497,801,717
21	Total Estimated Project Cost	**16,800,756,380**
22	Escalation @ 5% For 4 Years On (A, 12)	2,449,235,513
23	Total Project Completion Cost	**19,249,991,893**
		Say Rs. in Crores 1925

3. DESCRIPTION OF THE ENVIRONMENT

3.1 BACKGROUND AND ENVIRONMENTAL FEATURES

This chapter describes the existing environmental settings in the study area. The major purposes of describing the environmental settings of the study area are:

- To understand the project, need and environmental characteristics of the area.
- To assess the existing environmental quality, as well as the environmental impacts of the future developments being studied; and
- To identify environmentally significant factors or geographical areas that could preclude any future development.

The proposed project is construction of Bridge over River Brahmaputra along with approach roads in North Guwahati. The various factors that have been considered towards the formulation of a proper strategy for conducting the baseline studies are described in the next section.

The collection of baseline information on biophysical, social and economic aspects of the project area is the most important reference for conducting environmental study. The description of environmental settings includes the characteristic of area in which the activity of the project road would occur, and cover area affected by all impacts including potential compensation area. For conducting the environmental study, existing environmental conditions along the project road, have been obtained by primary data collection, monitoring, sampling and secondary data collection from published source and various government agencies. The collection of baseline data was designed to satisfy information requirements and focused on relevant environment aspects that are likely to be affected by the project road. Thus, to establish the baseline environment status of the Physical, Biological and Socio-economic environmental components along the project road, all necessary information required for study has been collected through survey conducted by environmental survey team, secondary data sources, and community consultations in the study area (10 km both side of the project road). The methodology adopted to carry out this study is deliberated in following sections.

3.2 METHODOLOGY ADOPTED FOR CONDUCTING BASELINE STUDY

The guiding factors for the present baseline study are the approved Terms of Reference issued by State Expert Appraisal Committee, Assam and local regulations and directives. The impact zone is within a radius of 500 m from the center of the alignment since most of the potential impacts are most likely to occur within this area. Further, a buffer area extending up to 10 km radius from the site has also been studied, though with a lesser degree of detail. The baseline study and primary data collection was carried out during the Post Winter season of the year 2018. The studies were conducted by considering the following:

- The various environmental attributes were divided into primary and secondary studies. Primary attributes such as air environment, water, soil, noise, flora and fauna, and Socio-economic were assessed by conducting field studies, on-site monitoring and review of the past studies conducted.
- Secondary attributes such as land use studies, geology, physiological characteristics, and socio-economic environment have been assessed by literature review of previous studies conducted by various government publications. An interdisciplinary team through discussions, criteria questions and professional judgment formulated the scoping and the extent of data generation. The baseline studies started with site visits and reconnaissance survey in the study area for fixing the monitoring locations for the primary data. As a

secondary data review, various Government agencies were approached for procuring information and relevant data of the area.

Overall, environmental information is based on primary data generated through field survey/ monitoring and also on secondary information from published sources. The primary data have been obtained from environmental monitoring of ambient air quality, ground water quality, soil quality and noise level conducted at different locations within 500 m radius of project boundary. Secondary data/ information has been collected from reliable sources for geology, hydrology, landuse, meteorology, ecology and socioeconomics.

3.3 STUDY AREA

For better understanding about the baseline environmental scenario the entire study area can be categorized under three parts: -

- Core Zone (Corridor of Impact (COI)): - The proposed site where the RoW lies.
- Buffer Zone: -It would be study area for baseline study of
- VECs which consists of 500 m and 2 km aerial coverage from the proposed alignment.
- Environmental Sensitivity Zone: -It would cover 10 km radius from the proposed alignment.

Basically, the study carried out in study area to gather the following information:

- Physico chemical of VECs
- Biological of flora and fauna
- Socio economics of human resource and settlement and Cultural and aesthetic

Location map showing site and surrounding environment features within the 10km area on Google map is provided in Figure 3.2. The Salient Environmental Features of plant site within 500m, 2 Km and 10 Km radius is summarised at Table 3.1.

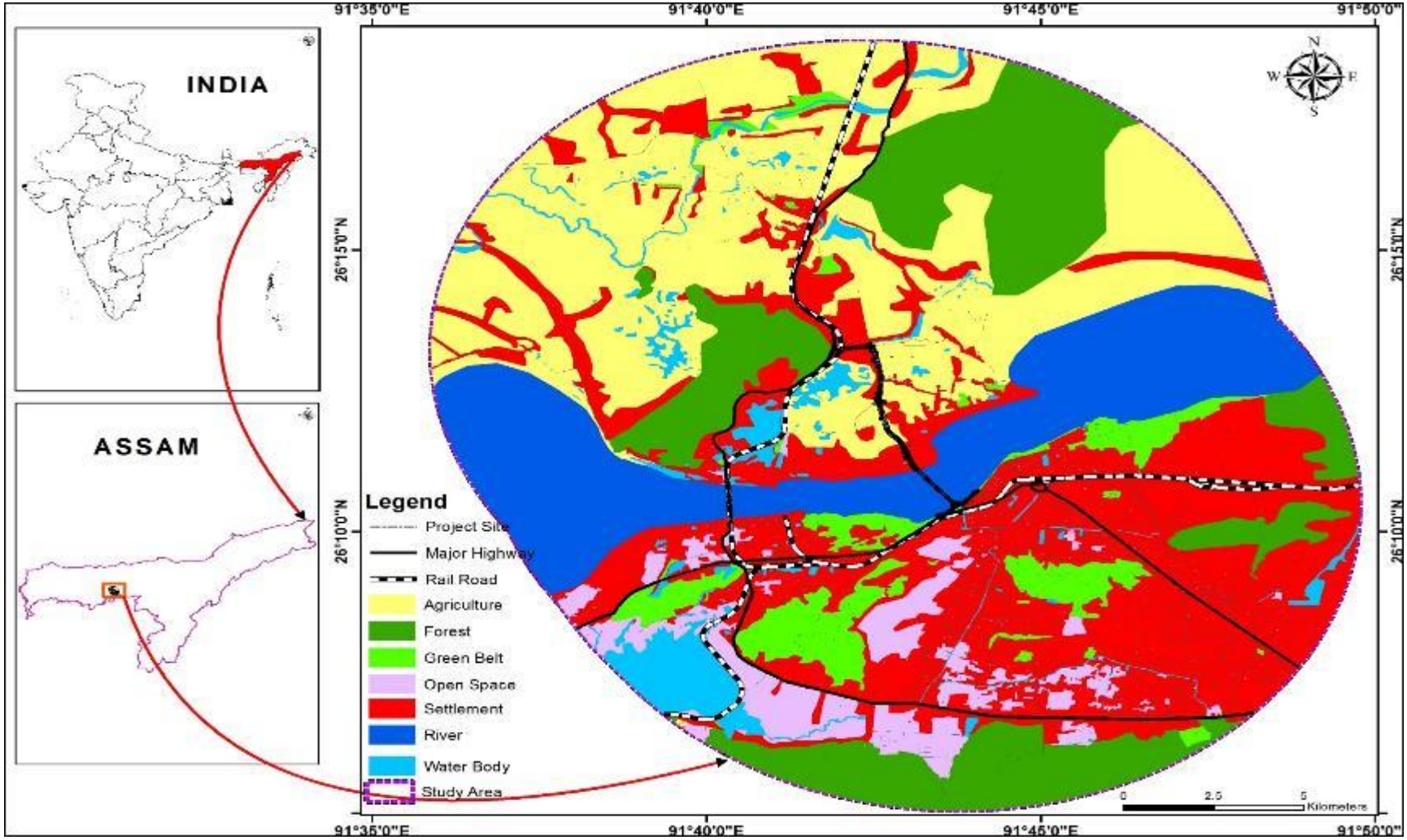


Figure 3.1: Location Map

Table 3.1: Salient Environmental Features of Proposed Site

S. No.	Environmental Features	Within 500 m area around project alignment	Within 2 km area around alignment	Within 10 km area around project alignment
A	**Ecological Environment**			
1.	Presence of Wildlife Sanctuary/ National Park/Biosphere Reserves/Protected	None	None	None
2.	Reserved Forests	Available	Available	Available
3.	Wetland of state and national interest	None	None	Available
4.	Migratory route for wild animals/ birds	Do not attract	Do not attract	Available
5.	Presence of schedule-I Fauna	Available	Available	Available
6.	Critically Polluted Area	Do not attract		
B	**Physical Environment**			
1.	Rail connectivity	No	Guwahati Railway Station 2.18, NE	Guwahati Railway Station 2.18, NE
2.	Defence Installation	No	Yes	Yes
3.	Densely Populated Area	Yes (Urban Settlement)	Yes (Urban Settlement)	Yes (Urban Settlement)
4.	Other village close to alignment	Gauripur, Abhaypur, Sila		
5.	Topography	Plain, elevation of site ranges between 55 to 65 amsl		
6.	Seismicity	Zone- V, Highest risk		
7.	Surface Water Resources (Rivers)	Brahmaputra and Bharalumuk	Brahmaputra and Bharalumuk	Brahmaputra and Bharalumuk
8.	Land-use	Urban Settlement	Urban and Rural settlement	Urban and Rural settlement
C	**Social Environment**			
1.	Physical Setting	Urban, rural and agricultural	Urban, rural and agricultural	Urban, rural and agricultural
2.	Physical Sensitive Receptors	School, Hospitals and Parks etc.	School, Hospitals, Temple etc.	School, Hospitals, Temple etc.
3.	Archaeological Monuments	Yes	Yes	Yes

Figure 3.2: Google Map of 10 km Study area

3.4 PRIMARY DATA COLLECTION: MONITORING PLAN AND QUALITY ASSURANCE PROCEDURES

Primary baseline data has been collected as per the ToR issued by SEIAA, Assam, in line with compliance of ToR, study period and followed methodology for primary data collection is summarized in **Table 3.2.**

Table 3.2: Summary of Methodology for Primary/Secondary Baseline Data Collection

Parameters	**No. of sampling locations**	**Frequency/ season**	**Remark**
Ambient Air Quality			
PM_{10}, $PM_{2.5}$, SO_2 NOx H_2S, CO,	6 locations (Refer Fig. No.3.5)	Twice a Week For Pre-Monsoon season	AAQ monitoring was carried out at 6 locations (representing upwind, downwind and sensitive locations). 24 hours sampling at each location was carried out as per CPCB guide lines (CPCB Gazette notification dated 18.11.2009 on AAQ).
Meteorology			
Temperature, Humidity, Wind speed, Direction, Rainfall etc.	One location	Hourly for Pre-Monsoon season	Met station was established close to the site to record the site-specific hourly met data.
Ground Water Quality			
Physical, chemical and biological parameters as per IS 10,500:2012	5 locations in study area (Fig 3.5)	Once in a season	Ground water: Sampling was conducted at 5 locations. Samples were preserved, transported and analyzed for different parameters based on APHA methods. Temp, conductivity and pH which were measured instantly at site itself.
Surface Water Quality			
Physical, chemical and biological parameters as per IS: 2296	5 locations in study area (Fig 3.6)	Once in a season	Surface Water: Sampling was conducted at five locations. Samples were preserved and transported for analysis for different parameters based on APHA methods. Temp, conductivity, DO and pH which were measured instantly at site itself.
Soil			
Texture, bulk density, pH, conductivity, cation exchange capacity, organic matter, Total N, P, K, and Heavy metals etc.	5 locations in study area (Fig 3.5)	Once in a season	Soil samples were collected at five locations within the study area and analyzed as per IARI method
Noise			

Ambient Noise	5 locations in study area (Fig 3.6)	Once in season	Noise monitoring was conducted within the 10-km area of project site for noise profiling for 24 hrs using integrated sound level meter, as per CPCB guidelines.
Biological Environment			
Flora & Fauna	Study area	Once	Primary survey and Secondary sources
Demography & Socio-economics			
Demography & Socioeconomic	Study Area	Once	Primary survey/ Secondary sources

Standard methods and procedures have been strictly adhered during the course of this study. QA/QC procedures were strictly followed which covers all aspects of the study, and includes sample collection, handling, data coding, laboratory analyses, statistical analyses, presentation and communication of results. All analysis was carried out in NABL accredited and recognized laboratory.

3.5 PHYSICAL ENVIRONMENT

2.18.1. Geology & Geomorphology

Geologically, the Guwahati city represents a Precambrian terrain that is an extension of the Shillong plateau.
Physiographically, the area can be divided into three units-

- The hilly region in the south,
- The alluvial plains in central part and
- The western parts and the swamps along Brahmaputra flood plains.

Geologically, the city is made up of the Precambrian gneissic complex, which is, directly overlain by Pleistocene-Holocene sediments. The hills are made up of the gneisses and granite bodies with quartzites, amphibolites and biotite schists; with the intermontane valleys are filled with Pleistocene-Holocene sediments. The rocks are affected by two dominant sets of joints, intruded by quartz veins, aplite and pegmatite. The Shillong Group of rocks occurs as inselbergs in alluvium and hill ranges in southern boundary of the district with Meghalaya. These rocks occupy about 1500 sq. km, area south out of Brahmaputra river and 100 sq.km (ten percent) in north bank. They constitute mainly of schists and gneisses of varied nature and composition. Migmatites, basic rocks, granites and veins of different composition are embedded in these schists and gneisses. The basement is overlain by a cover of Quaternary deposits of variable thickness composed of unconsolidated sand, silt and clay. Along many tracts occupied by paleo channels, the typical Brahmaputra sand with abundant biotite and mostly silt is encountered. Thin layers of residual clays, which are the weathered product of feldspar, are found intertwined with the alluvium at places.

2.18.2. Geomorphology of the study area

Geomorphologically, Guwahati city is located in an area, where the Shillong Plateau and the Floodplains of the Brahmaputra confront each other. Landforms within the city are therefore unique with dissected hills (originally part of the Shillong Plateau), plain areas and natural lakes (the beels), swamps and the mighty river Brahmaputra. Precambrian residual hills dotting all around interspersed with elongated low-lying plains. Broadly, the area is categorized into three geomorphic units.

i) The denudo structural hills (residual hills),
ii) The alluvial plains and

iii) The marshy lands including the static water bodies (Water bodies with paleochannels)

2.18.3. Seismicity of the Study Area

Assam is among the most seismically active parts of India. Geomorphologically, northeast India is located in an earthquake prone zone (zone V) of the Indian subcontinent. In this region earthquakes come with landslides, floods along with series of earthquakes of smaller magnitude. Here earthquakes of up to MM intensity IX can be expected. According to a hazard map by the Global Seismic Hazard Assessment Program, the state can expect to have a peak gravitational acceleration (PGA) of 0.24g to 0.48g.

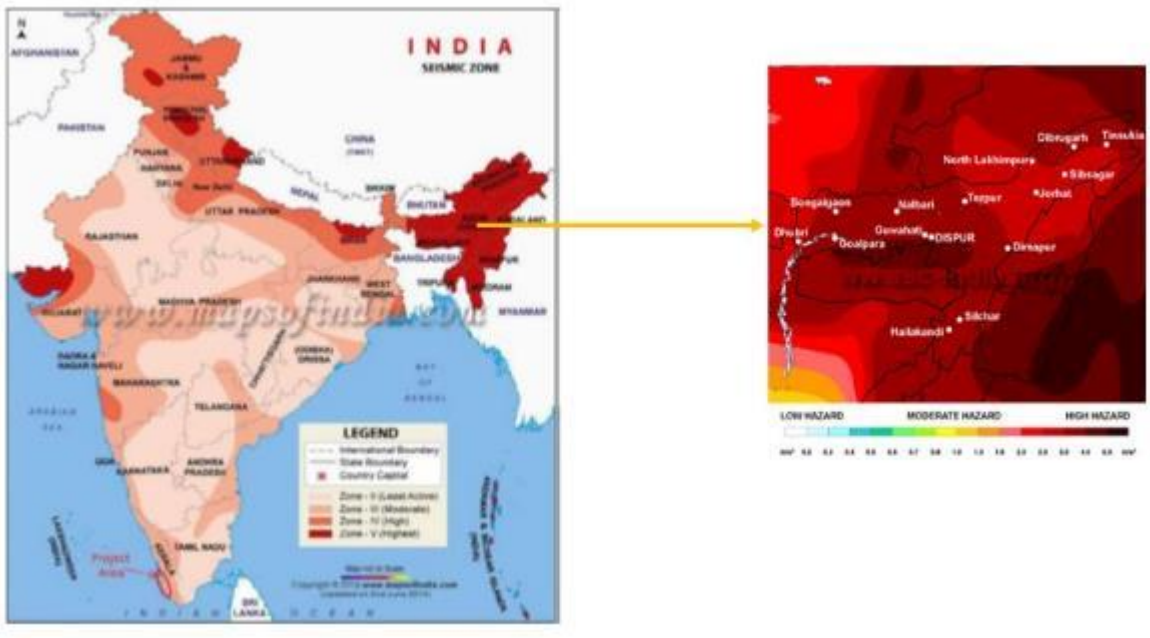


Figure 3.3: Seismic Zones Map

2.18.4. Topography

The topography of proposed alignment is flat terrain. The site elevation ranges between 55 to 65 amsl. However, careful analysis of the topography reveals that the greater Guwahati master-plan area can be divided into six well-defined natural divisions. The old city lies in a horse - shoe shaped valley surrounded on the north by the Brahmaputra river and on the other three sides by low hills comprising Kharghuli andChunchali hills in the east (maximum height 216m), Japarigog (277m), Nakarashura hill (293m) and Fatasil hills (292m) on the south and the famous Kamakhya (Nilachal hill) on the west (Maximum height 303m).

2.18.5. Drainage

The natural drainage system of Guwahati consists of the Bharalu River (a tributary of the Brahmaputra) and its inter-linkages to the beels and to the Brahmaputra river. The Brahmaputra which marks the northern boundary of the town is one of the most astonishing rivers in the world. The river is not truly dependent upon the monsoon rainfall alone for their Water supply; but it has also a supply from the melting of the Himalayan snow. The city of Guwahati lacks overall proper drainage system. The drains present along roads are not capable enough to handle excessive flow of water during monsoon season. The entire Guwahati Metropolitan Area is divided into seven drainage basins, through which all the waste water of the city is drained into the river Brahmaputra either directly or through various drainage channels and reservoirs indirectly. The drainage pattern of study area is as shown in figure no 3.4.

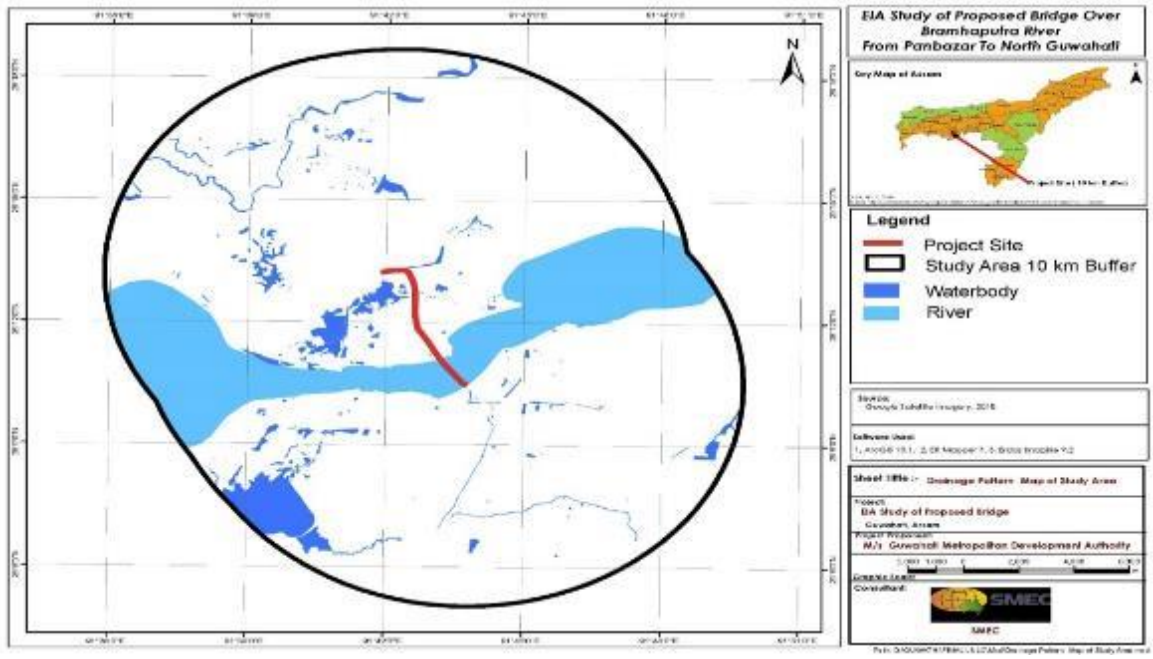


Figure 3.4: Drainage Map

3.6 LAND USE

Land use analysis was carried out using remote Sensing Data. Interpretation approach based on systematic digital imaging was used for delineating the land use classes. The demarcation of boundaries falling under different land use/land cover units is done using different colours assigned to different land use/land cover units of satellite imagery[1]

Land use depicts the use and pattern of land in the study area. Hence, the landuse map acts as the most important map for planning and site allocation and gives an idea about the availability of land for developed siting and the present use of that land. It reflects about the environmentally sensitive areas viz. reserved forests, plantations, water bodies, wetlands, etc. Land use and land cover pattern of project area is given in Table 3.3.

Table 3.3: Land use of the Study Area

S.N.	Name	Area (Sq. Km.)	%ge of Total Area
1	Agricultural Land	114.06	26.15
2	Forest	68.84	15.78
3	Green Belt	21.46	4.92
4	Open Space	22.23	5.10
5	Settlement	128.05	29.36
6	River	63.17	14.48
7	Waterbody	18.36	4.21
Total		436.17	100.00

Source: Satellite Image analysis

[1]The satellite Imagery of Indian Remote Sensing Satellite (IRS- ID, sensor P6, LISS III) of 24 m resolution was used. The Swath of the imagery is 141 Km x 141 Km. Band used are 4, 3, 2 and 5. LANDSAT imagery of 30 meter resolution and 185 x 185 km swath is also used for the comparative and overall analysis of the area. LISS III imagery and LANDSAT 4-5 TM imagery were used for the complete coverage of the study area

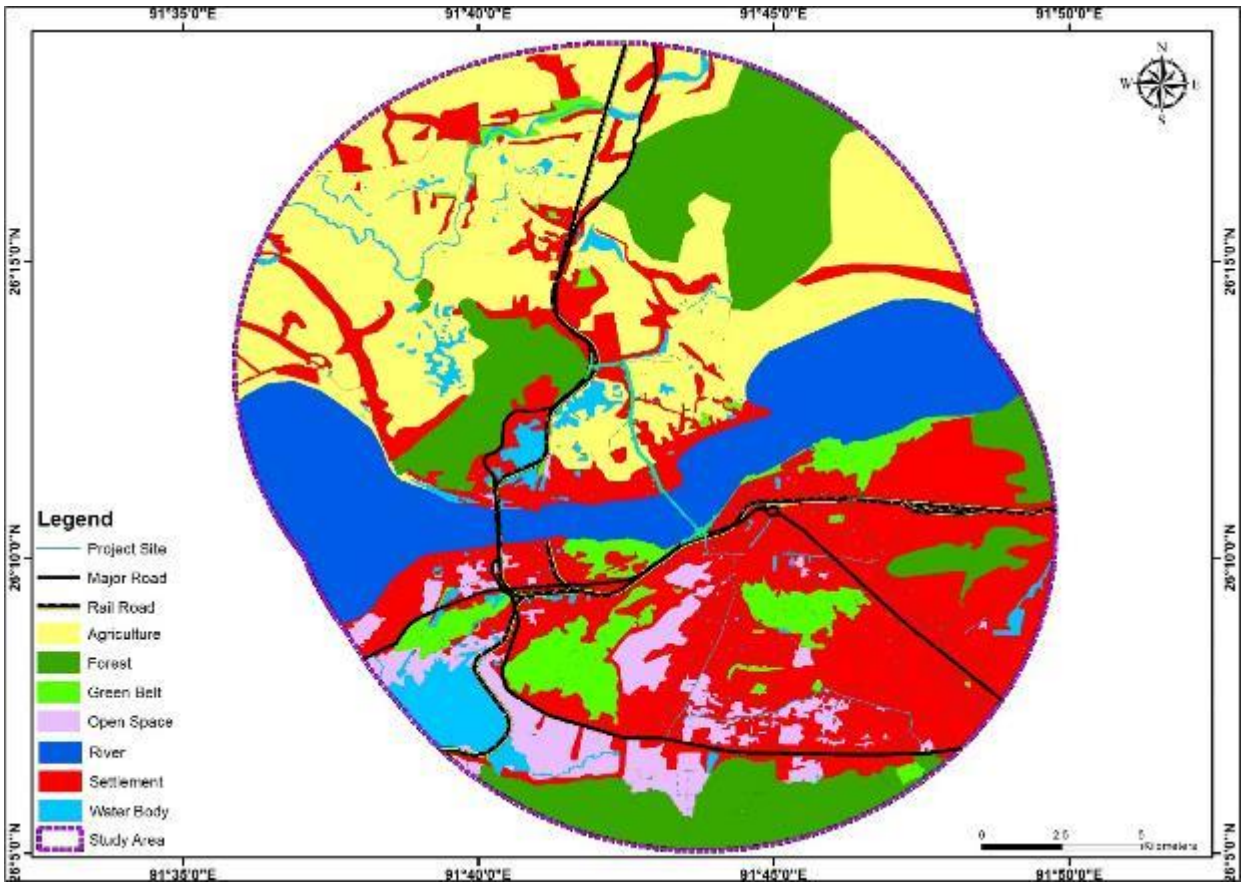


Figure 3.5: Area statistics for Land Use / Land Cover Categories in the Study Area

3.7 METEOROLOGY

Historical meteorological data was obtained from nearest IMD station located at Bhorjar. The predominant wind direction is from East and North-East direction during winter season. Details provided in **Table 3.4.**

Table 3.4: Long Term Meteorological Data of Bhorjar (30 years average)

Month	Temperature (°C) daily		Relative Humidity (%)		Rainfall (mm)	Predominant Wind Direction (From)	Pressure (hPa)	Wind Speed Km/hr
	Max	Min	Max	Min				
January	23.7	10.2	86	70	8.9	E, NE	1011.3	2.4
February	26.1	11.7	74	53	18.0	E, NE	1008.8	3.3
March	30.0	15.7	65	47	50.7	E, NE	1006.1	4.7
April	30.9	19.8	73	60	160.1	E, NE	1003.4	5.8
May	31.0	22.4	79	70	229.5	E, NE	1000.5	5.0
June	31.7	24.8	83	78	316.5	E, NE	996.1	4.3
July	31.7	25.4	85	80	356.6	E, NE	995.9	3.8
August	32.1	25.4	83	80	246.4	E, NE	997.2	3.8
September	31.5	24.5	83	81	180.2	E, NE	1001.2	3.3
October	30.2	21.7	83	80	82.8	E, NE	1006.1	3.1
November	27.4	16.6	84	79	23.3	E, NE	1009.7	2.7

December	24.5	11.6	87	78	7.1	E, NE	1011.6	2.2
Annual Total or Mean	29.2	19.1	80	71	1680.1	E,NE	1004.0	3.7

Source: IMD

- Temperature– December, January and February constitute winter months with daily mean minimum temperature around 10.2^{0}C and daily mean maximum temperature around 23.7^{0}C. May and June is the hottest month with daily mean maximum temperature at 39.2 ^{0}C and daily mean minimum temperature at 23.7 ^{0}C.
- Relative Humidity–April, May and June are driest with average relative humidity ranges between 60 - 83%. The maximum humidity during monsoon season is 85%.
- Rainfall– The annual total rainfall is 1680.1 mm.
- Wind Speed– The mean wind speed ranges from 2.2 to 5.8 kmph.
- Wind Direction– The predominant wind direction is from East and North-East direction in most of the year except monsoon season where wind blows from east and west direction.

2.20.1. Micro meteorology

Met data for 05th April 2018 to 05th May 2018 was generated at site. An automatic weather monitoring station was installed at near Project site, keeping the sensors free exposed to the atmosphere and with minimum interference with the nearby structures. The micro-meteorological data like wind speed, wind direction, temperature, relative humidity and atmospheric pressure were collected using the weather stationed cloud cover was recorded manually for the study period.

The wind directions, wind speed, temperature, rainfall and humidity recorded at site during study period are presented in Table 3.5. Site specific wind rose diagram for study period is presented in Figure 3.6.

Table 3.5: Site Specific Meteorological Data

Month	Temperature (deg C)		Relative Humidity, %		Wind speed (m/s)	Predominant wind Direction	Calm Period
	Min	Max	Min	Max	Average	(from)	%
April - 2018	20	34	38	89	6.6	NE, N	35

(Source: Field Survey)

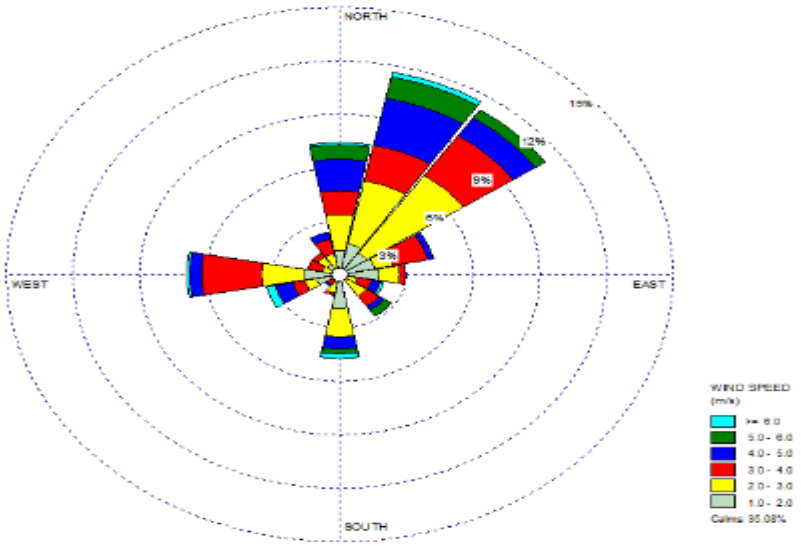


Figure 3.6: Wind Rose Diagram of Study Area (Pre-Monsoon Season) Map

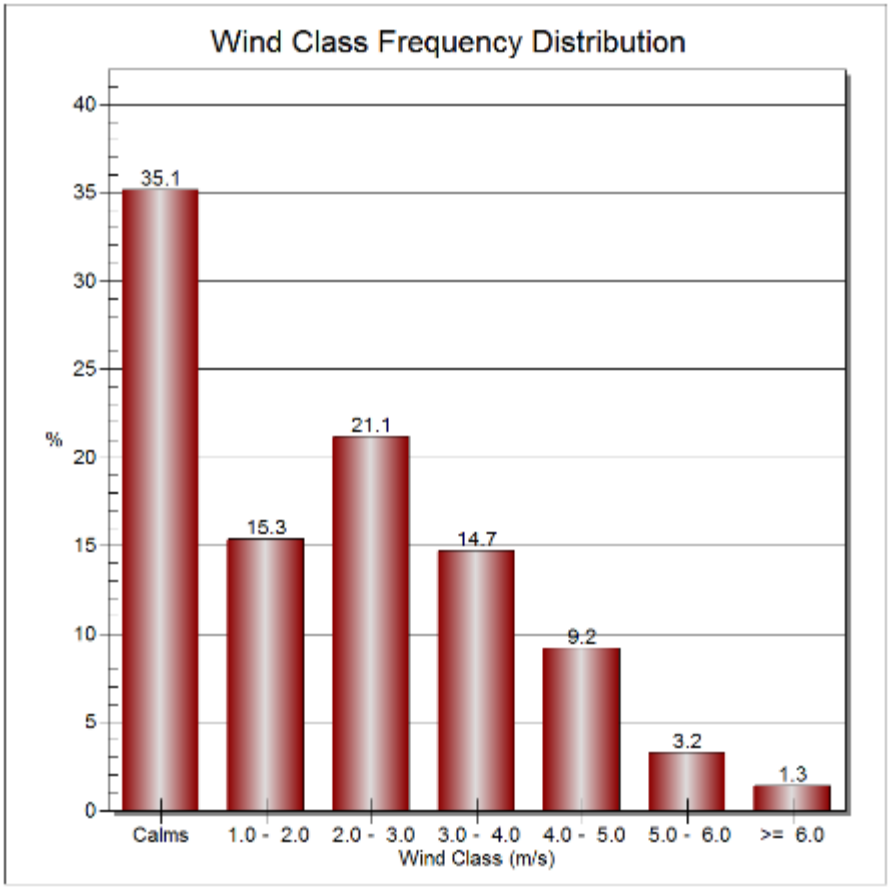


Figure 3.7: Wind Class Frequency Distribution

3.8 AMBIENT AIR QUALITY

CPCB guidelines were applied for selecting the appropriateness of monitoring locations. The location and height of the stations were so selected (>5 m from base) to avoid the capture of re-suspended road dust and fugitive domestic emissions due to burning. All the ambient air analysis with respect to each parameter were analyzed as per CPCB guidelines. AAQ monitoring was done at eight locations within the study area considering dominant wind direction, populated area and sensitive receptors.

The proposed project is a linear project where some air pollution is envisaged during operation phase due to vehicle movement and transpiration of material. During construction phase, air pollution may occur due to civil activities, material shifting, vehicle movement and D.G set operation. The sources of air pollution during construction and operational phases of the project are as follows: -

- Construction Phase: includes emissions from DG site, site clearance and preparation, Bridge and approach road, building of embankment and other related activities.
- Operational phase: includes emission from vehicle, transportation material and other ancillary activities

Furthermore, prime objective of collecting baseline air quality data is to assess the ambient air quality of the impact zone of proposed project alignement. Ambient air quality has been monitored at six locations and the locations were selected on the basis of dominant wind direction. Details of monitoring locations

are shown in **Table 3.6.** Monitoring Location map is shown in **Figure 3.8.** The summary of Ambient Air quality results is presented in **Table 3.7.**

Table 3.6: Location of Air Sampling

S. No.	Monitoring Location	GPS Location	Distance from Project Site (Km)	Direction from Project Site
AAQM- I	Gouripur Police Out Post, Amingaon, North Guwahati.	N:26º13'13" E:91º41'53"	3.28	West
AAQM- II	Ganesh Departmental Stores, Gouripur, North Guwahati	N:26º11'07" E:91º40'48"	3.30	South west
AAQM- III	North Guwahati Police Out Post, Abhyapur, North Guwahati	N:26º11'37" E:91º43'02"	0.20	East
AAQM- IV	Shankardev Park, Bharalumukh, South Bank, Guwahati	N:26º10'39" E:91º43'58"	0.40	East
AAQM- V	Near E Enterprise & Zahir Store, Sila, Koroibari, NH No.27	N:26º13'51" E:91º41'35"	0.40	North east
AAQM- VI	Near Aswaklanta Temple, Ferry Ghat, Majgaon, North Bank	N:26º11'13" E:91º43'22"	0.39	East

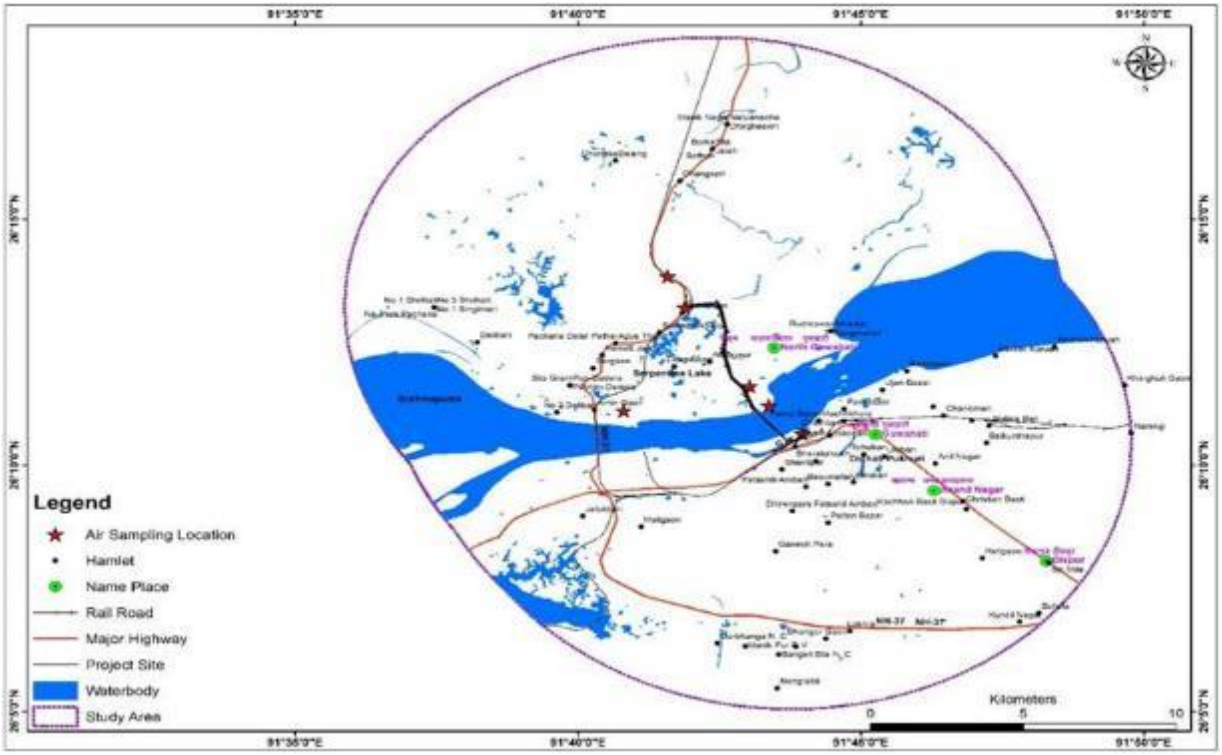


Figure 3.8: Ambient air sampling location

Some Photographs of Ambient Air Sampling within Study Area

Sampling above ground

Ongoing monitoring of air sampling

Table 3.7 (A): Ambient Air Quality Monitoring Results (24-hour average)

S. No.	Monitoring Location	GPS Location	PM_{10} (µg/m^3)				$PM_{2.5}$ (µg/m^3)			
			Min	Max	Mean	98 %tile	Min	Max	Mean	98 %tile
AAQM- I	Gouripur Police Out Post, Amingaon, North Guwahati	N:26º13'13" E:91º41'53"	70	85	77	84	28	36	31	34
AAQM- II	Ganesh Departmental	N:26º11'07" E:91º40'48"	54	74	65	74	20	31	26	31

	Stores, Gouripur, North Guwahati									
AAQM- III	North Guwahati Police Out Post, Abhyapur, North Guwahati	N:26º11'37" E:91º43'02"	55	73	63	72	22	32	27	32
AAQM- IV	Shankardev Park, Bharalumukh, South Bank, Guwahati	N:26º10'39" E:91º43'58"	58	80	68	79	21	35	26	35
AAQM- V	Near E Enterprise & Zahir Store, Sila, Koroibari, NH No.27	N:26º13'51" E:91º41'35"	60	81	69	80	25	35	30	35
AAQM- VI	Near Aswaklanta Temple, Ferry Ghat, Majgaon, North Bank	N:26º11'13" E:91º43'22"	57	75	65	74	22	32	27	35

Source: Primary Data Collection and analysis during April 2018

Table 3.7 (B): Ambient Air Quality Monitoring Results (24-hour average)

S. No.	Monitoring Location	GPS Location	SO_2 (µg/m³)				NOx(µg/m³)			
			Min	Max	Mean	98 %tile	Min	Max	Mean	98 %tile
AAQM-I	Gouripur Police Out Post, Amingaon, North Guwahati.	N:26º13'13" E:91º41'53"	5.0	8.5	6.5	8.3	12.0	16.4	13.9	16.3
AAQM-II	Ganesh Departmental Stores, Gouripur, North Guwahati	N:26º11'07" E:91º40'48"	4.8	8.0	6.4	7.8	10.0	14.7	12.2	14.5
AAQM-III	North Guwahati Police Out Post,	N:26º11'37" E:91º43'02"	4.3	7.8	5.9	7.7	10.4	14.6	12.5	14.5

S. No.	Monitoring Location	GPS Location	SO_2 (µg/m³)				NOx(µg/m³)			
			Min	Max	Mean	98 %tile	Min	Max	Mean	98 %tile
	Abhyapur, North Guwahati									
AAQM-IV	Shankardev Park, Bharalumukh, South Bank, Guwahati	N:26º10'39" E:91º43'58"	4.1	7.4	5.8	7.3	10.5	15.5	13.0	15.3
AAQM-V	Near E Enterprise & Zahir Store, Sila, Koroibari, NH No.27	N:26º13'51" E:91º41'35"	4.0	6.4	5.3	6.3	8.1	12.2	10.5	12.2
AAQM-VI	Near Aswaklanta Temple, Ferry Ghat, Majgaon, North Bank	N:26º11'13" E:91º43'22"	4.7	9.0	7.3	8.9	9.0	12.4	11.0	12.4

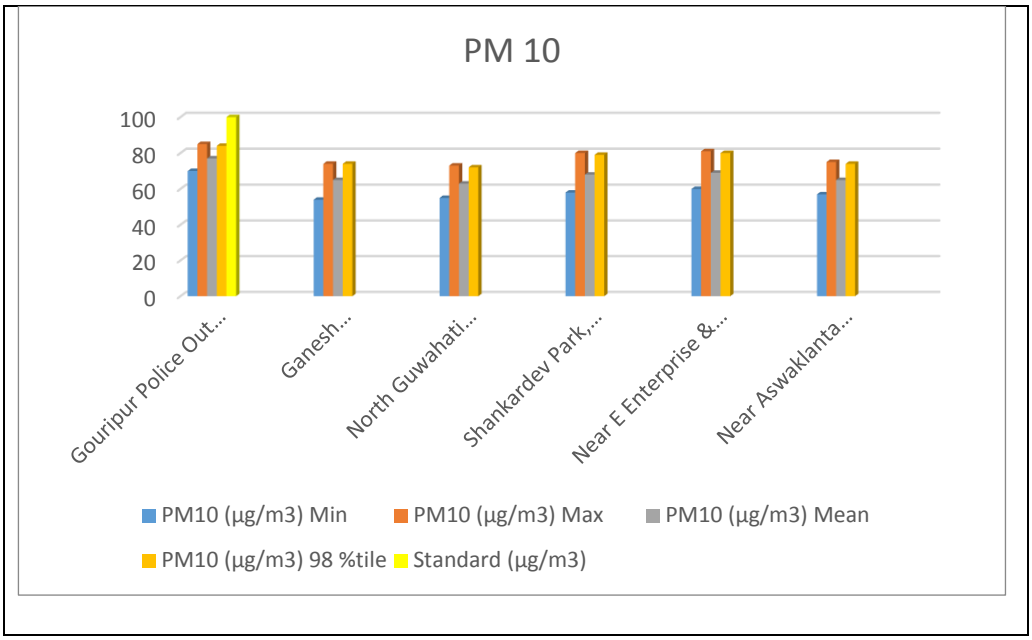
Source: Primary Data Collection and analysis during April 2018

Table 3.7 (C): Ambient Air Quality Monitoring Results (24-hour average)

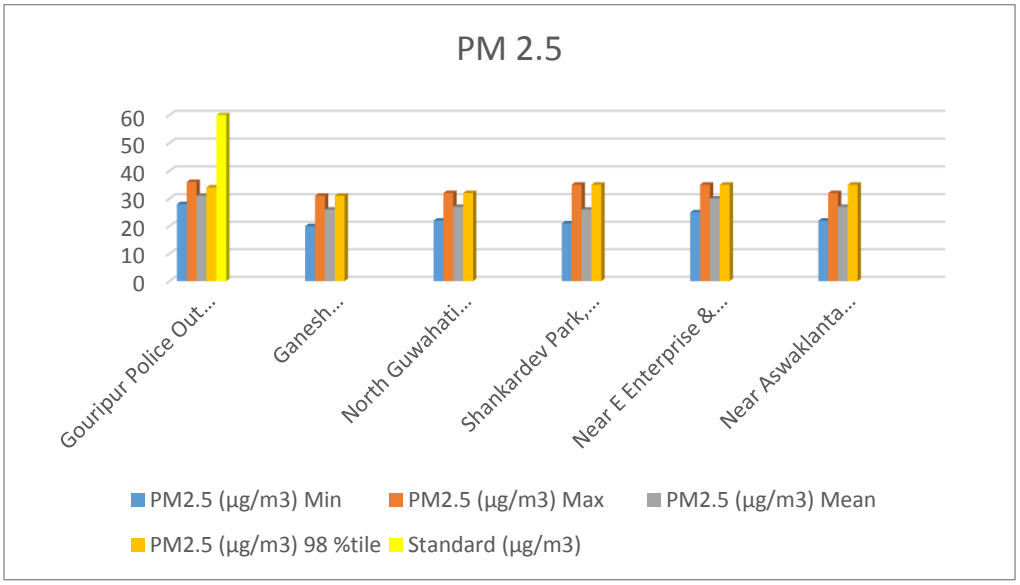
S. No.	Monitoring Location	GPS Location	CO(mg/m³) 8 hrs.			
			Min	Max	Mean	98 %tile
AAQM- I	Gouripur Police Out Post, Amingaon, North Guwahati.	N:26º13'13" E:91º41'53"	<0.1	<0.1	<0.1	<0.1
AAQM- II	Ganesh Departmental Stores, Gouripur, North Guwahati	N:26º11'07" E:91º40'48"	<0.1	<0.1	<0.1	<0.1
AAQM- III	North Guwahati Police Out Post, Abhyapur, North Guwahati	N:26º11'37" E:91º43'02"	<0.1	<0.1	<0.1	<0.1
AAQM- IV	Shankardev Park, Bharalumukh, South Bank, Guwahati	N:26º10'39" E:91º43'58"	<0.1	<0.1	<0.1	<0.1
AAQM- V	Near E Enterprise & Zahir Store, Sila, Koroibari, NH No.27	N:26º13'51" E:91º41'35"	<0.1	<0.1	<0.1	<0.1
AAQM- VI	Near Aswaklanta Temple, Ferry Ghat, Majgaon, North Bank	N:26º11'13" E:91º43'22"	<0.1	<0.1	<0.1	<0.1

Source: Primary Data Collection and analysis during April 2018

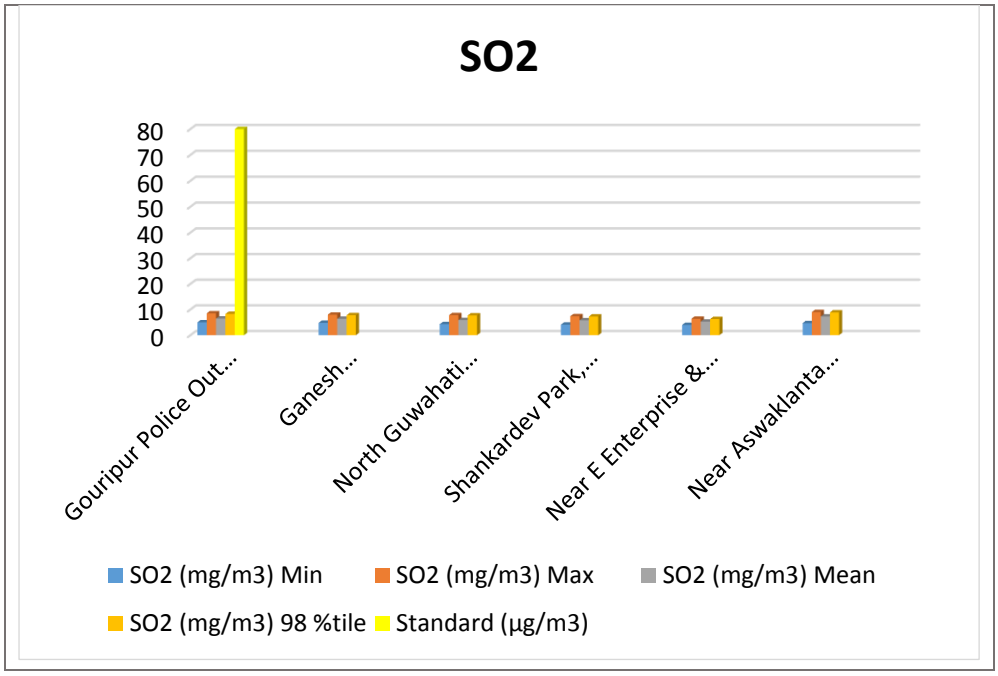
Observations on Ambient Air Quality (April 2017)



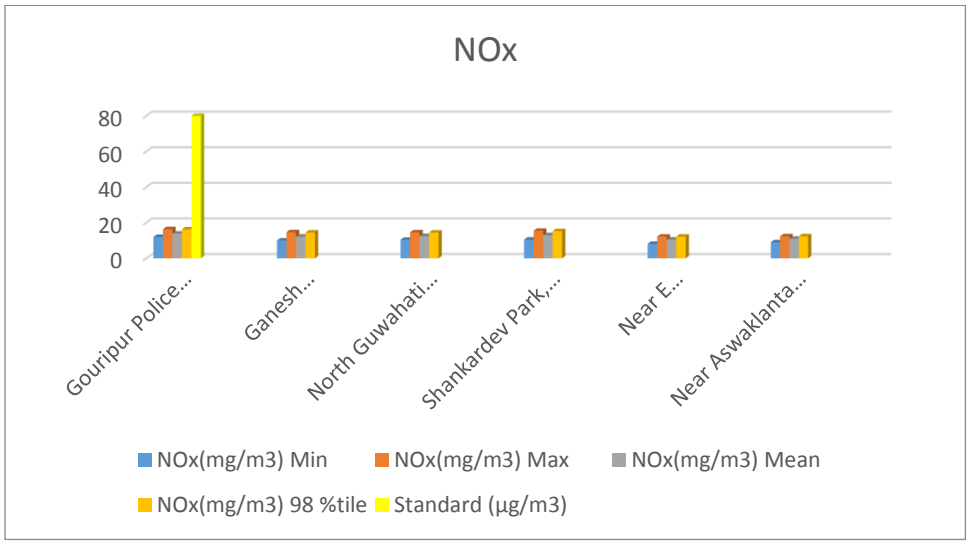
Particulate Matter (PM_{10}): The highest PM_{10} level were found at Gouripur Police Out Post, Amingaon, North Guwahati (85 µg/m^3) and lowest PM_{10} level at North Guwahati Police Out Post, Abhyapur, North Guwahati (55 µg/m^3) while the 98 % conc. of all location ranges between 72-84 µg/m^3. The PM_{10} level in all the monitoring locations is within permissible limit i.e. NAAQMS level 100µg/m^3.



Particulate Matter ($PM_{2.5}$): The highest $PM_{2.5}$ level was found at Gouripur Police Out Post, Amingaon, North Guwahati. (36 µg/m^3) and lowest $PM_{2.5}$ level was observed at North Guwahati Police Out Post, Abhyapur, North Guwahati (22 µg/m^3) while the 98%. of all location ranges between 26-31 µg/m^3. The $PM_{2.5}$ level in all the monitoring locations is within permissible limit i.e. NAAQMS level 60µg/m^3



Sulphur Dioxide (SO_2): The highest SO_2 level were found at Gouripur Police Out Post, Amingaon, North Guwahati. (8.5 µg/m3) and lowest SO_2 level were observed at Near E Enterprise & Zahir Store, Sila, Koroibari, NH No.27(4.0 µg/m3) while the 98%conc. of all location ranges between 6.3-8.9µg/m3. The SO_2 level in all the monitoring locations is within permissible limit i.e. NAAQMS level 80µg/m3.



Oxides of Nitrogen (NO_x): The highest NOx level was found at Gouripur Police Out Post, Amingaon, North Guwahati (16.4 µg/m^3) and lowest NO_x level were observed at Near E Enterprise & Zahir Store, Sila, Koroibari, NH No.27 (8.1 µg/m^3) while the 98%conc. of all location ranges between 12.2 to 16.3 µg/m^3. The NOx level in all monitoring location are under permissible limit i.e. NAAQMS level 80µg/m^3.

Other Parameters: The 8-hour concentration of CO was found below 0.1mg/m^3.

3.9 NOISE ENVIRONMENT

Noise levels have been measured at five locations also. The baseline study of noise levels in the study area of 10 Km has been carried out by selecting the noise monitoring location based on the following criteria.

- Source of noise.
- Proximity of the noise generating source to the human settlements.
- Exposure time.
- Time-scaled dose response ratio of individual receptor.

The noise levels were recorded for the day-night equivalent noise level (Ldn); it is calculated based on the equivalent noise level of day and night. Baseline monitoring was carried out at six selected monitoring locations for 24 hours during the study period of (April 2018). The noise monitoring location details is given in Table 3.8.

Table 3.8: Noise Monitoring Location

Monitoring Location	Distance	Direction
Gouripur Police Out Post, Amingaon, North Guwahati.	3.28	West
Ganesh Departmental Stores, Gouripur, North Guwahati	3.30	South west
North Guwahati Police Out Post, Abhyapur, North Guwahati	0.20	East
Shankardev Park, Bharalumukh, South Bank, Guwahati	0.40	East
Near E Enterprise & Zahir Store, Sila, Koroibari, NH No.27	0.40	North east
Near Aswaklanta Temple, Ferry Ghat, Majgaon, North Bank	0.39	East

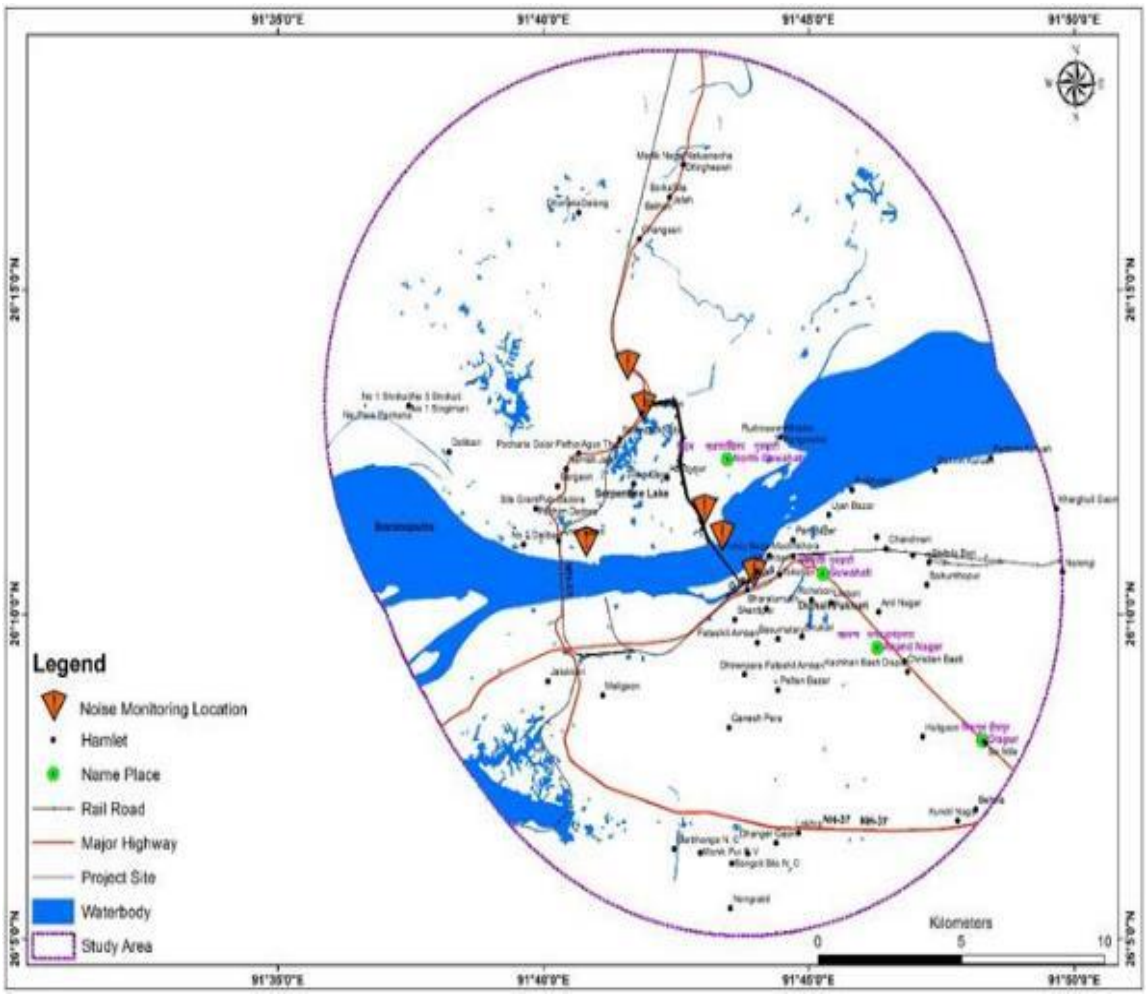


Figure 3.9: Ambient noise sampling location

Photographs of Ambient noise sampling

AANM - IV South Bank

AANM – V Near E Enterprise & Zahir Store, Sila, Koroibari

AANM - VI Noise Monitoring

Table 3.9: National Ambient Noise Quality Standards

Sl. No.	Area Code	Category of Zone	Limit Leq in dB (A)	
			*Day	**Night
1	A	Industrial	75	70
2	B	Commercial	65	55
3	C	Residential	55	45
4	D	Silence Zone	50	40

** Day Time – 6.00 am – 9.00 pm (15 hours)*

*** Night Time – 9.00 pm – 6.00 am (9 hours*)

Table 3.10: Summary of ambient noise level monitored

Location Name	Category	Day Time Leq dB(A)	National Standard Day Time Leq dB(A)	Value Night Time Leq dB(A)	National Standard Night Time Leq dB(A)
Gouripur Police Out Post, Amingaon, North Guwahati.	Commercial	61.3	65.0	48.3	70.0
Ganesh Departmental Stores, Gouripur, North Guwahati	Residential	56.6	55.0	45.8	45.0
North Guwahati Police Out Post, Abhyapur, North Guwahati	Commercial	52.4	55.0	42.4	45.0
Shankardev Park, Bharalumukh, South Bank, Guwahati	Residential	53.8	55.0	43.1	45.0
Near E Enterprise & Zahir Store, Sila, Koroibari, NH No.27	Residential	52.6	55.0	42.5	45.0
Near Aswaklanta Temple, Ferry Ghat, Majgaon, North Bank	Commercial	49.8	65.0	41.4	55.0

Observation on Ambient Noise Quality

The ambient noise quality of the study area is within the prescribed National Ambient Noise Quality Standards prescribed for industrial (Standards - 75 dBA during day time and 70dBA during night time) residential area (Standards - 55 dBA during day time and 45 dBA during night time) and commercial area (Standards - 65 dBA during day time and 55 dBA during night time), except location at Ganesh Departmental Stores, Gouripur, North Guwahati. Slightly higher value in this location may be due to vehicular noise come for shopping at night.

3.10 GROUND WATER

Groundwater is the water present beneath Earth's surface in soilpore spaces and in the fractures of rock formations. Groundwater is the water found underground in the cracks and spaces in soil, sand and rock. It is stored in and moves slowly through geologic formations of soil, sand and rocks called aquifers.

3.11 GROUND WATER QUALITY

Drinking water requirement of the study area is adequately meet through ground water resources. To assess the ground water quality of the study area six ground water samples were collected from different locations within the study area and analysed as per standard method. The water samples were examined for physico-chemical parameters as well as for bacteriological parameters. Samples for chemical analyses were collected in polyethylene carboys. Samples for bacteriological analyses were collected in sterilized bottles (APHA Method). The details of sampling locations with are presented in **Table 3.11**. Map showing water sampling location is given in **Figure 3.12.** Analysis results of groundwater are presented in **Table 3.12 (A)**.

Table 3.11: Ground Sampling location of Water Quality

S. No.	Sampling Location	GPS Location	Distance from Project Site (Km)	Direction from Project Site
GW- I	Gouripur Police Out Post, Amingaon, North Guwahati	N:26º13’16” E:91º41’54”	3.28	West
GW- II	Ganesh Departmental Stores, Gouripur, North Guwahati	N:26º11’08” E:91º40’48”	3.30	South west
GW-III	Near E Enterprise & Zahir Store,	N:26º13'53"	0.20	East

S. No.	Sampling Location	GPS Location	Distance from Project Site (Km)	Direction from Project Site
	Sila, Koroibari, NH No.27	E:91º41'36"		
GW- IV	North Guwahati P.S	N:26º11'37" E:91º43'02"	0.40	East
GW- V	Near Aswaklanta Temple, Ferry Ghat, Majgaon, North Bank	N:26º11'13" E:91º43'21"	0.39	North east

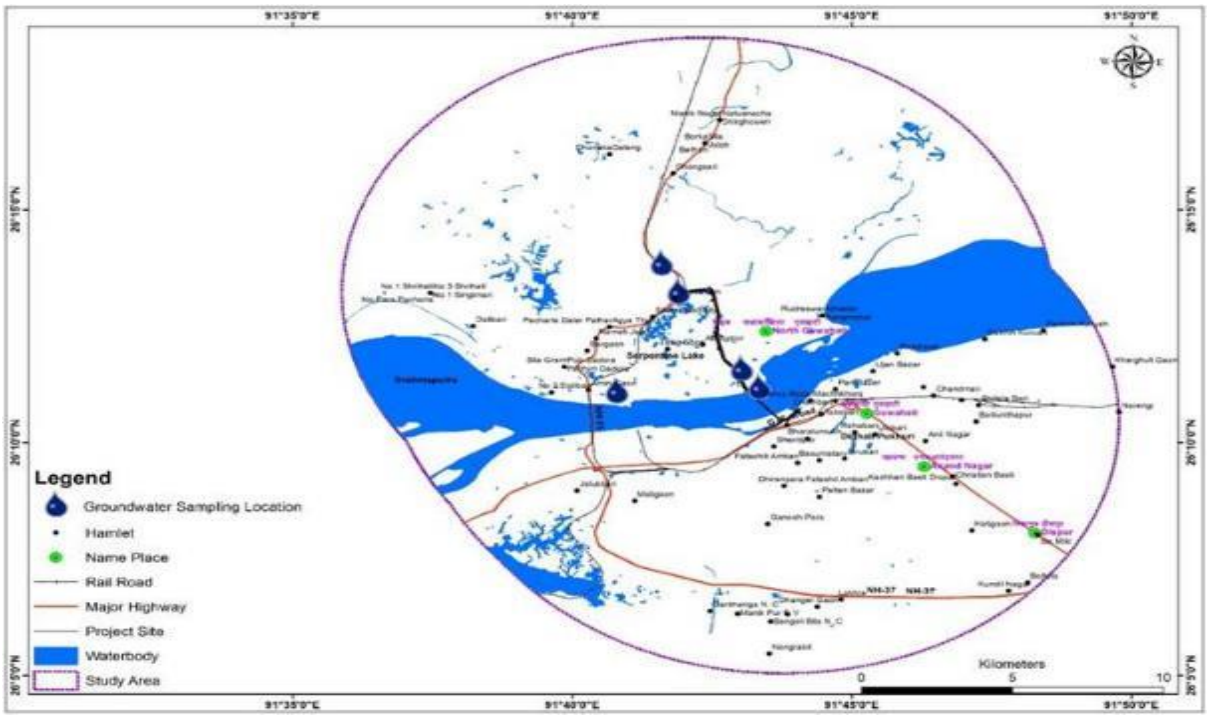


Figure 3.10: Sampling location of Ground Water

Some Photographs of Ground water sampling

GW – I Gouripur Police Out Post, Amingaon, North Guwahati

GW - II Ganesh Departmental Stores, Gouripur, North Guwahati

	
GW-III Near E Enterprise & Zahir Store, Sila, Koroibari, NH No.27	GW – V Near Aswaklanta Temple, Ferry Ghat,Majgaon, North Bank

Table 3.12: Ground Water Quality in the Study Area (April -2017)

S.N.	Parameters	GW-1	GW-2	GW-3	GW-4	GW 5	Method	Desired Limit /Permissible Limit
1	Colour Hazen	<5	<5	<5	<5	<5	Part 4	5-15
2	pH value	7.08	7.85	7.62	7.50	7.34	APHA-4500	6.5-8.5/ No relexation
3	Temperature 0C	23.5	23.6	24.0	23.8	23.8	Part 9	--
4	Conductivity, µmhos/cm	1272	596	1012	963	1120	APHA-4500	--
5	Turbidity (NTU)	0.68	0.34	0.31	<0.1	0.66	APHA-2030B	--
6	Total Dissolved solids mg/l	884	394	640	635	778	APHA-2540B	500/2000
7	Total Suspended solids mg/l	1.6	0.86	1.0	0.84	0.98	APHA-2540D	--
8	Total Hardness as CaCO3 mg/l	334	260	318	350	304	APHA-2340C	200/600
9	Chloride as Cl mg/l	128	48	78	71	120	APHA-4500B	250/1000
10	Total Alkalinity mg/l	296	168	324	451	310	Part -23	200/600
11	Sulphates as SO4 mg/l	104	90	110	26	88	APHA-4500E	200/400
12	Nitrates as NO3 mg/l	122	1.4	5.8	0.21	98	APHA-4500	45/No relexation
13	Fluoride as F mg/l	0.37	0.42	0.45	0.40	0.39	APHA-4500D	1/1.5
14	Iron as Fe mg/l	0.45	0.38	0.38	0.44	0.48	APHA-3111B	0.3/No relexation
15	Zinc as Zn mg/l	1.46	1.20	1.12	1.34	1.34	APHA-3111B	5/15

16	Calcium as Ca mg/l	58	60	78	74	62	APHA-3500B	75/200
17	Magnesium as Mg mg/l	45.6	26.5	29.8	40	37	APHA-3500B	30/100
18	Sodium as Na mg/l	88	24	70	56	82	APHA-3500	--
19	Potassium as K mg/l	20	4.5	15	2.2	16	APHA-3500 KB	--
20	Cadmium as Cd mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	APHA-3111B	0.003/No elexation
21	Copper as Cu mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	APHA-3111B	0.05/1.5
22	Nickel as Ni mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	APHA-3111B	0.02/No relexation
23	Lead as Pb mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	APHA-3111B	0.01/No relexation
24	Mercury as Hg mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	APHA-3112	0.001/0.001
25	Chromium (Total as Cr) mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	APHA-3111B	0.5/No relexation
26	Arsenic as As mg/l	<0.025	<0.025	<0.025	<0.025	<0.025	APHA-3114	0.01/0.05
27	Phenolic compound mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	Part 43	0.001/0.002
28	Total coliform MPN/100ml	Nil	Nil	Nil	Nil	Nil	APHA-9230B	Nil

Observation on Ground Water Quality

The Physico-chemical characteristics of the ground water samples were in good agreement with IS: 10500 permissible limits. TDS, Total Hardness, calcium, Magnesium chloride values are slightly above the desirable limit but within the permissible limits specified under Drinking Water Standard (IS: 10500). As regards heavy metals, only Fe and Zn were present but quite lower in concentration whereas the other heavy metals were in traces. Hence, the GW of the study area is neither contaminated nor high in any metallic contamination from any natural sources.

- The pH value of ground water is an important index of acidity or alkalinity. pH value of the sample varies from 7.08 to 7.85 in all locations, which is well within the specified standard of 6.5 to 8.5. In general, the pH of the ground water is slightly basic in nature.
- Electric Conductivity levels vary from 596 to 1272 µmho/cm & Total dissolved solids ranges from 394 to 884 mg/l. The TDS values were found within permissible limit of Indian Standard IS: 10500-2012 at all locations.
- The hardness values in ground water of the study area ranges between 260 to 350 mg/l. Hardness values is well within the permissible limit of Indian Standard IS: 10500-2012
- The chloride values in ground water of the study area ranges between 48 to 128 mg/l. Chloride values is well within the permissible limit of Indian Standard IS: 10500-2012 at all locations
- The fluoride content was found within the range.

- No biological and metallic contamination has been found in any of the ground water sample of the study area.

3.12 SURFACE WATER QUALITY

Four surface water samples were collected from the surface water sources of the study area. Two samples of Brahmaputra (one in upstream and one in downstream) and Two sample from pond were collected as per the standard method. Samples for bacteriological analyses were collected in sterilized bottles. The water samples were examined for physico-chemical parameters and bacteriological parameters. Samples were analyzed for various parameters using the CPCB's BDU Criteria. The name of sampling locations is presented in **Table 3.13**. The analysis results of surface water are presented in **Table 3.14.**

Table 3.13: Sampling location of Surface Water Quality

S. No.	Sampling Location	GPS Location	Distance from Project Site (Km)	Direction from Project Site
SW- I	South Bank of river Brahmaputra	N:26º10'40" E:91º43'57"	0.40	West
SW-II	North Bank of river Brahmaputra	N:26º11'10" E:91º43'21"	2.30	East
SW-III	Gouripur Pond	N:26º13'14" E:91º41'57"	0.20	East
SW-IV	Opp. North Guwahati PS, Abhaypur	N:26º11'36" E:91º43'01"	0.40	East
SW-V	Near Ganesh Departmental Store	N:26º12'34" E:91º42'36"	0.40	North east

Some Photographs of Surface water sampling

North Bank of river Brahmaputra

South Bank of river Brahmaputra

	
Gouripur II	Opp. North Guwahati PS, Abhaypur

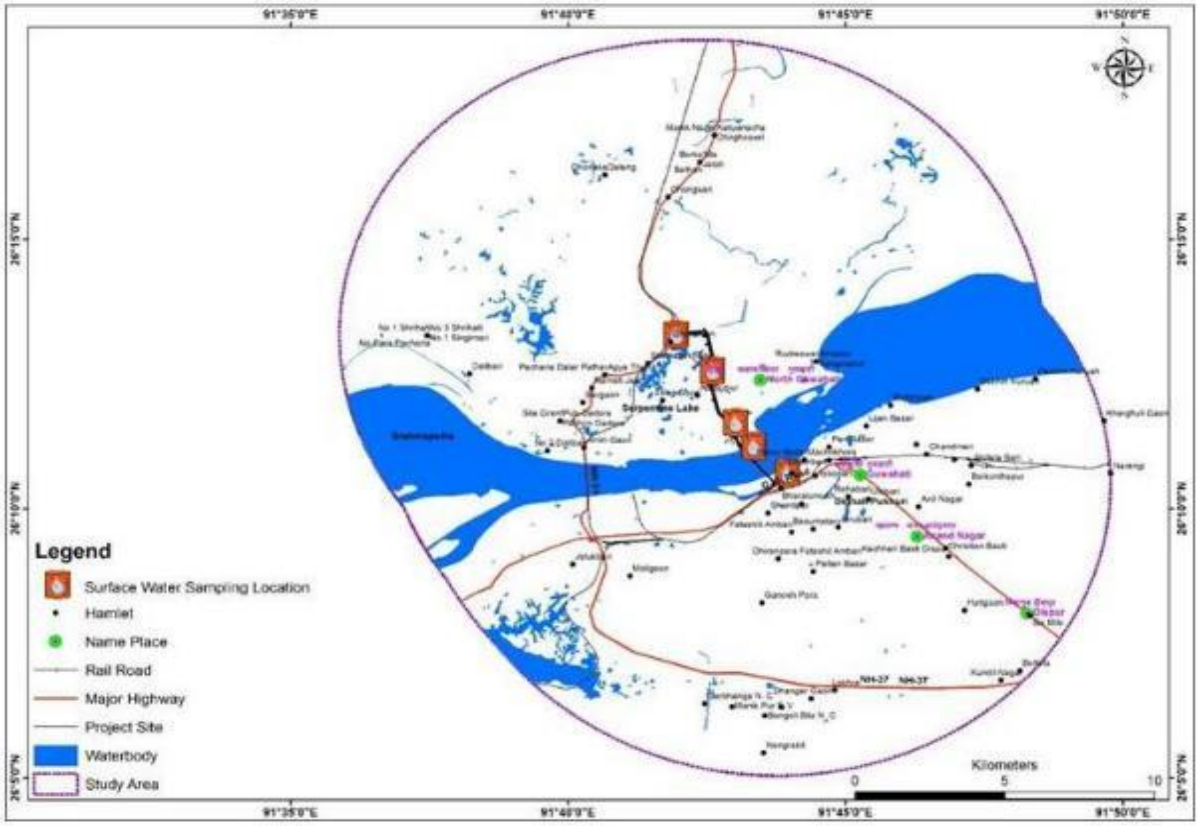


Figure 3.11: Surface water sampling location

Table 3.14: Surface Water Quality in the Study Area (April -2017)

S.N.	Parameters	SW1	SW2	SW3	SW4	SW 5	Method
1	Colour Hazen	<5	<5	<5	<5	<5	Part 4
2	pH value	7.30	7.35	7.33	7.85	7.28	APHA-4500
3	Temperature 0C	22.4	22.8	22,6	21.8	21.4	Part 9
4	Conductivity, µmhos/cm	510	490	356	898	367	APHA-4500
5	Turbidity (NTU)	2.1	2.5	1.7	4.5	2.1	APHA-2030B
6	Total Dissolved solids	330	316	252	608	285	APHA-2540B
7	Total Suspended	8	9	4	26	6	APHA-2540D

S.N.	Parameters	SW1	SW2	SW3	SW4	SW 5	Method
	solids						
8	Total Hardness as CaCO3	222	214	156	338	256	APHA-2340C
9	Chloride as Cl	34	32	28	168	36	APHA-4500B
10	Total Alkalinity	154	140	120	258	143	Part -23
11	Sulphates as SO4	16	17	13	38	16	APHA-4500E
12	Nitrates as NO3	0.34	0.38	0.29	2.3	0.35	APHA-4500
13	Fluoride as F	0.56	0.58	0.48	0.88	0.42	APHA-4500D
15	Zinc as Zn	1.22	1.28	1.10	1.45	1.35	APHA-3111B
16	Calcium as Ca	52	38	34	45	39	APHA-3500B
17	Magnesium as Mg	22.4	29.1	17.2	54.7	21.4	APHA-3500B
18	Sodium as Na	34	28	18	67	18	APHA-3500 Na B
19	Cadmium as Cd	<0.01	<0.01	<0.01	<0.01	<0.01	APHA-3111B
20	Copper as Cu	<0.01	<0.01	<0.01	<0.01	<0.01	APHA-3111B
21	Nickel as Ni	<0.01	<0.01	<0.01	<0.01	<0.01	APHA-3111B
22	Lead as Pb	<0.01	0.01	<0.01	<0.01	<0.01	APHA-3111B
23	Mercury as Hg	<0.001	<0.001	<0.001	<0.001	<0.001	APHA-3112
24	Chromium (Total as Cr)	<0.05	<0.05	<0.05	<0.05	<0.05	APHA-3111B
25	Arsenic as As	<0.025	<0.025	<0.025	<0.025	<0.025	APHA-3114
26	Phenolic compound	<0.001	<0.001	<0.001	<0.001	<0.001	Part 43
27	DO	6.5	6.8	6.2	<5.4	6.2	Part 38
28	Oil & Grease	<0.1	<0.1	<0.1	<0.1	<0.1	Part 39
29	BOD	10	9	8	18	9	Part 44
30	COD	36	30	26	70	29	Part 58
31	Fecal coliform MPN/100ml	2850	2680	1840	4250	2210	APHA-9230B

Observation on Surface water Quality

The Brahmaputra river water quality (upstream and downstream) parameters are compared with BDU Criteria of CPCB. The river and canal water quality with respect two pH and DO in river in both the sampling location comply with the Class A of BDU Criteria of CPCB. Where as, BOD and COD do not comply with the standards at all location. Heavy metals, only Fe and Zn have been recorded with lower concentration & rest of the heavy metals were in traces. No metal contamination has been found in surface water samples. Overall the surface water quality of the river (upsteam and downstream) is meeting the Class D of BDU Criteria of CPCB for its suitability for wild life and fisheries. Bacterial and metallic contamination was observed in the Gouripur pond water quality. The water quality of Pond was found to meet the Best Designated Use – 'D' Criteria of CPCB (i.e fit for fish propagation).

3.13 SOIL ENVIRONMENT

Soils may be defined as a thin layer of earth's crust that serves as a natural medium for the growth of plants wherein root zone develops. It is the unconsolidated mineral matter that has been subjected to and influenced by genetic and environmental factors. Soils serve as a reservoir of nutrients for plants and crops and also provide mechanical anchorage and favourable tilts. Soil is the seat of many macro and micro flora like algae, fungi, earthworms, bacteria etc. These are very beneficial in promoting soil reactions and decomposing the organic matter by which essential nutrients for plants are liberated.

3.14 SAMPLING METHODOLOGY

The soil samples were collected from five selected locations during Pre -monsoon season. The samples collected were homogeneous representatives of each location. At random five sub-locations were identified at each location and soil samples were collected from 5 to 15-cm below the surface. It was uniformly mixed before homogenizing the soil samples. The samples about 500-gms were packed in polythene bags labelled in the field with location & number and sent to the laboratory for the analysis of physicochemical parameters.

3.15 SAMPLING AND ANALYSIS

To assess the impacts of the proposed activities on the soils in the area, the physicochemical characteristics of soils within the study area have been examined by obtaining soil samples from selected points and analysis of the same. Sampling locations of soil is mentioned in **Table 3.15**. The physicochemical characteristics of the soils in the study area, as obtained from the analysis of the soil samples are presented in **Table 3.16.**

Table 3.15: Soil Sampling Locations

S. No.	Sampling Location	GPS Location	Distance from Project Site (Km)	Direction from Project Site
SS- I	South Bank	N:26º10’39” E:91º43’58”	3.28	West
SS- II	Near Gauripur	N:26º13'51" E:91º41'36"	3.30	South west
SS- III	North Guwahati	N:26º12'34" E:91º42'36"	0.20	East
SS-IV	Opp. North Guwahati Police Out Post, Abhyapur, North Guwahati	N:26º11'51" E:91º43'02"	0.40	East
SS-V	Near Aswaklanta Temple, Ferry Ghat, Majgaon, North Bank	N:26º11'13" E:91º43'21"	0.39	North east

Some Photographs of Soil Sampling

SS – I South Bank

SS - II Near Gauripur

SS-III North Guwahati

SS-IV Opp. North Guwahati Police Out Post, Abhyapur, North Guwahati

SS-V Near Aswaklanta Temple, Ferry Ghat, Majgaon, North Bank

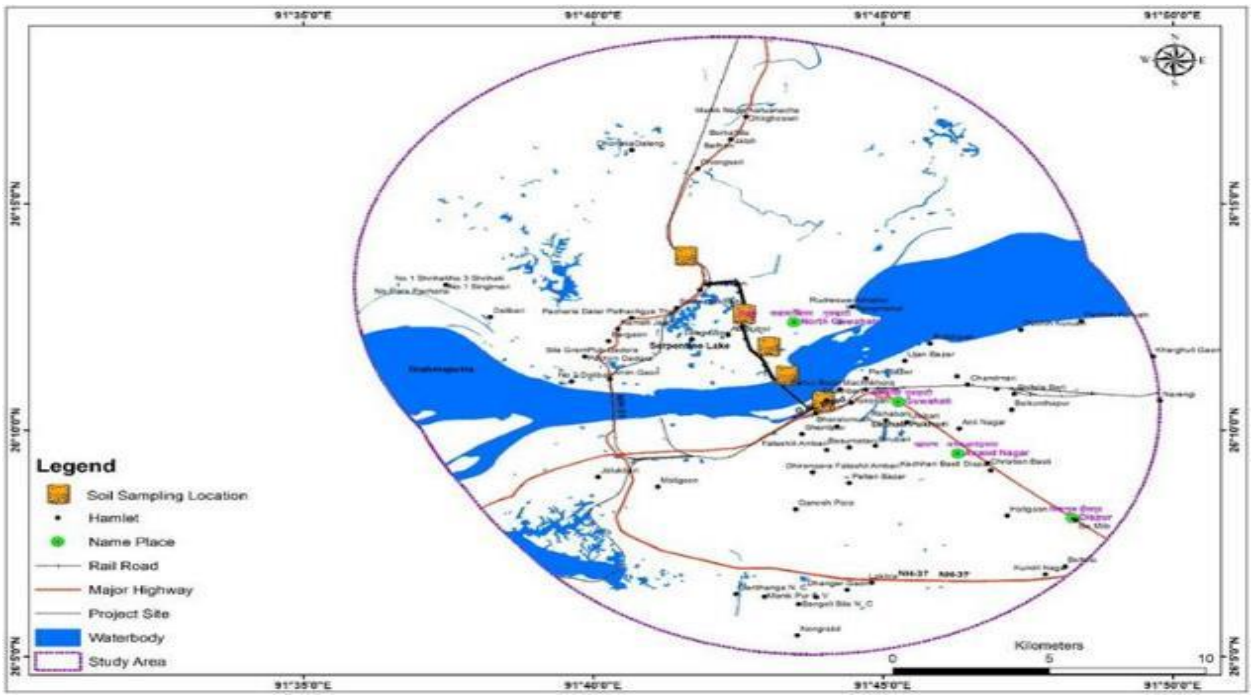


Figure 3.12: Soil sampling location

Table 3.12: Physiochemical Characteristics of Soil

S. No.	Parameters	Unit	S-1	S-3	S-2	S-5	S-4
Physical Characteristics							
1.	Color	-					
2.	Texture	USDA System	Sandy Loam	Sandy Clay Loam	Clay Loam	Sandy Loam	Clay
3.	Particle Size Distribution						
i)	Sand	%	56	56	28	57	19
ii)	Silt	%	26	23	37	24	36
iii)	Clay	%	18	21	35	19	45
4.	Porosity	%					
5.	Bulk Density (BD)	gm/cc	1.46	1.40	1.28	1.37	1.21
6.	Water Holding Capacity (WHC)	%	28.9	29.8	30.6	28.7	31.6
7.	Permeability	cm/hr	0.94	0.66	0.30	0.83	0.22
Chemical Characteristics							
8.	pH (1:5)	-	7.46	7.74	7.66	7.55	7.38
9.	Conductivity (EC)	µmhos/cm	140.6	135.4	155.4	132.7	144.1
10.	CEC	meq/100-gm	11.5	10.8	22.8	11.4	34.8
11.	Organic Matter	%	0.95	0.99	1.07	1.24	1.17
12.	Organic Carbon	%	0.55	0.58	0.62	0.72	0.68
13.	Zinc as Zn	mg/kg	0.85	0.77	0.68	0.58	0.72
14.	Iron as Fe	mg/kg	5.56	6.21	4.67	5.85	7.65
15.	Copper as Cu	mg/kg	3.45	4.45	5.35	4.16	5.66
16.	Manganese as Mn	mg/kg	45.8	68.5	56.8	62.5	76.8
17.	Boron as B	mg/kg	5.82	4.92	3.84	5.66	6.25
	Available Nutrients						
i)	Nitrogen as N	kg/ha	278.5	345.2	367.9	298.8	372.5
ii)	Phosphorus as P	kg/ha	25.6	16.9	22.5	18.5	26.4
iii)	Potassium as K	kg/ha	129.2	135.2	132.9	133.8	138.2

3.16 SOIL CHARACTERISTICS

Physical Characteristics

The physical characteristics examined include color, texture, bulk density, porosity and water holding capacity. As of texture as per 'USDA' Triangular Classification System, soils of all the sampling locations can be described as Sandy Clay Loam, Sandy Loam, Clay & Clay Loam Soils, Sandy Clay. Bulk density of soils in the study area varied between 1.16 to 1.46 gm/cm3. Water Holding Capacity of study area soils was observed as 28.7 to 32.5%. In the study area, permeability values were found to vary from 0.19 to 0.94-cm/hr.

Chemical Characteristics

The soils of the study area are slightly alkaline with pH range (7.28 to 7.74). Electrical conductivity (EC) was found varying between 132.7-155.4 µmhos/cm. Available potassium content in soil sample ranges between 129.2 & 138.2 kg/ha thereby is indicating that the soils are with medium of available potassium content. Available nitrogen content in the soil sample ranges between 278.5 & 385.2 kg/ha indicates that soils are medium in available nitrogen content. Available phosphorus content ranged between 16.9 & 26.4 kg/ha, indicating that soils having medium level of available phosphorus. The metelic contents in

soil samples are within the acceptable range. The overall fertility status of the soils within the study area is moderate.

3.17 ECOLOGICAL ENVIRONMENT

The environment has a limited carrying capacity and it can only sustain a negative impact up to a level, without further degradation. Several systems, however, temporarily disturb it leading to a new balance in order to re-establish the equilibrium between human activity and nature. But sensitive systems are not so resilient to cope up with changes in natural environment, thus not only leading to negative impact on them, but also, socio-economic losses may occur. Developmental projects are meant for improving the quality of life for people and growing the economy of the region and country as a whole. For all positive impacts of the developmental projects, there may be also some significant detrimental impacts on nearby natural environment. There can be direct or indirect impact on flora, fauna etc. Environmental considerations are therefore of prime importance in projects.

2.30.1. Baseline Scenario

The identification of environmental parameters, data collection and impact prediction form the crux of any Environmental Assessment study. It is pre-requisite to assess the baseline status of the proposed project site. This helps to anticipate the adverse impacts due to various stages of project implementation. The present section provides information on brief baseline environmental setting. The baseline status has been described for various environmental parameters which are categorized as below.

2.30.2. Terrestrial Ecology

The published documents of the concerned forest divisions, various published reports and research papers are used as the secondary source of data.
To gather primary data, a detail investigation was made to understand overall vegetation profile and floral resource characteristics of the proposed project area in Pre-monsoon season of the year.

Figure 3.13: Study area Map

The assessment of the flora of the study area is done by an extensive field survey of the area. General information was collected on the vernacular names and uses of plants made by local inhabitants. Plants species were identified based on their specific diagnostics characters of family, genus and species using available floral, other related literature and herbarium.

Forest and Forest Types has been documented as per Champain and Seth (1968) Forest classification of India.

Rare and endangered species were identified referring to the Red Data Book of India, WPA, 1972 and other available literature.
Interaction with local people for extracting information on the presence and relative abundance of various animal species has been accomplished to fold information of faunal species.
Ground surveys has been carried out by trekking for identification of important animal groups such as birds, mammals, reptiles and butterflies (insects) etc. inhabiting the area, along the riverbanks, adjoining areas, nearby water bodies and agricultural fields. Detailed ecological deliberation is as follows:
Details of flora, fauna, important environmental sensitive receptors in different project zones of the study are mentioned as under.

A. Core Zone (Corridor of Impact)

A total of 7455 (including Bamboo clusters and Horticultural plants) of plant species were recorded from the Corridor of Impact (COI). List of plant species found within the COI of the proposed project is given in Annexure 3.2.

B. Buffer Zone

The direct impact zone is 500m on either side of the corridor of impact. Details of important environmental sensitive receptors are as follows.

Table 3.18: Valued Environmental Components within 500 m on either side of the corridor of impact

Sl. No.	Name of the Environmental Receptors	Approximate distance (in m)	Design Chainage of the Alignment
South Bank			
1.	Sonarum High School	15	From Chainage 0+000
2.	Swagat Endoparalaspic Research Centre	500	From Chainage 0+000
3.	Shankardev Udyan	600	From Chainage 0+000
4.	Bhutnath Temple	840	From Chainage 0+000
5.	Mahendra Mohan Choudhury Hospital	1700	From Chainage 0+000
6.	Kamakhya Temple	2600	From Chainage 0+000
North Bank			
7.	Faculty Higher Secondary School	1800	From Chainage 1+600
8.	Shri Shri AswaklantaTemple	390	From Chainage 1+600
9.	Veterinary Hospital	25	From Chainage 2+340
10.	IIT, Guwahati	1100	From Chainage 2+900
11.	IITG, Hospital	1300	From Chainage 2+900
12.	North Guwahati College	370	From Chainage 3+600
13.	Rahadhola Primary School	On Alignment	Near Chainage 4+800
14.	Narayana Super Specialty Hospital	2500	From Chainage 6+800

Table 3.19: Other Sensitive Environmental Receptors

Sl. No.	Name of the Environmental Receptors	Approximate distance (in m)	Design Chainage of the Alignment
South Bank			
1.	Bharalumukh Police Station	15	From Chainage 0+000
2.	Head Quarter, 22 MC Group	800	From Chainage 0+000
3.	Pragjyoti ITA Cultural Centre, Machkowa	800	From Chainage 0+000
North Bank			
4.	North Guwahati Police Station	225	From Chainage 2+500

Environmental Sensitivity Zone

This zone covers 10 km on either side of the corridor of impact and ancillary sites such as borrow area, quarry site, waste disposal sites and construction camp sites etc.

Assam state is part of the transition zone between the Indo-Malayan and Indo-Chinese bio geographical regions. Favourable climate, topographic and edaphic factors support luxuriant growth of diverse plant communities and create varied habitats. The wet Evergreen, semi Evergreen, moist Deciduous, wet Savannah and Riparian forests as well as extensive network of river systems and swamps, marshes and wetlands provide ideal conditions and suitable habitats for subsistence of a wide variety of fauna be it mammals, primates, reptiles, amphibians, fish, molluscs, birds, butterflies, moths, that is, they support the existence of one of the most diverse faunal population.
The project site is located in Guwahati city in Kamrup district of Assam. The alignment for the proposed project is such that it would pass through Brahmaputra River, connecting north and south Guwahati along the two banks of river.

Forest Type

The forest in this region comprises of Tropical Moist Deciduous type forests. This forest is further divided into Sal forest and mixed deciduous forest. In these forests, Sal grows in association with Ajar (*Lagerstoemia* species), Makri Sal (*Schima wallichii*), Haldu (*Adina cordifolia*), Sam (*Artocarpus* sp.), Bor (*Ficus* sp.), Uraim (*Bischofia javanica*), Gomari (*Gmelina arborea*), Teeta champa (*Michelia champa*), Poma (*Toona ciliata*).

Forest Cover

The recorded forest area of the state is 21,647 sq. km., which constitutes 11.04% of its geographical area. Reserved Forests constitute (14,373 sq. km.) 66.40%, Protected Forests (2,886 sq. km.) 13.33% and Unclassed Forests constitutes (4,388 sq. km.) 20.27% of the total forest area. The forest cover in state is presented in **Table 3.20** and the forest cover map with marked project area is presented in **Figure 3.14.**

Table 3.20: Forest Cover in the Project State (km^2)

District	Geographical Area (GA)	VDF	MDF	OF	Total	% of GA
Assam State	27,673	1,444	11,404	14,825	27,673	35.28

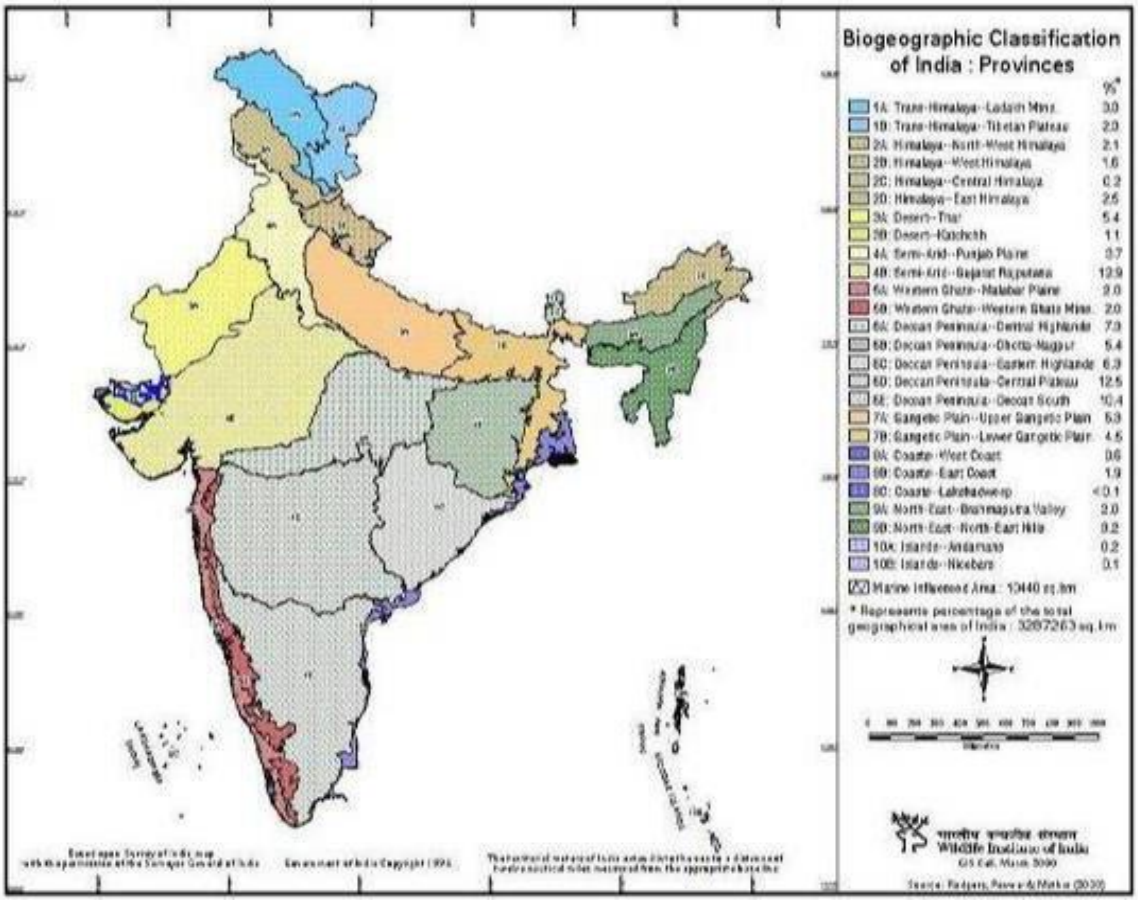
Source: India State of Forest Report, 2015
VDF: Very Dense Forest, MDF: Moderately Dense Forest, OF: Open Forest

Source: India State of Forest Report, 2015

Figure 3.14: Map of Assam showing distribution of forest cover

Biogeographical Zones

The study area falls under North East as far as the Indian Biogeographical Zones *(Rodger, Panwar, and Mathur 2000)* are concerned. Under the biogeographical provinces, the study area falls under the



category of 9A- North East- Brahmaputra Valley.

Figure 3.15: Map showing the Bio-Geographic Provinces of India

Ecological sensitive places

There is no national park and biosphere reserve is present within 10 km radius of the study area. However, Deepor Beel Bird Sanctuary and Ramasar site is 9.07km, Aamchung Wildlife sanctuary is about

13 km, Garbhanga Reserve Forest is 8.5 km and Guwahati Zoo – 5.4 km. In addition to the above, Kamakhya Temple is 2.6 km, interstate boundary with Meghalaya is 10.250 km away from the proposed project area.

Flora

It is observed that human settlements present within the study area of 10 km radius and many of villages have moderate ranges of plantations. Most of the vegetation area is in agricultural fields. During site assessment several floral species encountered within the 10km radius area.
List of major recorded flora of the study area is given as under.

Table 3.21: List of plant species of the Study area

Sl. No.	Scientific name	Habit
1.	*Abrus precatorius* L.	Herb
2.	*Abutilom indicum* G. Don.	Herb
3.	*Acacia auriculiformis* A. Cunn. ex Benth.	Tree
4.	*Acalypha indica* L.	Herb
5.	*Achyranthus aspera* L.	Herb
6.	*Adiantum sp.*	Fern
7.	*Adina cordifolia*	Tree
8.	*Aegle marmelos*	Tree
9.	*Aerides odoratum*	Orchid
10.	*Aerva sanguinolenta*	Shrub
11.	*Agave americana*	Shrub
12.	*Ageratum conyzoides* L.	Herb
13.	*Albizzia lebbek*	Tree
14.	*Alocasia sp.*	Herb
15.	*Alocasia indica* (Lour) koch	Herb
16.	*Aloe barbedense*	Shrub
17.	*Alstonia scolaris*	Tree
18.	*Alternanthera sp.*	Herb
19.	*Alysicarpus vaginalis*	Herb
20.	*Amaranthus sp.*	Herb
21.	*Amorphophallus campanulatus.*	Herb
22.	*Andropogon sp.*	Grass
23.	*Angiopleris evecta*	Fern
24.	*Anthocephalus cadamba* Miq.	Tree
25.	*Aquilaria agallocha*	Tree
26.	*Araucaria sp.*	Tree
27.	*Areca catechu* L.	Tree
28.	*Argenone maxicana* L.	Shrub
29.	*Artocarpus sp.*	Tree
30.	*Asplenium nidus*	Fern
31.	*Auxzonopus compressus*	Grass
32.	*Azadirachta india* A. Juss.	Tree
33.	*Azolla pinnata*	Fern
34.	*Bambusa balcooa*	Shrub
35.	*Bambusa offinis*	Shrub
36.	*Bambusa pallida*	Shrub
37.	*Bambusa tulda*	Shrub

38.	*Basella alba* L.	Climber
39.	*Bauhinia accuminata*	Tree
40.	*Bauhinia purpurea*	Tree
41.	*Bischofia javanica*	Tree
42.	*Boerhavia sp.*	Herb
43.	*Bombax malabaricum*	Tree
44.	*Borassus flabellifar*	Tree
45.	*Borreria articularis* (L.f.) F.N.Will.	Herb
46.	*Bougainvillea spectabilis*	Shrub
47.	*Bryophyllum pinnatum* Roxb.	Herb
48.	*Bulbophyllum careyanum*	Orchid
49.	*Bursera serrata*	Tree
50.	*Butea monosperma*	Tree
51.	*Caesalpinia pulcherima* (L.) Sw.	Tree
52.	*Calensuo* sp.	Shrub
53.	*Callistemon citrinus* (Curtis) Stapff.	Tree
54.	*Calotropis procera*	Shrub
55.	*Canna indica* L.	Shrub
56.	*Cannabis sativa* L.	Shrub
57.	*Cardiopermum helicacabum* L.	Climber
58.	*Carex* spp.	Grass
59.	*Carica papaya* L.	Tree
60.	*Cassia fistula*	Tree
61.	*Cassia tora*	Shrub
62.	*Cassuarina equisetifolia*	Tree
63.	*Catharanthus roseus* (L.) G. Don.	Shrub
64.	*Celosia critata* L.	Herb
65.	*Centella asiatica* (L.) Urban	Herb
66.	*Chenopodium album* L.	Herb
67.	*Chrysopogon aciculatus*	Herb
68.	*Cinamomum tamala*	Tree
69.	*Citrus* sp.	Tree
70.	*Cleome gynandra* L.	Herb
71.	*Cleome rutidosperma* DC.	Herb
72.	*Cleome viscosa* L.	Herb
73.	*Clerodendron viscum* Vent.	Herb
74.	*Clerodendrum indicum*	Shrub
75.	*Clitoria ternatea* L.	Climber
76.	*Coccinia grandis* (L.) Voigt.	Climber
77.	*Cocos nucifera* L.	Tree
78.	*Codiaeum variegatum* (L.) Bl.	Tree
79.	*Colocasia esculenta* (L.) Schott.	Herb
80.	*Commelina benghalensis* L.	Herb
81.	*Commelina diffusa*	Herb
82.	*Crinum asiaticum*	Herb
83.	*Crysopogon aciculatia*	Grass
84.	*Curcuma aromatica* Salish.	Herb
85.	*Cuscuta reflexa Roxb.*	Climber
86.	*Cyclosorus extensum*	Fern

87.	*Cymbidium oloifolium*	Orchid
88.	*Cynodon dactylon*	Grass
89.	*Cyperus brevifolius* (Rottle.) Hassk.	Herb
90.	*Cyperus compressus* L.	Herb
91.	*Cyperus distans* L.	Herb
92.	*Cyperus iria* L.	Herb
93.	*Dalbergia sisso* Roxb.	Tree
94.	*Datura metal* L.	Herb
95.	*Delonix regia* (Bojr.) Rsf.	Tree
96.	*Dendrobium nobile*	Orchid
97.	*Dendrocalamus hamiltonii* Nees.	Herb
98.	*Desmodium laburnifolium*	Shrub
99.	*Desmodium trifolium*	Herb
100.	*Desmodium triphylla*	Herb
101.	*Digitaria saligera*	Grass
102.	*Diospyros melanoxylon*	Tree
103.	*Diplazium esculentum*	Fern
104.	*Discorea alata* L.	Climber
105.	*Dracaena* sp.	Shrub
106.	*Drymaria cordata* (L.) Willd. Ex R. & S.	Herb
107.	*Drynaria quercifolia*	Fern
108.	*Duranta repens*	Herb
109.	*Dysoxylum biopectinatum*	Tree
110.	*Eclipta prostrata* (L.) L.	Herb
111.	*Eichhornia crassipes* (Mart.) Solms.	Tree
112.	*Elaeocarpus robustus*	Tree
113.	*Elephantopus scaber* L.	Herb
114.	*Eleusine indica* (L.) Gaert.	Herb
115.	*Embelica officinalis*	Tree
116.	*Emblica officinalis*	Tree
117.	*Eucalyptus sp.*	Tree
118.	*Euphorbia hirta* L.	Herb
119.	*Euphorbia nerifolia*	Herb
120.	*Evolvulus nummularius*	Herb
121.	*Ficus benghalensis* L.	Tree
122.	*Gmelina arborea*	Tree
123.	*Michelia champa*	Tree
124.	*Toona ciliata*	Tree
125.	*Ficus elastica*	Tree
126.	*Ficus gibbosa*	Tree
127.	*Ficus hispida*	Tree
128.	*Ficus racemosa*	Tree
129.	*Ficus religiosa* L.	Tree
130.	*Foeniculum vulgare* Gaertn	Herb
131.	*Geodorum* sp.	Orchid
132.	*Glorisa superba* L.	Climber
133.	*Grevellia robusta*	Tree
134.	*Gymnogramme pulchellus*	Fern
135.	*Hedyotis scandens*	Herb

136.	*Hemionites aurifolia*	Fern
137.	*Hibiscus rosa sinensis* L.	Tree
138.	*Hymenodictyon excelsum*	Shrub
139.	*Hyptis suaveolens*	Shrub
140.	*Imperata cylindrica* (L.) Beauv.	Herb
141.	*Imperate arundinacea*	Herb
142.	*Ipomea fistulosa*	Herb
143.	*Ipomoea aquatica* Forssk.	Herb
144.	*Ipomoea cirica*	Herb
145.	*Ipomoea fistulosa*	Shrub
146.	*Ipomoea quamoclit* L.	Herb
147.	*Ixora arborea*	Shrub
148.	*Ixora coccinea* Roxb.	Shrub
149.	*Lagerstroemia flos reginae*	Tree
150.	*Lantana camara*	Shrub
151.	*Macaranga indica*	Tree
152.	*Mangifera indica*	Tree
153.	*Microlepia speluncae*	Fern
154.	*Mimosa himalayana*	Shrub
155.	*Mimosa pudica*	Herb
156.	*Murraya koenigii*	Shrub
157.	*Musa paradisiaca*	Shrub
158.	*Polyalthia longifolia*	Tree
159.	*Pongamia pinnata*	Tree
160.	*Psidium guajava*	Tree
161.	*Pterocarpus indicus*	Tree
162.	*Saccharum spontaneum*	Herb
163.	*Saraca indica*	Tree
164.	*Schima wallichii*	Tree
165.	*Senna sophera* L.	Shrub
166.	*Senna tora* (L.) Roxb.	Shrub
167.	*Sesamum indicum*	Herb
168.	*Shorea robusta*	Tree
169.	*Solamum indicum*	Shrub
170.	*Spondias pinnata*	Tree
171.	*Syzygium cumini*	Tree
172.	*Tamarindus indica*	Tree
173.	*Tectona grandis*	Tree
174.	*Terminalia arjuna*	Tree
175.	*Terminalia belerica*	Tree
176.	*Terminalia chebula*	Tree
177.	*Tridax procumbens*	Herb
178.	*Viburnum colebrookianum*	Shrub
179.	*Xanthium stromarium*	Shrub
180.	*Zizyphus jujuba*	Tree

(Source: Working plan of forest department Research publications)

FAUNA

Table 3.22: (A, B &C): Details of Fauna Present in this study area

A. MAMMALS (in study area)

SN	Common Name	Scientific Name	Status
1	Hog Deer	*Axis porcinus*	EN
2	Wild Boar	*Sus scrofa*	LC
3	Leopard Cat	*Prionailurus bengalensis*	S-I/LC
4	Jungle Cat	*Felis chaus*	LC
5	Asiatic Jackal	*Canis aureus*	LC
6	Bengal Fox	*Vulpes bengalensis*	LC
7	Small Indian Civet	*Viverricula indica*	LC
8	Common Palm Civet	*Paradoxurus hermaphroditus*	LC
9	Indian Grey Mongoose	*Herpestes edwardsii*	LC
10	Small Asian Mongoose	*Herpestes javanicus*	LC
11	Western Hoolock Gibbon	*Hoolock hoolock*	S-I/EN
12	Rhesus Macaque	*Macaca mulatto*	LC |
13	Assam Macaque	*Macaca assamensis*	NT
14	Capped Langur	*Trachypithecus pileatus*	S-I/VU
15	Bengal Slow Loris	*Nycticebus bengalensis*	VU
16	Chinese Pangolin	*Manis pentadactyla*	S-I/EN
17	Indian Palm Squirrel	*Funambulus palmarum*	LC
18	Porcupine	*Hystrix brachyura*	LC
19	Lesser Bandicoot Rat	*Bandicota bengalensis*	LC
20	Hoary Bamboo Rat	*Rhizomys pruinosus*	LC
21	Indian flying Fox	*Pteropus giganteus*	LC
22	Short nosed Indian fruit Bat	*Cynopterus sphinx*	LC
23	Least horseshoe Bat	*Rhinolophus pusiilus*	LC
24	Lesser Asiatic yellow Bat	*Scotophilus kuhlii*	LC
25	Asian House Shrew	*Suncus murinus*	LC
26	Mole Shrew	*Anourosorex squamipes*	LC
27	Gangetic Dolphin	*Platanista gangetica*	S-I/EN

(S-I- Schedule-I of WPA- 1972; EN- Endangered; VU- Vulnerable; NT- Near Threatened; LC- Least Concern in IUCN red list)

B. AMPHIBIAN & REPTILES (in study area)

Sl. No.	Local Name	Zoological Name	Status
1	Tree frog	*Polypedates leucomystax*	LC
2	Ornamented Pygmy Frog	*Microhyla ornate*	LC
3	Indian bull frog	*Hoplobatrachus tigerinus*	LC
4	Common Pond Frog	*Fejervarya limnocharis*	LC
5	Assam Hills Frog	*Clinotarsus alticola*	LC
6	Water frog	*Hylarana garoensis*	LC
7	Asiatic Rock Python	*Python molurus*	LR/NT
8	Common Rat Snake	*Ptyas mucosus*	LC
9	North-eastern Kukri Snake	*Oligodon cyclurus*	LC
10	Rat Snake	*Coelognathus radiatus*	LC
11	Golden Tree Snake	*Chrysopelea ornata*	LC
12	Banded Krait	*Bungurus fasciatus*	LR/ NT

13	House Gecko	*Hemidactylus frenatus*	LC
14	Indian Garden Lizard	*Calotes versicolor*	LR/ NT
15	Asiatic Rock Python	*Python molurus*	LC
16	Indian Roofed Turtle	*Pangshura tecta*	LR/LC
17	South Asian Box Turtle	*Cuora amboinensis*	LC
18	Indian Soft-Shell Turtle	*Nilssonia gangetica*	LC
19	Peacock soft shell Turtle	*Nilssonia hurum*	LC
20	Indian Flap-shell Turtle	*Lissemys punctata*	LC

C. Birds (in study area)

S.No.	Common Name	Scientific Name	Status
1	Little Grebe	*Tachybaptus ruficollis*	LC.
2	Great Crested Grebe	*Podiceps cristatus*	LC
3	Great cormorant	*Phalacrocorcix carbo*	LC
4	Little cormorant	*Phcdacrocorax niger*	LC
5	Oriental Darter	*Anhinga melanogaster*	NT
6	Grey Heron	*Ardea cinerea*	LC
7	Cattle Egret	*Bubulcus ibis*	LC
8	Great Egret	*Casmerodius dibits*	LC
9	Purple Heron	*Ardea purpurea*	LC
10	Indian pond Heron	*Ardeola grayii*	LC
11	Intermediate Egret	*Ardea intermedia*	LC
12	Little Egret	*Egretta garzetta*	LC
13	Cinnamon Bittern	*Ixubrychus cinnamomeus*	LC
14	Great Bittern	*Botaurus stellaris*	LC
15	Black crown Night Heron	*Nycticorax nycticorax*	LC
16	Asian Open bill	*Anastonnis oscitans*	LC
17	Lesser Adjutant Stork	*Leptoptilos javanicus*	VU
18	Lesser Whistling Duck	*Dendrpcygna javanica*	-
19	Fulvous Whistling Duck	*Dendrocygna bicolor*	LC
20	Ruddy Shelduck	*Tadorna ferruginea*	LC
21	Pintail	*Anas acuta*	LC
22	Common Teal	*Anas crecca*	LC
23	Bar Headed Goose	*Anser indicus*	L/C
24	Cotton Pygmy Goose	*Nettapus coromandelianus*	LC
25	Tufted Duck	*Aythya fuligula*	
26	Swamp Francolin	*Francolinus gulans*	VU
27	Kalij Pheasant	*Lophura leucomelanos*	LC
28	Black Francolin	*Francolinus francolinus*	LC
29	Red Jungle Fowl	*Gallus gallus*	LC
30	Water Cock	*Gallicrex cinerea*	LC
31	White breasted Waterhen	*Amaurornis phoenicurus*	LC
32	Common Moorhen	*Gallinula chloropus*	LC
33	Purple Swamphen	*Porphyria porphyrio*	
34	Water Rail	*Rallus aquaticus*	LC
35	Common Coot	*Fulica atra*	LC
36	Pheasant -Tailed Jacana	*Hydrophasianus chirurgus*	LC
37	Bronze winged Jacana	*Metopidius indicus*	LC
38	Grey headed Lapwing	*Vanellus cinereus*	LC

39	Northern Lapwing	*Vanellus vanellus*	LC
40	Red wattled Lapwing	*Vanellus indicus*	LC
41	Common Name	*Scientific Name*	LC
42	Little Ringed Plover	*Charadrius dubius*	LC
43	Wood Sandpiper	*Tringa glareola*	LC
44	Common Sandpiper	*Actitis hypoleucos*	LC
45	Little Green Bee-eater	*Merops orientalis*	LC
46	Oriental Pied Hornbill	*Anthracoceros albirostris*	LC
47	Indian Roller	*Coracias benghalensis*	LC
48	Lineated Barbet	*Megalaima lineata*	LC
49	Blue throated Barbet	*Megalaima asiatica*	LC
50	Copper smith Barbet	*Megalaima haemacephala*	LC
51	Greater Flame back	*Chrysocolaptes lucidus*	LC
52	Black rumped Flameback	*Dinopium benghalense*	LC
53	Grey headed fish Eagle	*Ichthyophaga ichthyaetus*	LC
54	Pallas's Fishing Eagle	*Haliaeetus leucoryphus*	VU

Secondary Source: Forest Department Working Plan and from village people.

2.30.3. Aquatic Ecology

River Brahmaputra is a trans-boundary major river flowing through the north-eastern state of Assam, India and is the lifeline of its natural fisheries. It traverses 1,625 km in Tibet (known there as Yarlung-Tsangpo), and 918 km in India, before flowing through Bangladesh for 337 km and emptying into the Bay of Bengal through a joint channel with River Ganga (another transboundary major river flowing through India and Bangladesh). In India, the river flows through the north-eastern Indian state of Arunachal Pradesh in a north–south direction for 278 km (where it is known as Siang River), and across the east–west ranges of the Himalayas. After entering the plains of Assam, the Siang River (also known as Dihang) is joined by two large tributaries—Dibang and Lohit near Oiramghat (Dhemaji District). The combined river is thereafter called the River Brahmaputra. It flows westward through the state of Assam for about 640 km up to Dhubri, after which it abruptly turns south and enters Bangladesh and ultimately drains into Bay of Bengal (Bhattacharjya et al., 2017).

The Brahmaputra valley of Assam is bordered by the sub-Himalayan mountain ranges of Bhutan and Arunachal Pradesh in the north and northeast, the Nagaland Hills in the east and southeast, the Hills zone (Assam) and Meghalaya in the south and the plains of Bangladesh to the west. These mountains/hills give rise to many fast-flowing streams/rivers flowing down the gradient and ultimately joining R. Brahmaputra, which has 42 important tributaries in North-eastern India, of which 27 on the north (Subansiri, Jia Bharali, Pagladia, Manas etc.) and 15 are on the south bank (Disang, Dikhow, Dhansiri, Kopili etc.). These rivers crisscross the valley and have numerous floodplain wetlands (locally known as beels), which are created through river meandering action and/or tectonic activity (Bhattacharjya et al., 2017).

The river is a rich repository of aquatic biodiversity. However, of late, developmental activities in the form of dams in its tributaries, construction activities coupled with anthropogenic pressure, waste disposal along with a series of other factors has created a negative impact on its inherent biota and the ecology of the river. The present study was carried out to assess the present status of aquatic biodiversity, identifying possible impacts upon aquatic ecology of the river owing to the construction of a bridge connecting Panbazar and North Guwahati and suggesting possible mitigation measures to minimize the impact of the developmental activity upon aquatic ecology and thereby protect the rich aquatic life of the river. The objective of the present study is

- To study the diversity of aquatic biota (phytoplankton, zooplankton, benthos, fish and river dolphin) along selected sites of River Brahmaputra at Guwahati.
- To analyse the perceived impacts of the proposed developmental activity (construction of a bridge connecting Panbazar and North Guwahati) on the aquatic flora and fauna of River Brahmaputra and suggesting possible mitigation measures.

Three sampling stations were selected for the present study which includes 1. Kachari Ghat (upstream of the proposed site for bridge construction); 2. Bharalumukh (proposed site of bridge construction); and 3. Shantipur (downstream of the proposed site for bridge construction). The details of the sampling sites are given as follows.

Table 3.23: Sampling location of Aquatic Ecology

Site	GPS Co-ordinates	Remarks
Kachari Ghat	26°14'48'' N and 91°45'52.9'' E	Upstream of the proposed site for bridge construction
Bharalumukh	26°10'32.3'' N and 91°43'50.2'' E	Proposed site of bridge construction
Shantipur	26°11'9'' N and 91°44'27.4'' E	Downstream of the proposed site for bridge construction

Secondary information's are basically collected from different published literature. For primary data, fish landing at Uzan Bar has been taken into consideration.

Plankton i.e. both phytoplankton and zooplankton were collected from the surface waters by filtering 50 litres of water through a plankton net having 60 µ mesh size. The collected samples were preserved in 5% formalin and analysed in laboratory under a simple dissecting microscope. Identification of plankton was done following standard plankton identification manuals. Counting of plankton cells was carried out using Sedgewick Rafter cell. Benthos was collected from the three sites using Ekman grab (0.025 m^2 area) and sieved through a filter with 0.5 mm mesh size. Collected macro-benthos were preserved in 5% buffered formalin and identification was done in laboratory following standard manuals. List of fish diversity was prepared following previous literature; with the help of experts working in this field in various organizations and academic institutions; and by landing centre visit. Water quality analysis was carried out following standard protocols (APHA, 1998).

Photograph of Sampling Location and sampling

Sampling station 1 (Kachari Ghat)

Sampling station 2 (Bharalumukh)

Sampling station 3 (Shantipur)

Collection and preservation of sample

Collection and preservation of sample

RESULTS

PHYTOPLANKTON

Three classes of phytoplankton Bacillariphyceae (Tabellaria, Surrirella, Diatoma, Fragillaria, Gomphonema and Navicula) Chlorophyceae (Ulothrix and Microspora) and Myxophyceae (Anabaena) were observed at the selected stations. The numerical abundance of plankton ranged between from 35 to 60 nos./L. The dominant group found to be Bacillariophyceae contributing 45.28 % to 63.63 % followed by Chlorophyceae (24.24–32.08 %) and Myxophyceae (12.13- 22.64 %). Figures 6 to 9 depicts some of the phytoplankton species recorded during the study.

Some Photographs of Phytoplankton

Surirella

Navicula

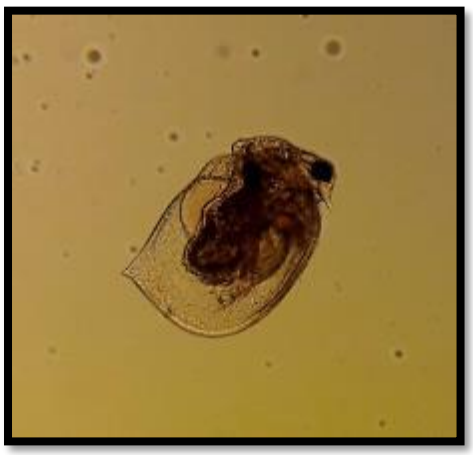
Microspora

Ulothrix

Table 3.24: Percentage contribution of phytoplankton groups across different stations of River, Brahmaputra at Guwahati

Class/ Stations	Kachari Ghat	Bharalumukh	Santipur
Bacillariophyceae	45. 28%	52.63 %	63.63 %
Chlorophyceae	32.08 %	28.94 %	24.24 %
Myxophyceae	22.4%	18.43 %	12.13%

Zoplankton (Rotifers and Cladocerans) were observed at a single sampling station at Bharalumukh. Zooplankton abundance was found to be 4 nos./50 L of water. Figures 10 and 11 depict some of the zooplankton species observed during the study.



Ceriodaphnia

Cyclops

BENTHOS

- During sampling only two species of Gastropods viz. *Melania* sp. from Shantipur and *Vivipara* sp. were collected from Bharalumukh sampling station. The abundance of benthos was found to be very low (1 nos./m^2) owing to the high-water current and increased run-off. It is seen that benthos organisms are recorded from River Brahmaputra only during dry season.

FISH DIVERSITY

A total of 141 fin fish species under 84 genera and 29 families has been recorded from Brahmaputra River in Assam along with two commercially important Prawn species namely *Macrobrachium*

gangeticum and *M. malcolmsonii* (Bhattacharjya et al., 2017). During the study as well from secondary information we have recorded 51 species under 14 families and 7 orders.

Table 3.25: Indigenous Fish diversity recorded from Brahmaputra River along Guwahati, Assam

Fish species	Conservation status*
ORDER: I. OSTEOGLOSSIFORMES **Family: (1) Notopteridae**	
1. *Chitala chitala* (Ham-Buch)	NT
2. *Notopterus notopterus* (Pallas)	LC
ORDER: II. CLUPEIFORMES **Family: (2) Clupeidae**	
3. *Gudusia chapra* (Ham- Buch)	LC
4. *G. variegata* (Day)	NE
5. *Tenualosa ilisha* (Ham-Buch)	NE
6. *Gonialosa manmina* (Ham-Buch)	LC
Family: (3) Engraulidae	
7. *Setipinna phasa* (Ham- Buch)	LC
ORDER: III. CYPRINIFORMES **Family: (4) Cyprinidae**	
8. *Chela cachius* (Ham- Buch)	LC
9. *C. laubuca* (Ham - Buch)	NE
10. *Amblypharyngodon mola* (Ham-Buch)	LC
11. *A. morar* (Ham- Buch)	LC
12. *Brachydanio. rerio* (Ham-Buch)	NE
13. *D. devario* (Ham- Buch)	NE
14. *Esomus danricus* (Ham-Buch)	LC
15. *Rasbora rasbora* (Ham- Buch)	LC
16. *Catla catla* (Ham- Buch)	NE
17. *Cirrhinus mrigala* (Ham-Buch)	LC
18. *C. reba* (Ham-Buch)	LC
19. *Labeo bata* (Ham- Buch)	LC
20. *L. calbasu* (Ham- Buch)	LC
21. *L. gonius* (Ham- Buch)	LC
22. *L. rohita* (Ham- Buch)	LC
23. *Pethia conchonius* (Ham- Buch)	LC

24. *P. ticto* (Ham- Buch)	LC
Family: (5) Balitoridae	
25. *Acanthocobitis botia* (Ham- Buch)	LC
Family: (6) Cobitidae	
26. *Lepidocephalus guntea* (Ham- Buch)	LC
27. *Botia dario* (Ham- Buch)	LC
ORDER: IV. SILURIFORMES **Family: (6) Bagridae**	
28. *Aorichthys aor* (Ham-Buch)	LC
29. *A. seenghala* (Sykes)	NE
30. *Mystus cavasius* (Ham- Buch)	LC
31. *M. vittatus* (Bloch)	LC
32. *Rita rita* (Ham-Buch)	LC
Family: (7) Siluridae	
33. *Ompok bimaculatus* (Bloch)	NT
34. *Wallago attu* (Scheidner)	NT
Family: (8) Schilbeidae	
35. *Ailia coila* (Ham-Buch)	NT
36. *Clupisoma garua* (Ham-Buch)	LC
37. *Eutropichthys vacha* (Ham-Buch)	NE
Family: (9) Sisoridae	
38. *Bagarius bagarius* (Ham-Buch)	NT
39. *Gagata cenia* (Ham-Buch)	LC
40. *G. gagata* (Ham-Buch)	LC
ORDER: V. BELONIFORMES **Family: (10) Belonidae**	
41. *Xenentodon cancila* (Ham-Buch)	LC
ORDER: VI. PERCIFORMES **Family: (11) Ambassidae**	
42. *Chanda nama* (Ham-Buch)	LC
43. *P. lala* (Ham-Buch)	NT
44. *P. ranga* (Ham-Buch)	LC
Family: (12) Mugilidae	
45. *Rhinomugil corsula* (Ham-Buch)	LC

Family: (13) Gobiidae	
46. *Glossogobius giuris* (Ham-Buch)	LC
ORDER: VII. TETRAODONTIFORMES **Family: (14) Tetraodontidae**	
47. *Tetraodon cutcutia* (Ham-Buch)	LC

*Based on CAMP report (1998); LC = Least Concern; NT = Near Threatened; NE = Not Evaluated

RIVER DOLPHIN

The river dolphin, *Platanista gangetica* is the most important aquatic mammal inhabiting the river Brahmaputra. The Ganges River dolphin belongs to the Platanistidae Family and inhabits freshwater areas. Internationally it is a protected organism classified as Endangered in the IUCN Red List and further described in the CITES Appendix I. In India, it is designated as a protected species (Schedule I) by the Indian Wildlife Law (1972), and it is positioned as a National Aquatic Animal as a symbol of India. Its habitat extends to four countries- India, Bangladesh, Nepal and Bhutan; and lives only in limited areas of the Ganges River, Brahmaputra River, and its tributaries (the Meghna River, Karnaphuli River, Sangu River, etc.). The number of inhabitants in the whole world was estimated to be 4,000 to 5,000 in the 1980s, and 2000 in the 1990s; but it is estimated to have been about 1,200 in 2012, the decrease remarkable. The main reasons for the decrease in population are the loss of species that act as prey to the dolphins due to poaching, bycatch, over catching, water pollution, and division of habitat due to dam construction and topography modification of the river through inflow / extraction of sediment.

The Brahmaputra River is a habitat for the Ganges river dolphins. Dolphins were observed throughout the entire Brahmaputra River from the Assam-Arunachal border to India-Bangladesh border and in the downstream areas of the Lohit River and Siang River.

The sum of the best estimates of group size for the entire survey indicated 264 dolphins in the entire Brahmaputra River system, with 212 individuals in the Brahmaputra mainstream and an encounter rate of 0.24 dolphin/km.

Best estimate was made by Dr. Abdul Wakid that, **24 dolphins from Tezpur to Guwahati** (153km stretch) and **36 dolphins from Guwahati to Jugighopa** (131km stretch) were recorded an encounter rate of 0.16 dolphin/km and 0.27 dolphin/km respectively.

The highest abundance of dolphins was recorded in the river stretch from Tezpur to Guwahati with 19.8% of total dolphin population of Brahmaputra River, followed by Guwahati to Jugighopa with 17%.

Encounter rate analysis showed that the river stretch from Tezpur to Guwahati stretch has the lowest density.

3.18 SOCIO - ECONOMIC PROFILE

Assam, the gateway to North East India, is the largest state in the North –East with a geographical area of 78438 sq.km. The state has 33 districts, 67 Sub-Divisions, 219 blocks. At present Assam has 26 districts under Normal or General Areas covered under Part IX of the Constitution and 7 districts under the Sixth Schedule viz. (i) Bodoland Territorial Council (BTC) covering Kokrajhar, Chirang, Baksa and Udalguri districts and (ii) Hill Areas covering Karbi Anglong, West Karbi Angolng and Dima Hasao districts. As per Census of India 2011 the population of Assam is 3.11 crores with a density of 397 population per sq. Km. The rural and urban population is 85.92% and 14.08% respectively. Sex ratio is 954 females over per 1000 male population. Total cropped area as per 2008-09 record 41.05 lakh hectare, out of which Net area sown is 28.10 lakh hectare. Major crop is Paddy and major fruits grown in the state are banana, pineapple, papaya, orange, Assam lemon and jackfruit. Amongst plantation crops, tea commands the most important place in the state.

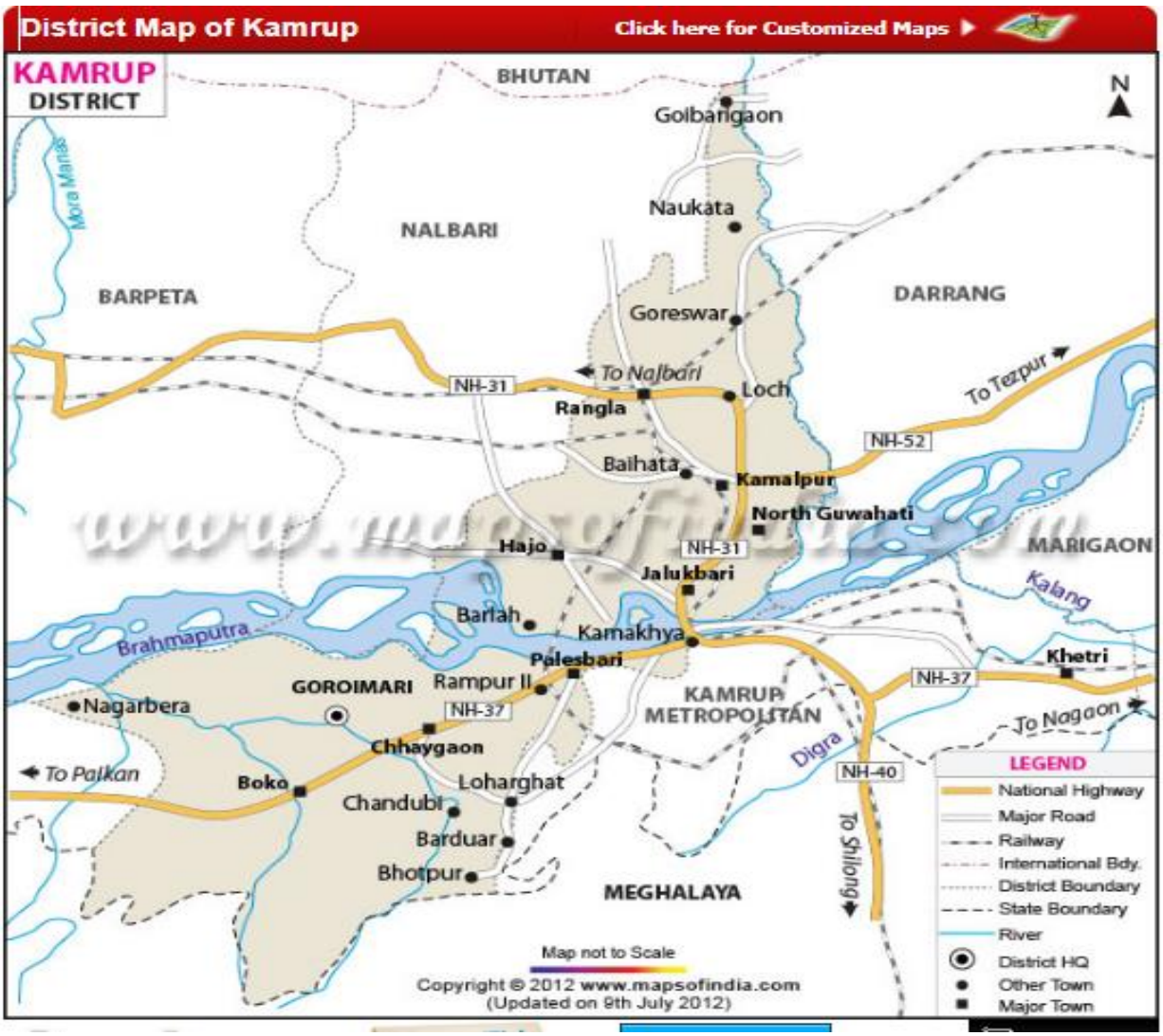
3.18.1 Socio- economic status of Project influence District

The entire project stretches of Brahmaputra Bridge and approach road passes through two district namely Kamrup metropolitan and Kamrup.

District profile

The Present Assam was referred to as Kamrup in many of the ancient Indian literature. It was also known as pragjyotishpur due to the astrology (Jyotish Shashtra) practices that prevailed in this part of the country during that time. However, "Kamrup" became a more predominant name in the later part of the history. There is a famous story which says the reason behind the naming of this place "Kamrup":

Lord "Shiva" married Parvati, the daughter of Daksha, a very powerful king of that time. The King however, did not like his son-in-law for some reasons and hence did not invite him for the "Jagna" (the great sacrifice) ceremony which the king organised in a great fashion. Parvati being the daughter of the king could not resist from attending the ceremony and went there with the permission from her husband. As she reached the auspicious venue, "Daksha" did pass on derogatory comments on her husband and that too in front of a huge gathering. She became very annoyed and got disgusted at the discourtesy shown to her husband and sacrificed her life on the spot itself.



Overcome with grief at the death of Sati (Parvati), Shiva began a grim penance and wandered about the world carrying her dead body on his head. Shiva's 'dance of death' and penance alarmed all the gods because it threatened to destroy the world. In order to stop the frightful wanderings of Shiva, the supreme god, Vishnu, cut the dead body of Sati into fifty- one pieces with his great weapon, the "Shudarshan Chakra" (Discus). The pieces fell onto the earth in fifty-one different places and wherever they fell, the ground was held to be sacred. One of the important organs of Sati fell on Nilachal hill in Guwahati and the place was thenceforth held sacred and it says that the famous Kamakhya Temple was originated from that "Sati's" organ only.

As Shiva continued to do penance, the other gods became afraid that he would thereby acquire universal power. They sent Kamadeva, the God of Love, to make Shiva fall in love again, and thereby break his penance. Kamdeva succeeded in his mission, but Shiva was so enraged at the result that he burnt Kamadeva into ashes by a fiery glance of his third eye. Kamadeva eventually regained his life and his original 'form' (Rupa) in Assam and the land where this took place become known as "Kamrup" ("Kamarupa").

Kamrup district occupies an area of 4,345 square kilometres (1,678 sq mi), comparatively equivalent to Australia's Kangaroo Island. Kamrup district has some territorial disputes with neighbouring West Khasi Hills district, Meghalaya, including that over the village of Langpih.

According to the 2011 census Kamrup district has a population of 1,517,202, roughly equal to the West African country of Gabon or the US state of Hawaii. This gives it a ranking of 327th in India (out of a total of 640).[7] The district has a population density of 436 inhabitants per square kilometre (1,130/sq mi) . Its population growth rate over the decade 2001-2011 was 15.67%. Kamrup has a sex ratio of 946 females for every 1000 males, and a literacy rate of 72.81%. The district has people belonging to various indigenous Assamese communities like Keots/Kaibarta, Bodo, Rabha, Tiwa/Lalung, Amri Karbi, Dom/Nadiyal, Koch-Rajbongshi etc. Kamrup District is divided into two parts Kamrup and Kamrup metropolitan.

Table 3.26: Socio-economic profile of Kamrup District

Parameters	Total	Male	Females	Rural	Urban
Population	1,517,542	7,78,461	7,39,081	13,75,148	1,42,394
No. of Agriculture labourers	42,121	31,540	10,581	40,859	1,262
No. of Cultivators	1,49,738	1,34,767	14,971	1,48,155	1,583
Household industry workers	29,452	14,420	15,032	21,861	7,591
Working population	1,99,933	1,66,136	33,797	1,68,845	31,088
Main working population	4,21,244	3,46,863	74,381	3,79,720	41,524
Marginal workers	2,07,710	81,629	1,26,081	1,93,062	14,648
Non-working population	8,88,588	3,49,969	5,38,619	8,02,366	86,222

Source: *Census of India 2011*

Table 3.27: Socio-economic Kamrup Metropolitan District

Parameters	Total	Male	Females	Rural	Urban
Population	12,53,938	6,47,585	6,06,353	2,16,927	1,037,011
No. of Agriculture labourers	8,259	5,843	2,416	5,783	2,476

No. of Cultivators	20,677	17,606	3,071	17,714	2,963
Household industry workers	7,973	5,355	2,618	2,106	5,867
Working population	3,75,613	1,15,319	4,13,154	62,916	3,12,697
Main working population	4,13,154	3,34,724	78,430	64,318	3,48,836
Marginal workers	9,357	5,376	3,981	4,013	5,344
Non-working population	7,63,006	2,71,972	4,91,034	1,29,159	6,33,847

Source: *Census of India 2011*

3.18.2 Project Impact Zone

The Bridge and approach road users and the population benefited / affected by the project are mainly the persons, who generally pass through or use the existing road / proposed alignment for their daily needs. The majority of the direct beneficiaries of the project reside in the vicinity of the road alignment, within approximately 5 km radius from the road alignment.

In order to carry out SES and conduct FGDs for preparing Social Analysis, the project impact zone has been defined as 1. Direct impact involves the habitations existing along the project road and 2. Indirect impacted habitations will involve those within 1 km on either of the project road.

Socio-economic profiling

The majority of the potentially affected / benefited persons living in the project influence zone frequently travel down the existing roads or proposed alignment of the subprojects. Their purpose of visit brings them generally to the prominent market places by the roadside or transport boarding points either side of the road. Other beneficiaries also pass through the important junctions of the feeder roads connecting the project roads / proposed alignment. These junction points served as the clusters from where sample households and FGD meetings were selected. Besides, administrative offices, places of worship, community structures, such as Childline centre, in the major settlements within the project impact zone were also taken into considerations for holding FGD / Key Informant Interview (KII).

The project influence area (PIA) of Brahmaputra Bridge and its approach road covers parts of two districts –Kamrup Matropolitan and Kamruo District wise list of projects influenced habitations falling under Direct and indirect influence zone is presented in Table 2-4.

Table 3.28: Project Affected Villages falling Under Impact Zone

State	District	Project Affected Villages under Impact Zone
Assam	Kamrup Metropolitan	0
	Kamrup	5

BASELINE DATA

Scheduled Caste & Scheduled Tribe Population

The SC population of Kamrup Metropolitan, Kamrup are 101780 and 1,07,827 respectably and similarly ST Population of Kamrup Metropolitan and Kamrup is 75,121 and 1,82,038. SC&ST Population brief is given Below Table No. 2-7 and 2-8 respectively

Table 3.29: SC Details

District	SC Population								
	Total	Male	Female	Rural	Urban	Rural Males	Rural Females	Urban Males	Urban Females
Kamrup Metropolitan	1,01,789	52,106	49,683	33,499	68,290	17,181	16,318	34,925	33,365
Kamrup	1,07,827	55,237	52,590	88,975	18,852	45,829	43,146	9,408	9,444

Source: Census of India 2011

Table 3.30: ST Details

District	ST Population								
	Total	Male	Female	Rural	Urban	Rural Males	Rural Females	Urban Males	Urban Females
Kamrup Metropolitan	75,121	37,902	37,219	29,574	45,547	14,731	14,843	23,171	22,376
Kamrup	1,82,038	92094	89944	180192	1846	91154	89038	940	906

Source: Census of India 2011

Literates

As 2011 Census, the states of Assam had Total literacy rate 73.18%. Similarly, district levels the comparison between male and female. The Literacy rates of Project District are shown in Table 2.7.

Table 3.31: No. of Literates

State / Districts	Total	Male	Female	Rural	Urban	Rural Male	Rural Female	Urban Males	Urban Females
Assam	19,177,977	10,568,639	8,609,338	15,68,5436	34,92,541	87,06,193	69,79,243	18,62,446	16,30,095
Kamrup Metropolitan	10,01,191	5,37,227	4,63,964	1,44,941	8,56,250	80,103	64,838	4,57,124	3,99,126
Kamrup	9,95,319	550219	445100	881782	113537	489607	3,92,175	60,612	52,925

Source: Census of India 2011

Sex Ratio & Density/KM of Project Road

According to census of India highest sex ratio of Project corridor is 949, 936 of Kamrup and kamrup Metropolitan respectably and population growth rate is also very low i.e. 15.69 of kamrup District. The Project impact Area districts is presented in Table below.

Table 3.32: State and District wise demographic Profile

State / Districts	Sex ratio	Density /KM^2	Population Growth
Assam	958	398	17.07

State / Districts	Sex ratio	Density /KM^2	Population Growth
Kamrup Metropolitan	936	1313	18.34
Kamrup	949	489	15.69

Source: Census of India 2011

CENSUS AND SOCIO-ECONOMIC SURVEY

The objective of the census and socio-economic survey were prepare the list of the project affected households and prepare the socio-economic profile of the project affected persons for evolving the entitlement framework

The cut-off date for the project road will be the date of commencement of the Census Survey. The structures enlisted during the survey is the final one, any structures build up after the Census survey shall not be eligible for compensation and assistance. Hence it is closed the cut

–off date for project road is 18.04.2018

The study time frame can be broadly divided into two phases comprising of Phase I to include secondary data search, Reconnaissance survey, Social strip mapping; and Phase II to include census and socio-economic surveys for titleholders.

The analysis of the data has been presented in the following sections for the titleholders separately.

Survey of Project Affected families

Project Affected Persons

The surveys for the Persons have been carried out under the three categories namely residential commercial and Residential cum commercial and squatters. The total project affected families are identified in North Guwahati. i.e. 45, 113 and 30 respectively. The distribution of PAFs as per the district is given in Table below.

Table 3.33: Distribution of usage of structures

Sl. No	Category	Kamrup	Total
1	Residential	48	48
2	Commercial	116	116
3	Residential cum Commercial	55	55
	Total	**219**	**219**

Source: *Primary survey (2018)*

Location

The analysis of the data on the location of the PAFs in the entire project stretch reveals that they are located on either side of the carriageway with a higher number on the left-hand side, as evident from Table below.

Table 3.34: District-wise Distribution of PAFs as per location with respect to NH

Sl. No	Location	Number of PAFs on Either side of Project corridor	
		Kamrup	Total
1	L/S	160	160
2	R/S	59	59
	Total	**219**	**219**

Source: *Primary survey (2018)*

Area of Project Affected Families

Table below presents the distribution of PAFs under the different area slabs and it clearly indicates that nearly 32910 m2. Whereas area under Temporary, Semi-Pucca and Pucca is 561m2, 2592m2 and 29757m2. Respectively. Is given in Table below.

SOCIO-ECONOMIC CHARECTERSTICS PAFs and PAPs

The socio-economic characteristics of the titleholder PAFs has been analysed district-wise with respect to the following characteristics:

Type of Family
Project Affected Families
Educational Status
Sex Ratio
Religious status
Marital Status
Occupational Pattern
Income Categories
Social Vulnerability

Type of Family

Table below presents the distribution of households as per the type of family i.e. nuclear, joint and extended.

Table 3.35: Type of Family

Type of Family	Numbers
Nuclear	125
Joint	75
Extended	19
Total	**219**

Source: *Primary survey (2018)*

Project affected families

Table below present the district-wise distribution of PAFs and PAPs as per the number of projects affected using the definition of family as per the R&R policy.

Table 3.36: Number of Project Affected Families

PAFs/PAPs	Number of PAFs/PAPs
Number of PAFs	219
Number of PAPs	1095

Source: *Primary survey (2018)*

EDUCATUION STATUS

Table below gives the distribution of total project affected population with respect to the educational status.

Table 3.37: Educational Status of the titleholders PAFs

	Education Lavel								
District	**Illiterate**	**Upto 5th**	**Upto 8th**	**9th & 10th**	**11th & 12th**	**Graduates**	**Master**	**Engineering**	**Total**
Kamrup	5	17	54	86	35	20	1	1	**219**

Source: *Primary survey (2018)*

SEX RATIO

Table below present the sex ratio of Kamrup districts, which is given below.

Table 3.38: Sex Ratio of PAPs

District	Total Population	Male	Female	Sex Ratio
Kamrup	1095	570	525	955

Source: *Primary survey (2018)*

RELIGIOUS STATUS

The district – wise Religious status of the affected families getting affected due to project is presented in Table below

Table 3.39: Religious Status of PAPs

Religion	Numbers of PAF
Hindu	101
Muslim	118
Total	**219**

Source: *Primary survey (2018)*

OCCUPATIONAL PATTERN

The occupation pattern of the PAFs is given in the Table below

Table 3.40: occupation of PAFs

Occupation	Number of Persons
Pensioner	15
Business	98
Service	30
Labour	1
Shopkeepers	50
Unemployed	20
Gaon Burah	1
Housewife	4
Total	**219**

Source: *Primary survey (2018)*

INCOME CATEGORY

The PAFs have been classified as per income slab given in table below and the Table clearly reveal that MM% of population is well above the poverty line. The poverty line for propose of this analysis has been assumed as INR. 30000 per annum or INR. 2500 per month.

Table 3.41: District-wise Distribution of PAPs as per income slabs

Annual income Slab	Number of Households
<=20000	2
20001-30000	1
30001-50000	14
50001-100000	77
>100000	125
Total	**219**

Source: *Primary survey 2018*

COMMON PROPERTY RESOURCES

Table 3.42: Common Property Details

S.No.	Common Property Resource (CPR) by type	Nos.
1	Temple	3
2	Graveyard	1
3	School	1
4	Training Centre	1
5	Survey Khamal	1
6	Child line(NGO)	1
	Total	8

Source: *Primary survey-2018*

SOCIAL VUNERABILITY

Below table present the analysis of data with respect to social Vulnerability like BPL, SC, ST, and WHH are covered.

Table 3.43: Social Vulnerability

Vulnerability	North Guwahati(No.)
BPL	1
WHH	1
SC	24
ST	44
OBC	13
Above 50 years	19
Total	**102**

Source: *Primary survey (2018)*

Dwelling Structure

So far as the type of dwelling structures is concerned, (Table below indicates some kind of economic well-being of the majority of the residents who can afford to build Pucca/ semi-Pucca type of houses.

Table 3.44: Type of Dwelling Structures

Sl. No	Type of Structures	Number	% of Total HH
1	Kutcha	21	9.5
2	Pucca	160	73.5
3	Semi-Pucca	38	17
	Total	**219**	**100**

Source: *Primary survey (2018)*

LAND ACQUISITION PLANNING FOR PROJECT

Based on outcome of the Feasibility Study, Social and Environmental Screening Exercise, the proposed alignment was finalized, and geometric design of highway was completed accordingly. Initially, the numbers of affected villages were identified as per the alignment. All the village Revenue maps were collected from the local revenue offices. The village Revenue maps were thoroughly reviewed and verified in the field. ROB location the stacking of alignment was done by survey expert at site with the

help of pegs and reference pillars. The stacked alignment was then transferred on Village revenue maps with respect to ground survey by land acquisition team and rechecked for correctness. The Land Acquisition Plan (LAP) was prepared accordingly. Based on the identified land plots by land acquisition team, local revenue officials were consulted to collect the names of owners of each plot. The details are available under the LA Plan prepared for the purpose of this project as a separate document.

IMPACT ON STRUCTURES

Based on socio-economic survey, a total of 219 private structures lie within 80 meters of either side of the existing centerline of road – both Brahmaputra Bridge and approach road. The structures are residential, commercial or residential cum commercial in their nature.

TYPE OF LAND BEING ACQUIRED FOR THE PROJECT

The Private land being acquired for the project is 223B-3K-0L (29.96Ha.) And Government land to be acquired is 59B-0K-16L (7.9 Ha.) land to be acquired for construction of Bridge and for approach road. Acquisition of land for south Guwahati is only Government land and no private land has been involved. The Area is presented in the Table below.

Table 3.45: Type of the Land Being Acquired for the project

SI.No	Name of Mouza	Name of Revenue Village	Private Land to be acquired	Govt. Land required	Total Land(Ap/PP+Govt. land)
1	Sila Sinduri Ghopa	Gauripur	46B-3K-14L	33B-0K-5L	51B-4K-3L
2	Sila Sinduri Ghopa	Sila	14B-2K-2L	17B-2K-10L	31B-4K-10
3	Sila Sinduri Ghopa	Abhoipur	116B-4K-18L	2B-2K-10L	119B-2K-8L
4	Sila Sinduri Ghopa	North Guwahati	45B-2K-6L	5B-0K-9L	78B-2K-11L
5	Sila Sinduri Ghopa	Jalah	---	1B-0k-04L	1B-0K-4L
Total			**223B-3K-0L**	**59B-0K-16L**	**282B-3K-16L**

B-Beega, K-Katha, L-Lessa (1-Beega=5 katha, 1 Katha=20 lessa) (1 Beega=1340m²(14,440 Sq feet), 1 Lessa=144 Sq feet(13.4 m²)

IMPACT OF LAND ACQUISITION

The analysis of the impact of land acquisition can be categorized into following subheads:

Loss of Land (Private and Government)

Loss of farm produces (standing crops)

Loss of Structures

Loss of Farm Produce

The stretch has relatively prosperous Agricultural land on either side of the highway. Acquisition of land will result in loss of crops. As land will be acquired in a phased manner, the owners will be able to cultivate some part of their land till construction time permits. They will be allowed to harvest produce and cash compensation will be paid for crops acquired at a price fixed by the Government.

Loss of Residential Houses

The project requires the demolition of residential houses and commercial properties. These will be acquired, and compensation paid before the start of project.

Loss of Income

Those losing agricultural lands will lose income opportunity. However, this will be a permanent setback, unless provided with adequate compensation amount and / or training facilities for new trades with sufficient seed capital.

Increase in Employment Opportunities

Commencement of road project will benefit the community through generation of direct and indirect employment within the project areas due to construction activity, minor repairs and maintenance works. The project will require a good number of unskilled workers and they can form a cooperative, which will supply labourers to contractors whenever required. Up gradation of roads and community development programs in the project plan will benefit the communities at large.

Table 3.46: Public Consultations issue

SI.No	Location	Existing Km Chainage	Date	Participants	Issue Raise/Discussed	Suggestion from Participants	Mitigation Measures
1.	Gauripur	3.850	10/04/2018	Gauripur Total participants are 10	The Project Background, Social, traffic safety issue and benefit from the project were explained to the Stakeholders The Main Issue of Public in Village Gauripur was: • Relocation of one roadside temple. • Proposed Widening options • Effect of Noise and Dust • Pollution during construction and after construction. • Safety of Local traffic and pedestrian in Built-up Zone • Road crossing problem. • Lack of safe drinking water facility • How many meters the road will be extend	• Provision of Drainage in Built-up Section to eliminate the issue of road side water-logging • Proper Improvement of Road Junction for Aim hospital • For Safety of Local traffic and pedestrian in Built-up Zone, footpath should be provided. • Adequate provision for minimizing the Dust and Noise Pollution during construction • There should be underpass for road crossing • Adequate compensation should be provided to the project	• Concentric widening in Built-up section has been agreed with provision of Covered roadside RCC Drain and footpath for pedestrians. • Proper EMP shall be finalize to minimize Dust and noise Pollution • During Construction work in Built-up Zone. • Proper traffic signage shall be provided for speed limits. • Proper improvement of Major Cross Junction included in design for minimizing the Traffic congestion as well to minimize the Noise, Dust and air pollution in Built-up Section. • Proper implementation of Rehabilitation package for affected

					from centerline? • Is there any preferences given by the governments to the encroachers who have built their shops for several years and paying taxes to the government? • If governments will give shop in case of shop to the squatters • Protect the temple by acquiring more agricultural land on the other side. If the temple destroyed then where the priest will get the income, is there any provision of the government to decide for the livelihood of the priest. • What will be the valuation of structure according to governments if it is acquired? • When the road construction will be started. • The payments will be	affected persons. • Should give sufficient time to shift to a new place • Alternate source of income for the priest should be ensured • If government land is available, then no private land should be taken for road construction • Proper compensation to affected persons	families.

					market price or government rate. • Whether governments will provide any job facility to demolished structure. • What will be preferences given by the government to the SC, ST & Women headed if there houses or shop destroyed.		
2.	Ganesh Store and Gauripur	4.800	11/04/2018	Local Residents, Villagers and public representative of Abhyapur Total participants are 17	The Project Background, Environmental, Social, traffic safety issue and benefit from the project were explained to the Stakeholders • Mostly Resettlement issues has been discussed during meeting and people are worried about their relocation. • Compensation related issues has been discussed. • People are worried about their restoration of income after demolition of their Shops and commercial	The main suggestion of participants was: • Peoples also demanded for proper traffic signage for speed limits for minimizing the accident. • Widening and strengthening work on both side of in Built-up Section so that one side people do not feel discriminated. • Provision for Bus Stop 2 No. (Up & Down). • Underpass for crossing road • Parking facility. • Compensation should	• Proper traffic signage shall be provided for speed limits. • Concentric widening in Built-up section has been agreed except for location with deficient alignment. • Proper implementation of Rehabilitation package for affected families.

					structures. • Main issue was compensation and restoration of livelihood of affected families. • Any income restoration provision for squatters.	be at market rate. • Provide a complex for settle their livelihood. • Provisions of Land for construction of new house. • Provide houses, who has lost houses after demolishing of existing houses.	
3.	North Guwahati and Majgaon	1.900	17/04/2018	Local people of North Guwahati Total participants are 32	The Project Background, Environmental, Social, traffic safety issue and benefit from the project were explained to the Stakeholders The Main Issue of North Guwahati was: • Road crossing problem for women and children. • Proposed Widening options • Compensation related issues	• Safe drinking facility to local public. • Toilet facility • Community hall for local people. • Provide Houses for affected families. • Land for land has been suggested by local people. • Compensation should be at market rate.	• During Construction work in Built-up Zone. • Proper traffic signage shall be provided for speed limits. • Proper improvement of Major Cross Junction included in design for minimizing the Traffic congestion as well to minimize the Noise, Dust and air pollution in Built-up Section.

4. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGITION MEASURES

4.1 GENERAL

The main aim of environmental impact assessment is to identify the nature and significance of environment impacts. The assessment of potential environmental impact consists of comparing the expected changes in the environment with or without the project.

The mitigation measures involve decisions and strategies taken during the design, construction and operation phase to minimize the negative impacts and enhance the positive impacts of the project on the surrounding environment. The design of the bridge and approach road is as per current design standards (both national and international) and involves:

- Construction of Bridge over River Brahmaputra
- Construction of bridge approach on either side
- Widening and strengthening of the existing road for approach road development
- Improvement of the road geometry for increased design speed;
- Rehabilitation and reconstruction of parallel and cross drainage structures;
- Enhancement of road safety measures; and
- Improvement of road aesthetics.

However, the construction of bridge and its approach may affect their nearby surrounding natural, socio-economic and cultural environment. These changes include both beneficial and adverse impacts. In order to minimize the adverse impacts of the bridge and its approach, avoidance and mitigation measures were formulated and implemented as part of the project design. Avoidance and mitigation of negative impacts involve the reduction and magnitude of the impacts through:

- Alternatives during design, site clearance, construction and operation phases of the approach road to avoid adverse impacts;
- Additional mitigation measures developed for unavoidable negative impacts on natural, socio-economic and cultural environment;
- The above-mentioned measures are incorporated in the project in the four stages; design, pre-construction (land acquisition and site clearance), construction and operation. Most of the measures were applicable to entire project corridor. However, some features warranted extra ordinary measures based on their applicability, both general and site specific, were incorporated as follows:
    a) **Standard:** The 'Standard designs' of the proposed project were arrived after detailed deliberations between Highway & Bridge design and the Environment team. The principal features incorporated in the initial design included establishment of a Corridor of Impact (CoI) and various road safety measures.

    b) **General:** Measures to avoid or mitigate negative impacts on natural, socio-economic and cultural environment were identified based on the characteristic features of the project corridors. Avoidance and mitigation for social impacts have been discussed separately in Resettlement and Rehabilitation Action Plan.

    c) **Specific:** In addition to the above measures, specific mitigation and compensatory measures were formulated for the negative impacts identified in the Hotspots Identification Matrices.

This chapter assesses the nature, type and magnitude of the potential impacts likely on the various relevant physical, biological and cultural components along the proposed bridge and its approach road. The environmental and social impacts can be direct as well as indirect. The direct area of influence includes the corridor of Impact and the construction sites for the project. The impacts on various environmental components can occur at any of the following stages of the project planning and implementation: (i) planning and design; (ii) construction; and (iii) operation.
The description and magnitude of impacts for the various environmental components for the bridge construction and approach road are presented in the following sections.

4.2 ASSESSMENT OF POTENTIAL ENVIRONMENTAL IMPACTS

The environmental impacts caused due to the development of the approach road can be categorized as primary (direct) and secondary (indirect) impacts. Primary impacts are those which are induced directly by the project whereas the secondary impacts are those which are indirectly induced and typically include the associated investment and changing patterns of social and economic activities due to the proposed action. Interaction of the project activities with environmental attributes is presented as Activity-Impact matrix in Table 4.1.

Potential direct and indirect impacts of the project during construction phase are as follows:

- Construction activity within river the Brahmaputra.
- Filling of low-lying areas for construction of embankments for the approach road.
- Loss of vegetation due to cutting of trees.
- Loss of topsoil due to clearing & grubbing of new alignment, borrow area and quarry operation, construction camp, material stacking yard.
- Temporary impacts in terms of polluted environment on flora and fauna due to the construction activities.
- Impacts on the drainage pattern due to raised embankment, introduction of new culverts.
- Impacts on traffic management system.
- Increased air pollution (including dust) during bridge and approach road construction.
- Increased noise level due to the movement of vehicles and construction activities.
- Increased soil erosion.
- Spillage of oils and other hazardous materials.
- Pollution of surface and sub-surface water resources.
- Pollution due to demolition of Project Affected Structure
- Pollution due to generation of Spoils and Solid Waste.

Potential direct and indirect impacts of the project during operation phase are the following:

- Increased noise pollution due to the vehicular movement.
- Impact on natural drainage pattern of the project area.
- Pollution of water bodies and impacts on its ecosystem due to hazardous chemical or oil spillage into the nearby surface water bodies.

The positive impacts of the project shall be:

- Reduced air pollution due to better service levels of the road and new bridge.
- Improved safe and efficient connectivity within North Guwahati to South Guwahati and other areas of Assam.
- Generation of local employment during road construction.
- Improvement of local economy and industry due to better infrastructure facilities.
- Connectivity of North Guwahati will increase the basic amenities and revenue value of land resource.

Table 4.1: Activity - Impact Identification Matrix

Sl. No	Activities	Impacts on Physical Environment			Biological Environment			Geology		Topography
		Air	Water	Noise	Flora	Fauna		Natural Drainage	Soil	
A.	**CONSTRUCTION PHASE**									
1	Labour Camp Activities		-Ve/T							-Ve/T
2	Quarrying	-Ve/T		-Ve/T	Ve/T			-Ve/T		-Ve/P
3	Material Transport & Storage	-Ve/T		-Ve/T						
4	Drilling & Blasting	-Ve/T		-Ve/T	-Ve/T		-Ve/T			-Ve/P
5	Earthwork							-Ve/T	-Ve/T	-Ve/T
6	Pavement Works	-Ve/T	-Ve/T	-Ve/T	-Ve/T				-Ve/T	-Ve/P
7	Use of Construction Equipment	-Ve/T	-Ve/T	-Ve/T			-Ve/T			
8	Plantation	+Ve/P		+Ve/P	+Ve/P					
9	Drainage Works							+Ve/P		
10	Pillaring of Bridge	-Ve/T	-Ve/T	-Ve/T			-Ve/T			
11	Culvert & Bridge Construction		-Ve/T	-Ve/T				-Ve/P		
12	Stripping of Top Soil								-Ve/T	
13	Debris Generation							-Ve/T	-Ve/T	
14	Oil & Grease								-Ve/T	
B.	**OPERATIONAL PHASE**									
1	Vehicular Movement	+Ve/P		+Ve/P	+Ve/P		+Ve/P			
2	Impacts on forest areas including Wildlife Sanctuary, National Park	No National Park/Wild Life Sanctuaries or, any other eco-sensitive areas are present along the project corridor.								

Note: -Ve- Negative, +Ve- Positive, T - Temporary; P - Permanent.

4.3 IMPACT AND MITIGATION DURING PRE-CONSTRUCTION STAGE

The major impacts during pre-construction and design stage are related with the land acquisition. Proposed RoW of bridge approach is 80 m. Therefore, acquisition of land is required for proposed RoW.

The land use along the approach road is agricultural land, followed by urban built-up, river scrub, pond, partially built up / built up, plantations and others. Adequate care has been taken during the design stage to minimize the impact on existing physiography.

3.3.1. Land Resources

The project mainly involves construction of 1.6 km long High-Level Bridge over the River Bramhaputra along with 4.15 km approach road and will have 80-meter Right of Way (RoW) in North Bank. The available RoW (10-12 m) at most sections is not sufficient to accommodate the proposed augmentation and improvement works and therefore, require additional land acquisition at those sections.

Impact

Construction of bridge approach is confined to 80 m Right of Way (RoW) in North Bank demarcated by the PWD stones along the road with minimum land acquisition.

Land Acquisition: There would be a direct impact on land due to the construction of Bridge over the River Brahmaputra along with approach roads.

Mitigation Measures

All the affected people shall be compensated as per *the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013*

- For land acquisition- before commencement of Construction works and the cost of compensation shall be finalized by the Competent Authority and the Project Proponent shall pay the compensation at all the entitles persons through the Competent Authority.
- It shall be ensured that all the land acquisition activities including implementation of related Environment Management Plan are completed before the start of work.
- Change in Land Use is not much expected as the terrain of the areas is not going to be changed as part of the project and care has been taken to minimize and impact on built up areas. Where, cutting is totally unavoidable then only such activities shall be taken up where adequate restoration measures for slope protection are provided.

3.3.2. Utilities

Impact

Several types of utilities serving local and regional needs are falling under CoI will need to be relocated from their present position due to the proposed project. These services are mainly electric poles, transformers, hand pump, water well etc., which required to be relocated at some locations. The summary of utilities is provided in **Table 4.2** and detailed list is enclosed as **Annexure 4.1**. Such type of impacts due to the planed project development is inevitable.

Table 4.2 : Details of Utilities to be Impacted

North Guwahati												
SL. No.	DESIGN CHAINAGE		ELECTRICAL POLE (EP)		TRANSFORMER (TF)		TELEPHONE POLE (TP)		OPTICAL FIBRE CABLE (OFC)		WATER TAP HAND PUMP	
	FROM	TO	LHS	RHS	LHS	RHS	LHS	RHS	LHS	RHS	LHS	RHS
1	0+000	1+000	0	0	0	0	0	0	0	0	0	0
2	1+000	2+000	3	0	0	0	2	0	0	0	0	0
3	2+000	3+000	5	3	0	0	0	1	0	0	0	0
4	3+000	4+000	3	2	0	1	0	0	0	0	0	0
5	4+000	5+000	46	44	1	2	0	0	2	2	1	0
6	5+000	6+000	58	11	8	2	0	0	5	1	0	0
7	6+000	7+000	36	1	2	0	0	0	5	0	0	0
	TOTAL		151	61	11	5	2	1	12	3	1	0

South Bank Road												
SL. No.	DESIGN CHAINAGE		ELECTRICAL POLE (EP)		TRANSFARMER (TF)		TELEPHONE POLE (TP)		OPTICAL FIBRE CABLE (OFC)		WATER TAP HAND PUMP	
	FROM	TO	LHS	RHS	LHS	RHS	LHS	RHS	LHS	RHS	LHS	RHS
1	-1+150.5	0+000	1	0	0	0	0	0	0	0	0	0
2	0+000	1+000	0	2	0	0	0	0	0	0	0	0
3	1+000	1+247.897	0	0	0	0	0	0	0	0	0	0
	TOTAL		1	2	0	0	0	0	0	0	0	0

Mitigation Measures

All the utilities shall be relocated in advance prior to the start of construction works. The required mitigation measures would be to instruct in advance to the relevant owners of these utilities to shift those before construction starts to avoid disruption of local services. The Concessionaire shall submit the details of such features falling within the alignment and inform the Implementation Authority. It shall be judicious for the Implementation Authority to assist the owners to get land for new locations.

3.3.3. Generation of Debris

Impact

Major source of debris generation is deep cutting, dismantling of road side residential and commercial structures and other community structure along the approach road. Further, shifting of utility which falls under project alignment would also be source of impact in nearby environment. Details of debris generated is as under.

Table 4.3: Details of debris generation

S. No.	Item Description	Unit	Quantity	Remarks	Quantity Reused	Surplus Quantity
1	Excavated material (top 150 mm thick) due to Clearing and grubbing	Cum	67500	No use	-	67500
2	Dismantiling of existing structures (Concrete)	Cum	7678.5	50% resue	3,839.25	3839.25
3	Road works	Cum	225000	90% reuse	2,02,500.00	22500
4	Culvert works	cum	2799		2,519.10	279.9
5	Minor Bridge works	cum	1084		975.60	108.4
6	RE wall work	cum	3292		2,962.80	329.2
7	VUP work	cum	1472		1,324.80	147.2
8	ROB works	cum	649		584.10	64.9
9	Major Bridge works	cum	17041		15,336.90	1704.1
10	Drain works	cum	19142		17,227.80	1914.2
11	Misc works	cum	2327		2,094.30	232.7
12	Dismantling of Bituminous material	cum	1050	90% reuse	945.00	105
13	Debris accumulated during floods	Cum	1000	No use	-	1000
14	Cement bags	Nr	1974100	100% reuse	19,74,100.00	0
15	Metallic parts from reinforcement	MT	2.6731	100% reuse	2.67	0
16	Paint tins	Nr	136	100% reuse	135.71	0
17	Plastic debris	Kg/year	25	50% reuse	12.50	12.5
18	Wood from suttering	Kg/year	25	80% reuse	20.00	5
19	Electric wiring	Kg/year	25	99% reuse	24.75	0.25

Mitigation Measures

The provision of onsite recycling plant has been proposed which shall be in line with C&D waste Management Rules, 2016. However, the debris generated from the project shall be utilized mostly in road construction.

It is estimated that from the generated debris that about one lakh cum surplus debris is required to be disposed off. These surplus debris will be disposed properly with all possible beatification activities in the viaduct area. Budgetary provision is included under management plan for terrestrial ecology.

Due to removal of structures (residential and commercial), utility shifting and pavement scarification lot of debris shall be generated, which need to be disposed off properly to avoid contamination of land. For safe and environmental friendly disposal of waste debris the instruction/procedure specified in Annexure 4.2 shall be applicable.

3.3.4. Ecological Environment

ANTICIPATED IMPACTS AND MITIGATION MEASURES ON TERRESTRIAL ECOLOGY

Anticipated impacts and mitigation measures are discussed in the following table.

Table 4.4: Anticipated Impact and Mitigation measures

Loss of vegetation due to construction The land being acquired for the proposed project and for approach road are 282B-3K-16L (37.86Ha.). A total of 7455 (including Bamboo clusters and Horticultural plants) of plant species were recorded from the Corridor of Impact (COI).	The impact will be definitely occurred within the core zone (Corridor of Impact) and permanent. Due to the fact that vegetation does not have a high conservation potential, the impact will definitely be moderately Severe and of moderate significance. Mitigation, through Growing indigenous vegetation, where possible, will reduce the significance of this impact to LOW. Avenue plantation will be done for the trees to be cut in the proposed project will compensate to extent.
Habitat loss, barriers to migration and dispersal of fauna.	Area is populated and constructed area, already road exist, bridge is being constructed over river Brahmaputra, there will be negligible impact on habitat, dispersion of terrestrial fauna. Moreover, for detailed Compensatory afforestion and management plan of terrestrial ecology has been invited from S tate Forest Department and is under process.

ANTICIPATED IMPACTS ON AQUATIC ECOLOGY

Impact on aquatic ecology of the river and its inherent biota owing to the construction of bridge will be probably minimal once the bridge is fully operationalized. However major, negative impact on aquatic ecology of the river is perceived to occur during the construction phase of the bridge. The possible impact on aquatic life during the construction phase of the bridge is discussed below:

- Significant sediment deposition and accumulation around bridge locations may occur as soon as construction of the bridge begins owing to natural flow obstruction. Construction of pillars acts as barriers to the natural flow leading to siltation. It has been well documented that increased sediment deposition can adversely change habitat conditions of aquatic life. Siltation can lead to fish mortality, reduced growth rates due to stress and spawning failure i.e. non-hatching of eggs. In addition, sediment deposition and accumulation can modify the suitability of fish habitats. Identified mechanisms causing changes in sediment suitability include: Altered porosity in the streambed affecting the development of fish embryo and benthic invertebrate production; reduction in the area of inter-gravel habitat for and juvenile fish; and benthic organisms; and reduction in available over wintering habitat for fish by filling of pools and interstitial voids.
- Construction activities can alter potential habitat for aquatic life or may cause direct loss of habitat of aquatic organisms. It may lead to loss of breeding and nursery grounds of fishes, owing to changes in water quality, siltation etc.

- Dredging of river bed for construction purpose, disturbs the river bed and re-suspension of sediment in the water column is likely to occur as a result of dredging action at the sediment-water interface, transfer of the sediment to a transporting vessel, slop or leakage from the vessel, and disposal of the sediment. Re-suspension of the sediments causes increased turbidity which may adversely affect aquatic life by clogging gills, decreasing visibility, and preventing oxygen diffusion. Increased water turbidity with less oxygen level is particularly harmful for fishes and more importantly for river dolphins.
- A long-term impact associated with the removal of sediments during dredging is the potential exposure of contaminated sediments. Mining and other sources of pollution can result in contamination of surface sediments. Over time, deposition of upstream sediments can bury the contaminated sediments, effectively sealing them off from the aquatic organisms. During the dredging activities, the upper layers of sediment are removed, potentially exposing previously contaminated sediments. Benthic organisms are exposed to the contaminants through uptake from pores, body walls, respiratory surfaces, and through ingestion.
- Construction of the bridge would generate noise from equipment such as motors, chain saws, frontend loaders, cranes, pile drivers and power generators. The effects of construction noise would be most noticeable in the area immediately surrounding the construction site. This would have a scaring effect upon fishes and may hamper their natural movement in search of food and movement to meet other biological requirements. If blasting with explosives and pile driving is required during construction, vibration as well as noise would be generated. In-water blasting and pile driving would generate pressure waves that would pose a consistent and adverse threat to fish and other aquatic resources.
- Water that comes into contact with cement, uncured concrete, concrete dust etc. used during construction quickly produces a strong alkaline solution that causes chemical burns to fish, insects and plants. If even a small volume of concrete wastewater is allowed to enter streams, lakes or wetlands it can cause immense damage to the environment.
- Dumping or accidental discharge of chemicals used during construction may cause immense harm to the aquatic ecosystem.
- There may be physical damage on aquatic organisms leading to mortality as a result of the construction activities.
- Aquatic mammals, particularly the river dolphin, a sizeable population of which is found in Brahmaputra may be negatively affected owing to the construction activities. Sound and vibrations in water as well as use of high pressure water jets can affect the echolocation properties of dolphins. Moreover, concrete structures may also hamper their echolocation through which they search for food. Poor water quality in the form of high turbidity which affects feeding in dolphins, high pH and low oxygenated waters can create an unfavourable environment for dolphins in the area. Moreover, physical injury and accidental trapping of dolphins in the construction area can cause immediate mortality.

MITIGIATION MEASURES

- Lowering the turbidity levels of water by all possible means, by taking special care during dredging and other construction related activities can help a lot in minimizing the impact of the bridge construction activity upon aquatic life. In cases relating to high turbidity levels in water coagulants can be used.
- Care should be taken to minimize the noise and vibration created during construction.

- In cases where it is seen that breeding and nursery grounds of fishes are destroyed, artificial pools can be created along the river, preferably upstream of the construction site which will act as site for breeding and nursery rearing of fishes.
- Care should be taken not to discharge the waste materials or any construction material like cement etc. directly in to water as it affects water quality.
- Biological monitoring can be carried out at regular intervals which track the health of biological systems. Measuring and evaluating the condition of biological systems, and the consequences of human activities for those systems, is central to biological monitoring. It aims to distinguish between naturally occurring variation and changes caused by human activities. Biological assessments are evaluations of the condition of water-bodies using surveys and other direct measurements of resident biological organisms (macro invertebrates, fish and plants).
- Construction work should be conducted during the periods that ensured that the fisheries resources were not impacted. A primary goal in every bridge construction project should be to develop construction methods that would minimize or alleviate disturbances to the underlying ecosystem as much as possible.
- Wash water or slurry mixed with cement should be directed onto an area of ground close to the work area, where the alkaline water is absorbed by the soil and neutralized by naturally occurring chemicals in the ground. Great care should be taken to ensure the water or slurry does not run overland to the waterway. A shallow pit dug into the ground may help avoid this and constant monitoring is necessary to prevent overflow.
- Moreover, for detailed mitigiation and management plan of impacts on fishes and Dolphin has been invited from CIFRI and is under process.

ADDITIONAL MITIGATION MEASURES SUGGESTED

- Past interactions with fishers of Amingaon fishing village during 2004-06 indicated the presence of one deep pool somewhere near the northern end of the proposed bridge. Such deep pools are very important micro-habitats for large aquatic animals like gangetic dolphins and big fishes like Gorua (*Bagarius bagarius*), freshwater shark (*Wallago attu*) etc. therefore care should be taken to identify and ensure minimum damage to such deep pools by way of siltation during the construction process.

ICAR-CIFRI will consider rendering technical advice on development and monitoring of detailed mitigation and management plan towards impact of the proposed interventions on fishes and Gangetic dolphins in the river stretch based on specific proposals.

3.3.5. Socio-Economic Environment And Land Acquisition

The land being acquired for the proposed project and for approach road are 282B-3K-16L (37.86Ha.). Details of the land requirement and impacted structures are discussed in section 3.18.

Mitigation Measures

- As far as possible the land acquisition has been kept to the minimum, by restricting the geometric improvement within the existing right of way in places where existing road is available. However, the land acquisition has been done at sections having width insufficient to accommodate the cross-sections & geometric improvements.
- All the Project Affected People (PAP) shall be compensated as per The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013, before commencement of construction work and the cost of compensation shall be finalized by the

competent authority. The project proponent shall pay the compensation to all the entitled persons.

- Community property shall be adequately relocated/ reconstructed.
- It shall be ensured that all resettlement activities including implementation of EMP are completed before the start of work.
- A budgetary provision has been kept in Social Impact Assessment.
- For the affected community structures enhancement measures shall be taken for shifting of the structures. Additionally, new bus stop has been provided as per design.

4.4 IMPACTS AND MITIGATION DURING CONSTRUCTION

During the construction phase, in general, there is an adverse influence on all the components of environment. Most of these impacts are primarily due to negligent practices but are short termed and reversible in nature. A proper care is essential to minimize the adverse impacts to the extent possible to facilitate the restoration of environment and are discussed under following sub-heads.

The standard road construction works involve: site clearance, excavation, filling of earth materials and sub grade materials, laying of bituminous mixtures, handling of hazardous materials like bitumen, diesel, etc. dumping of unusable debris materials, transportation of materials from production site to construction site and other constructional activities and associated works like mobilization of constructional equipment, setting up of different construction plant, setting up of workforce camp, quarrying, transportation of material, material storage etc. These activities have certain impacts of various magnitudes on different components of environment.

3.4.1. Geology

Impact

The proposed project is bridge over the river Brahmaputra in which different aspects of engineering activities would affect the geology of river. The pillaring within river may affect the upper strata of geology of project area. Furthermore, the llikely impact on the geological resources shall be minimum in this project as the excavated material from the land surface of project area shall be used for construction of approach road.

The boulders shall be procured from the authorized suppliers and prevalent rules shall be followed for borrowing of soil, sand and aggregates. Cutting in proposed alignment shall be carried out as per requirement in acceptable manner.

Mitigation Measures

There is an abundance of quarry sources and the availability of stones for construction activity. Moreover, the nearby land surface is sufficient to provide most part of the road construction materials and aggregates and hence dependence on outsourced aggregate material for the project would be minimum /very less.

There is an availability of good quality of stone aggregates in area shall be available from five quarries having the potential to meet aggregate demand for bituminous and non-bituminous works of the project, including concrete aggregates. The stone from the quarries can be crushed to produce aggregates of different sizes meeting the specification for different uses.

Aggregates procured during construction stage shall be from the authorized or licensed suppliers only. Selected soil borrow areas have been identified during the design stage of the project. Most of these borrow areas are local borrow areas and non-productive agricultural fields.

The details of quarry management are given in Annexure 4.5: ***Guidelines of New Quarry Management*** and *Annexure 4.6: Guidelines for Existing Quarry Management.*

3.4.2. Seismology

Impact

The construction of the bridge and approach road may not lead to any adverse impact on seismology settings of the regional environment as the approach road is falling under ZONE V of BIS, which is considered as a region of most active seismic hazard zone. (refer Figure 3.9).

Since, the earthquake database in India is still incomplete, especially with regards to earthquakes prior to the historical period (before 1800 A.D.), this zone offers a rough guide of the earthquake hazard in any particular region and need to be regularly updated.

Mitigation Measures

Adequate measures of safety as per the Seismic activity shall be planned in the project development and shall be incorporated in both existing and newly planned structures. Also, the existing structures shall be checked and designed as per earth quake resistance.

3.4.3. Land Environment

Impact

Clearing, grubbing and excavation of the land within the extent of formation width of the proposed alignment are the primary activity to prepare the bed for approach road construction. The excavation activity shall lead into generation of excavated materials which would consist of mainly soil mixed with pebbles and rocks. Most of these materials shall be re-used as filling materials, aggregates for construction of retaining walls. However, about 10-15 percent of the excavated material shall be disposed off due to being non-suitability as road filling materials. The disposal of debris materials in haphazard manner shall not only hamper the aesthetic look of the area but at also are potential contaminant of surrounding land area.

Some parcel of land would be required temporarily to establish site offices and construction camp, worker & labour camp. After completion of construction activity this land shall be returned back to its original condition.

Substantial amount of land would also be required for extraction of borrow materials. Such type of activity can lead into disfiguration of topography of the area. Water stagnation in the borrow pit

provides ideal breeding sites for mosquitoes and thereby can spread malaria and dengue if borrow pit is not properly managed. Borrow pits near settlements can pose health risk. Further, random cutting near water courses shall result in soil erosion and siltation of the nearby water bodies.

Mitigation Measures

- The Construction camps shall be located preferably on barren land and sufficiently away from settlements and water bodies;
- Borrow area shall be located preferably on barren or un-irrigated land;
- The Borrow pits shall not be dug within 500 m of town or village settlement or within RoW;
- After excavation is over, the borrow area shall be suitably rehabilitated; either by backfilling it off by dressing the sides of the borrow pit to create slope consistent to the adjoining land;
- Whether borrow pit can be developed as water recharging pond depending upon the terrain of the area the possibility shall be explored;
- Proper reclamation of pits shall be done;
- Bottom of the pits shall be graded towards natural outfalls to prevent water accumulation;
- The reclaimed area shall be seeded to provide grass coverage.
- Quarrying of material shall be done only at existing licensed quarry and the area shall suitably be rehabilitated after quarrying is over.
- The project structures shall be designed as per earth-quake resistant design.
- The Borrow Areas can be operated and managed as per the plan given in Annexure 4.7.

3.4.4. Soil Environment

Impact

Loss of top soil: The site clearance process includes excavation and vegetation clearance which ultimately induces vegetation loss as well as loss of top soil. Since, vegetation clearance shall be confined to the minimum area required for widening activities within the proposed RoW the area affected would be very less. The activities associated with the site preparation and excavation, movement of vehicles and equipment can disturb the surrounding lands.

Soil Contamination: Contamination of soil during construction stage is primarily due to construction and other 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. Unwanted disposal of construction spoil and debris shall add to soil contamination.
Soil Erosion: Erosion of top-soil can be considered a moderate, direct and long- term negative impact resulting from the construction and maintenance of roads. The potential soil erosion is high and pervasive during the construction stage. Clearing and grubbing of trees/ vegetation can lead to exposure of raw soil. The construction of new fill slopes for grading and bridge-end fills shall also lead to exposure of large areas to erosion, if protection methods are not implemented.

Mitigation Measures
Mitigative measures such as maintenance of vehicles and machinery and fuel refilling shall be carried

out in a confined area to avoid contamination of soil to the maximum extent possible.

Provision for oil interception chamber shall be made for treating the waste water generated from vehicle wash, refilling and maintenance areas. Fuel storage and refilling sites shall be kept away from cross drainage structures. All spoils shall be disposed off as desired and the site shall be fully cleaned before handing over. Following measures are expected to minimize the impact on soil contamination.

- Only major activity of bridge will be carried out in bank side while objective to reduce activity on bank side would be preferable.
- All spills and collected petroleum products shall be disposed off in accordance with MoEF&CC and PCB, Assam guidelines. Fuel storage and fueling areas shall be located at least 300m from all cross-drainage structures.
- The base of all machinery, generators shall be paved and all the waste/spill shall be drained to oil interceptor before discharging.
- Proper demarcation of the surface to be sprayed /paved shall be done to minimize the excessive spread of emulsion/hot mix.
- Residential facilities shall be provided with proper sanitation and planed setup of construction camp.
- Soil quality monitoring shall be carried out during construction stage as per the environmental monitoring program. Corrective actions to be taken if the soil quality is found deteriorating.
- For safe and environmental friendly disposal of waste debris the instruction/ procedure specified in Annexure 4.2 are suggested to be followed.

Slope: To minimize soil erosion, slopes should be restricted to 1V:2H in most of the locations. Places where embankment height is <3m, turfing has been proposed while in places where the embankment is >3m stone pitching is proposed.

Turfing (Grassing at slopes): For embankments height <3m, locally growing grasses and bushes which are best adapted to the local soil, temperature and rainfall conditions shall be used. The methods of providing vegetation cover on embankment slopes shall be carried out as per the provisions mentioned in IRC-56-1974, “Recommended Practice for Treatment of Embankment Slopes for Erosion Control”. Moreover, the separate ongoing proposed project of River Front Development in south bank would develop the beauty of green scape of proposed alignment.

Stone Pitching: For embankment height >3.0 m, stones or bricks are hand laid on the surface of the embankment and lightly tamped. The interstices between the stones are filled up with soil. Grasses may be dibbled into the soil filled spaces. As the grass grows, it develops a good binding effect on the pitching. Borrow and Quarry areas need to be reclaimed properly.

A comprehensive instruction/procedure is given in Annexure 4.4 for Site Clearance and Tree Felling while details about tree felling is summarized in **Annexure 4.3**

The Contractor may be directed to provide immediate control measures to prevent soil erosion and sedimentation that shall adversely affect construction operations, damage adjacent properties or cause contamination of nearby streams or other watercourses. They are required to follow the sedimentation control measure as given in Annexure 4.6.

3.4.5. Air Environment

The major indicators of Ambient Air Quality relevant to the road project are the concentration of suspended particulate matters (PM_{10}), Particulate matters ($PM_{2.5}$), Sulphur dioxide (SO_2), Nitrogen oxides (NOx) and Carbon monoxide (CO) in the atmosphere. To access the impact through line source, caline-4 model has been adopted to forecast the impact in nearby environment while the impact through point source emission has been forecasted through Aermod with considering the worst condition. Both modelling will help us in mitigate the anticipated impact and will be treated as a good decision taking tool. The report of same is attached as **Annexure- 4.11.**

Mitigation measures

Generation of Dust

- Water shall be sprayed during construction phase, in earth handling sites, asphalt mixing sites and other excavation areas for suppressing fugitive dust.
- Since, fly ash shall be used, dust emission during its loading and unloading, storage at open place and handling for road construction shall be suppressed by regular water sprinkling.
- Special care shall be taken when working near educational institutions, health centers and other sensitive receptors.
- The Stone crusher plant, hot mix plant and wet mix plant shall be located sufficiently away from settlement towards downwind direction and shall conform to the requirement under Environmental (Protection) Rules, 1986.

Gaseous Pollution

- All the Construction vehicles and machineries shall be regularly maintained to conform to the emission standards stipulated under Environment (Protection) Rules, 1986.
- Asphalt mixing sites should be located at list 500m away from any habitation or sensitive environmental site and at least 250 m away from highway towards downwind direction.
- All the DG sets shall conform to the emission standards as stipulated under Environment (Protection) Rules, 1986.
- The generation of Volatile Organic Compounds (VOC) from oil storage, hot mixing plant and emission from fuel burning shall be restricted through their high temperature burning in presence of oxygen.
- The workers at asphalt mixing and subsequent application of asphalt mix on road surface shall be provided with heat resistant shoes and masks.

Ambient air quality shall be monitored as per environmental monitoring programme during construction phase. Corrective action shall be taken if results found deteriorating.

Reuse of Excavated Pavement Material

The most appropriate recycling option for roads in India is Hot Recycling. Stretches of existing bituminous pavements which are to be reconstructed, left out due to curve improvements or may get buried under flyovers can be milled off and the Reclaimed Asphalt Pavement (RAP) transported to hot mix plant for recycling. The RAP material is combined with new materials (asphalt binder and aggregate) to produce hot mix asphalt (HMA) mixtures. However, the milled RAP needs to be regarded before combining with the new aggregates to ensure conformity to the specified gradation. Various forms of

drum and batch plant modifications exist, which allow the use of RAP in HMA production on a regular basis. The primary benefit of hot mix recycling is the control of the quality of the finished product and the ability to process the milled RAP. In drum plants, the RAP is introduced in that part which is not exposed to the burner flame and is heated by the superheated aggregates. Hot recycling of asphalt pavements has become a standard, proven practice in many countries of the world since the last 30 years. The success of the asphalt pavements has initiated the thinking of implementing the same in the proposed approach road.

Figure 4.1: Milling of existing asphalt pavement

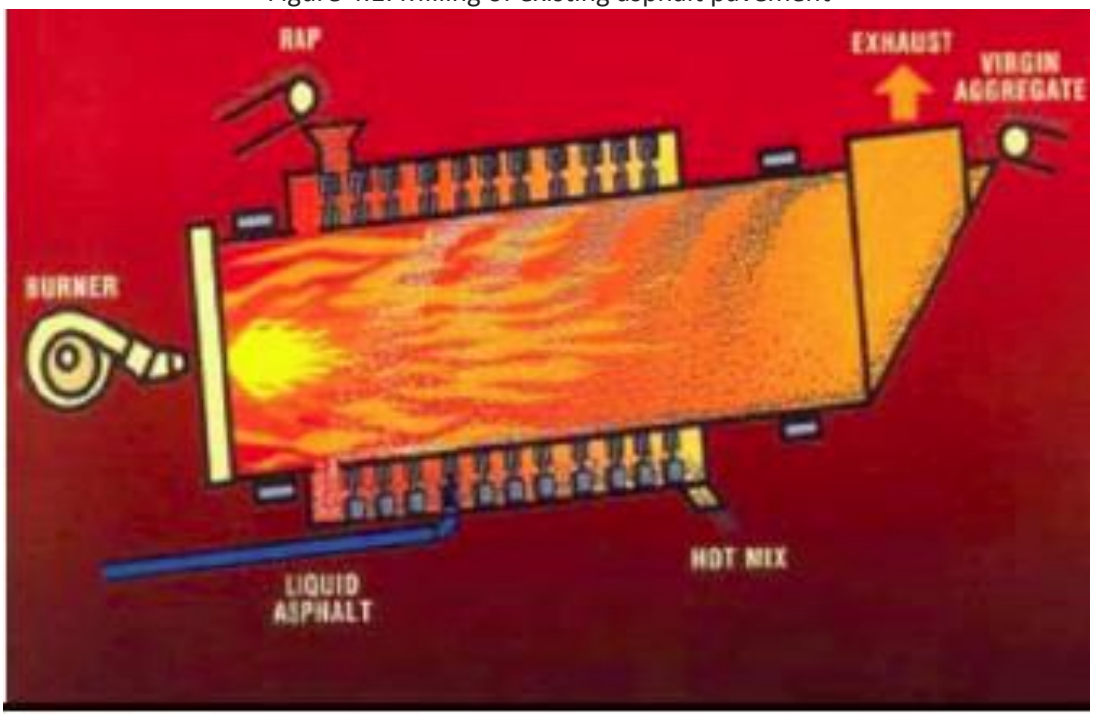


Figure 4.2: Hot mix recycling in double barrel drum plant

Resource Efficient Construction Technology (Warm Mix Asphalt, WMA)

Presently, most roads have bituminous surface constructed using naturally available road aggregates and bitumen at very high temperatures to produce Hot Mix Asphalt (HMA). Heating of bitumen to very high temperatures is linked to environmental degradation due to air pollution on account of increase in emission of gases into the atmosphere. In view of the above, low energy mixes such as WMA prepared and used at much lower temperatures than HMA are being extensively used in western countries to minimize air pollution, energy savings, etc. Production of WMA is at significantly lower temperatures between 100 to 140ºC as against HMA which is produced at high temperatures between 150 to 170ºC.

Use of WMA in green corridor stretch

The use of WMA is relatively new for India and tried only at a few locations particularly in urban roads in spite of several benefits. Lack of proper design guidelines, expertise, awareness, adequate number of successful test stretches in Indian conditions is some of the causes for limited application in India. Further, research is needed so as to validate the expected field performance of WMA mix especially with reference to mix compatibility, rate of gain of structural strength after construction, rutting potential, moisture sensitivity etc. before they can be widely applied to highway projects (**refer Figure 4.4**)

Figure **4.3:** Visible Emissions From HMA (Left) In Comparison To WMA (Right)

3.4.6. Water Environment

Impacts

Surface Water: Since, the proposed bridge shall be constructed over the Bramhaputra river, there shall be a direct and significant impact on the water quality of this river. Further, the proposed approach road is traversing through the other surface water bodies and water logging area such as ponds at several locations. Hence, significant impacts are anticipated on the water quality of these water bodies during construction phase. Silt load in the Bramhaputra River will pollute its water quality thereby affecting the river ecosystem.

Degradation of water quality is also 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.

Mitigation Measures

Major construction works close to the Brahmaputra River and other water bodies shall be avoided during monsoon period. Disposal of waste arising from the project activities as per norms of PCB, Assam and collecting and storing of bituminous wastes and taking it to approved disposal sites shall minimize the impacts.

The probability of accidents is minimal since enhancement of road safety measures such as improvement of curves and widening of the roads and other pedestrian facilities are taken care of the design stage. To minimize the oil contamination and sediment load to water bodies, provision of sedimentation tank and oil interceptor chamber can be provided.

Apart from the provision of mitigation measures, their effectiveness and further improvement in designs to reduce the concentration of pollutants in water due to construction activity shall be monitored. The frequency, duration and responsibility shall be as per the Environmental Monitoring Plan.

The issue of blocking of cross drainage should be taken care throughout the project stretch. Further, the engineering designing of left arm and right arm of south bank is totally designed to avoid any major impact on river ecology.

Ground Water: Depth of the ground water table in the project districts varied between 0.52 – 6.55 bgl and is depicted in Table 4.5. Some adverse impact is anticipated on ground water due to construction and such other activities of the project development.

Table 4.5: Ground Water Table of the Project District

Kamrup	
Pre-monsoon depth to water level range	1.83 to 6.55 m bgl
Post-monsoon depth to water level range	0.52 to 5.92 m bgl
Source: CGWB Report, 2013	

During the construction stage the project is not expected to alter the existing water quality on a permanent basis. There are various water bodies, along the road including rivers, and open wells. Some

impacts are anticipated on the water quality of these aquifer during the construction phase. The pillaring depth may cause the contamination in aquifer quality and the activity of approach road may impact the open well. In case of any water supply system at the downstream of the bridge location, prior information should be provided to the concerned department on the bridge construction across the river and the construction activities should avoid discharge of any hazardous chemicals in to the river water. Laying of pavement within the formation width may lead to reduction in the ground water recharge capacity.

Mitigation Measures

- The proposed approach road and their slope to meet the approach road is not close to bank of river. The piling of bridge structure would be in capped manner to avoid any contamination in the river Brahmaputra.
- As the area involved in the road construction is very less, the chances of reduction in the ground water recharge capacity due to laying of pavement within the formation width influence shall be non-significant.
- The depth of pillaring and any activities below ground level should be restricted to upper surface only which shall not impact the aquifer quality, extend possible.
- The closure piling shall be carried out to minimize contamination of construction material to the Bramhaputra river.
- Ground water quality shall be monitored as per environmental monitoring programme during construction phase as well as operation phase.
- Corrective action shall be taken if the ground water quality is found deteriorating.
- The Contractor may be directed to provide immediate control measures to prevent soil erosion and sedimentation that shall adversely affect construction operations, damage adjacent properties or cause contamination of nearby streams or other watercourses. They are required to follow the sedimentation control measure as given in **Annexure 4.8.**

Silt Fencing

- Silt fencing shall be provided to prevent sediments from the construction site entering into the nearby watercourses. The silt fencing consists of geo textile with extremely small size supported by a wire mesh mounted on a panel made up of angle / wooden frame and post. It is expected a single person shall be able to drive the angles by pressing from the top. The frame shall be installed at the edge of the water body along which construction is in progress. The numbers of such units to be installed can be decided depending upon the length of the water body along the side of the road construction. The silt fencing is given in Figure 4.5

- Silt fencing is proposed for a length of 250m which is sufficient to cover all minor and major bridge locations and the road side water bodies. Depending on the length of the individual water body, the number of units of silt fencing to be established is decided by the Independent Engineer.

Oil interceptor

- Oil and grease from road run-off is another major concern during construction as well as

operation. During construction, discharge of oil and grease is most likely from workshops, oil and waste oil storage locations, vehicle parking areas and the construction camps. A total of 3 oil interceptors shall be provided at all such locations to arrest oil and grease, as per Figure 4.6. The arrested products shall be disposed as per MoEF&CC and PCB, Assam guidelines. The location of all fuel storage and vehicle cleaning area shall be at least 300m from the nearest drain / water body.

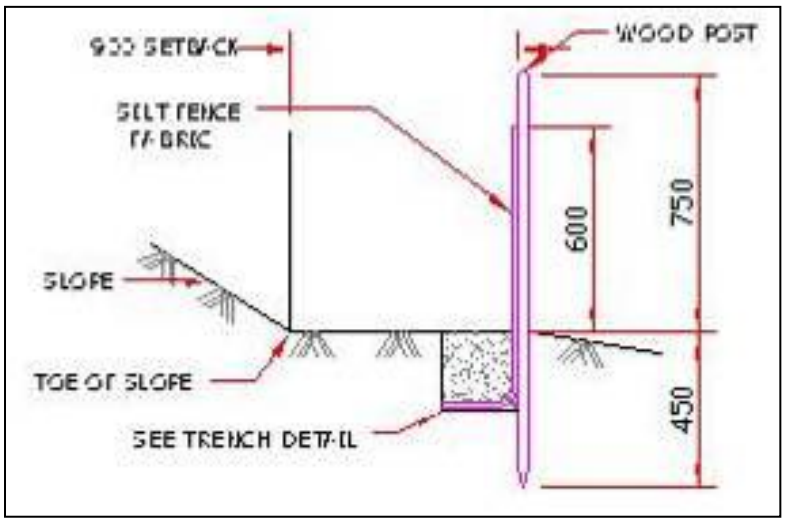


Figure **4**.4: Silt Fencing

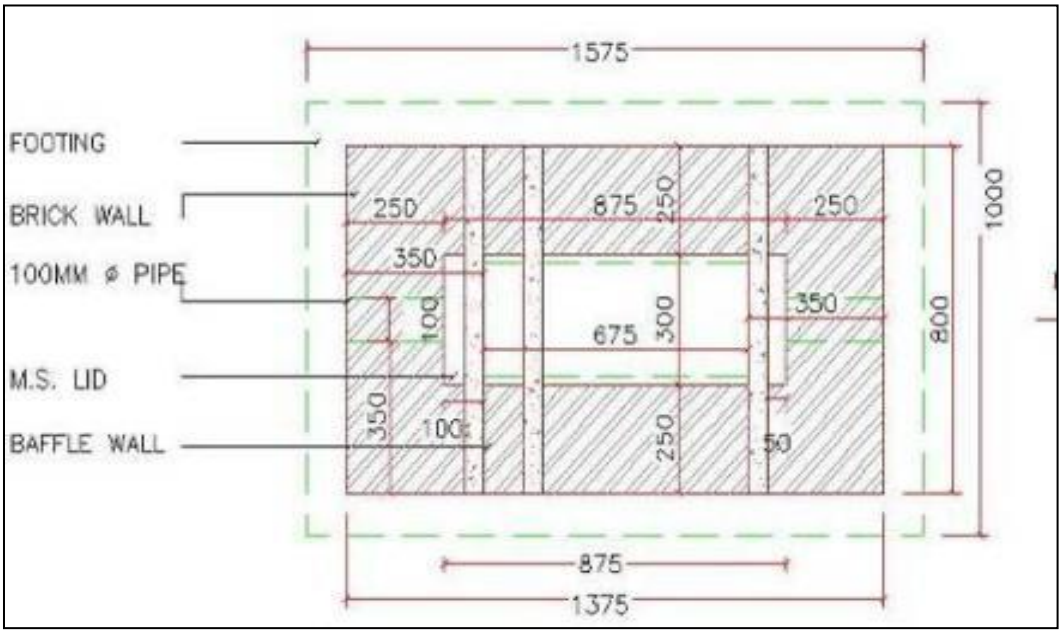


Figure 4.**5**: Oil interceptor

Storm Water Management (SWM)

Adequate drainage facility shall be provided all along the approach road as per the Typical Cross Section

as illustrated in Chapter-2.

3.4.7. Noise & Vibration Environment

Noise Impact

During the construction phase of the approach road, the major sources of noise pollution are vehicles transporting the construction material to the construction yard and the noise generating activities at the yard itself. Mixing, casting and material movement are primary noise generating activities in the yard and shall be uniformly distributed over the entire construction period. Construction activities are anticipated to produce noise levels in the range of 80 - 95 dB (A).

- The construction equipment shall have high noise levels, which can affect the personnel operating the machines. Use of proper Personal Protective Equipment (PPEs) such as earmuffs shall mitigate any adverse impact of the noise generated by such equipment.
- The noise likely to be generated during excavation, loading and transportation of material shall be in the range of 90 to 105 dB (A) and this shall occur only when all the equipment operate together and simultaneously. This is however, is a remote possibility.
- The workers in general are likely to be exposed to an equivalent noise level of 80 to 90 dB (A) in an 8-hour shift, for which all statutory precautions should be taken into consideration. However, careful planning of machinery selection, operations and scheduling of operations can reduce these levels.
- Uninterrupted movement of heavy and light vehicles at high speeds may cause increase in ambient noise levels on the approach road. It may have negative environmental impacts on the sensitive receptors close to the approach road. Variation of noise level with vehicle speed is given in Table 4.6. Table 5.15 presents the source of noise pollution and the impact categorization.

Table 4.6: Noise Levels Variations with Vehicle Speed

Speed (Km/hr)	Noise Levels in dB(A) at 15 m			
	Cars	Trucks	Buses	2/3 wheelers
40	59.00	76.00	76.00	61.00
50	63.00	80.00	80.00	66.00
60	65.00	81.00	81.00	68.00
70	68.00	81.50	81.50	70.00
80	70.00	82.00	82.00	72.00
90	72.00	83.00	83.00	74.00
100	74.00	83.50	83.50	76.00

Table 4.7: Source of Noise Pollution

S. No	Phase	Source of Noise Pollution	Impact Categorization
1.	Pre-Construction	Man, material & machinery movements Establishment of labor camps onsite offices, stock yards and	All activities shall last for a short duration and also shall be localized in nature

S. No	Phase	Source of Noise Pollution	Impact Categorization
		construction plants	
2.	Construction Phase	**Plant Site:** Stone crushing, asphalt production plant and batching plants, diesel generators etc. **Work Zones:** Communities residing near the work zones	**Plant Site:** Impact shall be significant within 500m. **Work Zones:** Such impacts again shall be of temporary nature as the construction site shall go on changing with the progress of the works.
3.	Operation Phase	Due to increase in traffic (due to improved facilities)	Shall be compensated with the uninterrupted movement of heavy and light vehicles till the facility reaches the level of service.

Vibration Impact

Construction activities, such as pile driving, dynamic compaction of loose soils, and operation of heavy construction equipment, induce ground and structure vibrations. Their effects range from a nuisance to habitats, existing infrastructure and the disturbance of working conditions for sensitive places like hospitals and academic institutions, to the diminution of structure serviceability and durability.

During construction of Pan bazar bridge, level of ground and structure vibrations depends on the energy level of vibration source; soil medium; heterogeneity and uncertainty of soil deposits at a site, distance from the source, characteristics of wave propagation at a site, dynamic characteristics and susceptibility ratings of adjacent and remote structures, and sensitivity of the local population to vibrations.

Mitigation Measures

- The entire activity will be performed through modern equipment which is equipped with such control device in their designing and manufacturing to avoid any vibration effects.
- The breakup in construction activity will reduce the risk of damage from low frequency ground vibrations.
- Foundation settlement will not be performed in loose soils.

3.4.8. Ecological Environment

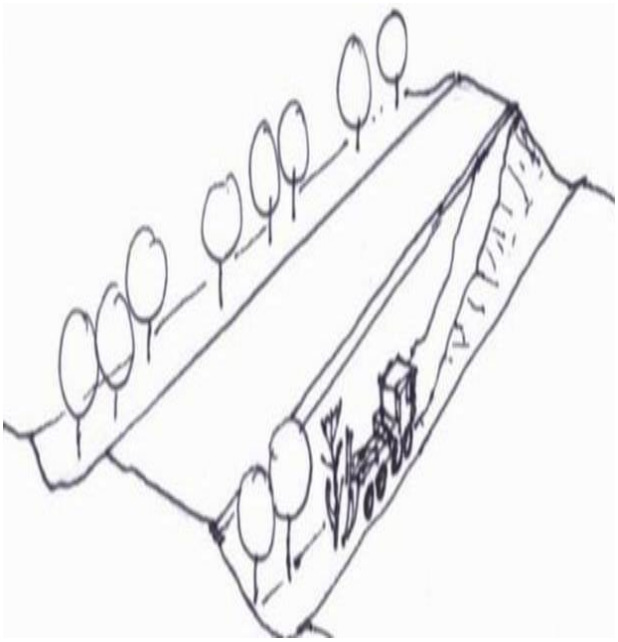
The present project does not involve diversion of any reserve forest land; Moreover, it is not passing close to any wildlife sanctuary or national park.

TREE TRANSPLANTATION

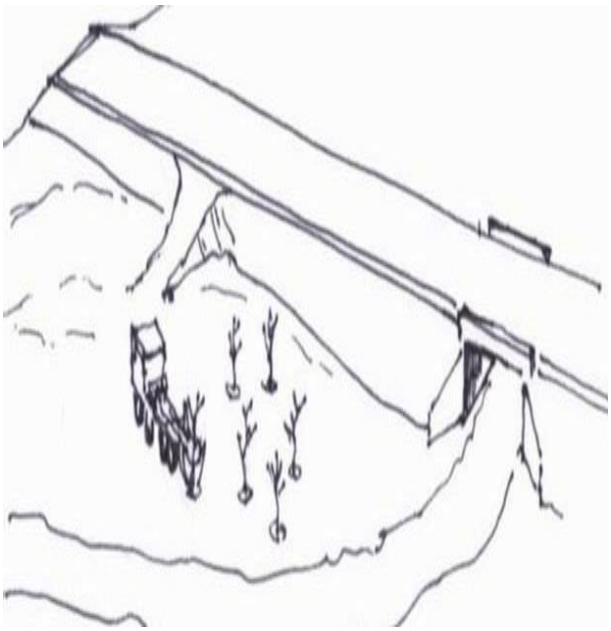
As part of the green corridor initiative, transplantation of smaller girth trees has been proposed. With this regard, the tree transplantation technique that has been successful during the previous attempts was discussed with the forest department and their knowledge has been utilized. Based on the discussions and available literature the methodology for tree transplantation has been proposed. The factors that need to be considered while implementing the tree transplantation scheme are detailed below:

Girth size of the trees should be below 90cm determined by the capacity of the transplanting machine,

- Trees having tap root system should be avoided unless they are very young thereby having smaller tap roots,
- There should be sufficient vertical clearance with respect to overhead utilities for the entire transplanting operation,
- The donor and the recipient sites should be free of underground utilities. The cone of soil dug out by the machine is approximately 2m in depth and has 2m diameter at the ground level,
- Accessibility of the multi- axle truck carrying the transplanting equipment to the donor and recipient sites needs to be ensured.



Temporary ramp to access the avenue trees to be



Temporary ramp to access the recipient site

transplanted

The tree transplanted is first used to dig the first pit at the recipient location

It is then moved to the donor location and positioned with its blades raised and the gate open around the tree

The gate is the closed and locked hydraulically and the entire unit is lowered to the ground

The blades are hydraulically inserted into the ground one at a time

The blades are inserted to their fullest depth after which stabilizers are lowered and vertical extraction of the ball and tree is completed

The extracted tree is then tilted into a horizontal position after which the stabilizers are raised and the tree transported to the recipient location.

Uprooted trees are carefully lowered in the recipient location filled with a solution of vermin-compost, anti-termite, antifungal, antibacterial and root promoter

The blades are raised and gate is opened after placing the tree in its recipient location

GREENBELT DEVELOPMENT

Greenbelt is an important sink of air pollutants and barrier of noise. The development of pioneer species will also reduce the soil erosion and play a major role in drainage control. Hence, green cover in Highway Projects not only helps in reducing pollution level, but also improves the ecological conditions and prevents soil erosion to great extent. It further improves the aesthetics and beneficially influences the microclimate of the surrounding. Many a times, it attracts the avifauna and other wildlife to re-colonize the area. The establishment of plant species also sequesters the soil "carbon, which is the leading gas responsible for the "Global Warming" in Planet Earth.

Greenbelt plantation would be developed in following areas:

- On Both Side of the Highways
- Median Plantation

The species of plantation would be selected considering the soil quality, place of plantation, chances of survival, commercial value etc. Only indigenous species should be planted. Mixed plantation should be done keeping optimum spacing between the saplings. The species for greenbelt development would be selected on the basis of their availability in the area and suitability for the particular location. Further, guideline for greenbelt development given in Central Pollution Control Board's publication "Guidelines for Development of Greenbelt CPROBES/75/1999-2000" would also be followed, while selecting the plant species for greenbelt development. In order to supply of seedlings for the continuing greenbelt development plan, a nursery may be developed in the nearby area. Sapling may be done from seeds or seedling collected from nearby forest areas.

The plant species for Greenbelt Development shall be selected on the basis of following characteristics:

- The species should be native and locally available.
- The species should be fast growing, deep rooted with colonizing behavior.
- The species should be fruit bearing/flowering with dense foliage cover and small/pendulous leave with smooth surface.
- The species should have good root-shoot ratio and soil-binding capacity.
- The species should have aesthetic beauty and should also be low water demanding.
- The species with ability to fix atmospheric Nitrogen (Preferably Leguminous species of family Fabaceae) may be preferred.

A total of 7455 no. of trees including bamboo clusters are recorded in the COI. The endemic species will be preferred for plantation.

Traffic Congestion & Safety

Impact

During construction of road, side drain, etc. temporary blockage of access or interference with the access to the properties located along the RoW may occur, causing inconvenience to the road users, increased traffic jam and enhanced accident risk if not managed properly.

Mitigation Measures

- Two arms in south bank for up and down will distribute traffic to minimize congestion.
- Detailed Traffic Control Plans shall be prepared prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day.
- Temporary diversion (including scheme of temporary and acquisition) shall be constructed with the approval of the Engineer and the Project Director. Special consideration shall be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night.
- The Contractor shall ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. The temporary traffic detours shall be kept free of dust by frequent application of water, if necessary.
- The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement.
- Safe and convenient passage for vehicles, pedestrians and livestock to and from roadsides and property accesses connecting the approach road shall be ensured by providing temporary access.
- Adequate signage and barricades shall be raised at the expected bottlenecks for safe movement of people.
- On completion of the works, all-temporary obstructions to access, i.e. all rubbish and piles of debris shall be cleared away.
- The guidelines for traffic control and safety during construction is given in Annexure 4.9.

3.4.9. Economic Environment

During operation mostly positive imapcts will be expected like employment generation, better communication, rise in standard of living etc.

3.4.10. Public Health and Safety

Impact

Health

- The effect of emission from gaseous pollutants is only for short term till the construction work is over but the effect may be significant from the point of view that the workers are directly exposed to these emissions.
- The dust and gaseous pollutant generation within the congested area during the

construction works shall adversely affect the health of people residing in the close proximity of the road.

- Stagnancy of water in borrow pits located nearby settlements during rains may enhance the possibility of spreading of diseases like malaria, cholera and other diseases.

Hygiene:

- The sewerage system for the camp if not properly designed, built and operated, may create unhygienic condition and health hazard; shall further add pollution to the air and ground water.
- The poor sanitation and accumulated garbage/ waste generated from labor camp may cause increase in communicable diseases if not properly managed / disposed off.
- Vulnerable people may get affected if construction camps if not sited away and adequate health care is not taken for the work force.

Safety:

- Safety risks to bridge and road workers, primarily in the areas of storage and handling of materials, operation of heavy machinery close to traffic, slopes, power line and water courses, are also involved during the construction works.
- The vehicles and equipment operation increase the chances of collision with vehicles, pedestrians and livestock.

Mitigation Measures

- The mixing plants and equipment shall be installed sufficiently away from the settlement;
- All the construction equipment and vehicles shall conform with the emission standards stipulated by the CPCB;
- Safe working techniques shall be followed up and all the workers shall be trained;
- All the workers shall be provided with proper Personal Safety Equipment (PPEs) at construction as well as plant site;
- Proper caution signage, barricading, delineators etc. shall be installed at construction zone and temporary diversions;
- Proper traffic management shall be ensured at the construction zone as per IRC;
- An Emergency Response system in case of any incidence shall be developed and implemented;
- Periodical health check facility shall be provided at camp sites.
- Latrines and urinals in an accessible place, and separate accommodation as per standards set by the Building and other Construction Workers shall be provided within the precincts of every workplace.
- Latrines and urinals shall be cleaned at least four times daily and at least twice during working hours and kept in a strict sanitary condition.
- If women are employed, separate latrines shall be provided for them. There shall be adequate supply of water, close to latrines and urinals.
- All temporary accommodation shall be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing.
- The sewerage system for the camp shall be properly designed, built and operated so that no health occurs and no pollution to the air, ground or adjacent watercourses takes place.
- Garbage bins must be provided in the camp and regularly emptied and the garbage disposed off in a hygienic manner.

- ❖ The separate collection of biodegradable and non-biodegradable will be practiced as per SWM Rules, 2016.
- ❖ Construction camps are to be sited away from vulnerable people and adequate health care is to be provided for the work force.
- ❖ On completion of the works, the whole of such temporary structures shall be cleared away, all rubbish burnt, excreta or other disposal pits or trenches filled in and effectively sealed off and the whole of the site left clean and tidy, at the Contractor's expense, to the entire satisfaction of the Engineer.
- ❖ Compliance with the relevant legislation must be strictly adhered to.
- ❖ The guidelines for setting and layout of construction camps are given in Annexure 4.10.

4.5 IMPACTS AND MITIGATION DURING OPERATION

During operation stage, the main sources of environmental impacts are increased traffic volume and speeds and better accessibility. The increase in traffic volume and speed may enhance the safety risk especially in the North Guwahati areas along the approach road. The better accessibility shall enhance the economic development of the region. However, no sudden change in traffic volume is expected as the road is already existing one and opened for public traffic. The project also provides the opportunities of the restoration of vegetation around the vicinity of the worksite and roads by implementing the compensatory plantation programme, which shall not only enhance the aesthetic view but can also help in reclamation of soil. This project will give pleasure appearance to proposed River Front Development and shall be attentive element for development of green lungs. During operational phase this shall be enhanced with the activities associated with the maintenance of landscape such as plantation programme, by providing roadside amenities, parks etc.

3.5.1. Soil Environment

Impact

Impacts on soil during operation stage are likely to be minimum as contaminations are expected only during periodical maintenance of approach road and from accidental spillage.

Mitigation Measures:

It shall be emphasized that the probability of such an accident is quite low, as one of the objectives of the design is the enhancement of road safety.

3.5.2. Air environment

Impact:

As the project envisages improvement of road conditions for smooth traffic flow, the project shall have beneficial impact on air quality of the region during its operation. However, when viewed with respect to the existing ambient air quality or with respect to compliance of ambient air quality standards during the post improvement phase of the road stretch, due to the increase in the traffic volume, the impact on air quality along the approach road is likely to be minor.

After improvement of the existing road, the traffic is expected to move smoothly at higher designed speeds, which shall assure lower emissions of gaseous pollutants, further improving air quality in the region and hence not expected to affect the air quality adversely.

The rate of emissions of various types of vehicles is presented in Table 4.8. However, the extent of these impacts, at any given time shall depend upon the rate of vehicular emission within a given stretch of the road; and the prevailing meteorological conditions. The impacts shall have strong temporal dependence as both of these factors vary with time. The temporal dependence would have diurnal, seasonal, as well as long-term components.

Table 4.8: Rate of Emissions of Various types of vehicles

Emissions	Emission factor in gm/km/vehicle					
For Diesel Vehicles						
Speed Km/hr	30	40	50	60	70	80
CO	12.53	9.40	7.52	6.27	5.37	4.70
NOx	22.28	16.71	13.37	11.14	9.55	8.36
For Petrol Vehicles (Speed Km/hr)						
	Car	2 Wheeler	3 Wheeler			
CO	2.72	2.0	4.0			
NOx	0.58	0.5	0.5			

Mitigation Measures

As indicated in this report earlier, the air pollutant shall be from vehicular movement on road and emission from road side industries. As such the nation and international bodies are quite active in controlling the air pollution through emission limit, auto technology and fuel quality which shall counter the increase in air pollution due to increase in traffic during operation phase. Additional measures/proposed are below:

- Pollution resistant species, which can grow in high pollutant concentrations or even absorb pollutants, can be planted along the roadside.
- Monitoring of air pollution levels at sensitive locations shall be carried out all through the operation stage to check that the pollution levels are within standards prescribed by CPCB. A monitoring plan to this effect has been prepared. Table 4.9 depicted the Summary of potential impacts and mitigation measures proposed during operation phase of the project.

Table 4.9: Summary of potential impact and mitigation measures proposed

Sl. No	Item	Impact	Reason	Mitigation/ Enhancement
1	Air Quality emissions- pre-Construction Stage	Temporary & Specific (Dust Generation)	Shifting of utilities Removal of trees and vegetation Transportation of material Installation of construction	Sprinkling of water Fine material to be completely covered during transport and stocking. Plant to be installed in downwind

			plants	direction from nearby settlement.
2	Air Quality emissions-Construction stage	Moderate Impacts (Gaseous pollutants and dust generation)	Clearing and grubbing materials Dumping brushing of the surface access roads to borrow areas Hot mix plants Crushers paving of asphalt layers Labour camps.	Air pollution Norms shall be enforced, Laborers shall be provided mask. Local people shall be educated on safety and precaution. On access roads, newly constructed embankments etc.
3	Air quality emissions-operational stage	Moderate Impacts (Gaseous pollutants)	Air pollutants from vehicular pollution, traffic dust emissions from tyres and transportation of any material	Compliance with future statutory regulatory requirements Auto technology, vehicle fuel quality-improvements
4	Air Quality Monitoring	-	Effectiveness/ shortfall (if any) Any unforeseen impacts	Measures shall be revised & improved to mitigate/enhance environment due to any unforeseen impacts.

3.5.3. Ambient Noise

Impact

Ambient noise level during operation is going to be slightly higher than the present noise level increased due to increase in traffic volume.

Mitigation Measures

Proposed tree and shrub plantations planned for avenue plantation especially close to settlements, may form an effective sound buffer during the operation stage.

Operation Stage

Though the level of discomfort caused by noise is subjective, there is a definite increase in discomfort with an increase in noise levels. Road noise depends on factors such as traffic intensity, the type and condition of the vehicles plying on the road, acceleration / deceleration/ gear changes by the vehicles depending on the level of congestion and smoothness of road surface. However, traffic will ply on high speed without congestion, the noise due to frequent honking would be less/ absent..

As part of mitigation measure, noise barrier may be provided at these locations as per **Figure 5.8**.

Broad leaf trees with good foliage cover and compound walls can be used as noise barrier in the environmentally sensitive locations. An example of such noise barrier is depicted in Figure 5.8 as follows:

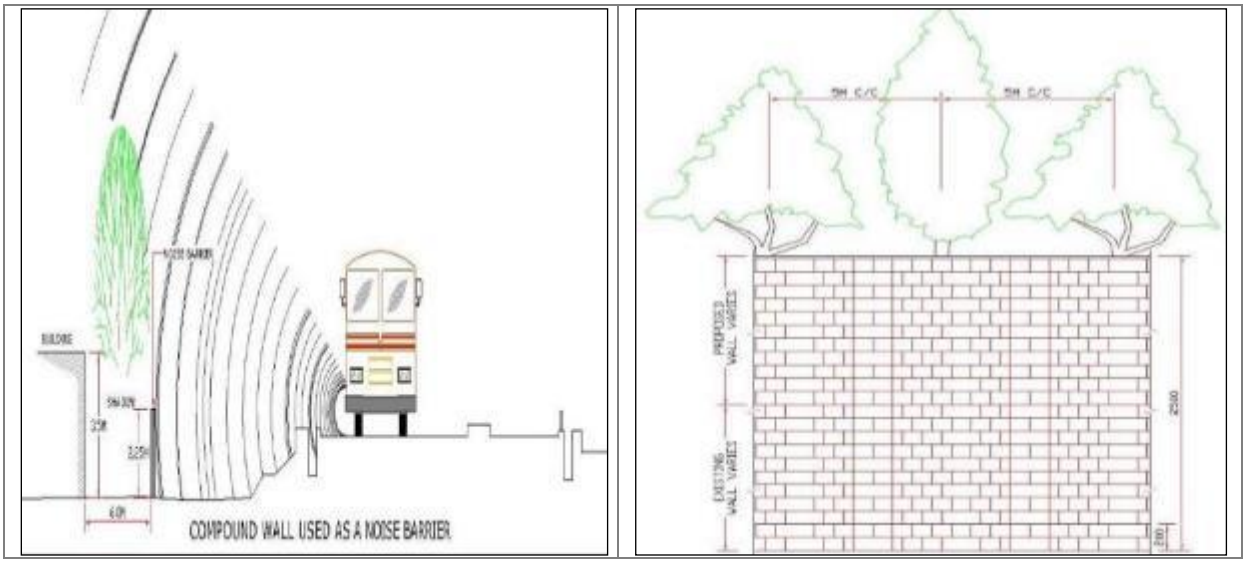


Figure 4.6: Compound wall and trees as noise barrier

Specific noise related mitigation measures are given in Table 4.10 as given below.

Table 4.10: Noise Related Mitigation Measures

Sl. No.	Item	Impact	Reason	Mitigation / Enhancement
1.	Sensitive receptors	Direct impact	Increase in noise pollution Man, material and machinery movements.	▪ Noise barrier in the form of increasing of school building boundary wall at along approach road and south bank of proposed bridge. ▪ No horn zone sign post
2a.	Noise Pollution (Pre-Construction Stage)	Direct impact, short duration	Establishment of labour camps, onsite offices, stock yards and construction plants	▪ Area specific and for short duration. ▪ Machinery to be checked and complied with noise pollution regulations. ▪ Camps to be setup away from the settlements, in the down wind direction
2b.	Noise Pollution (Construction Stage)	Marginal Impact	Stone crushing, asphalt production plant and batching plants, diesel generators etc. Community residing near to the work zones.	▪ Camps to be setup away from the settlements, in the down wind direction. ▪ Noise pollution regulation to be monitored and enforced. ▪ Temporary as the work zones shall be changing with completion of construction.
2c.	Noise Pollution (Operation	Marginal Impact	Due to increase in traffic (due to	▪ Shall be compensated with the uninterrupted movement

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

3.5.4. Ground Water Quality

Impact:

Ground Water may get contaminated due to the following reasons:

- Accidental spillage
- Refueling of vehicle (bus, truck, etc.)
- Leakage of oil during transportation
- Washing of vehicles
- Routine and periodical maintenance of the approach road

Mitigation Measures:

- Oil interceptor shall be provided at plant site and vehicle workshop.
- Automotive service centers shall be discouraged from establishing along the corridors without installing preventive measures against petroleum and oil contamination.

5. ANALYSIS OF ALTERNATIVES

5.1 GENERAL

The consideration of alternatives of projects is one of the more proactive sides of environmental assessment - enhancing the project design through examining options instead of only focusing on the more defensive task of reducing adverse impacts of a single design. This calls for the systematic comparison of feasible alternatives for the proposed project site, technology and operational alternatives. Alternatives are compared in terms of their potential environmental impacts, capital and recurring costs, suitability under local conditions and institutional, training and monitoring requirements.

Examining alternative means of carrying out a project involves answering the following three questions:

(i) What are the alternatives?

(ii) What are the environmental impacts associated with each alternative? and

(iii) What is the rationale for selecting the preferred alternative?

Analysis of alternatives involves a thorough study of the possible future conditions in the project study area in response to a set of alignment alternatives compared to without the project scenario.

5.2 ALIGNMENT OPTIONS

Three options were studied for planning the bridge on Brahmaputra nearby Pan Bazar.

The fundamental criterion for the alignment is to cater to a ruling speed of the vehicles and a ruling gradient for easy movement of traffic. Planning of the alignment has been made keeping the above aspect in consideration. It may be noted here that the requirements of inland water way authority also have been catered to in planning of the alignment on the Southern bank approach.

The following features have been incorporated in the alignment on the southern bank approach for all the three alignment options. Reference may be made to the Key plan for appreciation of the alignment.

The objectives of designing an alignment are:

1. To facilitate the smooth movement of traffic
2. To make possible the desired speed of the vehicles of 30- 40 Kmph.
3. To provide a gentle gradient of 1 in 30.
4. To be of optimum length.
5. To traverse through the obligatory points.
6. To cause minimum land acquisition and create least disturbance to the environment and general public.
7. To integrate the MRTS route along with the route for road traffic.

Further the following factors contribute for the selection of the alignment also.

1. Type of the main bridge across the river and its formation level.
2. Bed Level of the river corresponding to the Seismic Activities.
3. Present Road Layout.
4. Traffic demand at present and the projected traffic after 20years.
5. Minimum Tree cutting
6. Minimum impact on PAPs
7. Avoiding built up areas

I. Option-1A:

The alignment starts from place near Bharalumukh at South Bank and will end at NH-31 on North Bank near Silamahekhaity. Total length of road including a Six-Lane bridge is 5.84km.

South Bank

The approach road connecting to proposed bridge at Pan Bazar starts from AT road, 340m to west from Santipur Bus stop.

i) A rotary has been proposed near Bhutnath Bus stop and 435m away from Sonaram School compound to the west for smooth entry of traffic to the proposed Bridge. The rotary has a radius of 25m and the approach road ramp (inverted Y-shaped) connecting to the Main Bridge has a radius of 184.75m. This will facilitate easy movement of traffic from AT road / MG road travelling to North Guwahati.

ii) There is another rotary proposed at a distance of about 1300m from first rotary near Pragjyothi Cultural Complex on MG road. This will allow traffic coming from North Guwahati to South Guwahati to enter MG road / AT road. This rotary has a radius of 25m and the approach road ramp (inverted Y-shaped) has a radius of 184.75m.

Both the rotaries are connected for through movement of traffic from AT road to MG road with an elevated one way corridor on the River bank. A Y-junction has also been proposed to be developed near Bharalumukh Bus stop for providing access to existing AT road. One Minor bridge over Bharalumukh Nala is proposed to be constructed on the ramp. The existing bridge on the MG road will be taken up repair and retrofitting. It may be noted here that the proposed alignment is not affecting Sonaram High School and its ground. The connecting road on the river bank will be above the park area and hence will not disturb the park area. The entry to the rotary is on the land where the office of The Director of Surveys, Assam is located at present. Since this is a government building the same may be relocated to a suitable place. By this unnecessary delay for the Land acquisition will be prevented. South bank alignment and location map has been shown in **Figure 5.1**.

North Bank

The major portion of alignment i.e. (4.1km) is on North Bank including North approach of proposed bridge. The alignment will meet NH-31 Guwahati-Baihata road near Silamahekhaity on Northern side. End point of alignment is about 820 m (along the existing NH-31 Guwahati-Baihata road) away from Junction(Jaiguru Bus stop) of IIT road & NH-31 towards Gauripur Bus stop and about 1km form Gauripur Bus stop. The proposed alignment passes through villages like Maj Gaon, Abhaypur, Ghora Jan, Silamahekhaity and ends at NH-31 near Kali Pahar area. It crosses SH-2 (Barpeta-Hajo-Guwahati road) near Ch: 2+340, Gauripur-Bottling Plant Road near Ch: 3+928 and finally meet NH-31. It also crosses IR line near Ch: 5+690 between Station Agya Thuri and Station Changsari, ROB is proposed at this location. Important industries, factories like Gauripur Bottling plant, HPPL and CRPF camp, CRPF Godown etc. are avoided. Some portions of proposed location of SAIL, water treatment Plant and Raj Alco Brew Industry is falling under proposed alignment corridor. Efforts have been made to minimize acquisition of Structures / Buildings. Chainages of these locations are given in Table below. Alignment and location map is shown in **Figure 5.2**.

II. Option-1B:

The alignment starts from Bharalumukh at South Bank and will end at NH-31 via village Ghora jan and IIT Road on North Bank. Total length of road including a Six-Lane bridge is 6.2km.

South Bank:

The South Bank approach part upto the Main Bridge is same as Option 1A.

The approach road connecting to proposed bridge at Pan Bazar starts from AT road, 340m to west from Santipur Bus stop.

i) A rotary has been proposed at 435m from Sonaram School compound to the west for smooth entry of traffic to the proposed Bridge. The rotary has a radius of 25m and the approach road ramp (inverted Y-shaped) connecting to the Main Bridge has a radius of 184.75m. This will facilitate easy movement of traffic from AT road / MG road travelling to North Guwahati.

ii) There is another rotary proposed at a distance of about 1200m from first rotary near Pragjyothi Cultural Complex on MG road. This will allow traffic coming from North Guwahati to South Guwahati to enter MG road / AT road. This rotary has a radius of 25m and the approach road ramp (inverted Y-shaped) has a radius of 184.75m.

Both the rotaries are connected for through movement of traffic from AT road to MG road with an elevated one-way corridor on the River bank. A Y-junction has also been proposed to be developed near Bharalumukh Bus stop for providing access to existing AT road. One Minor bridge over Bharalumukh Nala is proposed to be constructed on the ramp. The existing bridge on the MG road will be taken up repair and retrofitting. It may be noted here that the proposed alignment is not affecting Sonaram High School and its ground. The connecting road on the river bank will be above the park area and hence will not disturb the park area. The entry to the rotary is on the land where the office of The Director of Surveys, Assam is located at present. Since this is a government building the same may be relocated to a suitable place. By this unnecessary delay for the Land acquisition will be prevented. South bank alignment and location map has been shown in **Figure 5.1**.

North Bank

The alignment for Option 1B on the Northern bank is same as in Option 1A upto the Village Ghora jan. Near this village the alignment turns towards IIT Guwahati and crosses the Railway tracks and IIT Road near Namani Jalah Mosque and then joins NH-31 nearby Narayana Super speciality Hospital. Chainages of these locations have been indicated in Table below. Alignment and location map are as shown in **Figure 5.1**.

III. Option-2:

The alignment starts from Bharalumukh at South Bank and will end at existing Gauripur junction to join NH-31 on North Bank. Total length of road including a Six-Lane bridge is 8.3 km (including south bank approach flyover).

South Bank:

The South Bank approach part upto the Main Bridge is same as Option 1A.

The approach road connecting to proposed bridge at Pan Bazar starts from AT road, 340m to west from Santipur Bus stop.

i) A rotary has been proposed at 435m from Sonaram School compound to the west for smooth entry of traffic to the proposed Bridge. This will facilitate easy movement of traffic from AT road / MG road travelling to North Guwahati.

ii) There is another rotary proposed at a distance of about 1200m from first rotary near Pragjyothi Cultural Complex on MG road. This will allow traffic coming from North Guwahati to South

Both the rotaries are connected for through movement of traffic from AT road to MG road with an elevated one-way corridor on the River bank. A Y-junction has also been proposed to be developed near Bharalumukh Bus stop for providing access to existing AT road. One Minor bridge over Bharalumukh Nala is proposed to be constructed on the ramp. The existing bridge on the MG road will be taken up repair and retrofitting. It may be noted here that the proposed alignment is not affecting Sonaram High School and its ground. The connecting road on the river bank will be above the park area and hence will not disturb the park area. The entry to the rotary is on the land where the office of The Director of Surveys, Assam is located at present. Since this is a government building the same may be relocated to a suitable place. By this unnecessary delay for the Land acquisition will be prevented. The alignment of proposed bridge project with all possible alternatives is shown in **Figure- 5.1.**

North Bank

The major portion of proposed alignment i.e. (8.3km) is on North Bank including North approach of proposed Six-lane Bridge.

After touching the North bank of Brahmaputra, the main bridge is connected to a viaduct of length 1.15km crossing villages such as Ghora Jan, State Highway 2- Barpeta-Hajo Guwahati Road. After the end of the viaduct the road goes via Abhaypur, college nagar, Gauripur and after Gauripur Bottling plant road crosses the railway tracks and then joins nearby the existing Gauripur junction with NH-31.

Mostly habitated built-up area is near the North Bank. Efforts have been made to minimize the acquisition of buildings, important industries, factories like Gauripur Bottling plant, HPPL etc. Chainages of these locations are given in Table below.

The comparison of all the three options studied is depicted in Figure 5.1 and enumerated in **Table 5.1** as follows.

Figure 5.1: Analysis of All the Three Options Studied

The comparative studies of all the three options are given as under:

Table 5.1: Analysis of Alternatives

S.No	Attributes	Option- 1A	Option- 1B	Option- 2
1.	Proposed alignment	(Bharalumukh at South Bank to NH-31 near Silamahekhaity on North Bank)	(Bharalumukh at South Bank to NH-31 via Ghora jan and IIT Road on North Bank)	From Bharalumukh (Pan Bazar) at South Bank to NH-31 at existing Gauripur Junction on North Bank
2.	Total Length	5842 m	6982.00m	8658 m
3.	Speed	100 Kmph (Main Bridge), 60-70 Kmph (Approach Ramps- Southern Bank)	100 Kmph (Main Bridge), 60-70 Kmph (Approach Ramps- Southern Bank)	100 Kmph (Main Bridge), 40 Kmph (Approach Ramps- Southern Bank), 60 Kmph (Southern Bank Road), 10 Kmph (At Rotaries) & 65-100 Kmph at Northern Guwahati Road
4.	R.O.W	90 m	90 m	80m
5.	Min curve radius(m)	187.5	184.75	170.00m (Ramps) & 250m (Approach Road
6.	Max curve radius(m)	4000m	1000m	1500m
7.	Max. S.E	7%	7%	5%
8.	Major affected structures	a) Ch: 1+600 to Ch: 1+700, (Both side) b) Ch: 2+180 to Ch: 2+380, (Both side) c) Ch: 3+200 to Ch: 3+500(LHS only) d) Ch: 3+800 to 4+000 Portion of water treatment Plant & other buildings near Bottling plant Road crossing. e) Ch: 4+320 to Ch: 4+380, portion of Raj Alco Brew Industry f) Ch: 4+520 to Ch: 4+600, portion of proposed SAIL location	1. Ch: 1+550 to Ch: 1+700, (Both side) 2. Ch: 2+000 to Ch: 2+550, (Both side) 3. Ch: 3+390 to Ch: 4+000, (Both side) 4. Near Ch: 5+260, (Left Side) 5. Near Ch: 6+100 to Ch: 6+150,(Both Side)	1. Ch: 1+550 to Ch: 1+750, (Both side) 2. Ch: 2+000 to Ch: 2+550, (Both side) 3. Near Ch: 3+400, (Left side) 4. Near Ch: 3+550, (Center) 5. Ch: 3+900 to Ch: 4+150 (Both side) 6. Ch: 4+300 to Ch: 4+400 (Both side) 7. Ch: 4+500 to Ch: 5+000 (Both side) 8. Ch: 4+500 to Ch: 5+000 (Both side) 9. Ch: 5+250 and Ch: 5+330 (Left side) 10. Ch: 6+700 to Ch: 6+800 (Both side)
9.	Major structures not affected	a) Gauripur Bottling plant on LHS at Ch: 3+400 (Approx. 35	All main buildings/factories like	All main buildings/factories like SAIL, Bottling plant, campus etc. and proposed

S.No	Attributes	Option- 1A	Option- 1B	Option- 2
		m from CL of Alignment) b) HPPL factory at Ch: 4+320 (Approx. 33 m from CL of Alignment)	SAIL, Bottling plant, campus etc.	site for AIIMS, Gauripur junction, College Nagar Junction.
10.	Length of Major Bridge	50m (RE Wall) +600m (South Viaduct) +1040m (obligatory span) +880m (North Viaduct) +215m (RE Wall)	1100m	1240 m
11.	Other Structures	*Proposed VUP Structure: -* 560m (RE Wall) +15m (obligatory span) +600m (RE Wall)	*Length of viaduct: -* South Bank (approx.)- 1200 m North Bank (approx.)- 950 m North via duct approach- 500 m	*Length of viaduct: -* South Bank (approx.)-369 m Length of flyover on South River Bank (approx.)- 1450 m North Bank (approx.)- 900 m North via duct approach- 265m
12.	Proposed ROB Structure	620m (RE Wall) + 68m (obligatory span)	500 m	85m
13.	Conclusion	Not Approved	Not Approved	Approved

5.3 RECOMMENDED ALIGNMENT

From the study of the above three Options the following inferences have been drawn.

i. The Option 1A although is straight poses the problem of connecting to NH-31 because of the presence of reserved forest on the Northern side of NH-31. This is an environmentally sensitive area and will take lot of time for land acquisition and approvals. To complicate the matters further the presence of the Railway tracks is very near to NH-31, thus creating lot many problems for the design of the junction along with ROB. The Engineers from SMEC have coordinated with NHAI Authorities on this matter also and it has been informed that NHAI has been planning for widening of the existing four lane Highway to a six lane Highway. It is therefore obvious that it will not be judicious to take up Option 1A as the feasible alignment.

ii. The Option 1B is similar to Option 1A upto the village Ghora Jan. However, it has to go via the IIT road and has to cross the Railway tracks. It has been informed that Railway has been planning for expansion of the existing station at Agiathuri to make it a smart railway station catering to all kinds of modern amenities. The approach roads to the station are still in planning stage and the option 1B alignment may have to be influenced due to the connecting approach roads to this station. Thus there may be requirements of more permissions from railways, IIT Authorities and construction of may be several other Structures yet to be known. All the above hindrances make this option not an easy one.

iii. Alignment Option 2 as observed from above is longer than Option 1B. This passes through some of the market places, villages etc. However, the advantage of the existence of a PWD road in Abhaypur, College Nagar and Gauripur areas makes it much easier to adopt. There is also an existing ROB along this route which will be studied further for widening/Reconstruction if need be. The existing Gauripur road also has a good junction with NH-31. As such the connection of the proposed alignment option 2 nearby the existing junction will be much easier and the approval process from NHAI/ Railways will be more convenient.

It is therefore obvious from the above that alignment Option 2 is the most feasible among all the alignments and hence has been recommended for adaption.

6. ENVIRONMENTAL MONITORING PROGRAMME

6.1 INSTITUTIONAL ARRANGEMENTS

An effective institutional mechanism needs to be incorporated in the project road management and execution system. Implementation Authority, shall be responsible for the implementation of all the mitigation and management measures suggested in EMP for the project road for Bridge over River Brahmaputra along with approach roads at North Guwahati Region. The Project Implementation Authority, shall also be responsible for implementation the mitigation measures and Environmental Management Plan.

The organizational and institutional capacity of Implementation Authority is to satisfactory complete and implement the mitigation measures and Environmental Management Plan.

6.2 ENVIRONMENTAL MONITORING PLAN

To ensure the effective implementation of the mitigation measures and environmental management plan during pre-construction, construction and operation phase of the project road, it is essential that an effective Environmental Monitoring Plan be designed. The same is given in Table 6.1.

5.2.1. Environmental Reporting System

Monitoring and Evaluation (M&E) are important activities in implementation of all projects. Monitoring involves periodic checking to ascertain whether activities are going according to the plans. It provides the necessary feedback for project management to keep the programme on schedule.

The reporting system shall operate linearly with the concessionaire, who shall report to Independent Consultant/ Engineer (IC) that finally in turn report to the Environmental Officer of their Concerned Departmental Head. All reporting by the Concessionaire and Independent Consultant shall be on monthly/quarterly/annual basis.

The compliance monitoring and the progress reports on environmental components may be clubbed together and submitted to the Implementation Authority regularly during the implementation period. The operation stage monitoring reports may be annual, or biennial provided the project Environmental Completion Report shows that the implementation was satisfactory. Otherwise, the operation stage monitoring reports shall have to be prepared as specified in the said project Environmental Completion Report. The summary of reporting of environmental components and responsibilities is depicted in Table 6.1 as follows:

The Guidelines for Environmental Monitoring Plan is given in Annexure 6.1.

Table 6-1: Summary of Reporting of Environmental components and Responsibilities

Format No.	Item	Timing	Independent Engineer		PWD and IA / Site office
			Supervision	Reporting	Overseeing / Compliance
CONTRACTOR MOBILIZATION AND SITE CLEARANCE					
M1	Reporting by contractor to IC for dumping locations & construction and labour	Before start of construction	As required	Quarterly	As required

Format No.	Item	Timing	Independent Engineer		PWD and IA / Site office
			Supervision	Reporting	Overseeing / Compliance
	camp site				
M2	Reporting by contractor to IC for construction and labour camp site	Before start of construction	As required	Quarterly	As required
M3	Target sheet for Tree cutting	Before start of work	As required	After cutting	As required
M4	Reporting for borrow areas	Before start of construction	As required	Quarterly	As required
CONSTRUCTION PHASE					
C1	Target sheet for Pollution Monitoring	As per Monitoring Plan	As required	After Monitoring	As required
C2	Top soil Conservation	Before start of work	As required	Quarterly	As required
OPERATION PHASE					
O1	Target sheet for Pollution Monitoring	During Operation	As required	After Monitoring	As required
O2	Redevelopment of Borrow Areas	After completion of usage of Borrow Area	As required	After Monitoring	As required
O3	Survival Rate of Trees	During Operation	As required	After Monitoring	As required

5.2.2. Environmental Monitoring Cost

A separate budgetary provision has been made for implementation of Environmental Monitoring Plan. The environmental monitoring cost is estimated based upon the environmental monitoring program being considered in Table 6.2. A budgetary provision of Rs. 33.08 Lakhs has been kept for environmental monitoring during construction and operation stages. The EMP budget is given in Chapter-10.

5.2.3. Ambient Air Quality (AAQ) Monitoring

Ambient air quality parameters recommended for road transportation developments are $PM_{2.5}$, PM_{10}, NOx, SO_2, CO and Pb. These are to be monitored at designated locations starting from the commencement of construction activities. Data should be generated twice in a week once in season during construction phase and operation phase at identified locations in accordance to the National Ambient Air Quantity Standards. However, monitoring locations may be changed in consultation with Independent Consultant. Frequency and parameters for ambient air quality (AAQ) monitoring are as given in Table 6.2.

5.2.4. Water Quality Monitoring

The physical and chemical parameters of water quality recommended for analysis is relevant to road development project that includes pH, turbidity, total solids, total dissolved solids, total suspended

solids, etc. The sample locations, duration and different water quality parameters to be monitored and their responding institutional arrangements in detailed are included under Environmental Monitoring Plan. The monitoring of the water quality shall be carried out at all identified locations for relevant parameters in accordance to the Indian Standard Drinking Water Specification - IS 10500. Frequency and parameters for water quality monitoring are as given in Table 6.2.

5.2.5. Noise Levels Monitoring

The measurement of noise levels would be carried out at all designated locations in accordance to the Ambient Noise Standards formulated by Ministry of Environment, Forests and Climate Change (MoEF&CC). Noise level would be monitored on interval of twenty-four hourly basis. Noise should be recorded at "A" weighted frequency using a slow time response mode of the measuring instrument. The measurement location, duration and the noise pollution parameters to be monitored and their other details are tabulated in Table 6.2.

5.2.6. Soil Erosion

Due to change in topography and vegetation cover at very micro level chances of soil erosion may occur. During and after raining, soil erosion shall need to be checked regularly.

5.2.7. Plantation

During construction and operation phases of the project road, need for plantation of trees to be inspected to monitor the survival of plants planted along the project road.

5.2.8. Tree Survival Rate

Roadside plantation of trees and their survival shall be an important activity for the management group; that shall include selection of plant, development of nurseries, protection of plant, interaction with roadside communities for the plantation management, and their maintenance, etc.

The planned project requires felling of roadside trees but no diversion of reserve forests. The compensatory plantation shall be done ten times of actual loss in consultation with the Forest Department of Kamrup District. Avenue plantation shall be done as per the IRC guideline IRC: SP-21-2009. Ten times of the tree cutting will be compensatory afforested as per GoA Compensatory Afforestation rules.

To ensure the proper maintenance and monitoring of the compensatory afforestation, a regular maintenance and monitoring of the survival rate of the planted trees is being proposed up to a period of 5 years from the operation of the project. This shall be monitored by implementing agency with the help of Forest Department, Assam.

Table 6.2: Environmental Monitoring Plan

Environmental Component	Project stage	Parameter	Standards	Locations	Duration / Frequency	Unit Cost (in INR)	Total Cost (in INR)	Implementation
Air	Construction Phase	PM_{10}, $PM_{2.5}$, SO_2, NOx, CO and Pb	Emissions Standards	Wherever the contractor decides to locate the Hot Mix Plant.	Continuous 24-hourly, twice a week once during Construction Phase	6000	6000*2*1= 12000	Contractor through an NABL approved monitoring agency
		PM_{10}, $PM_{2.5}$, SO_2, NOx, CO and Pb	National Ambient Quality Standards	Hot Mix plant site (1) and baseline monitoring locations (6) Total = 7 samples	Continuous 24-hourly, twice a week twice during Construction Phase	6000	6000*7*2*2*4 = 672000	Contractor through an NABL approved monitoring agency
	Operation Phase	PM_{10}, $PM_{2.5}$, SO_2, NOx, CO and Pb	National Ambient Quality Standards	Along the project corridor at locations of baseline monitoring Total = 6 samples	Continuous 24-hourly, twice a week twice in year for 5 years	7000	7000*7*2*2*5 = 980000	Contractor through an NABL approved monitoring agency
Water Quality	Construction Stage	Parameters as mentioned in IS 10500	As Water quality standards (IS 10500)	Hot Mix Plant site (1) Baseline monitoring location (9) (5 ground water and 4 surface water) Total = 10 sample	Three times during the Construction Phase (Pre-monsoon, Monsoon and Post Monsoon)	4500	4500*10*3*4 =540000	Contractor through an NABL approved monitoring agency

Environmental Component	Project stage	Parameter	Standards	Locations	Duration / Frequency	Unit Cost (in INR)	Total Cost (in INR)	Implementation
	Operation Phase	Parameters as mentioned in IS 10500	As water quality standards (IS 10500)	Hot Mix Plant site – (1) Baseline monitoring locations (9 (5 ground water and 4 surface water) **Total = 10 sample**	End of summer before the onset on monsoon, Monsoon and After Monsoon every year for 5 years	4700	4700*10*3*5 =705000	Contractor through an NABL approved monitoring agency
Noise and Vibration	Construction Phase	Noise Level in dB (A)	As per National Noise standards	Hot Mix plant site (1) and baseline monitoring locations (6) Total = 7 samples	One day hourly measurement, once in six months twice during the Construction Phase	1200	1200*7*2*4 = 67200	Contractor through an NABL approved monitoring agency
	Operation Phase	Noise Level in dB (A)	As per National Noise standards	Along the project corridor at locations of baseline monitoring Total = 6 samples	One day hourly measurement,	1400	1200*6*2*5 = 72000	Contractor through an NABL approved monitoring agency
Soil Erosion	Construction Phase	Soil erosion	--As	On slopes, high embankment and hilly terrain (**4 Samples**)	Before and After precipitation	3500	3500*4*2*4 = 112000	Contractor through an NABL approved monitoring agency
	Operation Phase	Soil erosion	--	On slopes, high embankment and hilly terrain (**4 Samples**)	Before and After precipitation	3700	3700*4*2*5 = 148000	Contractor through an NABL approved monitoring agency

Environmental Component	Project stage	Parameter	Standards	Locations	Duration / Frequency	Unit Cost (in INR)	Total Cost (in INR)	Implementation
Total EMP Cost for VECs							**3,308,200.00**	
Road Side/Median Plantation	Construction Phase	Monitoring of trees felling	As laid out in the detailed design for project	Entire stretch of the project approach road	During felling of trees	As per Dept. of Forest, GoA		Forest Dept. (GoA)
	Operation Phase	Survival rate of trees success of re-plantation	The survival rate is estimated to be at least 70% below which re-plantation shall be done.	Entire stretch of the project approach road of proposed bridge	Every year for 5 years	As per Dept. of Forest, GoA		Implementation Authority (PWD)

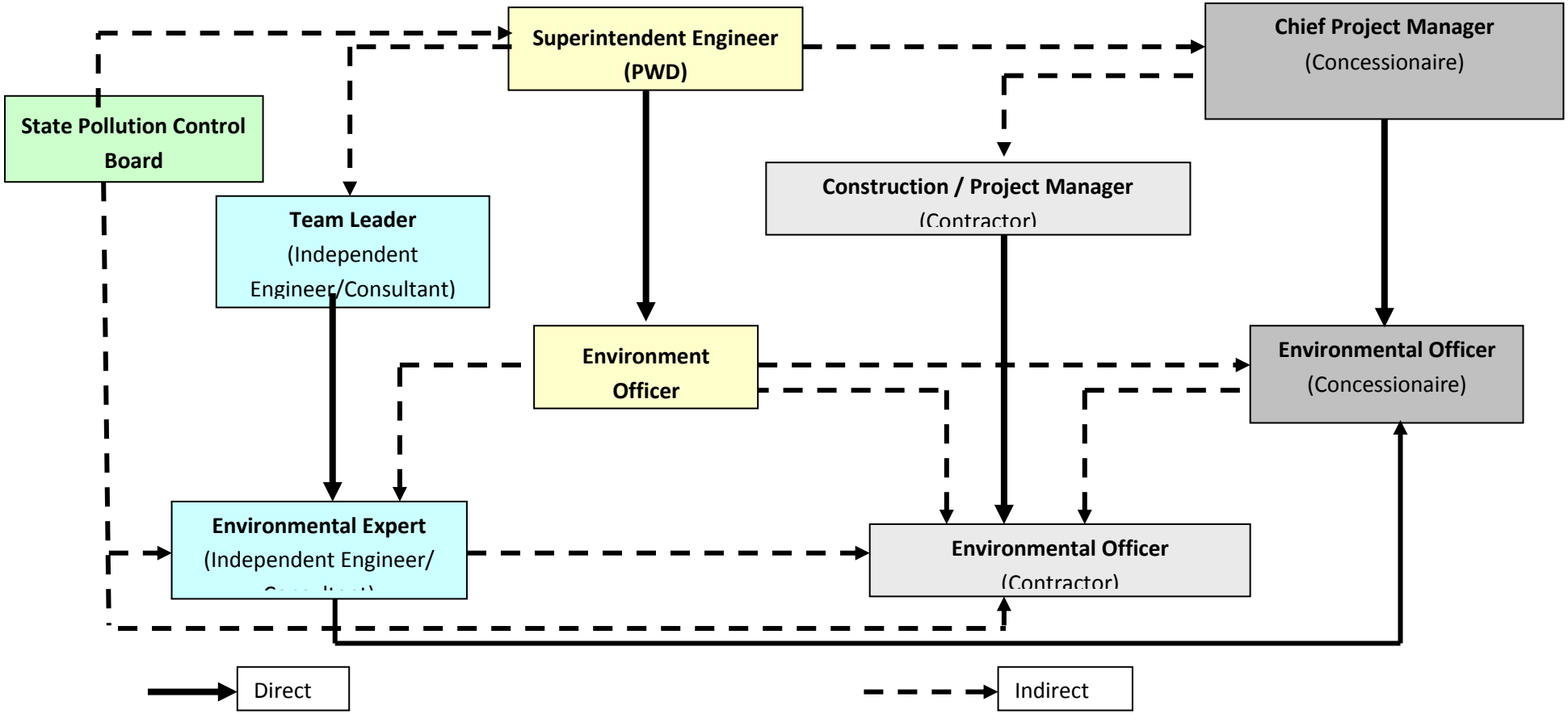


Figure 6.1: Proposed Organization Chart

7. ADDITIONAL STUDIES – HIGHWAY SAFETY AND TRAFFIC MANAGEMENT

7.1 GENERAL

Bridge create an important lifeline for the movement of goods and passengers from one bank to another, from a place of raw material to production end to the distribution end. Provision of traffic safety measures on bridge and approach road gains significance as the number of vehicles increases on the road and hence the accident rates also increases.

For higher traffic safety it is highly important to incorporate practical safety standards into the highway facilities at the design stage or during improvement and maintenance activities. The design and the safety measures should meet the expectations of the driver and warn them from unexpected changes in the road conditions which might lead to a traffic accident.

Keeping into account the traffic safety drawbacks on the existing facility during the "Road Safety Review", traffic safety measures has taken as a major criterion for the design of the Project Highway and its features to provide a safe and a speedy road travel.

7.2 OBJECTIVE

Objectives of Bridge, Highway Safety & Traffic Management are to :

- ✓ Ensure protection of workers on-site through strict enforcement of safety plans/ standards, proper training to the workers and through deployment of trained & experience workers staff at site.
- ✓ Ensure applicable and adequate safety measures at site through proper barricading, safe access to site, lighting etc. and use of Personal Protective Equipment's (PPE) & other safety tools and equipment.
- ✓ Ensure smooth, safe and uninterrupted traffic flow on the project highway at all times during construction.
- ✓ Give adequate information/warning sufficiently in advance about any situation/event /matter affecting the project highway through proper signages, demarcations etc.

Ensure safety of road users against the hazards due to:

- ➢ Diversion
- ➢ Road Condition
- ➢ Low Visibility
- ➢ Vehicle breakdown on carriageway
- ➢ Repair work etc. in progress on carriageway or for any other reason resulting in disturbance in free flow of traffic.
- ➢ Avoid risk of damage / disturbance to the properties adjacent to the project highway.
- ➢ Ensure safety of project assets and public utilities.
- ➢ Ensure the compliance to the applicable IRC & safety codes in good spirit.

To ensure safety of road users and workers during construction & defect liability period one Safety Officer shall be deputed at site for strict compilation to the safety standards during construction & operation phase. Proper signage shall be provided along the highway for safe flow of vehicles & users. Safety officer shall be responsible for systematic identification, evaluation and implementation of preventive control of different foreseeable hazards as per design standards.

7.3 PHASES IN HIGHWAY SAFETY & TRAFFIC MANAGEMENT

Highway Safety & Traffic Management can be further classified in three phases:

a. Pre-Construction Phase (Planning & Design phase)
b. Construction Phase
c. Operation & Maintenance Phase

7.4 SITE SAFETY RULES AND REGULATIONS

7.4.1 General Rules

- No drugs, alcohol or alcoholic beverages are permitted on work site.
- All connection for electricity, water supply and other temporary facilities made by authorized persons only and shall be in accordance with legal and contractual requirements.
- Work shall only be carried out if an authorized person has ordered it.

7.4.2 IRC Guidelines

- Highway Safety Codes IRC: SP-44-1996
- Guidelines for Pedestrian Facilities IRC: 103-1988
- Guidelines on Safety in Road Construction Zones IRC: SP-55-2001
- Guidelines on bulk bitumen transportation and storage equipment IRC: SP-39
- Road Safety for Children IRC: SP-32-1988.

7.4.3 Regulations & legal framework

- Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989
- Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 Motor Vehicles Act, 1988
- Workmen's Compensation Act, 1923
- Employees State Insurance Act, 1948
- Employer's Liability Act, 1938
- Contract Labour (Regulation & Abolition) Act, 1970
- Inter-state Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979
- Bonded Labour System (Abolition) Act, 1976
- Child Labour (Prohibition and Regulation) Act, 1986
- Children (Pledging of Labour) Act, 1933
- Minimum Wages Act, 1948
- Payment of Wages Act, 1936
- Equal Remuneration Act, 1976

- Payment of Gratuity Act, 1972
- Payment of Bonus Act, 1965
- Employees Provident Funds and Misc. Provisions Act, 1952
- Maternity Benefit Act, 1961
- Public Liability and Insurance Act, 1991
- Indian Electricity Act
- Explosives Act and Rules prescribed under the Act like SMPV Rules and Gas Cylinder Rules.
- Mines Act

7.5 SAFETY PROVISIONS

7.5.1 Health & Safety of Workers

Pre-employment health checkup: The contractor shall ensure that following examinations are carried out:

- Complete physical check-up of the worker
- The doctor shall record the medical history of the employee, including previous sickness or present conditions, medications, and therapies.
- The usual tests like blood tests, x-rays, urine, and stool exams

Record keeping: The following shall be maintained by the contractor:

- Records containing details of employees, work done, hours worked, rest, wages, receipts in the prescribed form should be maintained.
- Medical examination of every worker in hazardous jobs before assignment and records to be maintained annually.
- Register of workers containing workers name, work, group, relay etc.
- Certificate of fitness of the workers that is to be granted by certifying surgeon after examination to be renewed every 12 months.
- Notice of accidents for death and injury and enquiry status for every month.
- Documents containing certain dangerous occurrences of bodily injury or disability or not and notices that are sent by the Contractor and Manager to the authorities as per prescribed form and time.
- Notice of diseases which is to be sent by Medical Practitioner to the Chief Inspector giving name, address, disease of patient, and name and address of factory.
- Safety and occupational health surveys to be undertaken by Chief Inspector, DGFAS, DGHS, or their authorized officers at their discretion.

Provision of facilities

- The facilities to be provided by the contractor are:
- Adequate ventilation & comfortable temperature.
- Proper lighting and clean atmosphere.
- Drinking water as per the quality provision of IS 10500.
- Proper sanitation facilities and its cleaning whenever required.
- Availability of medical facility 24 hours.

General Safety Hints to the Workers

- Wear protective clothing or apparel where required to do so.
- Must wear other safety gear where required / indicated.
- Keep work site and work areas tidy.
- Use correct tools and safety apparel for the job.
- Maintain personal hygiene e.g. washing hands before meals.
- If you don't know ask.
- Report an unsafe condition to your supervisor and stop unsafe actions immediately.
- Think before you act.
- Don't horseplay or distract others.
- Don't take shortcuts, your safety and that of others is more important.
- Obey all safety rules and signs.
- Report all accidents however small, and have them treated immediately.

Training Facility: The Contractor shall determine the training requirements for all the employees and initiate a training programme to demonstrate that all persons employed, including subcontractors, are suitably qualified, competent, and fit to implement safety provisions. This shall include:

- Detailed job descriptions for all personnel to include their specific safety responsibilities.
- Specifications of qualifications, competency and training requirements for all personnel.
- Assessment and recording of training needs for all personnel, including subcontractors' employees in the workforce, vendor representatives, and site visitors.
- A safety protocol for evaluating and confirming that the system is effective.
- A matrix and schedule of training requirements covering general, task– specific, and SHE-related training, showing the training frequency and the interval between refresher courses.

The Contractor shall arrange training programme for all executives in how to identify, recognize, and eliminate unsafe acts and unsafe conditions. The refresher-training programme of all employees shall be conducted once in six months.

7.5.2 Emergency Response Plan

The Contractor shall prepare as required under Rule 36 of BOCWR, an Emergency Response Plan for all work sites as a part of the Contractor SHE Plan. The plan shall integrate the emergency response plans of the Contractor and all other subcontractors. The Emergency Response Plan shall detail the Contractor's procedures, including detailed communications arrangements, for dealing with all emergencies that could affect the Site. This include where applicable, injury, sickness, evacuation, fire, chemical spillage, severe weather and rescue.

The contractor shall ensure that an Emergency Response Plan is prepared to deal with emergencies arising out of:

- Fire and explosion
- Collapse of lifting appliances and transport equipment
- Collapse of building, sheds or structure etc.
- Gas leakage or spillage of dangerous goods or chemicals

- Bomb threatening, Criminal or Terrorist attack
- Drowning of workers
- Landslides getting workers buried floods, Earthquake, storms and other natural calamities.

Arrangements shall be made for emergency medical treatment and evacuation of the victim in the event of an accident or dangerous incident occurring, the chain of command and the responsible persons of the contractor with their telephone numbers and addresses for quick communication shall be adequately publicized and conspicuously displayed in the workplace.

Contractor shall require to tie-up with the hospitals and fire stations located in the neighborhood for attending to the casualties promptly and emergency vehicle kept on standby duty during the working hours for the purpose.

7.6 TRAFFIC SAFETY PLAN

Work on the approach road shall be carryout in a manner creating least interference to the flow of traffic. During execution of the work a passage would be constructed for traffic either along a part of the existing carriageway under improvement or along a temporary diversion constructed close to the highway, as per site requirement.

The execution of work shall be so planned that the inconvenience to the traffic is minimal. The temporary diversion, where constructed, shall conform to the following minimum standards:

- Width of diversion road shall be equal to the width of the existing carriageway but not less than 5.5 m.
- The crust composition shall be of 150 mm GSB + 150 mm WBM + 20 mm Mixed Seal Surfacing

7.7 GUIDING PRINCIPLES AND PRECAUTIONS

The construction zone creates an environment where the road user is faced with a series of hazards in the form of unfamiliar routes and standard horizontal and vertical alignment, adversely placed construction equipment. The road user also has to keep a watch over traffic control devices apart from performing normal driving functions of vehicle control and responding to other traffic hazards. These factors increase the strain on driver's performance and may lead to accidents. The safety performance of the management and Safety officer would be oriented towards reducing conditions which lead to such hazards and would give stress where risk of accident is more.

The guiding principles for safety in road construction zones are to:

- Warn the drivers I road user clearly and sufficiently in advance
- Provide safe and clear marked lanes for guiding road users
- Provide safe and clearly marked buffer and work zones
- Provide adequate measures that control driver behavior through construction zones, lane closures or traffic diversions.

The following defined precautions shall be applied to all the work sites:

- All the signs and delineators shall be maintained in a clean and brightly painted condition at all times.
- Adequate lighting arrangements shall be made for proper visibility after sunset in construction zones.
- Adequate arrangements like frequent sprinkling of water shall be made to keep the area dust free.

7.8 CONSTRUCTION ZONE

In order to plan and provide appropriate traffic management and safety measures, it is necessary to appreciate the concept of a construction zone. A construction zone can be defined as an area of the planned project which involves the conflict of the right of use between the road users and authority responsible for the maintenance/ improvement of the Project Highway. From traffic safety point of view, a construction zone comprises four sub zones as described hereunder:

Advance Warning Sub-Zone: The advance warning sub-zone is meant to prepare the driver for an alert behavior and is an essential part of any traffic control system. The warning system shall prepare the driver well in advance by providing information regarding distance, extent and type of hazard ahead so that he can gradually reduce the speed of his vehicle. The information in this sub-zone is conveyed mostly through a series of traffic signs along its length.

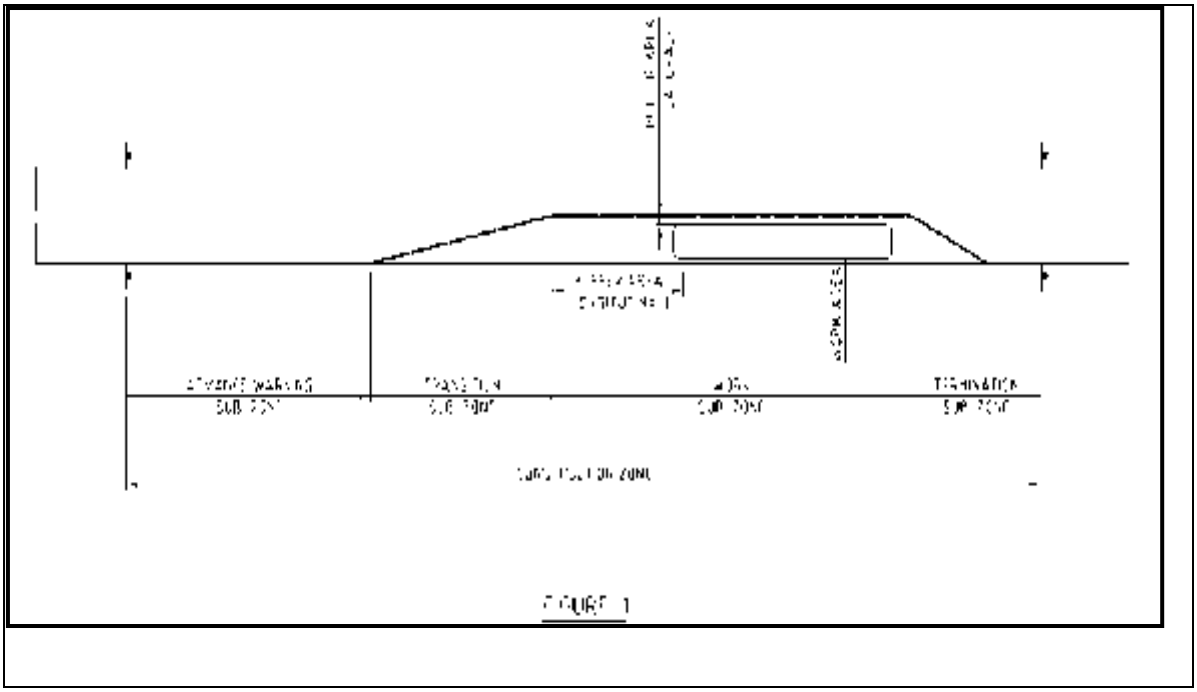
Transition Sub-Zone: The transition sub-zone is the area in which the traffic is steered and guided into and out of the diverted path around the work sub-zone. This is the most crucial sub-zone from safety point of view since most of the movements are turning movements. The traffic in this sub-zone is mostly taken across with the help of barricades and channelizes.

Work Sub-Zone: This is the actual area where construction or maintenance activity is taking place and the main concern, therefore, is the safety of the workers at the site from the plying traffic. The path of the traffic must, therefore, be very clearly delineated to avoid intrusion of vehicles moving into the work area. The work sub-zones shall not be close to each other and the distance between the two work sub-zones shall be such that the flow of traffic can return to normal stream by permitting fast moving traffic to overtake slow moving vehicles. These distances shall preferably be 2 km on urban sections and 5 to 10 km on rural sections of the highway. The length of work sub-zones shall vary. The length of warning and transition sub-zones shall be basically governed by the speed of approaching vehicles and shall be regulated.

Table 7.1: Recommended Length of Construction Zones

Average Speed (kmph)	Length of Advance Warning Sub-Zone (m)	Length of Transition Sub-Zone (m)	Length of Work Sub-zone (m)
≤50	100	50	Varies
51-80	100-300	50-100	
81-100	300-500	100-200	
Over 100	1000	200-300	

Termination Sub-Zone: The sub-zone is intended to inform the road users of the end of the construction zone. An information signboard shall be erected to inform road users of the end of construction Zone.



7.9 TRAFFIC SAFETY MEASURES AND CONTROL

Following traffic safety measures shall be ensured during construction:

- Erection and maintenance of bamboo stack poles, caution signs and markings and flagmen for the information and protection of traffic approaching or passing through the section of the highway under improvement.
- All culverts and bridges would be barricaded by providing two drums at the two ends of culvert. In between drums, bamboo with red and white stripes would be installed with reflective tapes on them for night visibility. The area to be cordoned off with safety barricading tape. Caution boards shall be placed at two ends of the bridge.
- Red lights or warning lights of similar type shall be mounted on the barricades at night and kept it throughout from sunset to sunrise.
- At the points where traffic is to deviate from its normal path as per site requirement, the channel for traffic shall be clearly marked. At high traffic area, Caution boards would be installed 60 meters before the respective diversion area "speed breaker" board. "DIVERSION' 3 board would be installed at the both ends of the diversion road.
- All diversions would be kept free of dust by frequent application of water
- Flagmen with red and green flag would be deployed at both ends of the respective diversion for the smooth flow of traffic as and when required.
- Deep excavation area would be barricaded by barricading tape.

For guidance of road user caution boards with regulatory and warning information such as "GO SLOW, MEN AT WORK" & for illiterates pictorial "GO SLOW, WORK IN PROGRESS" would be installed at 100 meter intervals.

7.9.1 Traffic Control Devices

Traffic control devices are the devices which perform the crucial task of warning, informing and alerting the driver / road user apart from guiding the vehicle movements so that the driver of the vehicle as well as the workers on site are protected and safe passage to the traffic is possible.

The primary traffic control devices used in work sub-zones are signs, delineators, barricades, cones, pylons, pavement markings, flashing lights etc. They shall be such that they are easily understood without any confusion, are clearly visible during day and night, conform to the prevailing speeds in immediate vicinity, stable against sudden adverse weather conditions and are easy in installation, removal and maintenance.

- **Safety Signs:** "Safety sign" is a sign, which uses a pictorial symbol to provide health or safety information or instruction. The sign may also include a written message. The construction and maintenance signs fall into the same three major categories viz. regulatory signs, warning signs arid guide signs as other traffic signs do. Warning, Cautionary, Prohibition and command signs shall be installed and shall not be removed or changed till they are required at site. These signs shall be placed on left hand side of the road.
- **Regulatory signs: Regulatory** signs mean legal restrictions on the traffic. The most common types for use in construction zones are "Do not enter", "Road Closed", "Speed limit" etc.
- **Warning Signs:** The most common type of warning signs to alert the drivers of the possible dangers ahead in construction zones are "Lane Closed", "Diversion to other Carriageway", "Divided Carriageway Starts", "Divided Carriageway Ends" and "Two Way Traffic" etc. Sometimes it might be advisable to explain these signs with the help of a rectangular definition plate of size appropriate to the size of warning triangle and placed 0.15 m below, from the bottom of the triangle.
- **Guide Signs:** Guide signs in construction zones shall have different background color than the normal informatory signs. These signs shall have black messages and arrows on yellow background. The commonly used guide signs are: "Diversion", "Road Ahead Closed" and "Sharp Deviation of route" etc.
- **Delineators:** Delineators are the channelizing devices such as cones, traffic cylinders, tapes, drums, which shall be placed in or adjacent to the roadway to guide the drivers along a safe path and to control the flow of traffic. These shall normally be retro-reflectorized for night visibility.
- **Traffic Cones and Cylinders:** Traffic cones are normally 0.5m to 0.75m high and 0.3m to 0.4m in diameter or are in square shape at the base. These are mostly made of plastic or rubber with retro reflectorized red and white band and have suitable anchoring so that they are not easily blown over or displaced. They shall be placed close enough together to give an impression of the continuity. The spacing shall be 3m (close) to 9m (normal). Larger size cones can be used for high speeds or where more conspicuous guidance is required.

- **Drums:** Empty bitumen drums (made of metal) cut to the required height shall also be used as channelizing devices since they are highly visible give the appearance of being formidable objects, thereby commanding the respect of the drivers. These drums can also be of plastic which are lighter, easy to transport and store. As delineators, these drums shall be about 0.80 to 1.0 m high and 0.30 m in diameter. They shall be painted in circumferential strips 0.10 m to 0.15 m wide, alternatively in black and white colours.

- **Barricades:** Whenever the traffic has to be restricted from entering the work areas, such as excavations or material storage sites so that protection to workers is provided or there is a need for separating the two-way traffic, barricades shall be used. The barricades can be portable or permanent type and can be made of wooden planks, metal or other suitable material. The horizontal component facing the traffic is made of 0.30 m wide wooden planks joined together and painted in alternate yellow and white strips of 0.15 m width and sloping down at an angle of 45 degree in the direction of the traffic. Fig. 4 shows three types of barricades. Types I and II are portable type useful for small works and Type III is permanent type, suitable for major work areas. Suitable support or ballasting shall be provided so that they do not over turn or are not blown away in strong winds. In case of a permanent type barricade, a gate or movable section shall be separately provided to allow the movement of construction/supervision vehicles.

- **Flagman:** On large construction sites, flagmen with flags and sign paddles shall be effectively used to guide the safe movements. The flags for signaling shall be 0.60 m x 0.60 m size, made of a good red cloth and securely fastened to a staff of approximately 1m in length.

7.10 SAFETY AND MANAGEMENT PRACTICES

Measures for providing safe movement of traffic in some of the most commonly occurring work zones on highways shall be as follows:

7.10.1 Temporary Diversion

In the cases of major repairs or reconstruction of cross drainage structures on an approach road, bridge section, damaged due to flood etc., the traffic may have to pass on a diversion, moving parallel to the highway.

The warning for the construction ahead shall be provided by the sign “Men at Work” about 1 km earlier to the work zone or a supplementary plate indicating “Diversion 1 km ahead” and I or a sign “Road Closed Ahead” shall be placed. It shall be followed by “Compulsory Turn Right/Left Sign”. The “Detour” and “Sharp Deviation” sign shall be used to guide the traffic onto the diversion. Hazard markers shall be placed just where the railings for the cross-drainage structures on the diversion starts.

7.10.2 Carriageway Repairs

Whenever the work of small magnitude is to be carried out in the middle of the carriageway, such as minor repairs of potholes, cracks and patches, then the traffic control measures shall mainly consist of providing cautionary signs of “Men at Work”, about 500 m before the work zone for the approaching vehicle and other cautionary sign of “Road Narrows”, shall be placed at 100m ahead of work area. Regulatory sign of “Keep Left/Right” shall be placed at the commencement point of the work zone and next to the barriers for the approaching vehicles. Movable type of barriers shall also be placed on both sides of the work area. Cones or drums shall be placed at suitable interval to demarcate the work area. The “Work Zone Ends” sign shall be installed 120m beyond the work area. If the operation is to continue during night time, necessary lighting arrangements with flashing lights shall also be provided.

7.10.3 Audit Parameters of Highway Safety

- Components of the Construction Zone
- Planning
- Sketches at cross-sections
- Alignment
- Roadside communities & Facilities
- Stretches at junction
- General
- Additional checks for roudabouts

7.11 Disaster and Flood Management Plan

Disaster Management Plan includes the formation of an Emergency Action Plan for any area. An emergency is defined as a condition of serious nature which develops unexpectedly and endangers downstream property and human life and required immediate attention. Emergency Action Plan should include all potential indicators of likely flood, since the primary concern is for timely and reliable identification and evaluation of existing of potential emergency.

This EAP presents warning and notification procedures to follow during the monsoon season in case of failure of drain or heavy rain The objective is to provide timely warning to nearby residents and alert key personnel responsible for taking action in case of emergency.

7.11.1 Administration and Procedural Aspects

The administrative and procedural aspects of the Emergency Action Plan consist of flow chart depicting the names and addresses of the responsible personnel of project proponent and the Dist. Administration. In order of hierarchy, the following system will usually be appropriate. In the event that the failure is imminent or the failure has occurred or a potential emergency conditions is developing, the IMD and Disaster Management Team is required to report it to the Junior Engineer who will report to the District Administration/ Metropolitan Chief/Executive Engineer / Superintending Engineer for their reporting to the Chief Engineer through a wireless system or by any available fastest communication system. The Engineer-in-Charge is usually responsible for making cognizant with the developing situation to the Civil Administration. Each personnel are to acknowledge his/her responsibilities under the EAP in an appropriate format at a priority.

7.11.2 Preventive Action

Once the likelihood of an emergency situation is suspected, action has to be initiated to prevent a failure. The point at which each situation reaches an emergency status shall be specified and at that stage the vigilance and surveillance shall be upgraded both in respect of time and level. At this stage a thorough inspection of the sensitive site should be carried out to locate any visible sign(s) of distress.

Department responsible for preventive action should identify sources of equipment needed for repair, materials, labour and expertise for use during an emergency. The amount and type of material required for emergency repairs should be determined to reduce, depending upon its characteristics, design, construction history and past behavior. It is desirable to stockpile suitable construction materials at appropriate sites. The anticipated need of equipment should be evaluated and if these are not available at the project site, the exact location and availability of these equipments should be determined and

specified. The sources/agencies must have necessary instructions for assistance during emergency. Due to the inherent uncertainties about their effectiveness, preventive actions should usually be carried out simultaneously with the appropriate notification on alert situation or a warning situation.

7.11.4 Evacuations Plans

Emergency Action Plan includes evacuation plans and procedures for implementation based on local needs. These could be:

- Demarcation / prioritization of areas to be evacuated.
- Notification procedures and evacuation instructions.
- Safe routes, transport and traffic control.
- Safe areas/shelters.
- Functions and responsibilities of members of evacuation team.

Any precarious situation during floods will be communicated either by an alert situation or by an alert situation followed by a warning situation. An alert situation would indicate that although failure of flooding is not imminent, a more serious situation could occur unless conditions improve. It would normally include an order for evacuation of delineated inundation areas.

7.11.3 Communication System

An effective communication system and a downstream warning system are absolutely essential for the success of an emergency preparedness plan. The difference between a high flood with their details must be made clear to the downstream population.

7.11.5 Evacuation Team

It will comprise of following official / Representative:

- District Magistrate (D. M.)/ His Nominated officer (To peacefully relocate the people to places at higher elevation with state administration).
- Engineer in charge of the project (Team Leader)
- Superintendent of Police (S. P.) / Nominated Police Officer (To maintain law and order)
- Chief Medical Officer (C. M. O.), (To tackle morbidity of affected people)
- Head of affected village to execute the resettlement operation with the aid of state machinery and project proponents.
- Sub committees at village level

The District Administration/Metropolitan Chief will be responsible for the entire operation including prompt determination of the flood situation time to time. Once the red alert is declared the whole state machinery will come into swing and will start evacuating people in the inundation areas delineated in the inundation maps. For successful execution, annually demo exercise will be done. The D.M. is to monitor the entire operation.

7.12 PUBLIC AWARENESS FOR DISASTER MITIGATION

In addition, guidelines that have to be followed by the inhabitants of flood prone areas, in the event of flood resulting from heavy rain, which form part of public awareness for disaster mitigation may also include following:

- Listen to the radio for advance information and advice.

- Disconnect all electrical appliances and move all valuable personal and household goods beyond the reach of floodwater, if one is warned or if one suspects that flood waters may enter the house.
- Move vehicles, farm animals and movables goods to the higher place nearby.
- Keep sources of water pollution i.e. insecticides out of the reach of water.
- Turn off electricity and LPG gas before one has to leave the house.
- Lock all outside doors and windows if one has to leave the house.
- Do not enter floodwaters.
- Never wander around a flood area.

7.13 NOTIFICATIONS

Notification procedures are an integral part of any emergency action plan. Separate procedures should be established for slowly and rapidly developing situations and failure. Notifications would include communication of either an alert situation or an alert situation followed by a warning situation. An alert situation would indicate that although failure or flooding is not imminent, a more serious situation could occur unless conditions improve. A warning situation would indicate that flooding is imminent as a result of torrential rain. It would normally include an order for evacuation of delineated inundation areas.

7.14 NOTIFICATION PROCEDURES

Copies of the EAP that also include the above described inundation map are displayed at prominent locations, in the rooms and locations of the personnel named in the notification chart. For a regular watch on the flood level situation, it is necessary that the flood cells be manned by two or more people so that an alternative person is always available for notification round the clock. For speedy and unhindered communication, a wireless system is a preferable mode of communication. Telephones may be kept for back up, wherever available. It is also preferred that the entire flood cells, if more that one, are tuned in the same wireless channel. It will ensure communication from the weather department to the control rooms. The communication can be established by messenger service in the absence of such modes of communication.

7.15 MANAGEMENT AFTER RECEDING OF FLOOD WATER

It is to be accepted that during flood, even with maximum efforts, the loss of human lives, livestock and property would be inevitable. Under such a scenario, a massive effort would be used by various government agencies to provide various relief measures to the evacuees. Formulation of a plan delineating such measures is beyond the scope of work of this document. However, some of the measures which need to be implemented are listed as below:

- Provision of various food items and shelter to the evacuees.
- Provision of fuel for various evacuees.
- Provision of adequate fodder supply.
- Arrangements for potable water supply.
- Commissioning of low cost sewage treatment and sanitation facilities, and disposal of treatment sewage.
- Expeditious disposal of dead bodies human and livestock.
- Immunization programmes for prevention of outbreak of epidemics of various water related diseases.
- Adequate stocks of medicines of various diseases, especially water-related diseases.

8. PROJECT BENEFITS

8.1 GENERAL

The proposed project is Construction of Bridge over River Bramhaputra along with approach road at North Guwahati side. Currently, boat from 4 ferry ghats is being used for connecting South Ghat with North Guwahati. The project stretch is falling connecting both bank of River Brahmaputra and the construction of the bridge on this River at the proposed location is going to be huge advantage for public of both sides. Currently North Guwahati region is far away from development of infrastructure and basic amenities despite of being at only 1.6 km of distance. Though bikers and the cyclists are passing the river using the existing boat service (ferry), but that is also time taking and not frequently available services, which can be used for connecting Northern and Southern Banks of the river. During monsoon and unfavorable weather, it's very difficult to commute from south bank to North Bank. Furthermore, the existing boating facility is limited to only few hours of day time and it poses different societal and economical risk.

The planned project will have tremendous benefits for the area and the region in various ways. The benefits of the proposed project are described below in following subsections.

8.2 DIRECT AND INDIRECT BENEFITS

The direct and indirect benefits of Construction of Bridge over River Bramhaputra along with approach roads are as given below:

8.2.1 Direct Benefits

- Fast and Safe Connectivity between South Bank of Guwahati Metropolitan area to North Guwahati region
- Reduce burden of development in South Bank area and provide opportunity to sprawl urbanization in North Guwahati region.
- Savings in fuel, travel time and total transportation cost of road users.
- Reduction in road accidents.
- Reduction in pollution due to constant flow and segregation of traffic from other roads

8.2.2 Macro Level Benefits

- Employment opportunity to people.
- Act like bridge for improvement in education and Hospitality
- Development of tourism.
- Development of local industry and handicrafts.
- Quick transportation of agricultural produce and perishable goods.
- Improved quality of life for people

8.3 REDUCTIONS IN OPERATION COST

Vehicle operating cost (VOC) shall be reduced due to improved road conditions. Maintenance and operation cost such as fuel consumption, wear and tear of tyres, shall be sufficiently reduced. The vehicle operating cost shall be further reduced by improving the geometrics and design. The benefits

perceived by the road user are in the form of lower expenditure. VOC consist of the following components:

- Fuel Consumption;
- Lubricating oil consumption;
- Spare part consumption and repairs
- Tyre consumption; and
- Vehicle depreciation.

8.4 IMPROVEMENTS IN THE PHYSICAL INFRASTRUCTURE

The planned project will provide much better infrastructure facilities to fulfill people requirements in the area and region.

Better road conditions will attract industrial and infrastructure development and boot economy of state.

8.5 IMPROVEMENTS IN THE SOCIAL INFRASTRUCTURE

8.5.1 Hospital (AIIMS)Connectivity

The AIIMS and IIT Guwahati will be approachable within 10 min from south bank of Guwahati.

8.5.2 No disturbance to Utility Shifting

All the utility falling in the ROW shall be shifted well before starting the construction. Therefore, no disturbance on existing utilities is anticipated.

8.5.3 Safety of Local People

The improved project road will increase accessibility to local and regional health centers, educational institute and other community support facilities. The project road shall be implemented with due considerations for safety of pedestrians and school children near populated areas.

The road safety measures will include speed humps, speed delimiting signs, cross walks, etc., as desired locations especially near habitations. Moreover, the upgraded road with improved geometrics will itself reduce the chances of accidents significantly. So, all these factors will cumulatively help to beneficially impact on the safety aspects of the road users and the local populace.

8.6 ECONOMIC IMPACTS

The relatively short-lived economic benefits of the construction phase are likely to be experienced in local communities for the duration of construction as workers will make everyday purchases from local traders. This is likely to give a short-lived stimulus to these traders. Wider, flow-on economic benefits shall be experienced in other sectors of economy as a result of purchase of construction materials and the payment of wages and salaries.

8.7 EMPLOYMENT POTENTIAL – SKILLED; SEMI-SKILLED AND UNSKILLED

The project road will provide employment opportunity to skilled; semi-skilled and unskilled persons during construction phase. The construction contractors are likely to use unskilled labour drawn from local communities; use of specialized road building equipment will require trained personnel not likely to be found locally.

It is anticipated that the construction labour inputs for the construction of the project shall be in the order of about 150 persons per day directly. However, this number will fluctuate and the number in any particular activities shall be higher and lower.

The construction workforce shall be made up of the following groups:

- Supervision, specialist and administrative personnel, normally about 5 per cent of the workforce - the contractor would probably arrange local accommodation using hotels, boarding houses or rented houses near the project road.
- Skilled workers, normally about 30 per cent of the workforce - the contractor will probably establish a construction camp for the skilled workers.
- Unskilled workers, normally about 65 per cent of the workforce - contractors normally recruit these workers locally.

The planned project shall be beneficial in terms of employment opportunities, as significant numbers of skilled, semi-skilled and unskilled persons will get employment for 3 years.

Even during operation phase, significant numbers of persons will get employment opportunity and indirectly the opportunity of small entrepreneurship will increase.

9. ENVIRONMENTAL COST BENEFIT ANALYSIS

The proposed project ""Bridges over River Brahmaputra connecting Panbazar to North Guwahati" has been planned with considering all the environmental aspects both during construction stage as well as operation phase.

The project design has been made with due consideration of environmental measures to minimize the usage of natural resources and conservation of resources through optimal usage in a planned manner.

9.1 Landuse

There will be no change in landuse due to project activities and the landuse will be conforming to the approved development plan of the area. The proposed project will not have any adverse impact on the surrounding environment. Instead, the development of proposed bridge will act like a life bridge for this area which will increase employment opportunities, improve connectivity from south bank to North Guwahati, enhance economic growth and other development activities.

9.2 Soil

Land/ soil environment may be temporarily affected due to activities like site preparation, excavation, material handling & storage etc. during construction phase but the proposed activity will not result in any significant land disturbance causing soil erosion, subsidence and instability.

9.3 Ground Coverage

Since, the proposed bridge is over Brahmaputra hence the plot area will be covered as ground coverage which is very minimum however maximum project area is of open to sky space, better for natural light & ventilation, air environment and landscaping.

9.4 Parking Facilities & Traffic Management

The vehicles to be engaged during construction phase will be ensured to have pollution under check/ control certificate and no vehicle will be allowed without PUC certificate.

During operation, it is envisaged that proposed project will increase life of vehicle due to better road facility and other ancillary facility.

9.5 Conservation of Energy

The power demand will be met from Assam Electricity Supply through grid supply, which will be reduce the load on self-generation. Moreover, 2 nos. of standby Diesel generator (DG) sets of total capacity 500 kVA (as required) will be used during power failure and low sulphur HSD will be used as fuel minimizing the pollutant emissions.

The design of the proposed project will be such that maximum use of natural lighting can be achieved. The proposed project will be designed to achieve minimum influx of heat while the street light will be equipped with LED bulb and fully automation system.

The stacks of DG sets will be provided at appropriate height as per norm so that the emission get dispersed properly and not affect the surrounding air-environment.

9.6 Conservation of Water

Fresh water requirement will be met from tanker supply and no ground water will be used in the project. There will not be any diversion of water from other users. Rise in water demand is a local phenomenon but the project would have limited regional impact on water reserves.

A low cost natural based treatment facility will be set-up and the entire wastewater generated during construction phase will be treated up to the tertiary level in the on-site Sewage Treatment Plant (STP).

During operations, there will be zero discharge, as the entire treated sewage will be recycled and will not be polluting land or and water environment.

9.7 Sensor Based Fixtures

Various types of sensor based technologies along with low flow devices (solenoid self-operating valves) will be used for lighting and water supply.

9.8 Storm water Drainage and Rainwater Harvesting

The ground surface has a mild and gentle slope allowing efficient surface run-off. The project is not likely to alter or obstruct any drainage courses. There is no natural watercourse passing through the project site. Hence the proposal does not involve alteration of natural drainage systems. As a result of excavation of topsoil during construction phase, the impact on drainage pattern, and run off characteristics will be restricted to the small area and may not last more than one monsoon.

The rainwater collected from the bridge and other paved areas within the project corridor will be conveyed into the rainwater harvesting system consisting of Desilting-cum-filter chamber, Oil & grease separator and Recharge pit with bore well for recharge into the groundwater. Thus the rainwater collected from paved area and bridge area will be treated and only clear treated water will be recharge in to ground through different proposed rainwater harvest pits and recharge wells.

During construction phase, all management plan shall be incorporated to avoid pollution or contamination in the river Brahmaputra of any kind is envisaged.

9.9 Air Environment

In construction phase water sprinkling will be carried out to suppress the dust generating from excavation, loading, unloading and construction activities to minimize the air pollution.

The emission from the stacks attached to standby DG sets would be very less. However suitable mitigation measures will be adopted to have less impact on environment.

- DG sets will be used only during power failure
- DG sets will comply with the applicable emission norms.
- Adequate stack height for DG sets will be provided as per CPCB norms.
- During operation stage, monitoring of ambient air quality will be carried out as per norms.

9.10 Noise Environment

The construction equipment as well as vehicular movement will be prime cause of noise generation within project area. Since, the proposed project has different landuse pattern hence the impact may vary in nearby surroundings. The DG sets will be used only as power back-up and will not be operational continuously. The DG sets will be place with suitable enclosures at basement. Low sulphur diesel will be used as fuel which is more energy efficient and generate less pollutant emission. All the DG sets will be as per the E (P) Rule and noise level from the DG sets will be as per the prevailing standards.

- All equipment will have noise and vibration control measures to avoid any impact
- DG sets will be installed away from habitation to minimize the impact on ambient noise.
- DG room will be provided with acoustic lining/ treatment to insure 25 dB (A) insertion loss as per the regulations.
- Adequate exhaust mufflers will be provided as per norms to limit the noise.
- The DG sets will be built in damper for anti-vibration.

9.11 Conservation of tree and plant species

There is no national park and biosphere reserve is present within 10 km radius of the study area. However, Deepor Beel Bird Sanctuary and Ramasar site is 9.07km, Aamchung Wildlife sanctuary is about 13 km, Garbhanga Reserve Forest is 8.5 km and Guwahati Zoo – 5.4 km. In addition to the above, Kamakhya Temple is 2.6 km, interstate boundary with Meghalaya is 10.250 km away from the proposed project area. Mostly common plant species were recorded within the study area with very few local species. A total of 7455 (including Bamboo clusters and Horticultural plants) of plant species were recorded from the Corridor of Impact (COI). Some of them will saved as per site clearance requirement.

The landscape plan has been designed for greenery development and plantation of tree species within the project complex which will improve the aesthetic, reduce the pollution and provide fresh air environment and a visual retreat and relaxation to the population.

9.12 Construction Material

The major materials required for construction of the bridge and their approach road will be steel, cement, bricks, sand, aggregates, steel, glass, fly-ash based products, sanitary and hardware items, electrical fittings, water, etc. which will be sourced from nearby authorized vendor and locally available places to reduce the transport of the material. This will reduce the fuel consumption and also the carrying cost of the materials.

Following low-energy/ recycled material-based finishes/ products will be used in the project which use low-energy materials and products and industrial waste/ recycled products and minimize the use of wood as a natural resource.

- Use of ready mix concrete containing fly ash or PPC which contains fly ash
- Use of PPC (which contains minimum 15% of fly ash) in mortar and plaster
- Use of PPC or fly ash based paving blocks/ tiles and pre-cast elements
- Composite wood products such as hardboards, block-boards, plywood etc. made from recycled wood scrap & dusts.
- Fibrous gypsum plaster boards made from industrial wastes
- Finished concrete flooring, ceiling tiles, ceramic tiles etc. which are made from low embodied energy products & recycled materials or from resource efficient finishes

9.13 Reduce, Recycle and Reuse.

The excavated earth material will be used partly for backfilling and other developmental activities like leveling. The excess excavated earth will be disposed in vacant low-lying lands of proposed corridor. The topsoil will be preserved separately and will be reused for backfilling & horticultural purpose.

Waste from construction like steel, iron rods etc. will be recycled and reused as far as possible.

The waste water will be treated low cost natural based treatment facility and will be reused for dust suppression and horticulture purpose making the unit as zero discharge project.

Recyclable solid wastes comprising paper, plastic, glass etc., will be sold to authorized recyclers for reuse.

Recycle of e-waste through authorized recyclers.

9.14 Improvement of Infrastructure and Socio-economic Condition.

By way of this proposed development bridge over the river Brahmaputra of the surrounding will be developed. Local people will be employed both during construction and operation phase which will lead to improve in their socio-economic condition.

Thus, by providing suitable mitigation measures and taking necessary steps during construction and operation phase the project and surroundings both will be benefited from environment point of view.

10. ENVIRONMENTAL MANAGEMENT PLAN

10.1 GENERAL

The Environmental Management Plan (EMP) is the synthesis of all proposed mitigative and monitoring actions, set to a time frame with specific responsibility assigned and follow-up actions defined. It contains all the information for the project proponents, the contractors and the regulatory agency to implement the project within a specified time frame. The EMP is a plan of action for avoidance, mitigation and management of the negative impacts of the project. The Environmental Enhancement is also an important component of Environmental Management Plan. This chapter details out the measures incorporated during the project design stage to avoid and mitigate anticipated adverse impacts on the various environmental components.

The management measures have been discussed in the same order as the impacts identified in **Chapter 4**, where impacts have been assessed for each of the environmental components. With regards to the maintenance component no significant impacts are envisaged. However, in the event of any unforeseen adverse impacts, they shall be adequately mitigated through measures suggested as a part of the Environmental Management Plan.

The EMP refers to all implementable tasks at different stages of project, namely:

i. Design

ii. Construction, and

iii. Operation

During the design, construction and operation stage of the Bridge construction and approach road, anticipated impacts have been identified, assessed and evaluated. To mitigate such adverse environmental impacts, environmental management plan has been suggested in following subsections. Cost of environmental monitoring plan, which is essential part of environmental management plan, has also been given in the EMP.

10.2 APPROACH TO MITIGATION MEASURES

The development of mitigation and avoidance measures for adverse impacts of the planned project has been an interactive process and has been a result of continued interaction between the design and environmental teams. This has resulted in incorporation of the environmental and social concerns into the project design. Though conscious efforts have been made to minimize the impacts of environmental and social components, certain impacts have been inevitable. The avoidance and mitigation measures involve reduction in magnitude of these impacts during various stages of the project through:

- Site clearance, construction and operation stages of the project to avoid adverse impacts.
- Additional mitigation measures for unavoidable negative impacts on the environmental components.

10.3 SPECIFIC ACTIVITIES BY PWD (NDB PROJECTS)

The role of project implementation body Public Works Department (PWD) (in NDB Funded Project) in the implementation of EMP involves the following activities:

- Permission from concerned forest division under *Forest Conservation Act 1980* for felling of trees.
- All other regulatory and non-regulatory clearance as applicable and mentioned in chapter- I.

10.4 SPECIFIC ACTIVITIES BY CONCESSIONAIRE

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

- Confirm the Tree Cutting Schedule based on the final design and provide modified schedule to PWD (New Development Bank Projects).
- Felling of trees after PWD (New Development Bank) secures necessary permission
- Selection of material sources (quarry and borrow material, water, sand etc.)
- Selection, design and layout of construction areas, hot mix and batching plants, labour camps etc.
- Apply for and obtain all the necessary clearances from the agencies concerned after finalising the locations of the sites.
- Planning traffic diversions and detours including arrangements for temporary land acquisition.
- Site Specific Management Plan

10.5 CULTURAL PROPERTIES

The planned project has been designed in such a way that it affects minimum numbers of structures and properties of cultural value. Impact on cultural properties during the road construction phase in the Corridor of Impact shall be avoided through adequate scheduling of vehicles and construction machineries. Sitting arrangement shall be provided wherever possible.

10.6 SENSITIVE FEATURES

Noise barriers in the form of compound walls have been proposed along educational institute. The existing compound walls shall be raised to a height of 3 m.

10.7 COMMUNITY PROPERTIES

Religious properties are proposed in place of the existing place which are directly impacted, cost of which has been incorporated in civil cost. Water resources to be impacted shall be relocated prior to construction works.

10.8 IMPLEMENTATION OF EMP

The Environmental Officer of the concessionaire shall be available for the entire duration of the project. The Environmental Officer of the concessionaire shall be primarily responsible for compliance of EMP. The Environmental Specialist shall monitor the compliance of the EMP. The key issues that require special attention along with the mitigations to be implemented have been detailed in Table 10.1.

Table 10.1: Environmental Management Plan

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
DESIGN STAGE						
Geometric Design	The proposed alignment is selected / adjusted (within IRC / MoRT&H specifications) To Minimize Land Disturbance to Avoid Culturally & Environmentally Sensitive Areas – Cultural Properties, Water Bodies Etc.		During alignment Design	Concessionaire / Contractor	PWD (New Development Bank Projects)	Design Report
Issues from stakeholder Consultations	Various issues raised were examined & suitably incorporated based on merit & other road safety measures.		During Design	Concessionaire / Contractor	PWD (New Development Bank Projects)	SIA Report
Orientation of Implementation Agency	A comprehensive training / orientation schedule has been prepared at different stages of PWD (New Development Bank Projects).		During Design	PWD (New Development Bank Projects)	PWD (New Development Bank Projects)	Design Report
Road safety issue due to poor geometrics	Design of Geometric improvements as per IRC codes and MoRT&H Specifications		During alignment design	Concessionaire / Contractor	PWD (New Development Bank Projects)	IRC codes and MoRT&H Specifications
Environmental	Mitigation Measures[6]	Location[7]	Time Frame[8]	Responsibility		Cross

[2] Some of the mitigation measures are preventive in nature while some others include additional measures in terms of environmental conservation and involve physical and construction work.
[3] Unless otherwise stated, the Project Site covers area beyond ROW, such as borrow areas, access roads, service roads and equipment storage sites (MoRT&H: 306.3).
[4] Time frame refers to the duration or instant of time when the mitigation measures shall be taken.
[5] The contract requirements refer to the following:
Ministry of Road Transport & Highways, (MoRT&H) Government of India, Specifications for Road and Bridge Works, Specific and general conditions of the contract.
[6] Some of the mitigation measures are preventive in nature while some others include additional measures in terms of environmental conservation and involve physical and construction work.
[7] Unless otherwise stated, the Project Site covers area beyond ROW, such as borrow areas, access roads, service roads and equipment storage sites (MoRT&H: 306.3).
[8] Time frame refers to the duration or instant of time when the mitigation measures shall be taken.

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
Impact / Aspect				Implementation	Supervision	reference[9]
PRE-CONSTRUCTION STAGE						
Land Acquisition	The land acquisition shall be done as per Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013. Compensation shall be paid to PAPs based on the Entitlement Policy.	Right of Way (ROW)	Before construction starts	Collaborating Agencies, SLAO, PWD (New Development Bank Projects), District Revenue authorities	PWD (New Development Bank Projects)	R&R Report
Relocation of Utilities	All community underground and overhead utilities shall be shifted as per Utility Shifting Plan, prior permission shall be required from regional offices of Electricity, Telecommunications, OFC, Water works etc.	ROW	Post design to Pre-construction	R&R Officer, Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	Utility Relocation Plan
Loss of drinking water sources	Private drinking water source replaced according to RAP and public water sources replaced. Temporary arrangements shall be provided, if the existing water supply is disrupted accidentally.	ROW	Post design to Pre-construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	Utility Relocation Plan
Cultural Properties	Cultural properties affected to be relocated as per Public Consultation.	ROW	Pre-construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MoRT&H: 301.5
Loss of existing bus stops and waiting shed facilities	Bus stops suitably relocated or integrated to the design. Bus lay byes and bus waiting shed designs are provided.		During design stage.	Design Consultants		DPR
Mobilisation & Site Clearance						
	Vegetation shall be removed from the ROW	ROW	Before	Concessionaire /	IE, PWD (New	Design;

[9] The contract requirements refer to the following:
Ministry of Road Transport & Highways, (MoRT&H) Government of India, Specifications for Road and Bridge Works, Specific and general conditions of the contract.

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
Removal of Vegetation	before the commencement of Construction after obtaining necessary permissions from the forest Department.		construction Starts After centre line marking at site	Contractor	Development Bank Projects)	MoRT&H: 201
Procurement of Crushers, Hot-mix plants & Batching Plants, other Construction Vehicles, Equipment and Machinery	Specifications of crushers, hot mix plants and batching plants, other Construction Vehicles, Equipment and Machinery to be procured shall comply to the relevant Bureau of Indian Standard (BIS) norms and with the requirements of the relevant current emission control legislations		Prior to mobilisation at site	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	Contract, MoRT&H: 111, GoI Air & Noise Standards, Environment Protection Act, 1986
Setting up of construction camps	The construction camps shall be located at least 500 m away from habitations & 1 km away from sensitive locations The Concessionaire / Contractor during the progress of work shall provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour to standards and scales approved by the IE.	All areas in immediate vicinity of construction campsite chosen by the Concessionaire / Contractor and approved by the Independent Engineer	During Establishment, Operation and Dismantling of Such Camps.	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MoRT&H: 111.1, 111.14
Setting up of Hot mix Plants and crushers	Hot mix plants, crushers and batching plants shall be located at least 1000m away from the nearest habitation. The Concessionaire / Contractor shall obtain the consent to operate the plants from the PCB, Assam and submit a copy to the Independent Engineer	All Hot mix Plants Batching Plants	During erection, testing, operation and dismantling of such plants	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MoRT&H: 111.5
CONSTRUCTION STAGE						
Clearances and approvals	Secure the following clearances prior to start of construction activity: *Type of clearance* | *Applicability*		Construction stage (Prior to initiation of any work). Time period in	PWD (New Development Bank Projects), PCB, Assam, CPCB, Chief	Concessionaire / Contractor	General Conditions of Contract. Clause 111.3,

Environmental Impact / Aspect	Mitigation Measures[2]		Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
					Implementation	Supervision	
	NOC and consents under Air, Water & Environment Act NOC and consents under Air, Water &Environment Act and noise rules from PCB, Assam Explosive License from Chief Controller of Explosives Permission for storage of hazardous chemical from CPCB Borrow Area, approval Consent letter, lease agreement with the Owner of land. Quarry Lease Deed and Quarry License from State Department of Mines Permission for extraction of ground water for use in road construction activities from State Ground Water Board	For establishment of construction camp. For operating construction plant, crusher, batching plant etc. For storing fuel oil, lubricants, diesel etc. Manufacture storage and Import of Hazardous Chemicals Borrow area for excavation of earth Quarry operation (for new quarry) Extraction of ground water		getting the permission is 2-3 months.	Controller of Explosives, District Collector State Department of Mines, State Ground Water Board, State Irrigation Department, Labour Commissioner Officer		MoRT&H

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	Labour license from labour commissioner office | Engagement of Labour Provide a copy of all necessary clearances to the IE Adhere to all clearance terms and conditions Obtain written permission from private landholders to conduct construction activities on their land prior to commencing works.					
Land						
Soil Erosion and Sedimentation control	Main reason of soil erosion is rains. Concessionaire / Contractor should plan the activities so that No naked / loose earth surface is left out before the onset of monsoon, for minimising the soil erosion following preventive measures to be taken such as: EMBANKMENT SLOPES TO BE COVERED, SOON AFTER COMPLETION. Next layer / activity to be planted, soon after completion of clearing and grubbing, laying of embankment layer, sub-grade layer, sub-base layer, scarification etc. Top soil from borrow area, debris disposal sites; borrow area, construction site to be protected / covered for soil erosion. Debris due to excavation of foundation, dismantling of existing cross drainage structure shall be removed from the water course immediately.	Throughout Project Corridor, Service roads and equipment storage sites, etc.	Upon completion of construction activities at these sites. During construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MORT&H Specification 305.2.2.2, 306, 307, 308

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	Diversions for bridges shall be removed from the water course before the onset of monsoon Along sections abutting water bodies, stone pitching needs to be carried out. At the outfall of each culvert, erosion prevention measure, such as the following, shall be undertaken,					
Loss of agricultural top soil	All areas of cutting and all areas to be permanently covered shall be stripped to a depth of 150 mm and stored in stockpile. The stockpile shall be designed such that the slope does not exceed 1:2 (vertical to horizontal), and the height of the pile is to be restricted to 2m. Stockpiles shall not be surcharged or otherwise loaded and multiple handling shall be kept to a minimum to ensure that no compaction shall occur. The stockpiles shall be covered with gunny bags or tarpaulin. It shall be ensured by the Concessionaire / Contractor that the topsoil shall not be unnecessarily trafficked either before stripping or when in stockpiles. Top soil shall be safeguard from erosion and shall be reused as follows: Covering all borrow areas after excavation is over. Dressing of slopes of road embankment Agricultural field, acquired temporarily	All along Project Corridor, where productive land is acquired	During construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MoRT&H: 301.3.2, 301.7, 305.3.3 & 305.3.9
Compaction of Soil	Construction vehicles should operate within	Throughout Project	During	Concessionaire /	IE, PWD (New	MORT&H

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
and Damage to Vegetation	the Corridor of Impact avoiding damage to soil and vegetation. Diversions, access road used shall be redeveloped by Concessionaire / Contractor, to the satisfaction of the owner / villagers. Construction vehicle, machinery and equipment shall move or be stationed in the ROW only. While operating on temporarily acquired agricultural land for any construction activities, top soil shall be preserved in stockpiles.	Corridor and all areas temporarily acquired.	construction	Contractor	Development Bank Projects)	Specification 112.6, 201.2
Contamination of soil	Guidelines of "Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 shall be enforced. Vehicle / machinery and equipment operation, maintenance and refueling shall be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. An "oil interceptor" shall be provided for wash down and refueling areas. Fuel storage shall be in proper abunded areas. All spills and collected petroleum products shall be disposed off in accordance with MoEF&CC and PCB, Assam guidelines at designated locations. PLANT TO BE SET UP 500 M AWAY FROM SURFACE WATER BODY. Oil interceptor shall be installed at construction site. Septic tank shall be constructed for safe disposal of waste.	At fuel storage areas – usually at construction camps, temporarily acquired site.	During Construction.	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
Quarrying Material sources	Quarry material shall be sourced from approved and licensed aggregate and sand quarries. Copy of licenses to be submitted to the IE For operating new quarries, the concessionaire / contractor shall obtain materials from quarries only after consent of the DOF or other concerned authorities and only after development of a comprehensive quarry' redevelopment plan. Adequate safety precautions shall be ensured during transportation of quarry material from quarries to the construction site. Vehicles transporting the material shall be covered to prevent spillage. Operations to be undertaken by the concessionaire / contractor as per the direction and satisfaction of the IE		During construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MORT&H Specification 111.3, 302, 305.2.2.
Generation of Debris	Debris generated due to the dismantling of the existing pavement structure and the cutting of the hillside for the widening shall be suitably reused in the proposed construction as fill materials for embankments	Throughout Project Corridor.	During Construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MoRT&H: 112.6 & 112.2
Disposal of Debris	The entire debris would be managed as per the guidelines stipulated in Construction and Demolition Waste Management Rules, 2016. The disposal of debris shall be carried out only at sites identified for the purpose. The Concessionaire / Contractor shall carry out the disposal of debris.	Sites identified by the Concessionaire / Contractor and approved by the Independent Engineer	During Construction	Concessionaire / Contractor, IC / SC	PCB, Assam, IE, PWD (New Development Bank Projects)	

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	All arrangement for transportation during construction including provision, maintenance, dismantling and clearing debris, where necessary shall be considered incidental to the work and should be planned and implemented by the Concessionaire / Contractor as approved and directed by IE.					
Air						
Dust Generation	Vehicles delivering materials should be covered to reduce spills and dust blowing off the load. Clearing and grubbing to be done, just before the start of next activity on that site. In laying sub-base, water spraying is needed to aid compaction of the material. After the compaction, water spraying should be carried out at regular intervals to limit the dust to below Road surface should be cleaned with air compressor and vacuum cleaners prior to the construction works. Manual labour using brooms should be avoided, if used labour to be provided masks. Embankment slopes to be covered with turfing / stone pitching immediately after completion. The concessionaire / contractor shall take every precaution to reduce the level of dust emission from the hot mix plants and the batching plants up to the satisfaction of the	Throughout Project Corridor, all access roads, temporarily acquired sites.	Beginning with & throughout construction until asphalting is completed, and side slopes are covered.	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MORT&H Specification 111.1, 111.5, 111.8, 111.9, 111.10 & 118.1

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	IE. All existing highways and roads used by vehicles of the concessionaire / contractor, or any of his sub-contractor or suppliers of materials or plant and similarly roads which are part of the works shall be kept clean and clear of all dust/mud or other extraneous materials dropped by such vehicles or their tyres. Plants, machinery and equipment shall be so handled (including dismantling) as to minimise generation of dust.					
Equipment Selection, Maintenance and Operation	The discharge standards promulgated under the environment protection act, 1986 shall be strictly adhered to. All vehicles, equipment and machinery used for construction shall conform to the relevant bureau of Indian standard (BIS) norms. All vehicles, equipment and machinery used for construction shall be regularly maintained to ensure that pollution emission levels comply with the relevant requirements of PCB, Assam and the independent engineer	Throughout Project Corridor, all access roads, sites temporarily acquired and all borrow areas.	During Construction.	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MORT&H Spec 106, IRC: 72-1978, IRC: 90-1985, 111.5, 111.9, 111.10, 2013
Emission from Crusher	All crushers used in construction shall conform to relevant dust emission control legislations. Clearance for siting shall be obtained from the PCB, Assam. Alternatively, only crushers already licensed by the PCB, Assam shall be used. Water shall be sprayed during the non-	All Aggregate Crushing Plants.	During Erection, Testing, Operation and Dismantling of Such plants.	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MoRT&H: 111.1

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	monsoon months, regularly to minimise dust, in the whole crusher plant area.					
Water						
Loss of water bodies/ surface / ground	No excavation from the bund of the water bodies. NO DEBRIS DISPOSAL NEAR ANY WATER BODY. Prior written permission from authorities for use of water for construction activity shall be submitted to IE. Construction labours to be restricted from polluting the source or misusing the source. Shifting of source to be completed prior to disruption of the actual source. Alternate measures to be taken / ensured during disrupted period. Source to be replaced immediately, in case of accidental loss. Construction work shall be restricted to 3m – 4m width from the existing formation near ponds. The volume of water storage lost shall be compensated for by excavation of an equal volume of similar depth at closest possible location in the direction of flow and shall be done with the approval of the independent engineer	Near all water bodies	During construction	Concessionaire / Contractor	Concessionaire	MORT&H Specification 111.4, 201.2, 301, 304, 306 & 305.4.1
Alteration of drainage	Diversions shall be constructed during dry season, with adequate drainage facility, and shall be completely removed before the	Throughout Project Corridor, all access roads, temporarily	Whenever encountered during	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MORT&H Specification 201.2, 301, 304,

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	onset of monsoon. Debris generated due to the excavation of foundation or due to the dismantling of existing structure shall be removed from the water course. Temporary silt fencing to be provided on the mouth of discharge into natural streams. Continuous drain (lined / unlined) is suggested / shall be provided. Obstruction, if any, shall be removed immediately.	acquired sites.	construction			306, 312.
Runoff and drainage	THROUGHOUT CONTINUOUS DRAIN IS PROVIDED. Lined drain is provided at built-up locations for quick drainage. Increased runoff due to increased impervious surface is countered through increased pervious surface area through soak pits and rain water harvesting structures.		During Construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	
Water requirement for project	Concessionaire / contractor shall provide a list of sources (surface / ground) for approval from IE Prior to use of source concessionaire / contractor shall take the written permission from authority, to use the water in construction activity, and submit a copy to IE During construction only permitted quantity (permission taken) from approved sources shall be used. Concessionaire / contractor shall ensure optimum use of water; discourage labour	Throughout Project Corridor, all access roads, temporarily acquired sites.	During Construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	from wastage of water.					
Silting / sedimentation	Measures suggested under "soil erosion and sedimentation control" shall be enforced. Silt fencing is provided around water bodies. Construction activities shall be stopped near water bodies during monsoon. Soil trap are suggested / shall be provided in all ancillary sites and camps.		Throughout construction period	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MORT&H Specification 111.4, 306 EP Act, 1986
Contamination of water	Measures suggested under "contamination of soil" shall be enforced. Construction work close to water bodies shall be avoided during monsoon. Labour camps shall be located away from water bodies. Car washing / workshops near water bodies shall be avoided.	All areas in immediate vicinity of construction campsite chosen by the Concessionaire / Contractor.	Throughout construction period, During Establishment, Operation and Dismantling of Labour Camps.	Concessionaire / Contractor	IC, PWD (New Development Bank Projects)	MORT&H Specification 111.1, 111.4, 111.9, 111.13, 122, 201.2, 201.4, 301.1.3.10, 304.3.3, 306
Noise						
Noise from Vehicles, Plants and Equipment	Noise standard at processing sites, e.g. Aggregate crushing plants, batching plant, hot mix plant shall be strictly monitored to prevent exceeding of noise standards. Workers in vicinity of loud noise, and workers working with or in crushing, compaction, concrete mixing operations shall wear earplugs and their working time should be limited as a safety measure. In construction sites within 150 m of sensitive receptors construction shall be stopped from 22:00 to 06:00. Machinery and vehicles shall be maintained to keep their noise to a minimum.	Throughout Project Corridor, all access roads, sites temporarily acquired and all borrow areas.	Throughout construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MORT&H Specification No. 111, 111.1, 111.13, 111.5 & 111.6 Environment (Protection) Rules, 1986.

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	Construction of noise barriers at sensitive receptors. All vehicles and equipment used in construction 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. Noise limits for construction equipment used in this project (measured at one metre from the edge of the equipment in free field) such as compactors, rollers, front loaders, concrete mixers, cranes (moveable), vibrators and saws shall not exceed 75 db(a), as specified in the environment (protection) rules, 1986.					
Noise from Pre-splitting Operations (If required)	Blasting shall be carried out only with permission of the independent engineer. All the statutory laws, regulations, rules etc., pertaining to acquisition, transport, storage, handling and use of explosives shall be strictly followed. Blasting shall be carried out during fixed hours (preferably during mid-day), as permitted by the independent engineer. The timing should be made known to all people within 500m (200m for pre-splitting) from the blasting site in all directions. People, except those who actually light the fuse shall be excluded from the area of 200m (50m for pre-splitting) from the blasting site in all	All Blasting and Pre-splitting Sites.	During Preparation, Operation and Closure of Such Sites.	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MoRT&H: 302.1 & 302.4

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	directions at least 10 minutes before the blasting.					
Flora & Fauna						
Loss of trees and Avenue Planting	The impact will be definitely occurred within the core zone (Corridor of Impact) and permanent. Due to the fact that vegetation does not have a high conservation potential, the impact will definitely be moderately Severe and of moderate significance. Mitigation, through Growing indigenous vegetation, where possible, will reduce the significance of this impact to LOW. Avenue plantation will be done for the trees to be cut in the proposed project will compensate to extent. Concessionaire / contractor has to make sure that no trees / branches to be fell by labourer for fuel, warmth during winter. Enough provision of fuel to be ensured. Area is populated and constructed area, already road exist, bridge is being constructed over river Brahmaputra, there will be negligible impact on habitat, dispersion of terrestrial fauna. Due care should be taken by Concessionaire / contractor to ensure safety of wildlife.		After completion of construction activities	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MORT&H Specification, 111, 111.5, 201.5, 306, 308
Vegetation clearance	Clearing and grubbing should be avoided beyond that which is directly required for construction activities. Next activity to be planned / started immediately, to avoid dust generation and		During cleaning operations. During construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MORT&H Specification 201.2

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	soil erosion during monsoon. Turfing / re-vegetation to be started soon after completion of embankment.					
Fauna	Construction workers must protect natural resources and wild animals. Aquatic fauna shall not be affected. Hunting shall be prohibited. Nesting grounds & migratory paths shall be protected.		During construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MORT&H Specification 111.1, 111.6.
Socio – economic environment						
Public Health and Safety	Debris generated shall be disposed to the satisfaction of Independent Engineer. Monitoring of air, water, noise and land during construction and operational phase.		During Construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	
Accidents	The Concessionaire / Contractor shall provide, erect and maintain barricades, including signs marking flats, lights and flagmen as required by the Independent Engineer.		During Construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	
Resettlement Action of People	Affected population shall be compensated as per Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013		During Construction	Concessionaire / Contractor, PWD (New Development Bank Projects)	IE, PWD (New Development Bank Projects)	
Sensitive community and cultural facilities	Precaution to be taken for any accidental loss to community and cultural property Any loss made shall be the responsibility of the concessionaire / contractor and made good by him at his own cost Through access / identification to be maintained		During Construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	Endeavour towards enhancement of community and cultural property Community consultations for any relocation, mitigation measures adopted					
Temporary Loss of Access	The concessionaire / contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property accesses connecting the project road. Work that affects the use of side roads and existing accesses shall not be undertaken without providing adequate provisions to the prior satisfaction of the independent engineer. The works shall not interfere with or cause inconvenience to public or restrict the access to use and occupation of public or private roads, and any other access footpaths to or of properties whether public or private. Access across the work-zone shall be provided for two slots every day during construction (2 hours in the morning and 2 hours in the afternoon). For this purpose the concessionaire / contractor shall maintain a strip of pavement across the work zone of such quality that light motor vehicles (lmv) can pass without difficulty or danger of breaking down.	All along the Project corridor	During Construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MoRT&H: 112.7
Road safety and construction safety						
Traffic Delays and Congestion	Detailed traffic control plans shall be prepared and submitted to the independent	All along the Project Corridor.	During Construction	Concessionaire / Contractor	IE, PWD (New Development	MoRT&H: 112.1

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	engineer for approval, 5 days prior to commencement of works on any section of road. The traffic control plans shall contain details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day. The concessionaire / contractor shall ensure that the running surface is always maintained in running condition, particularly during the monsoon so that no disruption to the traffic flow occurs.				Bank Projects)	& 112.2
Traffic Control and Safety	The concessionaire / contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the independent engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement. All signs, barricades, pavement markings shall be as per the MoRT&H specification. Before taking up construction on any section of the highway, a traffic control plan shall be devised to the satisfaction of the independent engineer.	Entire Project site.	During Construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MoRT&H: 112.1 & 112.4
Risk from Operations	The concessionaire / contractor is required to comply with all the precautions as required for the safety of the workmen as per the international labour organisation	Entire Project site.	During Construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	Factory Act

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	(ilo) convention no. 62 as far as those are applicable to this contract. The concessionaire / contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workers and staff. The concessionaire / contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress. No child labour shall be utilized in the project.					
Risk from Electrical Equipment	Adequate precautions shall be taken to prevent danger from electrical equipment. No material or any of the sites shall be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights shall be provided to protect the public. All machines to be used in the construction shall conform to the relevant Indian standards (is) codes, shall be free from defect, shall be kept in good working order, shall be regularly inspected and properly maintained as per is provisions and to the satisfaction of the independent engineer.	Entire Project site.	During Construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MoRT&H: 106
Risk at Hazardous Activity	All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc., shall be provided with protective footwear and protective goggles.	Entire Project site.	During Construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MoRT&H: 111.1

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stonebreakers shall be provided with protective goggles and clothing and shall be seated at sufficiently safe intervals. The use of any toxic chemical shall be strictly in accordance with the manufacturer's instructions. The independent engineer shall be given at least 6 working days' notice of the proposed use of toxic chemical. A register of all toxic chemicals delivered to the site shall be kept and maintained up to date by the concessionaire / contractor. The register shall include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product.					MoRT&H: 111.6
Risk caused by Force' Majeure	All reasonable precaution shall be taken to prevent danger of the workers and the public from fire, flood, drowning, etc. All necessary steps shall be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work.	Entire Project site	During Construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	
First Aid	At every workplace, a readily available first aid unit including an adequate supply of sterilised dressing material and appliances shall be provided as per the factory act. Suitable transport shall be provided to facilitate take injured or ill person(s) to the	Entire Project site.	During Construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	MoRT&H: 1207.6, Factories Act, 1948

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	nearest applicable hospital.					
Safety Measures During Construction	All relevant provisions of the factories act, 1948 and the building and other construction workers (regulation of employment and conditions of service) act, 1996 shall be adhered to. Adequate safety measures for workers during handling of materials at site shall be taken up. The register shall include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product.	All construction sites	During construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	Factories Act, 1948 and The Building and other Construction Workers (Regulation Of Employment and Conditions of Service) Act, 1996
Hygiene	Latrines shall be provided with septic tank. The effluents can be diverted for horticulture inside the camps. The septic tank may be cleaned once in 6 months and filter cleaned after a year. All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. Garbage bins must be provided in the camps and regularly emptied and the garbage disposed off in a hygienic manner. Adequate health care is to be provided for the work force. Unless otherwise arranged for by the local sanitary authority, the local medical health or municipal authorities.	All Worker's Camps	During construction	Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	On completion of the works, all such temporary structures shall be cleared away, all rubbish burnt, septic tank and other disposal pits filled in and effectively sealed off and the outline site left clean and tidy, at the concessionaire / contractor's expense, to the entire satisfaction of the independent engineer.					
Clearing of Construction of Camps & Restoration	Concessionaire / Contractor to prepare site restoration plans for approval by the Independent Engineer. The plan is to be implemented by the Concessionaire / Contractor prior to demobilisation. On completion of the works, all temporary structures shall be cleared away, all rubbish burnt, excreta or other disposal pits or trenches filled in and effectively sealed off and the site left clean and tidy, at the Concessionaire / Contractor's expense, to the entire satisfaction of the Independent Engineer. Residual topsoil shall be distributed on adjoining / proximate barren / rocky areas as identified by the Independent Engineer in a layer of thickness of 75mm - 150mm.	All Workers' Camps		Concessionaire / Contractor	IE, PWD (New Development Bank Projects)	
Monitoring at critical locations	The monitoring of Air, water and Noise to be carried out identified critical locations besides locations identified by along the project corridor.			Concessionaire / Contractor	IE	
OPERATION STAGE						
Water quality	Silt fencing, Oil & Grease traps, etc. shall be	At sensitive water	During Operational	PWD (New	PWD (New	As per

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
degradation due to road run-off	provided at sensitive water bodies to ensure that the water quality is not impaired due to contaminants from road run-off. Monitoring shall be carried out as specified in the Monitoring plan	bodies identified. As specified in the monitoring plan	Stage	Development Bank Projects) and / or OSPCB	Development Bank Projects)	Monitoring plan
Contamination of Soil and Water Resources from Spills Accidents	Contingency plans to be in place for cleaning up of spills of oil, fuel and toxic chemicals. Spill of oil, fuel and automobile servicing units without adequate disposal systems in place to be discouraged. Accidental spills are potentially disastrous, but its probability is quite low as one of the objectives of this project is to enhance road safety. The public shall be informed about the regulations on land pollution. Land pollution monitoring program has been devised for checking pollution level and suggesting remedial measures.	Entire Project corridor.	During Operational Stage	Concessionaire / Contractor	IE	
Traffic and Accident Safety	Depending on the level of congestion and traffic hazards, traffic management plans shall be prepared. Traffic control measures including speed limits to be enforced strictly. Road control width to be enforced. Local government bodies and development authorities shall be encouraged to control building development along the highway.	All along the Project corridor and surrounding areas.	During Operational Stage	Concessionaire / Contractor, Local Government Bodies, Development Authorities.	PWD (New Development Bank Projects) / Concessionaire / Contractor	Through Operation Stage.
Accidents involving Hazardous Materials	Compliance with the hazardous wastes (management and handling) rules, 1989 Creation of an emergency response team	All along the Project corridor and surrounding areas	During Operational Stage	Concessionaire / Contractor	PWD (New Development Bank Projects),	

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	For delivery of hazardous substances, permit license, driving license and guidance license shall be required. Public security, transportation and fire fighting departments shall designate a special route for vehicles delivering hazardous material. These vehicles shall only be harboured at designated parking lots. In case of spill of hazardous materials, the relevant departments shall be intimated at once to deal with it with the spill contingency plan.				Motor Vehicles Department, District Administration	
Road side tree plantation	Trees planted along the corridor shall be maintained for a period of five years. Maintenance works include, watering of the saplings, and all necessary measures for survival of the sapling. The avenue plantation should be completed, maintained and casualties to be replaced. Discouraging local peoples from cutting tree / branches for fuel, cattle food etc. Educating people about the usefulness of trees.	All along the corridor Immediately from the planting of sapling	During Operational Stage	Concessionaire / Contractor	PWD (New Development Bank Projects), IE	
Monitoring at critical locations	The monitoring of Air, land, water and Noise to be carried out identified critical locations besides locations identified by IE along the project corridor.			Concessionaire / Contractor	IE	
Noise	Horn prohibited sign post shall be enforced Maintenance of noise barriers Discouraging local people from establishing sensitive receptor near the road.	After completion of construction Throughout and after project development	During Operational Stage	PCB, Assam State Police, Traffic Police, State Forest Dept., Transport	IE	IRC 35-1971 IRC 79-1981 IRC 93-1995

Environmental Impact / Aspect	Mitigation Measures[2]	Location[3]	Time Frame[4]	Responsibility		Cross reference[5]
				Implementation	Supervision	
	The public shall be informed about the regulations on noise pollution.	period		Dept., Concessionaire / Contractor and Planning Authorities		

10.9 ENVIRONMENTAL MONITORING PROGRAMME

The Environmental Monitoring Programme has been detailed out in Chapter 6 and in Annexure 6-1. Successful implementation of the Environmental Monitoring Program is contingent on the following:

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

10.10 MONITORING OF EARTHWORKS ACTIVITIES

Most of the environmental problems related to the construction works are anticipated to be associated with the earthworks, particularly for the Quarries and Borrow Areas. Details regarding the guidelines and procedures adopted to minimise the environmental impacts of opening, operating and closing of Quarries and Borrow Areas are presented in Annexure 4.5, 4.6 and 4.7. Other environmental effects associated with the earthworks include the development of adequate temporary drainage to minimise detrimental effects (e.g. erosion) due to run-off, and safety aspects related to Works implementation.

10.11 MONITORING OF CONCESSIONAIRE / CONTRACTOR'S FACILITIES, PLANT AND EQUIPMENT

All issues related to negative environmental impacts of the Concessionaire / Contractor's Facilities, Plant and equipment are to be controlled through:

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

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

10.12 ENVIRONMENTAL BUDGET

The environmental budget for the various environmental management measures proposed in the EMP is detailed in Table 10.4. There are several other environmental issues that have been addressed as part of good engineering practices, the costs for which have been accounted for in the Engineering Cost. The rates adopted for the budget has been worked out on the basis of market rates and the Schedule of rates. Various environmental aspects covered under engineering costs are listed below:

- Turfing and Pitching of slopes
- Construction of slope protection works as retaining walls; breast walls toe walls, drains, and gabions.
- Construction of roadside amenities as bus stops etc.

MANAGEMENT PLAN FOR TERRESTRIAL ECOLOGY

Avenue plantation will be done for the trees to be cut in the proposed project will compensate to extent. A budgetary provision of **lumpsum Rs. 3.859 crores (including budgetary provision for beatification of surplus desbris disposal area)** are earmarked for avenue plantation and maintenance for 3 years and Compensatory Afforestation as per GoA. Details of the scheme has been from State Forest Department, Assam and is under process. Details is annexued as Annexure 10.1.

Table 10.2: Summary of Budget of Management Plan for Terrestrial Ecology

S.No.	Measures	Quantity	Estimated Biudget (INR)
1	Compensatory Afforestation Plan	29820	11803688
2	Median Plantation	2157	341465
3	Avenue Plantation	9768	1546567
4	Wired Fencing of Trees	11925	5962333
5	Grass Turfing @ Rs. 15/sq feet	645834	9687510
6	Flowering Creepers and Climbers	640	192000
7	Hanging flowering pots at light post @250/pot	640	160000
8	Initial Fertilizer Cost @ 1000/metric ton	500	500000
9	Organic Fertilizer cost @ 50000/Quarter	60	3000000
10	Maintainance Cost @ 30000/Month	180	5400000
11	Watch and Guard Cost @ 15000/Month	180	2700000
Total Cost			**38593564**

MANAGEMENT PLAN FOR AQUATIC ECOLOGY

MANAGEMENT PLAN FOR CONSERVATION OF FISHES

- Carry out systematic field survey and experimental fishing to study the fish diversity of the proposed area.
- Identify the most vulnerable and keystone species and study their biology which includes feeding, migratory and breeding behaviour.
- Identify the potential habitat of fishes and monitor the impact of construction activities upon those habitats.
- Restore the degraded habitats if any to optimal level.
- Setting up protected areas to conserve the fishes.
- Evaluation of the genetic diversity of the fishes and development of in vitro systems for possible future captive breeding efforts.
- Ensuring Critical Levels of Water Flow in Riverine Habitats of fishes.
- The involvement or active participation of local stakeholders like traditional fishing community and other riverbank communities is essential for their conservation.
- There is a need to bring about awareness among people on the need to conserve our indigenous fish fauna.

Detailed Fisheries Management Program are as follows:

a. Establishment of Fish Farms

The Department of Fisheries, Assam must arrange and select the site for construction of fish farms, the budgetary provision is to be provided for design and establishment of fish pond and farm by the project authority. The water supply facilities of the farm should be managed to cater the requirement of water, appropriate to produce fish seeds at required capacity. For capacity development of workers for construction of tanks is included in the budgetary provision. Provision for other requirement like feed, medicines, net, aerator etc. is considered.

b. Production and Rearing of Fish Seed

Budgetary provision is provided for, procurement of brood stock and maintenance of stock at the fish farm in order to produce the seed required for stocking. The budgetary provision is included for provision of hatching at the farm, maintenance of reared stock and health management and feeding of the reared stock.

Stocking of Fish Seed in the River

Budgetary provision is provided for stocking of fish seed at the site, necessary facilities like packaging materials, oxygenation equipment, feeder/ graders, etc. will be purchased. A budge provision for maintaining a vehicle required for transportation of fish seed reared at the farm to the stocking site will be maintained. Apart from this the vehicle will be used to carry items required for survey and monitoring of water quality and stock assessment fortnight on monthly basis.

Analysis of Water Quality and Soil Quality

Prior to seed stocking, detailed study of physical, chemical and biological characteristics of water and the soil of river is required. For assessment of fish stock and water/ soil quality at the site technical expertise is required. Workforce will also be required to carry out various activities at the farm ranging from maintenance of brood, stock, rearing of fish seed, health management and transport of the stocking material to the site. For this scientific experts and manpower will be arranged and budgetary provision is included.

Capacity Building and Training Program

The budgetary provision is provided for capacity development of workforce for management and **maintenance** of fish farm.

Other Requirements

For the control of noxious weeds, harvesting of fishes (for rapid growing fishes and non-cultivable fishes) and maintenance of embankments, the Fishery Department needs some mechanical control devices, boats and chemicals. Budgetary provisions are included, so that these equipment's can be made available at the existing facilities and could be used.

Institutional Mechanism

The plan is proposed to be implemented through the State Fisheries Department or Central Inland Fisheries Research Institute (CIFRI). The funds for which is to be released periodically by the project authorities to implementing agency. An Advisory Committee is proposed headed by executing agency, which would monitor the implementation aspects, prioritize activities, etc. The committee would offer advice on development of practices and organization of training program for workforce and project authorities, keeping in mind people's participation in fisheries development schemes.

A Farm Superintendent appointed full time on behalf of the Advisory Committee would coordinate and oversee the operation of the proposed Fisheries Development and Management Plan. Various terms led by Farm Managers would be constituted to look after activities such as:

(i) development of fish farm facilities and office at allocated site,

(ii) execute fish breeding activity and

(i) monitoring of water quality

The Farm Superintendent would evaluate/monitor both financial and administrative aspects at the Farm Office. The implementation, monitoring and appraisal of the plan should be reported regularly, after five years of management and maintenance.

Budget: A total of Approx. Rs. 2 crore rupees is earmarked for conservation of fishes (Table 10.3). Details of the mitigation measures and management plan has been invited from Central Inland Fisheries Research Institute (CIFRI) and is under process.

Table 10.3: Cost Estimate for Fisheries Management Plan

S.No.	Proposed Measures	Estimated Budget (Lakhs)
	Survey and Monitoring of Water Quality (weekly)	10
	Stock Assessment	20
	Assessment of soil quality for site selection	0.2
	Construction of Fish Farms	30
	Construction of Hatchery	20
	Procurement of Pelleted Feed Mill	3
	Vehicle for transportation of Fish and fingerlings	10
	Arrangement of packaging materials, oxygenation equipment, feeder/ graders	10
	Fish Seeds (indigenous species)	5
	Pelleted Feeds	10
	Salaries for Scientist/ Fishery Experts	25
	Health and Safety Management	10
	Watch, Guard and other Salaries	10
	Miscellaneous and Maintenance cost @5 Years	10
	Aquatic weed and predator control	1
	Liming and Fertilization of pond	0.8
	Conservation and restoration of fish habitats	20
	Capacity Building, Education and Awareness	5
Total Cost		**200**

CONSERVATION OF DOLPHIN

As per the conservation action plan for he gangetic dolphin 2010-2020 strategies is under.

- Ensuring that any catch or other uses of the Gangetic Dolphin are sustainable
- Protected areas
- Reducing incidental mortality through rescue and release efforts
- Managing future dolphin-oriented tourism
- Habitat protection and restoration
- Researching and reducing environmental pollution
- Reducing the effects of water development on rivers in Brahmaputra Basin

Identification of areas of research for long term conservation of the Dolphin

- Evaluate the viability of the River dolphin populations for long-term survival, and prepare management plans for each population.
- Develop and utilise the most appropriate methodology for the population estimation of dolphins and carry out population status surveys.
- Develop methods for safe handling of River dolphins for scientific and rescue efforts.
- Study and monitor the impact of the construction activities upon dolphin population, their behaviour and habitat.
- Assessment of the habitat of the River dolphin. A model Dolphin Habitat Restoration Project in stretches of habitat that are considered to have been degraded to a suboptimal level needs to be initiated.
- Study the movement and dispersal pattern of the River dolphin to assess the home range and habitat utilising modern technologies such as satellite tracking.
- Develop and utilise health markers in the River dolphin to rapidly assess the health of an individual.
- Study bio-accumulation of toxins, and their effects, in the River dolphins.
- Evaluation of the genetic diversity of the species and development of in vitro systems for possible future captive breeding efforts.
- Ensuring Critical Levels of Water Flow in Riverine Habitats of Dolphins.

Increase National Awareness about the River dolphin and the importance of freshwater ecosystems

- Identification of target groups to execute conservation actions.
- Development of education and publicity material.

Identification of potential dolphin sanctuaries in the Brahmaputra river system

- Potential sites for intense dolphin conservation should be demarcated in the Brahmaputra River System.

Provision of institutional support for the long-term survival of the Ganges River dolphin and Capacity building

- The establishment of Dolphin Conservation Centres and strengthening of research facilities available in India will aid in better coordination among agencies responsible for the conservation of the River dolphin.
- In addition to establishing dedicated Centres training programme for frontline protection staff as well as university researchers and teaching staff on research methodologies needs to be conducted.

Community Involvement in river dolphin Conservation and Management

- The involvement or active participation of local stakeholders like traditional fishing community and other riverbank communities is essential for dolphin conservation.

Environmental Budget: A total of Rs. 2.14 crore rupees is earmarked for conservation of dolphins.

The proposed conservation action plan for Ganges River dolphins (Platanista gangetica gangetica) consist of following.

CAPACITY BUILDING FOR GANGETIC DOLPHIN CONSERVATION AND MANAGEMENT: An estimated budget of Rs. 30 Lakhs is proposed to ensure funding support for capacity building and other conservation efforts. The proposed budget is inclusive of development of system to provide guidance and assistance to research scholars to encouragement the guided research and development activities on Gangetic Dolphin in River Brahmaputra and its tributaries. As per “The Conservation Action Plan for The Gangetic Dolphin” by MOEF&CC, some of the identified organizations who could take up such capacity

building programmes in various regions are WWF-India, Wildlife Institute of India, and Patna University and Central University of Bihar.

MINIMIZING FISHERIES INTERFACE: Based on publication "Protection of Endangered Ganges River Dolphin in Brahmaputra River, Assam, India" Wakid, A. & Braulik, G. (2009), it is found that mortality through fisheries by-catch was one of the major threats to Ganges dolphins in the Brahmaputra. Therefore, an estimated budget of Rs. 30 Lakh is provided is proposed for to review the existing fisheries practices and development of plan to minimize the fisheries interface. Also, there is a need for the development of a sustainable fishery. management plan compatible with river dolphin existence. As per "The Conservation Action Plan for The Gangetic Dolphin" by MOEF&CC, the Central Inland Fisheries Research Institute, Barrackpore or the Tata Institute of Social Sciences, Mumbai could take up this as a national review with help of each of the concerned state level fishery department.

PREVENTION, MITIGATION AND RESTORATION OF IMPACTS ON DOLPHIN HABITATS FROM DEVELOPMENTAL PROJECTS: Accidental killing of dolphin through gill net entanglement, poaching, population fragmentation through water development projects, water pollution and over-exploitation of fish fauna, are the major factors threatening the Gangetic dolphin subspecies (Sinha et al., 2000). Dolphins are killed for meat and oil. 'Missing' tribes of Eastern Assam kill dolphins mainly for meat, whereas in Western Assam, they are killed for oil, which is used as bait for catfish Clupisoma garuam (Mohan et al., 1997; Bairagi, 1999). Most of the riverine villagers in remote areas believe that dolphin oil has medicinal value and they use it to treat different rheumatic diseases (Wakid, 2005). Dolphin poaching for medicinal oil and for the oil bait fishery is one of the major causes of dolphin mortality in Assam, however extensive community-based conservation initiatives of the Gangetic Dolphin Research & Conservation Programme of Aaranyak has reduced the mortality considerably over last 3 years. An estimated budget of Rs.50 Lakh to model Dolphin Habitat Restoration Project in stretches of habitat that are considered to have been degraded to a suboptimal level. The project will include the detailed assessment and impacts of river valley projects and other development projects on Gangetic Dolphin.

COMMUNITY INVOLVEMENT IN RIVER DOLPHIN CONSERVATION AND MANAGEMENT: The involvement or active participation of local stakeholders like traditional fishing community and other river bank communities is essential for dolphin conservation. There have been some initiatives in this direction such as 'Dolphin Mitra' in Bihar and 'Community based Dolphin Watch Programme' in Chilika Lake. Communities involved in such activities with benefit sharing options such as 'River Cruise' or 'Dolphin Watch Programme' have helped popularise Dolphin Conservation and Management Activities. A budgetary provision of Rs. 24 Lakh is provided to start such initiatives in identified Dolphin Hotspots (Wakid, 2005).

EDUCATION & AWARENESS: Awareness can be generated by conducting seminars and workshops for wildlife management authorities, local communities and fishermen communities. The major focus of seminar and workshops will be make people aware regarding the status of Gangetic dolphin in the Brahmaputra River, the factors affecting the survival rate (threats) importance of Gangetic dolphin and the conservation measures that can protect the endangered species. Community based conservation plan can be prepared and can be implemented by support of local NGO's. A budgetary provision of Rs. 20 Lakh is provided for education and awareness among local communities and officials. The budget will include preparation and implementation of Community based conservation plan.

Initiation of Identified Research: Financial budget of approximate Rs. 50 Lakhs can be proposed to take up the identified research capability provided in "The Conservation Action Plan for The Gangetic Dolphin"

by MOEF&CC and "CONSERVATION OF GANGETIC DOLPHIN IN BRAHMAPUTRA RIVER SYSTEM, INDIA" by A. Wakid, 2005. The identified research for which the budget is provided is as below:

Population status and distribution pattern of Gangetic dolphin

Study of habitat ecology (Detail study on water quality, habitat geomorphology, food availability) and Studies of inflow of toxin into river and impact on aquatic flora fauna

Population estimation

Evaluation of threat and development of Management Program

The details of summary financial support provided for dolphin conservation program based on the existing research and future scope of research is given in Table below.

Table 10.4: Summary of Budget for Conservation Action Plan for Dolphin

S.No.	Task	Proposal	Budgetary Provision (Lakhs)
1.	Capacity Building for Gangetic Dolphin Conservation and Management	Proposal for capacity development of 3 institutions (IIT Guwahati, Guwahati University and Cotton University) @ 10 Lakh*3	30
2.	Minimising Fisheries Interface	Development and implementation of sustainable Fisheries Management Plan @ 30 Lakh for completed tenure of project.	30
3.	Prevention, Mitigation and Restoration of Impacts on Dolphin Habitats from Developmental Projects	Monitoring of Aquatic Ecology @ 5 lakh*5 Years Identification of habitat degradation and restoration @ 5 Lakh*5Years	50
4.	Community Involvement in river dolphin Conservation and Management	Development of Dolphin Watch Program @ 24 Lakh	24
5.	Education & Awareness	Educational and training camps for dolphin conservation @ 4 Lakh*5years	20
6.	Initiation of Identified Research	Studies on movement and dispersal pattern @ 20 Lakh Population estimation @ 10 Lakh Evaluation of threat and development of Management Program @10 Lakh Studies of inflow of toxin into river and impact on aquatic flora fauna @ 20Lakh	50
Total			**2.14 Crore**

Table 10.5: Environmental Management Plan cost

Sl. No.	Component	Description	Unit	Quantity	Unit cost INR	Total cost In Lakhs
1	Terrestrial Ecology	Net present Value of plants	No.	7455	-	83.43
		Management Plan for Terrestrial Ecology	No.	74550	158.33	386
2	Aquatic Ecology	Dolphin Conservation				214
		Fish Conservation				200
3	Sewage	Provision of Sewage and sanitation facilities for the construction camps, including maintenance for 5 years cost	No.	4	2200000	84
4	Oil	Provision of Oil Interceptors Project Site (1), Workshop (2)	No.	4	25000	1
5	Air	Dust Suppression at site Rs. 1000/trip X 10 trips/Day X 365 days X 3 years	Trip	10950	1000	109.5
6	Water	Silt fencing and oil Interceptor as part of the project	Lumpsum	500	1450	7.5
7	Noise	Noise barrier at sensitive locations	No.	6	49000	2.94
8	Environmental Monitoring Cost	Environmental Monitoring Cost				33.08
Total						**1121.45**
Contingency @ 5% on total environmental cost						**56.0725**
Grand total						**1177.52**

11. CONCLUSION AND RECOMMENDATIONS

11.1 GENERAL

Based upon available documents and site visits of proposed Pan Bazar bridge and their approach road, it is concluded that overall the project shall not have any significant adverse environmental impact except the temporary impact on aquatic ecology of the river Brahmaputra. Most of the impact are considered to be limited to the construction stage only and with the implementation of EMP as suggested in the project such impacts can be minimized. The detailed conclusion and recommendation is given below:

- This planned project does not attract any notified National Park or Wildlife Sanctuary within 10 km boundary from both sides from the project road.
- As part of the feasibility study adequate alternative measures has been undertaken for (i) minimum impact on environmental aspects; (ii) provide minimum disturbance to the structures.
- Additionally, road safety measures and road furniture are also provided including traffic management measures and street lighting.
- As a result of up-gradation of the project road, number of accidents shall be reduced and life of vehicle will get increase.
- Reductions in adverse environmental impacts of transportations i.e. reduced emissions and noise.
- The EMP measures are required to be monitored for effective implementation.
- Compensatory afforestation shall be undertaken ten (10) times of tree cutting.

Moreover, proposed project will give better connectivity and access between South Bank to North Guwahati with reductions in travel time through superior access facility in all weather and 24hrs. The proposed project will increase the carrying capacity of South Bank and play a major intervention in urbanization of North Guwahati. Therefore, it can be concluded that the proposed up-gradation, construction, operation, and maintenance of Bridge and approach road does not involve any significant environmental impact. Strategically, the positive impact on environment with parallel economic growth is envisaged with this proposed bridge project.

12. DISCLOSURE OF CONSULTANT

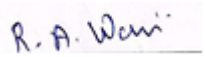
Declaration by Experts Contributing to the EIA/EMP Report for Bridges over river Brahmaputra connecting Panbazar and North Guwahati by Public Works Department (PWD). I, hereby, certify that I was a part of the EIA team in the following capacity that developed the above EIA.

EIA Coordinator:

Name:	**Om Prakash Shukla**
Signature	
Period of involvement	**February 2018 to finalization of report**
Contact Information:	**Wolkem India Ltd.** Consultancy Divison, Post Box. No.- 21E-102 Mewar Industrial Area, Udaipur, Rajasthan-313003 Email- info.wcs@wolkem.com

Functional Area Experts

Functional Areas	Name of the Expert	Involvement (Period and Task**) February 2018 to finalization of report	Signature
Air Pollution Monitoring & Control (AP)****	Vivek Ojha	• Micro Meteorology, establishment of air pollution monitoring network also quality check. • Impact assessment, mitigation & environmental management plan preparation.	
Air Quality Modeling and Prediction (AQ)****	KV Ramesh	• Analysis of collected baseline data • Processing of micrometeorological data for using in model. • Analysis of predicted impact due to the modelling result.	
Water Pollution (WP)	Dr SK Yadav	• Water Quality monitoring network designing. • Sampling of water samples (surface and ground water). • Monitoring of water quality. • Water Balance • Identification & assessment of quantum of water pollution and its Mitigation measures. • Waste water treatment Suggestion.	
Noise and Vibration*	PM Jain	• Analysis of collected baseline data • Processing of data for modelling purposed.	

Functional Areas	Name of the Expert	Involvement (Period and Task**) February 2018 to finalization of report	Signature
		• Analysis of predicted impact due to the modelling result.	
Ecology and Bio-diversity Conservation (EB)**	Dr Om Prakash Shukla	• Conducted Ecological survey & preparation of status report. • Application of taxonomy in resource inventory (Flora & Fauna) • List of species animals and plants report. • Identification & assessment of ecological impact due to proposed project and its Mitigation measures.	
Solid and Hazardous Waste Management (SHW)	Vivek Ojha	• Identification of hazardous and non-hazardous wastes. • Reuse and recycling of solid wastes. • Handling and disposal of solid waste and C&D waste.	
Socio-Economics (SE)***	Mr. N.S. Chundawat	• Baseline socio economic survey (Interviews, Questionnaires, focused group discussion) • Evaluation of Socio economic development status of the area. • Enterprise social commitment provisions.	
Land use (LU)	Mr. Mahesh Kumar Khadekar	• Development of landuse maps of study area using GIS / related tools, site visit for ground truth survey, finalization of landuse maps	
Risk and Hazards (RH)	Mr. R.A. Wani	• Identification of hazards due to proposed project. • Analysis and Mitigation of project risk. • Preparation of risk assessment report and onsite emergency plan.	
Geology (GEO)	Mr. Manoj Bhatnagar	• Description and assessment of Geology and impact evaluation • Mitigation measures and remediation plan	
Hydrogeology (HG)	Mr. Manoj Bhatnagar	• Description and assessment of Hydrogeology and impact evaluation • Mitigation measures and remediation plan	

Functional Areas	Name of the Expert	Involvement (Period and Task**) February 2018 to finalization of report	Signature
Soil Conservation (SC)	Dr SK Yadav	• Soil Quality monitoring network designing. • Sampling of soil samples (surface and ground water). • Monitoring of soil quality. • Identification & assessment of quantum of soil pollution and its Mitigation measures.	

* XXXX has contributed for Noise and Vibration (NV) with concerned FAE.

** XXXXXXXXX has contributed for Ecology and Bio-diversity Conservation (EB) with concerned FAE.

*** XXXXXX have contributed for Socio-Economics (SE) with concerned FAE.

****XXXXX……has contributed for AP, WP & AQ respectively with concerned FAE.

Declaration by the Head of the Accredited Consultant Organization/authorized person

I, Om Prakash Shukla, hereby confirm that the above-mentioned experts for the EIA/EMP Report for Bridges over river Brahmaputra connecting Panbazar and North Guwahati by Public Works Department (PWD) has worked on this project. I also confirm that the consultant organization shall be fully accountable for any mis-leading information mentioned in this statement.

Signature	
Name	Om Prakash Shukla
Designation:	Head, Consultancy Division
Name of the EIA Consultant organization	Wolkem India Ltd
NABET Certificate No. and date	NABET/EIA/1720/RA 0080, Dated: 14th Dec, 2017

Annexures

ANNEXURE 3.1

METHODOLOGY OF MONITORING OF ENVIRONMENTAL PARAMETERS

1. Air Quality Monitoring Methodology

1.1 *Respirable Particulate Matter (PM_{10})*

The sampling of ambient air was performed with Respirable Dust Sampler, which is primarily a High Volume Sampler fitted with a cyclone separator for pre-separation of particles larger than 10-micron diameter. Air exiting from the separator is drawn at a measured rate through the separator followed by a pre-weighed glass fiber sheet of 20 cm x 25 cm sizes (Whatman, EPM-2000). The RPM concentrations are determined gravimetrically from the average airflow rate, sampling period and the mass of particulate matter collected over the GF filter surface.

1.2 *Fine Particulate Matter ($PM_{2.5}$)*

The sampling of ambient air was performed with Fine Particulate Sampler for particles less than 2.5-micron diameter. The PM concentrations are determined gravimetrically from the average airflow rate, sampling period and the mass of particulate matter collected over the PTFE filter surface.

1.3 *Sulphur Dioxide*

The sampling of ambient air for evaluating SO_2 concentrations was performed with a Multiage Sampler, using the vacuum created by the Respirable Dust Sampler for drawing the air samples through the impinges. Air is drawn at a measured and controlled rate of 300 ml/min through a solution of sodium tetra-chloromercurate.

After completion of the sampling, the used absorbing reagent is treated with dilute solutions of sulfamic acid, formaldehyde and pararo saniline hydrochloride. The absorbance of the intensely coloured pararo saniline methyl sulphonic acid is measured and the amount of SO_2 in the sample is computed from graphs prepared with standard solutions. The ambient SO_2 concentrations were computed from the amount of SO_2 collected and the volume of air sampled.

1.4 *Oxides of Nitrogen*

The sampling of ambient air for evaluating NOx concentrations was performed with a Multigas Sampler, using the vacuum created by the Respirable Dust Sampler for drawing the air samples through the impingers. Air is drawn at a measured and controlled rate of about 300 ml/minute through an orifice-tipped impinger containing solutions of sodium hydroxide and sodium arsenite. After completion of the sampling, an aliquot of the used absorbing solution was treated with solutions of H_2O_2, sulphanilamide and NEDA. The nitrite ion present in the impinger was calculated from the absorbance of the resulting solution and from the graphs prepared with standard solutions. The ambient NOx concentrations were computed from the total nitrite ion present in the impinges, overall efficiency of the impinger and the procedure, and the volume of air sampled. A summary of the methodology is given in Table below.

1.5 CARBON MONOXIDE

The Non Destructive Infra Red (NDIR) spectroscopy (IS: 5182, part X, 1976) has been followed using portable detection equipment of range 0-5000 ppm.

Table 1: Procedure for Determining Various Air Quality Parameters

Parameters	Testing Procedure
PM_{10}	Respirable Dust Sampler (RDS)
$PM_{2.5}$	Fine particulate sampler
SO_2	Absorption in Sodium Tetra Chloromercurate followed by Colorimetric estimation using P-Rosaniline hydrochloride and Formaldehyde (IS : 5182 Part. II. 1969)
NO_x	Absorption in dil. NaOH and then estimated calorimetrically with sulphanilamide and N(I-Nepthyle) Ethylene diamine Dihydrochloride and Hydrogen Peroxide (IS:5182 1975, Part VI)
CO	NDIR spectroscopy

2. Water Quality Sampling Methodology

Ground/surface water samples were collected by adopting grab sampling method. The samples were filled into sampling bottles. The Physico-chemical quality of water samples were characterized by adopting the relevant parts of IS:3025, “Standard Methods for Water Analysis” and the methods prescribed under IS:10500.

3. Ambient Noise Level Monitoring Methodology

For measurement of ambient noise level noise monitor (Pulsar 33) was used. The measurements were carried out continuously for the 24-hour period to obtain hourly equivalent sound pressure level. From these values, day and night time as well as 24-hour Leq values were also calculated. The Leq is the equivalent continuous sound level, which is equivalent to the same sound energy as the fluctuating sound measured during observation period.

4. Soil Sampling Methodology

Soil samples were collected from a depth of 0-30 cm. The excavated soil from each location was mixed thoroughly and about 2 kg of mixed sample was collected by ‘Cone & Quartering method'. The sample was packed in a polyethylene bag, sealed and brought to the laboratory.

After drawing sample for moisture content, the remaining samples were air dried for a few days. For chemical characteristics, air-dried samples were ground in an agate mortar with the help of a wooden hammer and passed through a 2-mm (10-mesh) sieve. The coarser materials were rejected and the sieved material was sampled by the standard ‘cone and quartering' method.

Characterization of soil samples was performed by adopting methods prescribed under relevant parts of IS: 2720, “Indian Standard Methods of Test for Soils”.

Annexure 3.2: List of Plant Species in COI

Dag Identity	Local Name of plant	Size	
North Bank			
619	Tamul	S	10
	Bah	L	1
732			
734	Kol	M	25
	Narikol	L	2
756	Tamul	S	17
	Kol	M	25
	Bah	M	1
757			
759	Narikol	L	2
	Mahaneem	M	2
	Aam	S	2
	Nimbu Tenga	S	3
	Pan Gach		4
	Narikol	S	3
	Aam	S	2
	Tamul	L	5
	Dalchini	S	1
	Kol gach	S	25
	Kamala	M	1
	Bah	L	1
760			
761	Kol gach		25
	Bah Gach		2
763	Narikol	L	1
	Aam	M	1
	Tamul	L	3
	Maduri Aam	M	1
	Oi tenga	L	1
	Kol gach	M	15
	Tamul	L	1
	Bel	L	1
764	Sunaru		4
	Tamul	M	2
	Bel	L	1
	Sissoo		3
	Bah gach		1
	Narikol	S	2
	Kaothal	S	1
765			
766			
767			

Dag Identity	Local Name of plant	Size	
866			
867			
868			
871			
873			
874			
875			
876			
878			
879			
880	Jati Bah		1
880	Jati Bah		2
880			
881			
891	Kol gach	L	20
	Narikol	M	2
	Tamul	L	3
907			
908			
975	Tamul	S	17
	Oi gach		
869/1405			
874/1835			
6			
115			
115			
116			
117			
118			
120			
121			
123			
125			
128			
130			
284	Jaluk	M	1
	Phul	M	7
	Maha Neem	M	1
	Dalim	M	1
	Tamul	S	6
	Narikol	S	1
284	Koilgach	L	9
	Amita	L	1
285			
286	Phul	M	5

Dag Identity	Local Name of plant	Size	
	Bel	M	2
	Champa Phul	M	1
287	Amita	L	5
288	Kol gach	L	3
288	Tamul	S	13
	Aam	S	3
	Maduriaam	S	5
	Pan	S	1
	Bilahi	L	1
288	Maduriaam	M	1
	Tamul	L	2
	Bagena	L	2
	Phul	L	25
	Amita	L	4
	Dalim	S	
289	Tamul	L	30
	Tamul	S	15
	Narikol	L	2
	Maduriaan	M	3
	Kol gach	L	20
	Aam	M	3
	Jati bah (1C)	M	25
	Aamlakhi	S	1
	Mahaneem	M	1
	Phul	M	15
290		-	
291		-	
293		-	
294		-	
309		-	
310		-	
322		-	
323		-	
324		-	
330		-	
331		-	
332		-	
333		-	
334		-	
362	Aam	M	2
	Narikol	L	1
	Amita	L	2
105	Aaam	S	2
105	Aam	S	2
	Aam	M	1

Dag Identity	Local Name of plant	Size	
	Tamul	M	1
	Narikol	L	3
	Narikol	S	3
	Amita	L	2
426		-	
433		-	
434		-	
435		-	
486		-	
487		-	
418		-	
518	Kol	L	15
	Dalim	L	1
521		-	
522		-	
523		-	
523	Kol	L	4
	Tamul	L	1
	Tamul	S	4
523	Tamul	S	10
525		-	
528	Tamul	L	2
	Amita	L	1
	Phul	L	2
	Kothal	S	1
	Maduriaam	S	1
	Shawali phul	-	1
530	Tamul	S	
	Narikol	L	1
	Jaba Phul	-	15
	Nimbu tenga	-	2
	Rabab tenga	L	1
	Mousambi	S	1
	Dalim	S	1
	Paniol	S	1
	Kamala	S	1
	Mahaneem	S	1
530	Tamul	L	1
	Amita	L	1
	Maduriaam	S	2
528, 530	Tamul	L	5
	Narikol	L	3
	Maduri aam	L	1
	Tamul	S	4
	Kothal	S	1

Dag Identity	Local Name of plant	Size	
	Pan	L	1
528, 530	Tamul	L	1
	Aam	L	1
	Maduriaam	L	1
	Tamul	L	3
	Jaba Phul	L	3
	Amita	S	5
531		-	
551		-	
553		-	
553, 530, 523	Tamul	L	20
	Tamul	S	100
	Narikol	L	5
	Narikol	S	4
	Kothal	L	1
	Kothal	S	2
	Maduri amm	M	4
	Aam	L	2
	Jamun	S	3
	Nimbu Tenga	S	2
	Jalakia	M	15
	Pan	L	5
	Kol	L	10
	Bagari	M	1
557		-	
558	Tamul	S	5
	Bagari	S	1
	Maduriaam	M	1
	Narikol	S	1
	Kol	S	6
	Narikol	L	2
	Narikol	L	5
	Narikol	S	4
	Kothal	L	1
	Kothal	S	2
	Maduriaam	M	4
	Kordhai	M	1
	Damil	L	1
	Aam	L	2
	Tamul	L	5
	Amita	M	3
	Madhuri aam	M	1
	Pan	M	1
	Rabab tenga	M	1
563		-	

Dag Identity	Local Name of plant	Size	
525/588	Maduriaam	L	1
	Kol	L	10
	Mahaneem	-	1
	Sewaliphul	-	1
	Phul	-	64
	Tamul	L	4
	Tamul	S	7
	Pan	L	1
	Aam	L	1
	Nimbu tenga	-	4
604	Narikol	M	5
	Tamul	S	10
290/617		-	
523/655	Nimbu tenga	L	1
	Amita	L	2
	Tamul	S	4
	Dalim	L	2
	Kol	L	5
	Mahaneem	-	1
	Kothal	S	1
	Bogari	L	1
	Kamala	S	1
	Madhuriaam	S	1
160	Tamul	L	15
	Tamul	S	10
	Narikol	-	4
	Aam	-	1
	Segun	-	12
	Moj	-	1
	Aam	-	1
	Hunaru	-	3
160		-	
160		-	
160		-	
160	Tamul	-	4
	Momai Tamul	-	2
	Modhuri Aam	S	4
	Narikol	S	3
	Kolgoch	-	15
	Aamlokhi	-	1
	Hilikha	L	1
	Hilikha	S	1
160	Moj	-	1
	Tamul	L	10
	Tamul	S	5

Dag Identity	Local Name of plant	Size	
	Kolgoch	-	3
	Jiyagoch	L	3
	Jiyagoch	S	1
160		-	
160	Jiya	-	4
		-	
161		-	
164		-	
164	Aam	-	1
	Kolgoch	L	30
	Kolgoch	S	10
	Modhuri Aam	-	1
	Nimbu	-	2
	Aam	-	1
164	Kolgoch	-	2
	Amita	-	1
164	Segun	-	7
	Tamul	-	2
	Narikol	-	1
164	Segun	L	6
	Segun	S	1
	Kothal	L	1
	Kothal	S	1
164	Segun	S	5
	Hunaru	-	2
	Kolgoch	L	10
	Kolgoch	S	10
164	Segun	S	3
	Moj	S	3
164	Narikol	L	3
	Narikol	S	2
4	segun	-	
4	Moj	-	3
	Jiyagoch	-	2
	Segun	L	10
		S	10
	Neem	-	1
	Gomari	-	2
	Tamul	-	6
	Moj	-	
164	Hunaru	-	1
	Kolgoch	-	12
	Segun	S	4
165		-	
166		-	

Dag Identity	Local Name of plant	Size	
228		-	
228	Himolu	-	1
	Segun	-	2
	Jiya	-	1
	Bah (1C)	-	100
	Moj	-	1
	Gomari	-	1
	Oui Goch	L	1
	Oui Goch	-	1
234		-	
235		-	
236	Segun	-	36
	Jiyagoch	-	1
	Kota Bah (5C)	-	500
237	Segun	s	150
	Hunaru	-	120
	Moj	M	130
330	Segun	L	57
	Aam Goch	-	4
	Gomari	-	1
	Bel	-	4
	Kota Bah	-	7
	Jiya	-	3
	Dimoru	-	1
	Kothal	-	4
	Khejuri	-	4
	Teteli	-	1
	Hunaru	-	6
	Moj	-	1
	Thekera	-	1
	Bel	-	4
	Kothal	-	4
	Teteli	-	1
330	1.Bel	L	4
	Kothal	L	4
	Khejuri	L	4
	Aam Goch	L	4
	Teteli	L	1
330	Segun	L	34
		S	60
	Aam goch	-	1
	Gomari	L	5
	Bel	-	8
	Kota Bah	-	6
	Jiya	-	2

Dag Identity	Local Name of plant	Size	
	Dimoru	-	6
	Kothal	-	3
	Khejuri	-	10
	Hunaru	-	6
	Himolu	-	11
	Bel	-	8
	Kothal	-	3
333		-	
334		-	
365		-	
366		-	
418		-	
419		-	
420		-	
422		-	
423		-	
424		-	
425		-	
569		-	
517		-	
518	Aahot	-	7
	Dimoru	-	5
	Moj	-	12
	Bhelkol	-	100
	Jiya	-	2
	Himolu	-	2
	Udal	-	1
	Poma	-	3
	Hunaru	-	1
519	Moj	-	
	Segun	-	
518, 519	Narikol	-	1
	Kolgoch	L	30
	Kolgoch	S	10
	Pan	-	1
	Tamul	-	10
	Kordoi	-	1
	Modhuri	-	2
	Mewa	-	6
	Khejuri	-	6
	Ougoch	-	3
	Narikol	-	1
	Segun	L	1
	Segun	S	10
	Kolgoch	-	40

Dag Identity	Local Name of plant	Size	
	Pan	-	1
	Tamul	-	10
	Gomari	L	3
	Gomari	S	3
	Kordoi	-	1
	Hunaru	-	1
	Jiya	-	5
	Modhuri	-	2
	Dimoru	-	3
	Moj	-	23
	Mewa	-	1
	Bah bhaluka (1C)	-	4
	Bah Jati	-	1
	Bhelkol	L	52
	Bhelkol	S	50
	Dimoru	S	5
	Khejuri	-	6
	Jori	-	2
	Udal	-	2
	Himolu	L	1
	Himolu	S	1
	Kuroch	-	2
	Poma	-	4
	Aahot	L	3
	Aahot	S	4
	Mewa	-	6
	Ougoch	-	3
561	Hunaru	-	2
	Segun	-	1
	Kourach	-	1
	Moj	-	2
	Tamul	-	1
	Korach	-	3
562	Pan	-	2
	Tamul	-	10
	Segun	-	3
	Kourach	-	5
	Neem	-	1
	Dambru	-	1
	Modhuri	L	1
	Kol	-	2
	Hunaru	-	5
	Neem	-	
564	Sogina	-	1
564	Tamul	-	8

Dag Identity	Local Name of plant	Size	
	Kothal	-	1
	Bel	-	1
	Moj	L	2
		S	4
	Kothal	-	
	Belgoch	-	
	Modhuri	-	1
	Pan	-	2
565		-	
565	Aam	L	1
	Tamul	-	6
567		-	
567	Tamul	-	3
	Pan	L	5
	Pan	S	5
	Kolgoch	-	10
567	Aam Goch	-	3
	Tamul	-	8
	Amora	M	1
	Nimbu	-	1
	Tamul	-	2
567	Kolgoch	-	5
	Nimbu	L	5
	Nimbu	S	5
567	Tamul	-	5
	Narikol	-	2
	Kolgoch	-	5
	Segun	L	4
		S	2
	Himolu	-	1
	Aam	-	4
	Kodam	-	2
		-	
567	Aam	-	4
	Kodom	-	2
	Jiya	-	1
	Himolu	-	1
	Segun	L	4
		S	2
	Debodaru	-	1
	Aahot	-	1
	Bhelkol	L	1
		S	1
	Red chandalwood	S	3
568	Moj	L	2

Dag Identity	Local Name of plant	Size	
		S	4
	Oou	-	
	Bel goch	-	1
	Kothalgoch	-	1
	Tamul	-	
	Kothal	-	
	Modhuri	-	1
	Pan	-	2
567	Nimbu	-	1
	Tamul	-	2
567, 568	Kordoi	-	1
	Aam	L	1
	Aam	S	4
	Narikol	-	5
	Kodom	-	1
569	Tamul	-	3
	Nimbu	-	3
	Modhuri	-	1
569		-	
569		-	
569, 570	Tamul	-	3
	Nimbu	-	3
	Modhuri	S	2
570		-	
570/484	Jati Bah (2C)	-	300
	Moj	-	1
574	Moj	-	8
	Debodaru	-	1
	Narikol	-	2
575	Kolgoch	L	8
	Kolgoch	S	4
	Kolgoch	L	8
	Kolgoch	S	4
577	Aam	-	1
	Tamul	-	1
	Jam	-	1
	Sogini	-	1
	Segun	-	3
	Red Sandalwood	L	1
		S	2
	Aahot	-	1
	Moj	-	2
	Aam	-	1
	Jam	-	1
578	Segun	-	5

Dag Identity	Local Name of plant	Size	
	Neem	-	1
	Gomari	-	1
	Moj	-	2
	Tamul	-	1
		-	
		-	
		-	
579	Segun	-	1
579		-	
579		-	
579	Serun	-	
579		-	
580	Kothal	-	2
	Narikol	-	2
	Ou	-	1
	Sogina	-	1
165		-	
580	Kothal	-	2
	Kothal	S	1
	Ouu	-	1
	Himolu	-	1
	Bhelkol	-	1
	Gomari	-	1
	Korach	-	1
566		-	
2016/574	Gomari	-	2
	Segun	-	7
	Moj	-	3
	Tamul	-	8
	Pan	-	1
	Narikol	-	1
	Kordoil	-	1
238	Kothal	-	1
	Kol	-	7
	Tamul	-	4
	Nimbu	-	2
	Bel	-	1
238	Kol	-	5
	Sogina	-	1
	Kodam	-	1
	Segun	-	3
238	Segun	-	5
Dag No.	Local Name of plant	Size	Numbers/ Cluster
184	Dalim	-	1

Dag Identity	Local Name of plant	Size	
	Tamul	L	4
	Joba Phul	-	3
	Aam	S	1
	Rabab Tenga	-	1
	Amita	-	7
	Hewali Phul	-	1
	Nimbu Tenga	s	3
173	Bel	-	1
	Aam	-	4
	Sirish	-	1
	Jobab Phul	-	5
	Hewali Phul	-	1
	Nimbu Tenga	s	5
	Tamul	L	5
	Tamul	S	4
	Narikol	L	4
	Kol	L	20
	kol	s	20
	Aam	s	2
	Kordoi		1
	Bel		1
	oou Gos		1
	Modhuri Aam	s	4
	Rabab Tenga	S	2
	Nimbu Tenga		5
	Khajuri	L	7
	Bah (1C)	L	40
	Bah (1C)	S	10
	Jiya		1
	Aam		1
173	Segun		2
	Kadam		1
	Kothal		1
	Aam		2
	Jam		1
	Neem		2
	Korash		2
	Shrish		1
	Jiya		1
	Jati Bah (4C)		400
	Nimbu Tenga	L	
	Amita		1
	Tamul	L	15

Dag Identity	Local Name of plant	Size	
	Tamul	S	10
	Narikol	L	1
	Aam	L	2
	Aam	L	2
	Kothal	L	1
	Modhuri Aam	L	2
	Neem Tree		2
	Jam	L	1
	Bah (1C)	L	140
	Bah (1C)	S	20
	Kol		60
	Narahingho		1
	Plam	L	1
	Jaba Phul		3
	Korash		2
	Jiya		1
	Sirish		1
	Korash		3
175	Narikol	L	5
	Tamul	L	5
	Aam	L	1
	Kol		7
175	Modhuri Aam	S	1
	Aam	S	1
	Narahingho		1
	Jaba Phul		3
176			
181			
182			
183			
184	Kol		4
185	Neem		
	Tamul	L	4
	Aam	S	1
	Neem		1
	Kol		10
	Nambu		2
	Kathanda Phul		3
	Jaba Phul		1
186			
186, 187	Tamul	S	8
186, 187			
	Jam		1

Dag Identity	Local Name of plant	Size	
	Kol		10
	Amita		5
	Tamul	L	11
	Narikol	L	4
	Narikol	S	2
	Aam	L	2
	Bagari		1
	Maduri Aam		1
	Maha Neem		3
	Kothal		1
	Shawali Phul		2
187			
188			
188	Siris		4
188	Maduri Aam		1
0	Karash		
0	Siris		
0	Karash		
0	Siris		
189			
190	Dimru	S	
190	Siris	S	
193	Amita	L	1
193	Aam	S	1
0	Tamul	L	10
0	Tamul	S	30
194			
194	Siris		3
194	Sagun	S	9
195			
196	Kothal	S	1
196	Kol		25
196	Tamul	L	5
196	Tamul	S	20
196	Amita		3
196	Sajana		1
196	Kol (Jahaji)		20
196	Kol (Malbhug)		5
196	Maduri Aam		1
196	Jaba Phul		5
197	Oui Gash		1
197	Saghun	S	1
197	Siris	S	1

Dag Identity	Local Name of plant	Size	
197	Bijuli Bah (3C)		150
197	Tamul	L	8
197	Oui Tenga		1
197	Sajana		1
197	Narikal	L	1
197	Kothal		1
197	Bah (1C)		150
197	Nimbu		3
197	Kamala		1
197	Narikal		2
197	Tamul	L	8
197	Maduri Aam		1
197	Aam	L	1
197	Kol		50
198	Karash		
	Gamari		
198	Karash		
	Gamari		
198	Siris	L	2
	Siris	S	1
	Sagun		9
0	Siris		1
0	Kadam	S	
0	Siris		3
198			
200			
201			
206			
206	Maduri Aam	S	1
207			
207	Sagun	S	2
	Gamari	S	1
	Devdaru	S	1
207	Devdaru		2
207	Narikal	S	10
	Tamul	S	13
	Maduri Aam		5
	Aam	S	
	Kol		10
	Nimbu		2
207, 209			
207, 210	Narikal	S	27
207, 210	Amita	L	2
	Maduri Aam		1
	Kol		15

Dag Identity	Local Name of plant	Size	
	Tamul (Small)		10
	Aam	S	1
	Neem		1
	Aamlakhi		1
	Silikha		1
0	Siris		1
210			
218			
219			
218, 219	Barun	M	1
	Devdaru	S	4
	Baghnala	S	1
	Amita	L	3
	Nimbu	L	2
	Kamala	S	1
0	Siris		2
	Karash		1
	Arjun		1
0	Devdaru	M	12
	Siris		4
	Aahot		1
	Neem		1
	Momai Tamul		4
	Baghnala	M	2
	Aam	S	3
	Neem		1
	Hewali		1
	Narikol	L	4
		S	2
	Modhuri Aam		3
	Bogori	L	1
	Talgoch		2
	Dalim		1
0	Korash		1
	Arjun		1
	Korash		1
220	Siris		1
	Korash		2
	Krishnasura		1
	Tamul	L	2
220	Korash		2
220	Tamul	L	2
221			
222			
223	Aahot		1

Dag Identity	Local Name of plant	Size	
224			
225			
226			
227	Korash		3
227	Aam		2
	Korash		4
	Tamul	L	10
	Narikol	L	1
	Aam	L	2
	Modhuriaam	L	1
	Nimbu goch		4
227	Narikol	L	2
	Tamul	L	2
	Modhuriaam		1
	Robab Tenga		1
227	Narikol	L	1
	Tamul	L	3
	Modhuriaam		1
	Jobabphul		1
	Kol		10
231	Bah (1C)	L	180
	Bah (1C)	S	20
231	Kol		5
	Tamul	L	1
231	Kol		5
232			
233			
234			
235			
236			
249			
250			
254			
256			
259			
287			
288	Aahot		2
	Siris		1
	Jiya		3
314	Korash		1
	Devdaru		1
	Aahot		1
314	Kol	L	30
	Kol	S	20
	Tamul	L	5

Dag Identity	Local Name of plant	Size	
	Narikol	L	2
	Narikol	M	3
	Kothal	L	1
	Aamlokhi	S	1
	Tezpat		1
	Nimbu		2
	Mousambi	S	1
	Lechu	S	1
	Aam	S	2
	Sogena		1
314	Kothal	L	1
	Tamul	L	20
	Tamul	S	5
	Mohaneem		2
	Bogori	L	1
	Kol		5
	Modhuri Aam		3
315	Aahot		9
	Siris		5
	Modar		2
286, 286	Sagun	M	30
	Neem		10
	Aahot		2
	Gomari		1
	Devdaru		8
	Moha Neem		10
	Sogina	L	1
	Tamul	S	30
	Aomita		2
286			
288			
0			
0			
314			
0			
316			
317			
318			
319			
321			
356			5
932			
933			
934			

Dag Identity	Local Name of plant	Size	
935			
937			
938			
939	Korash		20
	Aahot		2
	Himolu		1
	Moj		2
	Ajar		1
941			
942			
943			
945			
946			
947/1212			
957			
967			
968			
969			
970	Moj		1
	Jati Bah		3
971			
972			
983			
984			
985			
986			
992	Segun		6
	Gomari		1
	Neem		1
	Kol	L	15
	Aam	L	1
	Aam	S	5
	Narikol	L	3
	Narikol	M	4
	Nimbu	L	2
	Tamul	L	5
		S	3
	Pan	L	4
	Neem	L	1
0	Narikol	L	4
		S	2
	Tamul	L	7
		S	2
	Aam	L	1

Dag Identity	Local Name of plant	Size	
	Aam	S	2
	Kol		8
	Modhuri Aam		1
993			
993	Kol	L	5
994	Aam		1
994	Moj		2
	Sisu		1
	Segun		1
	Siris		1
	Jati Bah		1
	Narikol	L	3
	Tamul	L	5
		M	3
	Pan		4
	Kol	L	
970	Bah (1C)	L	100
	Bah (1C)	S	60
	Khejuri		3
970	Khejuri		2
0	Moj		2
	Modar		1
	Gomari		1
	Jiya		1
1001	Sagun		1
	Hunaru		1
	Jiya		3
	Jati Bah (3C)		300
	Bah (1C)	L	40
	Bah (1 C)	S	20
	Khejur		3
0	Kaitiya bah (1C)		100
1002			
1007			
0			
1008			
1009	Sagun		2
0	Tamul	L	20
	Narikol	L	3

Dag Identity	Local Name of plant	Size	
	Aam	L	3
	Robab Tenga	L	1
	Kordoi		1
	Kol	L	30
	Pan	L	3
	Nimbu	L	1
	Tamul	M	20
	Tamul	S	12
1009	Sagun		10
	Krishnasura		2
	Gomari		1
	Jati Bah (5C)		500
	Tamul	L	12
	Tamul	S	8
	Narikol	L	6
	Narikol	S	4
	Modhuri Aam	L	3
	Aam	M	1
	Kol		10
	Aamlokhi		1
	Nimbu Tenga		1
	Mohaneem	M	1
	Jobaphul		5
0			
0			
0			
0			
0			
1009	Devdaru	S	
	Kol	L	5
	Kaminikanchan	S	1
1018			
1038			
1160			
1187			
220/1160	Aam		6
	Mojolia		18
	Jam		1
	Tamul	L	8
	Narikol	S	3
	Aam	L	4
	Aam	S	3
	Modhuri aam		10
	Pan		2

Dag Identity	Local Name of plant	Size	
	Nimbu		3
	Jam		1
	Aam	S	8
	Amita		3
	Jabaphul		3
	Gulabphul		1
0	Moha neem		2
	Kol		4
	Aam	L	1
	Kordoi		1
	Pan	L	2
	Tamul	L	2
	Narikol		2
946/1210			
947/1211			
207/1237			
2018/1240			
182/1241			
210/1251			
207/1252			
237/1260			
197/1274	Tamul	L	1
197/1278	Korash		2
	Bhelkol		1
	Bijuli		1
	Aam	L	1
	Bijuli Bah (1C)		50
	Amita		2
215/1286			
Sorth Bank			
Survey Office	Papaya	L	3
	Coconut	L	4
	Mango	L	3
	Areca nut	L	4
	Guava	L	1
	Jackfruit	L	1

Dag Identity	Local Name of plant	Size	
	Tezpat	L	1
	Kol	L	1
	Black Berry	L	1
	Neem	L	1
	Aam	L	1
	Neem	M	1
	Jam	L	1
	Rainpu	L	1
	Ahot	L	1
	Eucaliptus	L	1
	Kadam	L	1
	Ahot	L	1
	K Sura	L	1
Shankardev Udyan	Kadam	L	1
River side	Kadam	L	1
	Ahot	L	1
	Ahot	M	1
	Kadam	L	1
	Kadam	M	1
	Bhooj	M	1
	Dimaru	M	1
	Pakori	M	1
	Kadam	M	1
	Kadam	M	1
	K Sura	M	1
	Bhooj	M	1
	Ghoraneem	L	1
	Pakori	L	1
	Ghoraneem	M	1
	Kadam	L	1
	Sissu	L	1
	Sissu	M	1
	Sissu	M	1
	sissu	M	1
	Sissu	M	1
	Sissu	M	1
	Sissu	M	1
	Sissu	M	1
	Sissu	M	1
	Sissu	L	1
	Sissu	M	1
	Simal	L	1
	Kadam	L	1
	Kadam	L	1
Shankardev Udyan	Simal	L	1

Dag Identity	Local Name of plant	Size	
Road Side	Sissu	L	1
	Sissu	L	1
	Gomari	L	1
	Gomari	M	1
	Sissu	M	1
	Sissu	L	1
	Sissu	L	1
	Sissu	L	1
	Gomari	L	1
	Sissu	L	1
	Pakori	L	1
	Gomari	M	1
	Gomari	L	1
	Sissu	L	1
	Pine	M	1
	Pakori	L	1
	Pakori	L	1
	Pakori	L	1
	Neem	M	1
	Aam	M	1
	Pakori	L	1
	Pakori	L	1
	K Sura	L	1
	Sissu	L	1
	Neem	M	1
	Bhooj	M	1
	Pakori	L	1
	Bhooj	M	1
	Ahot	M	1
Survey Office	Debadaru	M	1
River side	Sissu	L	1
shankardev Udyan road side	Sissu	L	1
	Sissu	L	1
	Sissu	L	1
	Sissu	L	1
	Sissu	L	1
	Ahot	L	1
	Ahot	M	1
	Bhooj	M	1
	Sissu	L	1
	Bhooj	L	1
	Kadam	L	1
	Sissu	L	1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ANNEXURE 4.1: DETAILS OF UTILITY SHIFTING

North Guwahati

SL. No.	DESIGN CHAINAGE		ELECTRICAL POLE (EP)		TRANSFORMER (TF)		TELEPHONE POLE (TP)		OPTICAL FIBRE CABLE (OFC)		WATER TAP HAND PUMP	
	FROM	TO	LHS	RHS	LHS	RHS	LHS	RHS	LHS	RHS	LHS	RHS
1	0+000	1+000	0	0	0	0	0	0	0	0	0	0
2	1+000	2+000	3	0	0	0	2	0	0	0	0	0
3	2+000	3+000	5	3	0	0	0	1	0	0	0	0
4	3+000	4+000	3	2	0	1	0	0	0	0	0	0
5	4+000	5+000	46	44	1	2	0	0	2	2	1	0
6	5+000	6+000	58	11	8	2	0	0	5	1	0	0
7	6+000	7+000	36	1	2	0	0	0	5	0	0	0
	TOTAL		**151**	**61**	**11**	**5**	**2**	**1**	**12**	**3**	**1**	**0**

South Bank Road

SL. No.	DESIGN CHAINAGE		ELECTRICAL POLE (EP)		TRANSFARMER (TF)		TELEPHONE POLE (TP)		OPTICAL FIBRE CABLE (OFC)		WATER TAP HAND PUMP	
	FROM	TO	LHS	RHS	LHS	RHS	LHS	RHS	LHS	RHS	LHS	RHS
1	-1+150.5	0+000	1	0	0	0	0	0	0	0	0	0
2	0+000	1+000	0	2	0	0	0	0	0	0	0	0
3	1+000	1+247.897	0	0	0	0	0	0	0	0	0	0
	TOTAL		1	2	0	0	0	0	0	0	0	0

ANNEXURE 4.2: GUIDELINES FOR DEBRIS DISPOSAL SITE AND MANAGEMENT

The debris disposal shall be carried out with following Construction and Demolition Waste Management Rules, 2016. The waste generator (Concessionaire) shall prime prima-facie be responsible for collection, segregation of concrete, soil and others and storage of construction and demolition waste generated, as directed or notified by the concerned local authority in consonance with these rules. The generator shall ensure that other waste (such as solid waste) does not get mixed with this waste and is stored and disposed separately. Furthermore. the Waste Generator (Concessionaire) must follow the C&D Waste Management Rules, 2016 to carry out any activities related to demolition of structure falls under this project.

Based on quantification of waste (more than 20 TPD or 300 Tonnes Per Project/month) the waste generator shall be responsible for collection and their processing. The generator will pay the fixed amount for these services to ULB/Third party.

If the waste generator is proposing to establish storage, processing or recycling facilities for construction and demolition waste and application of construction and demolition waste and its products then: -

The site for storage and processing or recycling facilities for construction and demolition waste shall be selected as per the criteria given in Schedule I of C&D Waste Management Rules, 2016 which states that: -

(1). The concerned department in the State Government dealing with land shall be responsible for providing suitable sites for setting up of the storage, processing and recycling facilities for construction and demolition and hand over the sites to the concerned local authority for development, operation and maintenance, which shall ultimately be given to the operators by Competent Authority and wherever above Authority is not available, shall lie with the concerned local authority.

(2). The Local authority shall co-ordinate (in consultation with Department of Urban Development of the State or the Union territory) with the concerned organizations for giving necessary approvals and clearances to the operators.

(3). Construction and demolition waste shall be utilized in sanitary landfill for municipal solid waste of the city or region as mentioned at Schedule I of thse rule. Residues from construction and demolition waste processing or recycling industries shall be land filled in the sanitary landfill for solid waste.

(4). The processing or recycling shall be large enough to last for 20-25 years (project based on-site recycling facilities).

(5). The processing or recycling site shall be away from habitation clusters, forest areas, water bodies, monuments, National Parks, Wetlands and places of important cultural, historical or religious interest.

(6). A buffer zone of no development shall be maintained around solid waste processing and disposal facility, exceeding five Tonnes per day of installed capacity. This will be maintained within the total area of the solid waste processing and disposal facility. The buffer zone shall be prescribed on case to case basis by the local authority in consultation with concerned State Pollution Control Board.

(7). Processing or recycling site shall be fenced or hedged and provided with proper gate to monitor incoming vehicles or other modes of transportation.

(8). The approach and or internal roads shall be concreted or paved so as to avoid generation of dust particles due to vehicular movement and shall be so designed to ensure free movement of vehicles and other machinery.

(9). Provisions of weigh bridge to measure quantity of waste brought at landfill site, fire protection equipment and other facilities as may be required shall be provided.

(10). Utilities such as drinking water and sanitary facilities (preferably washing/bathing facilities for workers) and lighting arrangements for easy landfill operations during night hours shall be provided and Safety provisions including health inspections of workers at landfill sites shall be carried out made.

(11). In order to prevent pollution from processing or recycling operations, the following provisions shall be made, namely:

a) Provision of storm water drains to prevent stagnation of surface water;
b) Provision of paved or concreted surface in selected areas in the processing or recycling facility for minimizing dust and damage to the site.
c) Prevention of noise pollution from processing and recycling plant:
d) Provision for treatment of effluent if any, to meet the discharge norms as per Environment (Protection) Rules, 1986.

(12). Work Zone air quality at the Processing or Recycling site and ambient air quality at the vicinity shall be monitored.

(13). The measurement of ambient noise shall be done at the interface of the facility with the surrounding area, i.e., at plant boundary.

(14). The following projects shall be exempted from the norms of pollution from dust and noise as mentioned above:

For construction work, where at least 80 percent construction and demolition waste is recycled or reused in-situ and sufficient buffer area is available to protect the surrounding habitation from any adverse impact.

(15). A vegetative boundary shall be made around Processing or Recycling plant or site to strengthen the buffer zone.

Further, the duties of local authority shall ensure to give appropriate incentive to generator for salvaging, processing and or recycling preferable insitu while BIS and IRC shall be responsible for preparation of code of practices and standards for use of recycled materials and products of construction and demolition waste in respect of construction activities and the role of Indian Road Congress shall be specific to the standards and practices pertaining to construction of roads.

In the absence of any C&D Waste Processing unit in nearby area and waste generator is not adopting in-situ processing, the location of Disposal sites has to be selected such that:

- Productive land to be avoided and available wasteland to be given preference.
- Disposal sites to be located at least 1000m away from sensitive locations like Settlements, Water body, notified forest areas, Sanctuaries or any other sensitive locations.
- Should be located in the downwind side of nearest settlement locations.
- Disposal sites do not contaminate any water sources, rivers etc. for this, site should be located away from water body, and disposal site should be lined properly to prevent infiltration of water.
- Public perception about the location of debris disposal site has to be obtained before finalizing the location.
- Permission from the Villager/local community is to be obtained in writing by contractor for finalizing the disposal site identified.
- The Plan must be approved by EO/Supervision Consultant/GMDA and NDB.

Precautions to be adopted during disposal of debris & Waste Material

The contractor shall take the following precautions while disposing off the waste material:

- During the site clearance and disposal of debris, the contractor will take full care to ensure that public or private properties are not damaged/ affected, there is no dwellings below the dumpsite and that the traffic is not interrupted.
- Contractor will dispose off debris only to the identified places or at other places only with prior permission of Engineer/EO.
- In the event of any spoil or debris from the sites being deposited on any adjacent land, the contractor will immediately remove all such spoil debris and restore the affected area to its original state to the satisfaction of the Engineer/EO.
- The contractor will at all times ensure that the entire existing drains within and adjacent to the site are kept safe and free from any debris.
- The contractor will utilize effective water sprays during the delivery and handling of materials when dust is likely to be created and to dampen stored materials during dry and windy weather.

- Materials having the potential to produce dust will not the loaded to a level higher than the side and tail boards and will be covered with a tarpaulin in good condition.
- Care will always be taken to maintain the hydrological flow in the area.

Rehabilitation of Disposal Sites

- The dumpsites filled only up to the ground level could be rehabilitated as per guidelines below and to be decided by the engineer and the supervision consultant:
- The dumpsites have to be suitably rehabilitated by planting local species of shrubs and other plants. Local species of trees has also to be planted so that the landscape is coherent and is in harmony with its various components.
- In cases where a dumpsite is near to the local village community settlements, it could be converted into a play field by spreading the dump material evenly on the ground, if possible. Such playground could be made coherent with the landscape by planting trees all along the periphery of the playground.
- Material excavated for foundation of bridge works should not be dumped in the water course; if same has to be refilled then precaution has to be taken so that the excavated material should not be carried away by flowing/rainy water, thereby silting the water course.
- Care should always be taken to maintain the hydrological/drainage flow in the area.

ANNEXURE 4.3: GUIDELINES FOR SITE CLEARANCE AND TREE FELLING

1. Vegetation Clearance

Vegetation clearance shall comprise uprooting of vegetation, grass, brushwood, shrubs, stumps, trees and saplings of girth up to 30 cm. measured at a height of 1.37 meter at breast level. Where only clearance of grass is involved it shall be measured and paid for separately. The procedure/ steps involved for uprooting, skating and felling trees are described below.

1.1 Uprooting of Vegetation

- The roots of trees and saplings shall be removed to a depth of 60 cm. below ground level or 30 cm. below formation level or 15 cm below sub grade level, whichever is lower.
- All holes or hollows formed due to removal of roots shall be filled up with earth rammed and leveled.
- Trees, shrubs, poles, fences, signs, monuments, pipe lines, cables etc. within or adjacent to the area, which are not required to be disturbed during vegetation clearance shall be properly protected by the contract\or at his own cost.

1.2 Staking & Disposal

- All useful materials obtained from clearing and grubbing operation shall be staked in the manner as directed by the Engineer.
- Trunks and branches of trees shall be cleared of limbs and tops stacked properly at the places indicated by the Engineer- in – charge. These materials shall be the property of the Government.
- All unserviceable materials are disposed off in such a manner that there is no livelihood of getting mixed up with the materials meant for construction.

1.3 Tree Felling

- ***Marking of Trees*****:** Trees above 30 cm. Girth (measured at a height of 1.37 meter at breast level.) to be cut, shall be approved by the Engineer-in-charge and then marked at the site.
- ***Felling of trees*****:** Felling of trees shall include taking out roots up to 60 cm. below ground level or 30 cm. below formation level or 15 cm. below sub-grade level, whichever is lower.
- ***Filling:*** All excavations below general ground level arising out of removal of trees, stumps etc. shall be filled with suitable material in 20 cm. layers and compacted thoroughly so that the surface at these points conforms to the surrounding area.
- ***Sizing:*** The trunks and branches of trees shall be cleared of limbs and tops and cut into suitable pieces as directed by the Engineer-in-charge.
- ***Staking:*** The serviceable materials shall be staked in the manner as directed by the Environmental specialist of Supervision Consultants/Engineer-in-charge.
- ***Disposal:*** The material, which cannot be used or auctioned shall be removed from the area and disposed off as per the directions of the Engineer-in-charge. Unsuitable waste materials should not get mixed with construction material during disposal.

ANNEXURE 4.4: GUIDELINES FOR SITE CLEARANCE AND TREE FELLING

1. Vegetation Clearance

Vegetation clearance shall comprise uprooting of vegetation, grass, brushwood, shrubs, stumps, trees and saplings of girth up to 30 cm. measured at a height of 1.37 meter at breast level. Where only clearance of grass is involved it shall be measured and paid for separately. The procedure/ steps involved for uprooting, skating and felling trees are described below.

1.1 Uprooting of Vegetation

- The roots of trees and saplings shall be removed to a depth of 60 cm. below ground level or 30 cm. below formation level or 15 cm below sub grade level, whichever is lower.
- All holes or hollows formed due to removal of roots shall be filled up with earth rammed and leveled.
- Trees, shrubs, poles, fences, signs, monuments, pipe lines, cables etc. within or adjacent to the area, which are not required to be disturbed during vegetation clearance shall be properly protected by the contract\or at his own cost.

1.2 Staking & Disposal

- All useful materials obtained from clearing and grubbing operation shall be staked in the manner as directed by the Engineer.
- Trunks and branches of trees shall be cleared of limbs and tops stacked properly at the places indicated by the Engineer- in – charge. These materials shall be the property of the Government.
- All unserviceable materials are disposed off in such a manner that there is no livelihood of getting mixed up with the materials meant for construction.

1.3 Tree Felling

- ***Marking of Trees*****:** Trees above 30 cm. Girth (measured at a height of 1.37 meter at breast level.) to be cut, shall be approved by the Engineer-in-charge and then marked at the site.
- ***Felling of trees*****:** Felling of trees shall include taking out roots up to 60 cm. below ground level or 30 cm. below formation level or 15 cm. below sub-grade level, whichever is lower.
- ***Filling:*** All excavations below general ground level arising out of removal of trees, stumps etc. shall be filled with suitable material in 20 cm. layers and compacted thoroughly so that the surface at these points conforms to the surrounding area.
- ***Sizing:*** The trunks and branches of trees shall be cleared of limbs and tops and cut into suitable pieces as directed by the Engineer-in-charge.
- ***Staking:*** The serviceable materials shall be staked in the manner as directed by the Environmental specialist of Supervision Consultants/Engineer-in-charge.
- ***Disposal:*** The material, which cannot be used or auctioned shall be removed from the area and disposed off as per the directions of the Engineer-in-charge. Unsuitable waste materials should not get mixed with construction material during disposal.

ANNEXURE 4.5: GUIDELINES FOR NEW QUARRY MANAGEMENT

1. Management Plan for New Quarry

The concessionaire shall prepare a quarry management plan for operation of new quarries and submit it to the IE for approval and necessary actions. The plan shall consist of the following:

1.1 *Selection Details*

1.1.1 *Location and Layout*

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

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

1.1.2 *Selection Criteria*

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

1.1.3 *Agreement with landowners*

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

1.1.4 *Licenses and permits*

Concessionaire shall state the licences and permits that are necessary for operation, and attach them as appropriate. The environmental clearance from DEIAA is required, if applicable.

1.2 Operation

1.2.1 *Method of extraction*

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

1.2.2 *Loading and haulage*

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

1.2.3 *Crusher Plant*

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

1.2.4 *Storage of explosives*

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

1.2.5 *Products*

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

1.2.6 *Testing and quality assurance*

- Refer quality assurance plan of concessionaire if any.

If not, concessionaire to provide details of sampling frequency, who takes the does the testing, which standards are to be complied with, and any further Concessionaire to indicate the operations that shall need water, and its source (an indication on the sketch map will suffice).

1.2.7 *Safety*

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

1.2.8 *Workers Accommodation*

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

1.2.9 *Environmental Management*

Environmental Management during Operation

1.2.10 *Removal of trees and plants*

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

1.2.11 *Overburden*

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

1.2.12 *Silt management*

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

1.2.13 *Surface water drainage*

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

1.2.14 *Soil and water contamination*

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

1.2.15 *Air pollution*

- What are the sources of air pollution?

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

1.2.16 ***Noise***

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

1.2.17 ***Traffic***

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

1.2.18 ***Approach road***

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

1.3 Environmental Management at Closure of the site

1.3.1 ***Dismantling and removal of machinery***

Concessionaire to state whether and when this shall be done.

1.3.2 ***Slope stabilisation and / or protection***

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

1.3.3 ***Rehabilitation***

- Rehabilitation plan of the quarry.
- The concessionaire shall be responsible for the Redevelopment Plan prior to completion after five years, during the defect liability period. The IC and the Works Department (World Bank Projects) shall be responsible for reviewing this case of redevelopment prior to the issuing the defect liability certificate.

1.3.4 ***Hand-over***

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

1.3.5 ***Removal of debris and solid waste***

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

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

Sl. No.	Item	Unit	Details	*Remarks by IC, if any*
1.	Name / identity of the location			
2.	Nearest project road Chainage.			
3.	Name of the owner			
4.	Area involved	m^2		
5.	Existing land use (verification from land records with revenue department)			
6.	Land use of the area surrounding the proposed site including a map			
7.	Access roads – existing conditions, proposed development and maintenance			

8.	Tree cutting and vegetation clearance if any, along with compensation measures	Nos.		
9.	Arrangement with the owner (agreement with land owner should be attached as an Annexure)			
10.	Quantity of material to be withdrawn vis-a-vis the material available	Cum		
11.	Particular areas to be quarried should be clearly identified			
12.	Machinery & equipment to be used			
13.	Drainage plans			
14.	Top soil management			
15.	Description of the operating practices to be adopted.			
16.	Health facilities			
17.	Safety provisions made including fire protection systems and the availability of different personal protective equipment			
18.	Monitoring plans for air, noise and water quality			
19.	Copy of the consents to establish and operate should be attached as an Annexure.			
20.	Copy of the license from Mining & Geology, Police & Fire dept.			
21.	Conditions laid down in the clearances / licenses and plans to ensure compliance			
22.	Information on whether or not the quarry will be closed under this project. If yes, the proposed closure & restoration plan.			
23.	Concerns of the local people living in the immediate / near vicinity should be identified and appropriates measures should be reflected			
24.	Photograph of the quarry prior to commencing operations.			
25.	*Sketch of the layout of the quarry*			

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

Submitted **Checked & Approved**

Signature Signature

Name Name

Designation Designation

Concessionaire Independent Engineer

ANNEXURE 4.6: GUIDELINES FOR EXISTING QUARRY MANAGEMENT

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

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

Construction Stage

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

i) Adequate drainage system shall be provided to prevent the flooding of the excavated area

ii) At the stockpiling locations, the Concessionaire shall construct sediment barriers to prevent the erosion of excavated material due to runoff

iii) Construction of offices, laboratory, workshop and rest places shall be done in the up-wind of the plant to minimize the adverse impact due to dust and noise.

i) The access road to the plant shall be constructed taking into consideration location of units and also slope of the ground to regulate the vehicle movement within the plant.

iv) In case of storage of blasting material, all precautions shall be taken as per The Explosive Rules, 1983.

Quarry Operations Including Safety

i) Overburden shall be removed and disposed in line with Guidelines for Debris Disposal Site and management giving in Annexure- 9.1

Sl. No.	Item	Unit	Details	*Remarks by IE, if any*
1.	Name / identity of the location			
2.	Nearest project road Chainage.			
3.	Name of the owner			
4.	Area involved			
5.	Arrangement with the owner (agreement with the third party / contractor should be attached as an Annexure and should necessarily require the adaptation of good quarry management practices - a description of the requirements should be included)	Cum		
6.	Quantity of material to be withdrawn vis-à-vis the material available			
8.	Machinery & equipment to be used	Cum		
9.	Drainage plans			

Sl. No.	Item	Unit	Details	*Remarks by IE, if any*
10.	Top soil management			
11.	Description of the operating practices			
12.	Health facilities			
13.	Safety provisions made including fire protection systems and the availability of different personal protective equipment			
14.	Copy of the consents to operate from PCB, licences from Mining & Geology, Police & Fire dept should be attached as an Annexure.			
15.	Conditions laid down in the clearances / licenses and plans to ensure compliance			
16.	Monitoring plans for air quality			
17.	Information on whether or not the quarry will be closed under this project. If yes, the proposed closure & restoration plan.			
18.	Photograph of the quarry prior to commencing operations.			
19.	*Sketch of the layout of the quarry*			

ii) During excavation, slopes shall be flatter than 20 degrees to prevent their sliding. In cases where quarry strata are good and where chances of sliding are less this restriction can be ignored.

iii) In case of blasting, procedure and safety measures shall be taken as per The Explosive Rules, 1983

iv) The contractor shall ensure that all workers related safety measures shall be dune as per guidelines for Workers and Safety.

v) The Concessionaire shall ensure maintenance of crushers regularly as per manufacturer's recommendation.

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

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

Post Construction Stage

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

For existing quarry managed directly by a third party / contractor from whom the concessionaire is

sourcing the materials, the plan should contain the following:

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

REMARKS

Submitted	**Checked**	**Approved**
Signature	Signature	Signature
Name	Name	Name
Designation	Designation	Designation
Contractor	Concessionaire	Independent Engineer

ANNEXURE 4.7: GUIDELINES FOR SITING, OPERATION & REDEVELOPMENT OF BORROW AREAS

(A) Siting

Specific locations of borrow areas to be used will be identified by contractor based on the recommendations of the EIA report. In case the contractor or the concessionaire wants to open any new borrow areas other than mentioned in this report, and then the selection and recommendations for borrow areas will be based on environmental as well as civil engineering considerations. Location of source of supply of material for embankment or sub-grade and the procedure for excavation or transport of material shall be in compliance with the environmental requirements of the MoEF&CC, State Road Development Authorities and as specified in IRC: 10-1961.

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

(B) Operation

To avoid any embankment slippage, the borrow areas will not be dug continuously, and the size and shape of borrow pits will be decided by the Engineer. Redevelopment of the borrow areas to mitigate the impacts will be the responsibility of the contractor. The contractor shall evolve site-specific redevelopment plans for each borrows area location, which shall be implemented after the approval of the IE.

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

Non-Cultivable Lands: Borrowing of earth will be carried out up to a depth of 2.0 m from the existing ground level. Borrowing of earth shall not be done continuously. Ridges of not less than 8m width shall be left at intervals not exceeding 300 m. Small drains shall be cut through the ridges, if necessary, to facilitate drainage. Borrow pits shall have slopes not steeper than 1 vertical in 4 horizontal.

Productive Lands: Borrowing of earth shall be avoided on productive lands. However, in the event of borrowing from productive lands, under circumstances as described above, topsoil shall be preserved in stockpiles. The conservation of topsoil shall be carried out as described in section of this chapter. 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.

Elevated Lands: At locations where private owners desire their fields to be levelled, the borrowing shall be done to a depth of not more than 2 m or up to the level of surrounding fields.

Borrow pits along Roadside: Borrow pits shall be located 5m away from the toe of the

embankment. Depth of the pit should be such that the bottom of the pit shall not fall within an imaginary line of slope 1 vertical to 4 horizontal projected from the edge of the final section of the bank. Borrow pits should not be dug continuously. Ridges of not less than 8 m width should be left at intervals not exceeding 300 m. Small drains should be cut through the ridges to facilitate drainage.

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.

Community / Private Ponds: Borrowing can be carried out at locations, where the private owners (or in some cases, the community) desire to develop lands (mostly low-lying areas) for pisciculture purposes and for use as fishponds.

Borrow Areas near Settlements: Borrow pit location shall be located at least 0.8 km from villages and settlements. If unavoidable, they should not be dug for more than 30 cm and should be drained.

Table 1: Probable Borrow Area along the Project Corridor

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

(C) Criteria for Evaluation of Borrow Areas

i. Existing land use (Agricultural / Barren / Scrub / grazing / any other type)

ii. Vegetation / trees to be removed

iii. Erosion/degradation potential

iv. Distance and name of the nearest settlement

v. Distance from the nearest surface water body

vi. Drainage pattern of the area

vii. Distance of the nearest Reserve Forest (if any)

viii. Distance of the nearest Sacred Tree (if any)

ix. Distance from the nearest school / hospital / primary health centre

x. Daily / Occasional use of borrow area by the community

xi. Any schemes or avenues for generation of income for adjoining community

(D) Documentation of Borrow Pit

Following checklist provides guidelines in order to ensure that redevelopment of borrow areas must comply with MoRT&H, Clause 305.2.2.2 and EMP Requirement. The contractor must ensure that following data based must be documented for each identified borrow areas that provide the basis of the redevelopment plan.

- Chainage along with offset distance
- Area (in Sq m)
- Type of Access/ width/ katchha/ pakka etc. from carriageway
- Soil Type
- Slope / Drainage Characteristics
- Water Table of the area or identify from nearest well etc/ask people
- Existing Land-use such as barren/agricultural/grazing land
- Location/Name/Population of Nearest Settlement/Community & distance from Borrow Area/Type and characteristics of settlement
- Daily / occasional use of the Borrow Area by the community, if any
- Identification of any other community facility in the vicinity of the borrow pit

(E) Guidelines for Stripping, Stocking, Preservation of Top Soil

During the excavation of the borrowing material contractor must ensure that the topsoil from all areas of cutting and all areas to be permanently covered shall be stripped to a specified depth of 150mm and stored in stockpiles. At least 10% of the temporarily acquired area shall be earmarked for storing topsoil. The stockpile shall be designed such that the slope does not exceed 1:2 (vertical to horizontal), and the height of the pile is restricted to 2m. Stockpiled will not be surcharged or otherwise loaded and multiple handing will be kept to a minimum to ensure that no compaction will occur. The stockpiles shall be covered with gunny bags or tarpaulin.

It shall be ensured by the contractor that the topsoil will not be unnecessarily trafficked either before stripping or when in stockpiles. Stockpiled topsoil will be returned to cover the disturbed area and cut slopes. Residual topsoil will be distributed on adjoining/proximate barren/rocky areas as identified by the Engineer in a layer of thickness of 75mm-150mm. Top soil shall also be utilized for redevelopment of borrow areas. Landscaping along slopes, medians, incidental spaces etc.

(F) Guidelines for Enhancement

As far as possible borrow area selected for enhancement shall be on government / community land in the vicinity of settlement. The contractor must ensure that any enhancement design proposed should be workable, maintenance free and preferably worked out in consultation with the community and proposed enhancement materials should be locally available. The borrow area can be developed either of the following:

(G) Vegetative Cover:

- Vegetative cover must be established on all affected land.
- Topsoil must be placed, seeded, and mulched within 30 days of final grading if it is within a current growing season or within 30 days of the start of the next growing season.
- Vegetative material used in reclamation must consist of grasses, legumes, herbaceous, or woody plants or a mixture thereof.
- Plant material must be planted during the first growing season following the reclamation phase.
- Selection and use of vegetative cover must take into account soil and site characteristics such as drainage, pH, nutrient availability, and climate to ensure permanent growth.
- The vegetative cover is acceptable if within one growing season of seeding:
- The planting of trees and shrubs results in a permanent stand, or regeneration and succession rate, sufficient to assure a 75% survival rate;
- The planting results in 90% ground coverage.
- The site shall be inspected when the planting is completed and again at one year to ensure compliance with the reclamation plan.

  Certificate of Completion of Reclamation
- Contractors have to obtained certificate of satisfaction from the landowner and submit it to the Engineer before final payment is to done.

(H) Working Plan

The contractor must prepare a working plan before enhancing the identified borrow areas. Following are the inputs that provide the guidelines to the contractor to formulate the working plan:

- Access of Property / width of access / material
- Orientation of property with respect to the road
- Site Slope
- Local Drainage / water logging etc if any
- Location of nearest culvert etc if any to drain water if required
- Any other community resources such as tube well/well etc in vicinity
- Location of trees including Species / girth / foliage spread and afternoon shaded area on ground
- Surrounding land use; nearby settlements (name of structure/pattern of settlement)
- Mark on plan part of the borrow area, most suitable for storing and staking topsoil.

(I) Drawings to be Prepared

- The contractor has to prepared the drawings showing both cross-section as well as plan of the identified borrow areas incorporating following inputs:
- Contours if any, depth if any

- Location of trees, height, foliage spread and afternoon shaded area on ground
- Any other existing details at the road / property interface such as signage/railing/etc.
- Details of immediate surrounding for at least 5m on either sides

(J) Photographs to be Include

The contractor must ensure that photographs are to be taken before and after the excavation of borrow materials and also after the implementation of redevelopment plan, incorporating the following:

- Overall View from access side
- Any other community resource in the vicinity
- All spots to be detailed such as access to borrow pit /cluster of existing trees etc.

(K) OUTPUTS

The contractor must ensure based on the above-mentioned guidelines following outcomes must be evolved:

- Working plan
- Cross Section
- Longitudinal Section/Elevation of Site
- Details of all proposed Enhancements including signage etc.
- BoQ.

ANNEXURE 4.8: GUIDELINES FOR SEDIMENT CONTROL

The proposed bridge over river Bramhaputra reflects a good art of civil and mechanical engineering but their activity shall be responsible for deposition of silt and other concrete materials which leads to reduce visibility, decrease in DO and increase TSS. The selection of material is an integral component of engineering design which ensure minimal impact on existing ecology, South Bank of alignment is no exception. During planning and designing stage, it has also considered to avoid erosion and siltation due to any proposed activities. However, for this project, all materials shall meet commercial grade standards and shall be approved by the Engineer before being used in the work.

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

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

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

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

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

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

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

Based on different aspects of activities, the contactor shall be responsible to effective environmental management plan on site which must be approved from IE and meet the objective of less impact on natural resource and nearby environment.

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

The temporary erosion, sedimentation and pollution control features installed by the Contractor shall be maintained by him till these are needed, unless otherwise agreed by the Engineer

ANNEXURE 4.9: TRAFFIC CONTROL AND SAFETY DURING CONSTRUCTION

a. Traffic Management Practices

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

(i) Make traffic safety an integral and high priority element of every project

(ii) Avoid inhibiting traffic as much as possible

(iii) Guide drivers in a clear and positive way

(iv) Perform routine inspection of traffic control elements and traffic operations

(v) Give care and attention to roadside safety

b. Traffic Control Devices

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

(i) ***Comprehension:*** All traffic control devices should be capable of being easily understood. A particular device must convey one and only one meaning. Good and clean condition of the device aids comprehension.

(ii) ***Visibility and Stability***: Devices should be within the cone of vision of the driver and be placed such that it allows adequate time at the average approach speed or the desired speed through the traffic control zone. All traffic control devices should be clearly visible by day and night, at these speeds and under the usually prevailing climatic conditions. They should be kept properly aligned and legible at all times. Foliage or any other obstruction should not be allowed to impede the view of these devices, nor should wind, road dirt or the like be allowed to obscure their face. The traffic control devices must be able to resist the local wind pressure, rain and the vibrations etc. of the passing traffic but these should not act as rigid obstacles in the event of a collision;

(iii) ***Installation and Removal:*** All traffic control devices should be installed for the minimum required time. Traffic control devices by their nature are a hindrance to the normal traffic flow

and should be removed immediately after the need, being met by these is fulfilled. Existing devices like signs or lane markings should be removed during the temporary works and reinstated thereafter or covered while the temporary devices are in operation. The installation and removal of the temporary traffic control devices and the reinstatement of the pre-existing or new (where the scheme improves the road) traffic control devices must, therefore, be meticulously supervised to ensure the minimum period when there are no signs or markings.

c. Signs

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

ANNEXURE 4.10: GUIDELINES FOR SITING & LAYOUT OF CONSTRUCTION CAMP

The proposed project is one of the major project within city of Guwahati hence it is considered that local labour shall be employed for this project. However, in North Guwhati region need of a construction camp is envisaged. During selection and establishment following methodology and facility should be adopted: -

(A) SITING

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

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

(B) LAYOUT

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

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

***Shelter at Workplace*:** At every workplace, there shall be provided free of cost, four suitable

shelters, two for meals and two others for rest, separately for use of men and women labourers. The height of shelter shall not be less than 3m from floor level to lowest part of the roof. Sheds shall be kept clean and the space provided shall be on the basis of at least $0.5m^2$ per head.

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

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

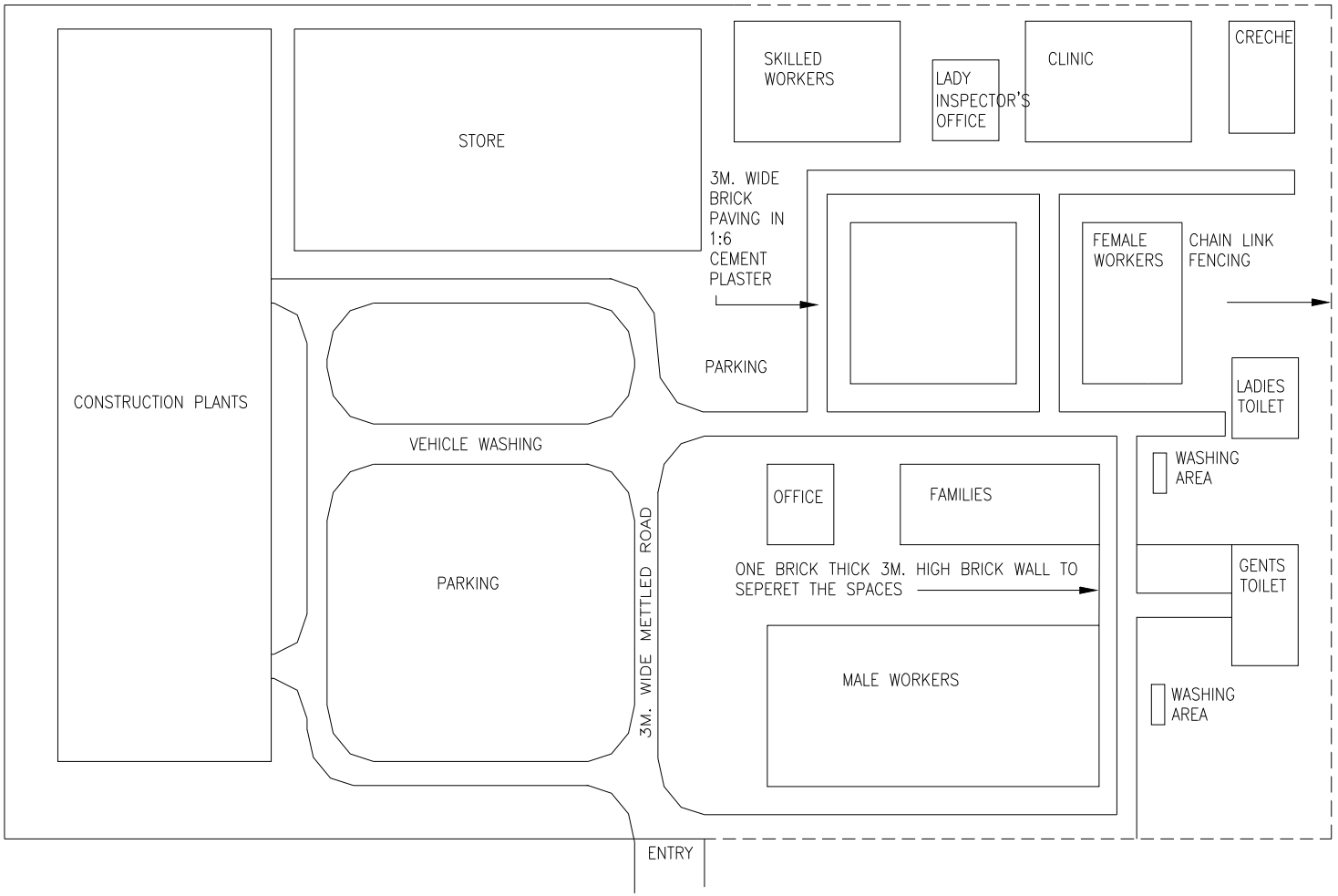
***Health Care Facilities*:** Health problems of the workers should be taken care of by providing basic health care facilities through health centres temporarily set up for the construction camp. The health centre should have at least a doctor, nurses, duty staff, medicines and minimum medical facilities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

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

***Day Crèche Facilities*:** At every construction site, provision of a day crèche shall be worked out so as to enable women to leave behind their children. At construction sites where 20 or more women are ordinarily employed, there shall be provided at least a hut for use of children under the age of 6 years belonging to such women. Huts shall not be constructed to a standard lower than that of thatched roof, mud walls and floor with wooden planks spread over mud floor and covered with matting. Huts shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provision of sweepers to keep the places clean. There shall be two maidservants (or aayas) in the satisfaction of local medical, health, municipal or cantonment authorities. Where the number of women workers is more than 25 but less than 50, the contractor shall provide with at least one hut and one maidservant to look after the children of women workers. Size of crèches shall vary according to the number of women workers employed.

Annexure 4.10

FIGURE A: TYPICAL LAYOUT OF CONSTRUCTION CAMP



Annexure- 4.11: Air Quality Modelling

4.11 Prediction of Carbon Monoxide (CO, NO_2 & PM) Concentration Using CALINE 4 Dispersion Model along the Project Road.

The air quality model CALINE 4 was used to predict the air quality after the road improvement. The methodology used for conducting the model is elaborated briefly in the following paragraphs

4.11.1 Environmental Significance of Carbon Monoxide (CO)

Carbon Monoxide is colourless and odourless gas, chemically inert under normal conditions and has an estimated atmospheric mean life of about two and half months. CO is emitted by incomplete burning of fossil fuel. The National Ambient Air Quality Standard (CPCB) prescribes standard limit for CO in the ambient air as 2 mg/m^3 for 8 hourly monitoring and 4 mg/m^3 for 1 hourly weighted average. At higher concentrations, i.e., above 5 mg/m^3 it can seriously affect human aerobic metabolism, owing to its high affinity for haemoglobin and thus would affect the central nervous system, impairing a person's time interval discrimination and brightness discrimination and over 10 mg/m^3, concentration would result in cardiac, pulmonary functional changes/failure leading to death. Similarly NO_2 and particulate matter has serious implication on human health especially on respiratory system related disorders.

4.11.2 Objective

The objective of the study is to predict CO, NO_2 and PM concentration in the ambient air on project road by using CALINE 4 dispersion model. The Ministry of Environment and Forests (MoEF&CC) has made CO concentration study as mandatory and recommends CALINE 4 model for Highway projects. The weighted average emission rate of the local vehicle fleet, expressed in terms of grams / mile per vehicle. The Run Conditions screen contains the meteorological parameters needed to run CALINE4.

4.11.3 CALINE 4 Dispersion model

CALINE 4 (Caltras, 1989) is a dispersion model that predicts impacts near roadways. CALINE 4 is a simple line source Gaussian plume dispersion model.

4.11.3.1 Meteorology:

The ambient air temperature significantly affects these vehicular emissions. Average annual temperature (28.0°C) as recorded at meteorological monitoring stations at Nimpura is used for the modeling study. Mixing height is the altitude to which thermal turbulence occurs due to solar heating of

the ground. Hourly mixing height data is taken referring book published by S.D Attri, Siddhartha Singh, B. Mukhopadhaya and A.K Bhatnagar. Atmospheric Stability Class is a measure of the turbulence of the atmosphere. Values 1 through 6 corresponds to the standard definitions for stability class A through F. Stability class F (or 6) represent the most stable conditions. Atmospheric stability is expressed as a function of wind speed, insolation and cloud cover.

4.11.3.2 Emission Factor:

Emission factors for different type of Vehicle is taken referring published database of "Emission Factor for different categories of vehicle in India CPCB 2000". The weighted average emission rate of the local vehicle fleet, expressed in terms of grams /mile per vehicle.

4.11.3.3 Traffic data:

The hourly traffic volume anticipated to travel on each link, in units of vehicles per hour is taken by conducting Traffic survey at different chainage of the proposed corridor.

4.11.3.4 Run Type:

Run type determines averaging times (for CO concentrations) and how the hourly average wind angle (s) will be determined. In the present case "worst-case wind angle" run type has been considered to assess the air quality during project operation in worst meteorological conditions.

4.11.3.5 Ambient Pollutant Concentration:

This measure reflects the pre-existing background level of Carbon Monoxide, expressed in parts per million (ppm) and remaining in micrograms per meter cube. The background concentration is assumed to be zero to predict the incremental concentration as a result of the proposed expansion.

4.11.3.6 Averaging Interval:

Simulation is carried for 1-hour average CO concentration at all the receptors. Thus the predicted incremental CO concentration is averaged over 1 hour interval to predict the maximum possible concentration or the worst case scenario. However the background CO concentration monitored is averaged over 8 hour.

4.11.4 Approach and Methodology:

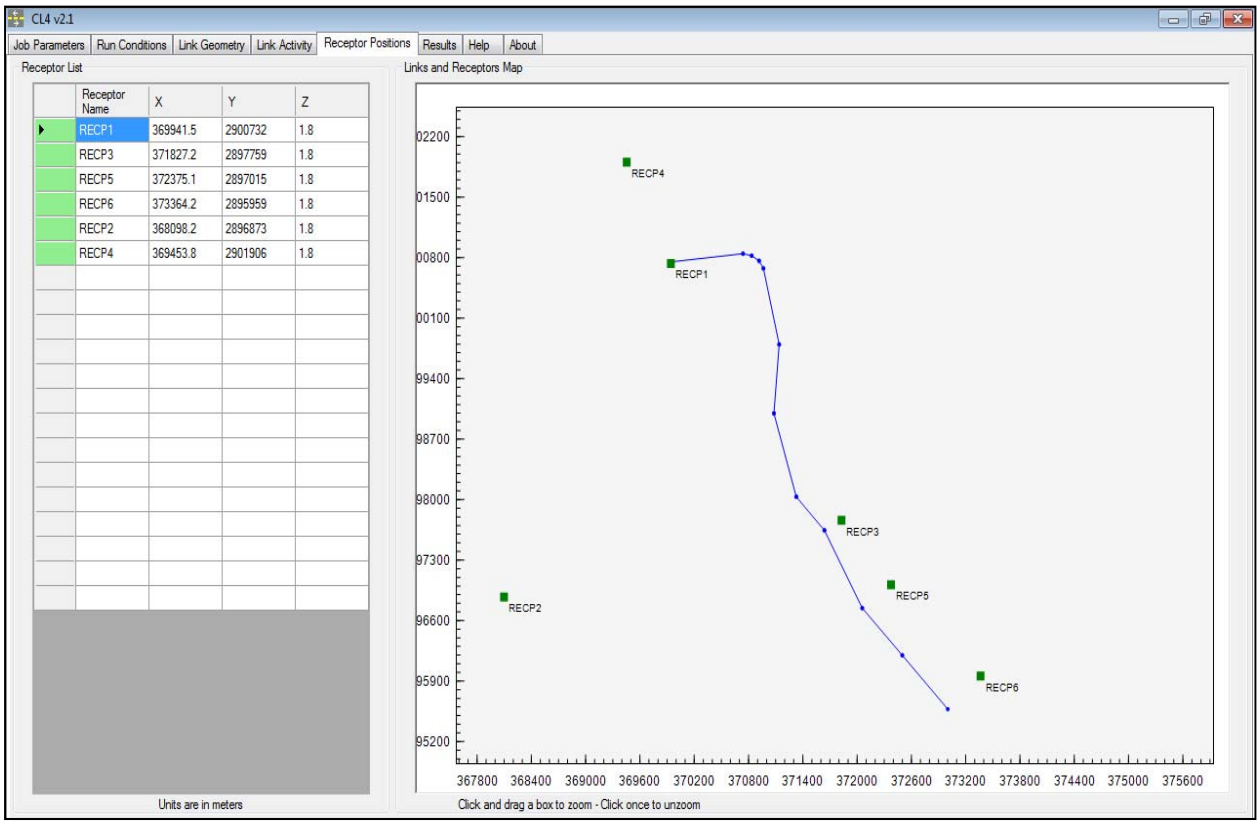
Based on the traffic volume, land type and environmental setup, the project corridor has been divided into four sections. For the CO dispersion study the project road is considered as Sub-urban and sections carrying various traffic volumes are defined in their respective links. The various links and receptors

considered for modeling the CO concentration of the proposed project is shown in the **Table 4.1** and **Table 4.2** below

Table 4.1: Link Geometry, Traffic and Environmental Data used for Executing the Model

Segments	Chainage (km)	Aero-dynamic Roughness Coefficient	Traffic Volume in / PCU)	Average Temp. (°C)	Emission Factor (gm/Mile)	Avg. Alt. above MSL (m)	Mixing Zone Width (m)
			2017		2010		
1		Sub-urban	23430	28	4.90	44	86
2		Sub-urban	23430	28	4.92	44	86
3		Sub-urban	23430	28	4.91	44	86
4		Sub-urban	23430	28	4.90	44	86
5		Sub-urban	23430	28	4.91	44	86
6		Sub-urban	23430	28	4.90	44	86

Table 4.2 Showing the receptor locations on either side of the proposed road alignment



4.11.5 Results

CALINE 4 CO dispersion model software was run by using data on link geometry, traffic volume and environmental receptors given in the table above. The output CO results at specified locations along the project road are presented in **Table 4.3** below.

Table 4.3: Predicted incremental Concentrations

Receptor Code	Distance from Mixing Zone Width(m)	Area Type	Background CO Conc. (ppm)	Total Predicted 'CO' including background Conc. (ppm)	NAAQS for CO (mg/m^3) for Residential, Rural & Other areas	Background NO_2 (ppm)	Predicted NO2 (ppm)	Background PM (µg/m3)	Predicted contribution PM (µg/m3)
AAQ1	86	Sub-urban	1.05905	3.0	4	0.0064	0.01	78	3.0
AAQ2	86	Sub-urban	0.882542	3.0	4	0.0043	0.0	68	3.0
AAQ3	86	Sub-urban	0.882542	3.44	4	0.0070	0.01	64	38.3
AAQ4	86	Sub-urban	0.882542	3.0	4	0.0081	0.01	76	3.0
AAQ5	86	Sub-urban	0.882542	3.2	4	0.0075	0.01	66	27.4
AAQ6	86	Sub-urban	0.882542	3.4	4	0.0064	0.0	72	42.5

4.11.6 Conclusion

The predicted incremental CO concentrations on existing ambient level at all locations are found to be within the National Ambient Air Quality Standards for the proposed project. However, the maximum predicted concentration is found near North Guwahati Police post. This aberrant behaviour may be attributed to the presence of higher industrial activity and poor road condition in the vicinity of the receptor location. Thus it can be concluded that the proposed project will not have any significant impact on the existing ambient air quality, on the contrary there will improvement in terms of both gaseous and particulate emission after the commencement of the proposed widening project.

ANNEXURE 6.1: ENVIRONMENTAL MONITORING PLAN

1. Monitoring Parameters and Standards

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

1.1 Ambient Air Quality Monitoring (AAQM)

The air quality parameters viz: Sulphur Dioxide (SO_2), Oxides of Nitrogen (NO_X), Carbon Monoxide (CO), Hydro-Carbons (HC), and Respirable Particulate Matter (RPM) (size less than 10 µm and 2.5 µm) shall be regularly monitored at identified locations from the start of the construction activity. The air quality parameters shall be monitored in accordance with the National Ambient Air Quality Standards as given in Table 1. The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan Table 5.

Table 1: National Ambient Air Quality Standards

Sl. No.	Pollutants	Time-weighted average	Concentration in Ambient Air		Methods of Measurement
			Industrial, Residential, Rural & other Areas	Ecologically Sensitive Areas (notified by Central Government)	
1	Sulphur Dioxide (SO_2) µg/m^3	Annual*	50	20	Improved West & Gaeke Ultraviolet fluorescence
		24 hours**	80	80	
2	Nitrogen Dioxide (NO2) µg/m3	Annual*	40	30	Modified Jacob and Hochheiser (Na-Arsenite) Chemiluminescence
		24 hours**	80	80	
3	Particulate Matter (size less than 10 µm) or PM10 µg/m3	Annual*	60	60	Gravimetric TOEM Beta attenuation
		24 hours**	100	100	
4	Particulate Matter (size less than 2.5µm) or PM2.5 µg/m3	Annual*	40	40	Gravimetric TOEM Beta attenuation
		24 hours**	60	60	
5	Ozone (O3)µg/m3	8 hours**	100	100	UV photometric Chemiluminescence Chemical Method
		1 hours**	180	180	
6	Lead (Pb) µg/m3	Annual*	0.50	0.50	AAS/ICP method after sampling on EPM 2000 or equivalent filter paper ED-XRF using Teflon filter
		24 hours**	1.0	1.0	
7	Carbon Monoxide (CO) (mg/m3)	8 hours**	02	02	Non Dispersive Infra Red (NDIR) spectroscopy
		1 hours**	04	04	
8	Ammonia (NH3) µg/m3	Annual*	100	100	Chemiluminescence Indophenol Blue Method
		24 hours**	400	400	
9	Benzene (C6H6)	Annual*	05	05	Gas chromatography based

	µg/m3				continuous analyser Adsorption and Desorption followed by GC analysis
10	Benzo(a) Pyrene Particulate Phase only ng/m3	Annual*	01	01	Solvent Extraction followed by HPLC/GC analysis
11	As ng/m3	Annual*	06	06	AAS/ICP method after sampling on EPM 2000 or equivalent filter paper
12	Ni ng/m3	Annual*	20	20	AAS/ICP method after sampling on EPM 2000 or equivalent filter paper

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

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

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

Source: MoEF Notification dated 16th November, 2009

1.2 Noise Quality Monitoring

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

Table 2: National Ambient Noise Quality Standards

Category of Area / Zone	Limits in dB(A) Leq	
	Day Time	Night Time
Industrial area	75	70
Commercial area	65	55
Residential area	55	45
Silence Zone	50	40

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

1.3 Water Quality Monitoring

Water quality parameters such as pH, BOD, COD, DO, coliform count, total suspended solids, total dissolved solids, Iron, Fluorides etc. shall be monitored at all identified locations during

the construction stage as per standards prescribed by Central Pollution Control Board and Indian Standard Drinking water specifications IS 10500, 1991, presented in Table 3 & 4 respectively. The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed out in the Environmental Monitoring Plan 5.

Table 3: Primary Water Quality Standards

Sl. No.	Designated Best Use	Class of Water	Criteria
1	Drinking Water source (with conventional treatment)	A	Total Coliform MPN/100 ml shall be 50 or less pH between 6.5 to 8.5 Dissolved Oxygen 6 mg / 1 or more Biochemical Oxygen demand (BOD) 5 days 20^0C 2 mg/1 or less
2	Outdoor bathing (organised)	B	Total Coliform MPN/100 ml shall be 500 or less pH between 6.5 to 8.5 Dissolved Oxygen 5 mg / 1 or more Biochemical Oxygen demand (BOD) 5 days 200C 3 mg/1 or less
3	Drinking Water source (without conventional treatment)	C	Total Coliform MPN/100 ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4 mg / 1 or more Biochemical Oxygen demand (BOD) 5 days 200C 3 mg/1 or less
4	Propagation of Wildlife	D	pH between 6.5 to 8.5 for fisheries Dissolved Oxygen 4 mg / 1 or more Free Ammonia (as N) 1.2 mg/1 or less
5	Irrigation, Industrial Cooling, Controlled Waste	E	pH between 6.0 to 8.5 Electrical Conductivity at 250C µmhos/cm Max. 2250 Sodium absorption rations Max. 26 Boron, Max.2 mg/1

Table 4: Indian Standard Drinking Water Specifications: IS 10500: 1991

Sl. No.	Substance / Characteristics	Requirement (desirable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
Essential Characteristics						
1	Colour, Hazen Units, Max.	5	Above 5, consumer acceptance decreases	25	3025 (part4) 1983	Extended to 25 only if toxic substances, in absence of alternate sources.
2	Odour	Un-objectionable	-	-	3025 (parts 5): 1984	A test cold and when heated. Test at several dilution
3	Taste	Agreeable	-	-	3025 (part 8): 1984	Test to be conducted only after safety has been established
4	Turbidity NTU, Max.	5	Above 5, consumer acceptance decreases	10	3025 (part 7): 1984	
5	PH value	6.5 to 8.5	Beyond this range the water will not affect the mucous membrane and /or water supply system	No relaxation	3025 (part 11): 1984	
6	Total hardness (as CaCo3) mg/1, Max.	300	Encrustation in water supply structures an adverse effect on domestic use	600	3025 (part 21): 1983	
7	Iron (as Fe) mg /l Max.	0.3	Beyond this limit taste/appearance are affected has adverse effect on domestic uses and water supply structures and promotes iron bacteria	1	3025 (part 21): 1983	
8	Chlorides (as Cl) mg/1	250	Beyond this limit, taste corrosion	1000	3025 (part 32):	

Sl. No.	Substance / Characteristics	Requirement (desirable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
	Max.		and palatability are affected		1988	
9	Residual, free chloride, mg/1 Min.	0.2			3025 (part 26): 1986	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be Min. 0.5 mg/1
Desirable characteristics						
1	Dissolved solids mg/1 Max.	500	Beyond the palatability decreases and may cause gastro intestinal irritation	2000	3025 (part 16): 1986	
2	Calcium (as Ca) mg/1 Max.	75	Encrustation in water supply structure and adverse effects on domestic use	200	3025 (Part 16) 1986	
3	Magnesium (as Mg) mg/1, Max.	30	Encrustation in water supply structure and adverse effects on domestic use	1.5	16,33,34 of IS 3025: 1964	
4	Copper (as Cu) mg/1 Max.	0.05	Beyond taste, discoloration of pipes, fitting and utensils will be caused beyond this	0.3	35 of 3025: 1964	
5	Manganese (as Mn) mg/1, Max.		Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures.	0.3	35 of 3025: 1964	
6	Sulphate (as 200 So2), mg/1, Max.	200	Beyond this causes gastro intestinal irritation when	400	3025(part 24): 1986	May be extended up to 400 provided (as Mg) does not

Sl. No.	Substance / Characteristics	Requirement (desirable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
			magnesium or sodium are present			exceed 30
7	Nitrate (as No2) mg/l, Max.	45	Beyond this methaemoglobinemia take place	100	3025 (part24): 1988	To be tested when pollution is suspected
8	Fluoride (as F) mg/1, Max.	1	Fluoride may be kept as low as possible. High fluoride may cause fluorosis	1.5	23 of 3025:1964	To be tested when pollution is suspected
9	Phenolic compounds (as C6H5OH) mg/1, Max.	0.001	Beyond this it may cause objectionable taste and odour	0.002	54 of 3025:1964	To be tested when pollution is suspected
10	Mercury (as Hg) mg/1, Max.	0.001	Beyond this the water becomes toxic	No relaxation	(See not mercury ion analyses)	To be tested when pollution is suspected
11	Cadmium (as cd), mg/1, Max.	0.01	Beyond this the water becomes toxic	No relaxation	(See note)	To be tested when pollution is suspected
12	Selenium, (as Se). mg/1, Max.	0.01	Beyond this the water becomes toxic	No relaxation	28 of 3025:1964	To be tested when pollution is suspected
13	Arsenic (As) mg/1, Max.	0.05	Beyond this the water becomes toxic	No relaxation	3025 (part 37); 1988	To be tested when pollution is suspected
14	Cyanide (as CN) mg/1, Max.	0.05	Beyond this the water becomes toxic	No relaxation	3025 (part 27) 1988	To be tested when pollution is suspected
15	Lead (as Pb), mg/1, Max.	0.05	Beyond this the water becomes toxic	No relaxation	(See note)	To be tested when pollution is suspected
16	Zinc (as Zn) mg/1, Max.	5	Beyond this limit it can cause astringent taste and an opalescence taste and an opalescence in water	15	39 of 3025:1964	To be tested when pollution is suspected

Sl. No.	Substance / Characteristics	Requirement (desirable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
17	Anionic detergents (as MBAS) mg/1, Max.	0.2	Beyond this it can cause a light froth in water	1	Methylene-blue extraction method	To be tested when pollution is suspected
18	Chromium (as Cr6+) mg/1, Max.	0.05	May be carcinogenic above this limit	No relaxation	38 of 3025:1964	To be tested when pollution is suspected
19	Poly nuclear aromatic hydra carbons (as PAH) mg/1, Max.	-	May be carcinogenic above this limit	-	-	-
20	Mineral oil mg/1, Max.	0.01	Beyond this limit undesirable taste and odour after chlorination take place.	0.03	Gas Chromatography method	-
21	Pesticides mg/1, Max.	Absent	Toxic	0.001	-	-
22	Radioactive material	-	-	-	58 of 3025:1964	-
23	Alpha emittersbq/1, Max.	-	-	0.1	-	-
24	Beta emitter pci/1, Max.	-	-	1	-	-
25	Aluminium (as Al) mg/1, Max.	200	Beyond this limit taste becomes unpleasant	600	13 of 3025:1964	-
26	Aluminium (as Al) mg/1, Max.	0.03	Cumulate effect is reported to cause dementia	0.2	31 of 3025:1964	-
27	Boron mg/1, Max.	1	-	5	29 of 3029:1964	-

Source: *Indian Standard Drinking Water Specification – IS 10500, 1994*

Annexure – 10.1

Budgetary provision for Compensatory Afforestation

A total of 7455 (including Bamboo clusters and Horticultural plants) of plant species were recorded from the Corridor of Impact (COI). Budgetary provision of Rs. 11803688 (No. of trees 7455 x 4 times x Unit Cost with maintenance Rs. 395.83) has been earmarked in this head. Details Compensatory Afforestation Plan has been invited from State Forest Department and is under process.

Budgetary provision for Median plantation

Chainage		Length (m)	Median width (m)	No of Flowering Shrubs/orchids (ROW-1)	Cost (INR)	Remarks
From	To					
330	2375	2045	2.6	682	107928	Main Bridge & Viaduct Part
2375	2680	305	2.6	102	16097	Viaduct Approach
2680	2845	165	2.6 to 4	55	8708	
2845	3340	495	4	165	26124	
3340	3540	200	4 to 2.6	67	10555	
3540	4640	1100	2.6	367	58054	VUP at College Nagar Junction
4640	4743	103	2.6 to 4	34	5436	
4743	5794	1051	4	350	55468	Minor Bridge(4x6x3) at Ch. 5+498
5794	6006	212	-	71	11189	Rotary
6006	6150	144	4	48	7600	
6150	6200	50	4 to 3.6	17	2639	
6200	6800	600	3.5	200	31666	ROB (1x 85)
Total		**6470**		**2157**	**341465**	

Plantation in Space Between MCW & Service Road

Chainage	Available Width between LHS Carraigeway toe line and Service Road toe line	Available Width between RHS Carraigeway toe line and Service Road toe line	Row -1 (Ornamental Trees/orchids)	Row -2 (Shade Bearing trees)	Row -3 (Shade Bearing and screening trees)	Cost (INR)

1650	5.647	5.359				
1700	6.211	6.433	33	33		10555
1750	5.324	6.603	33	33		10555
1800	5.546	6.157	33	33		10555
1850	6.972	5.423	33	33		10555
1900	5.660	6.977	33	33		10555
1950	0.121	7.934	17	17	17	7917
2000	0.000	8.245	17	17	17	7917
2050	0.000	0.000	0	0	0.000	0
2100	5.490	7.567	33	33	17	13194
2150	6.670	7.457	33	33	17	13194
2200	8.237	7.389	33	33	33	15833
2250	7.103	6.627	33	33	17.000	13247
2300	5.085	6.895	33	33		10555
2350	5.458	6.557	33	33		10555
2400	5.140	6.112	33	33		10555
2450	5.230	6.884	33	33		10555
2500	6.563	7.754	33	33	17	13194
2550	6.973	6.764	33	33		10555
2600	5.799	6.636	33	33		10555
2650	6.084	7.572	33	33	17	13194
2700	5.277	6.565	33	33		10555
2750	5.655	7.554	33	33	17	13194
2800	5.614	6.044	33	33		10555
2850	6.419	5.032	33	33		10555
2900	5.609	7.071	33	33	17	13194
2950	4.351	5.067	33	33		10555
3000	6.324	6.479	33	33		10555
3050	4.136	6.537	33	33		10555
3100	4.508	4.620	33	33		10555
3150	4.657	4.240	33	33		10555
3200	4.424	4.912	33	33		10555

3250	7.845	0.000	17	17	17.000	8075
3300	0.293	0.565	0	0		0
Total			**984**	**984**	**201**	**343259.44**

Plantation in Space Between Toe line & PROW

Chainage	Available Width between LHS Outer most Toe line & PROW	Available Width between RHS Outer most Toe line & PROW	Row -1 (Ornamental Trees/orchids)	Row -2 (Shade Bearing trees)	Row -3 (Shade Bearing and screening trees)	Row -4 (Shrubs and grass turfing / Shade Bearing and screening trees)	Cost (INR)
1650	2.723	2.399					
1700	1.392	2.826	33				5278
1750	2.662	3.567	33				5278
1800	1.447	3.785	33				5278
1850	3.155	2.436	33				5278
1900	2.465	3.603	33				5278
1950	0.000	2.431	17				2639
2000	0.000	0.000					0
2050	2.882	0.000	17				2639
2100	2.715	3.905	33				5278
2150	3.019	4.337	33				5278
2200	3.737	0.891	17				2639
2250	3.042	2.661	33				5278
2300	2.333	2.958	33				5278
2350	1.655	2.663	33				5278
2400	1.687	2.197	33				5278
2450	2.764	2.090	33				5278
2500	3.065	3.035	33				5278

2550	2.054	2.414	33				5278
2600	2.126	2.477	33				5278
2650	2.003	2.751	33				5278
2700	3.612	3.554	33				5278
2750	3.436	4.360	33				5278
2800	2.679	3.793	33				5278
2850	4.233	3.021	33				5278
2900	3.691	3.538	33				5278
2950	2.750	3.210	33				5278
3000	3.197	4.222	33				5278
3050	2.784	3.636	33				5278
3100	2.634	3.115	33				5278
3150	2.746	2.926	33				5278
3200	3.116	3.226	33				5278
3250	0.000	0.000	0				0
3300	0.000	0.990	0				0
3350	4.917	4.993	33	33			10555
3400	6.986	6.467	33	33			10555
3450	9.499	8.057	33	33	33		15833
3500	8.702	10.499	33	33	33		15833
3550	15.333	15.578	33	33	33		15833
3600	13.286	14.867	33	33	33		15833
3650	12.730	12.073	33	33	33		15833
3700	12.449	11.499	33	33	33		15833
3750	13.812	13.299	33	33	33		15833
3800	13.922	14.412	33	33	33		15833
3850	13.885	13.428	33	33	33		15833
3900	14.399	13.676	33	33	33		15833
3950	14.718	15.750	33	33	33		15833
4000	15.222	13.442	33	33	33		15833
4050	14.567	13.474	33	33	33		15833
4100	14.896	13.689	33	33	33		15833

4150	13.229	13.043	33	33	33		15833
4200	13.358	14.278	33	33	33		15833
4250	14.291	13.979	33	33	33		15833
4300	14.070	12.272	33	33	33		15833
4350	15.264	14.265	33	33	33		15833
4400	14.721	14.856	33	33	33		15833
4450	14.248	13.541	33	33	33		15833
4500	12.921	14.212	33	33	33		15833
4550	13.265	14.281	33	33	33		15833
4600	14.381	15.275	33	33	33		15833
4650	25.776	15.202	33	33	33		15833
4700	26.231	13.541	33	33	33		15833
4750	12.429	12.599	33	33	33		15833
4800	12.362	12.697	33	33	33		15833
4850	12.968	13.439	33	33	33		15833
4900	12.527	13.268	33	33	33		15833
4950	11.565	13.170	33	33	33		15833
5000	11.467	12.626	33	33	33		15833
5050	10.950	13.105	33	33	33		15833
5100	12.191	12.424	33	33	33		15833
5150	12.957	12.315	33	33	33		15833
5200	12.504	12.201	33	33	33		15833
5250	12.065	11.720	33	33	33		15833
5300	12.205	10.949	33	33	33		15833
5350	10.773	10.179	33	33	33		15833
5400	13.962	10.238	33	33	33		15833
5450	12.375	10.498	33	33	33		15833
5500	6.262	8.374	33	33	33		15833
5550	11.342	10.887	33	33	33		15833
5600	10.457	10.748	33	33	33		15833
5650	9.713	11.091	33	33	33		15833
5700	9.422	9.656	33	33	33		15833

5750	7.859	7.180	33	33	33		15833
5800	10.188	6.315	33	33	33		15833
5850	7.000	0.000	33				5278
5900	7.000	0.000	33				5278
5950	7.000	0.000	33				5278
6000	13.649	13.509	17				2639
6050	13.022	13.644	33	33	33	33	21111
6100	12.358	11.685	33	33	33	33	21111
6150	11.300	13.348	33	33	33	33	21111
6200	10.631	24.850	33	33	33	33	21111
6250	11.715	24.850	33	33	33	33	21111
6300	13.409	24.850	33	33	33	33	21111
6350	13.486	24.850	33	33	33	33	21111
6400	13.727	24.850	33	33	33	33	21111
6450	Existing Road use as a Service Road	24.850	17	17	17	17	10555
6500		24.850	17	17	17	17	10555
6550		24.850	17	17	17	17	10555
6600		24.850	17	17	17	17	10555
6650		24.850	17	17	17	17	10555
6700		24.850	17	17	17	17	10555
6750		24.850	17	17	17	17	10555
6800		24.850	17	17	17	17	10555
Total			**3133**	**2067**	**2000**	**400**	**1203308**

Additional budgetary provision and maintenance

Sl. No.	Measures	Physical	Financial (INR)
1.	Wired Fencing of Trees	11925	5962333
2.	Grass Turfing @ Rs. 15/sq feet	645834	9687510
3.	Flowering Creepers and Climbers	640	192000
4.	Hanging flowering pots at light post @250/pot	640	160000
5.	Initial Fertilizer Cost @ 1000/metric ton	500	500000
6.	Organic Fertilizer cost @ 50000/Quarter	60	3000000

7.	Maintainance Cost @ 30000/Month	180	5400000
8.	Watch and Guard Cost @ 15000/Month	180	2700000
Total			**27601843**

Note: Grass turfing is to be carried out at all empty spaces in median, RoW, embankment slopes and areas under special structures, to avoid soil erosion as given in appendix II of IRC SP- 021 – 2009. Species are to be selected as given in appendix I of IRC SP- 021 - 2009

INLAND WATERWAYS AUTHORITY OF INDIA
(MINISTRY OF SHIPPING, GOVT. OF INDIA)
भारतीय अन्तर्देशीय जलमार्ग प्राधिकरण
(पोत परिवहन मंत्रालय, भारत सरकार)
Regional Office : Pandu Port Complex, Pandu, Guwahati – 781 012 (ASSAM)
• Telefax No. 0361-2570099 • Ph. No. 0361- 2676925, 2676929
• E-mail : iwaighy@yahoo.co.in / dirguw.iwai@nic.in

No. IWAI/GHY/3(20)/2016-17 Vol-II/1235 Date: 24/28-02-2018

To,

The Superintending Engineer
Guwahati Metropolitan Development Authority
(GMDA)
Bhangagarh
Guwahati-781005

Sub: Clearance for construction of Bridge over River Brahmaputra(NW2) connecting Bharalumukh, Guwahati to North Guwahati, Assam-reg.

Ref: Letter No. GMDA/DEV/62/2016/PT-I/19 dated 19-01-201

Sir,

Reference above, Competent Authority has accorded no objection to your proposal for construction of Bridge over River Brahmaputra(NW2) connecting Bharalumukh, Guwahati to North Guwahati, at Ch.260 km, upstream of Pandu.

2. This No objection is granted for navigational purpose only as per Gazette Notification 'Inland Waterways Authority of India (Classification of Inland Waterways in India), Regulation 2006 dated January 20-26, 2007 and Amendment, Regulation 2016 dated 7th November 2016'.

3. It is to intimate that the condition indicated in Annex-II shall be followed during the construction process. The official of IWAI shall be permitted to visit the sites as and when required during the construction to ensure compliance. In case of violation, IWAI reserves the right to stop the construction and the same shall be removed at the cost of GMDA.

Yours faithfully,

(A K Bansal)
Director

Encl: As above

Copy for information to : Director(NER), IWAI, Noida.

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Annexure-II

Conditions to be followed while undertaking construction of structure across National Waterway

1. The construction of the structure shall commence only after obtaining clearance from the Authority.
2. The person shall take up construction as per the approved clearances issued by the Authority and get it completed within the time frame mentioned in the application.
3. During construction period, the Chairman of the Authority or his authorized representatives shall have the right to inspect the site to ensure that the construction is in progress as per the approved clearance. In the event of violation, the Authority shall have the right to issue 'stop order' immediately for such period as deemed fit by the Authority. The work shall be resumed only on getting a fresh clearance from the Authority.
4. The person shall undertake construction activity without adversely affecting the smooth voyage/movement of vessels through the waterway. Boards indicating "CONSTRUCTION UNDER PROGRESS" shall be erected 500 metres upstream and 500 metres downstream of the location for cautioning the vessels. Necessary warning signals (both day and night marks) shall be provided by the person, as per the directives of the representative of the Authority to ensure safety of voyage of vessels while negotiating the construction site.
5. Damage, if any, caused to any vessel, crew, materials, cargo etc. due to the construction activities shall be compensated by the person.

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ToR Compliance Report

Application No. GMDA/DEV/62/2016/Pt-IV/04 Dated: 06/03/2018

Proposal for Construction of Bridge over river Brahmaputra Connecting Bharalumukh (Panbazar) to North Guwahati by the Chief Executive Officer, Guwahati Metropolitan Development Authority, Bhangagar, Guwahati.

TERMS OF REFERENCE (TOR) FOR EIA/EMP STUDY

Sl. No.	ToR Point	Compliance Status
	The EIA/EMP study is to be carried out through a NABET-QCI accredited EIA Consultant only.	**Complied.** **EIA Consultant:** TRP Social Consultants Pvt. Ltd. in association with Wolkem Consultancy Services: A Division of Wolkem India Ltd.
	The TOR for EIA/EMP Study for the proposed project are as follows:	
1.	**Generic structure of EIA/EMP Report as given in the EIA Notification 2006 is to be followed, i.e.** Executive Summary 1. Introduction 2. Project Description 3. Description of environment (Physical, Ecological, Socioeconomic) 4. Anticipated environmental impacts & mitigation measures 5. Analysis of alternatives (Technology & Site) 6. Environmental Monitoring Programme 7. Additional Studies 8. Project Benefits 9. Environmental Cost-benefit Analysis	**Complied.** The EIA/EMP Report structure is as given in the EIA Notification 2006.

	10.Environmental management Plan (EMP) 11.Summary and Conclusions 12.Disclosures of Consultants engaged TOR Compliance Report	
2. 1.	**Specific requirements** **Introduction** A. Background B. Project Rationale C. Category of the Project and scope of the EIA study along with maps, etc. to be provided. D. Methodology adopted for the EIA study including modelling **Policy, Legal & Administrative frameworks** A. National Environmental policy framework B. Social Regulatory Requirement of India & Assam C. International Treaties & Relevance to the project	**Compliance of** **Introduction in Chapter 1.** A. in section 1.1. B. in section 1.2. C. in section 1.3. D. in section 1.4.3 and Annexure 4.10. **Policy, Legal & Administrative frameworks** A. in section 1.7. B. in section 1.7 and SIA report. C. in section 3.17.2. B.
2.	**Project Description** A. Type of project B. Location & feature of the proposed project C. Engineering surveys & investigations D. Project traffic for the design E. Components of the project F. Proposed alignment & conceptual plan of the project covering in connection of proposed roads to the bridge G. Examine details of landscape as per master plan covering 10km radius of the project site. Analysis	**Compliance of** **Project Description in Chapter 2.** A. in section 2.1. B. in section 1.5.1. C. in section 2.9. D. in section 2.5. E. in section 2.2. F. in section 2.9. G. in section 3.6.

	shall also be considered. H. Submit details of environmentally sensitive places, land acquisition status rehabilitation of communities and villages. I. Examine the details of transport of materials for construction which should include source and availability. J. Examine traffic & transportation study should be made for existing projected passengers & cargo traffic. K. Submit a copy of the contour plan with slopes, drainage pattern of site and surrounding area any obstruction of the same by the project. L. Other investigations as mentioned below: a) Examine the details of source of water, water requirement use of treated water & prepare a water balance chart. b) Examine the depth of G.W table for rain water harvesting, examine details of solid waste generation, treatment and dispose. c) Examine & submit use of solar and alternative source of energy. Energy conservation and energy efficiency. d) D.G sets to be used during construction and operation phase of the project. Emission from DG sets must be taken into consideration while estimating the impact on air environment. e) Examine the emission natural monitoring plan with cost and parameters. f) Submit details of comprehensive disaster management plan including emergency evacuation during natural disaster and manmade disaster. g) The cost of project (Capital cost & recurring cost) and cost towards implementation of EMP should be clearly mentioned. h) Examine & submit the details of use of fly ash in road construction if available. Examine & submit the details of sand quarry borrow area, stone and rehabilitation. i) Explore the possibilities of utilizing the debris/ waste material in and around the project area. j) Examine the impact during construction activities due to generation of fugitive dust from crusher, air emission from hot mix plant & vehicles for transportation of materials prediction impact on ambient air quality using appropriate mathematical model, dispersion model, etc. k) Examine & submit the details about the protection to existing habitations from dust, noise, odours, etc. during construction phase, IRC guidelines to be followed for traffic safety while	H. in table 3.18, Section 3.18.1 and 3.18.2. I. in section 2.13. J. in section 2.5. K. in section 3.5.5. L. Other investigations in Chapter 2.

	passing through the habitat. l) Details ensure free flow of water in case the alignment passes through water bodies/streams, etc.	
3.	**Description of environment covering the following points (Baseline environment in 10 km area surrounding the project site)** A. Physical environment components such as meteorology, climate & hydrological study, sedimentation, etc., geology of proposed area along with river basin, topography, soil characteristics, air quality, surface and subsurface water quality. B. Biological environmental components such as aquatic, biotic, flora and fauna, mammals, reptiles and avian fauna, fishes, micro and macro invertebrates, etc. and biodiversity study, forest and vegetation and wildlife habitat distribution pattern of flora and fauna to be monitored along with seasonal activities of the area. Conservation effort of the species shall also be considered in the study. Enumeration of the standing tree to be cut and should be furnished in detail along with conservation plan. Emphasis should be given in river dolphin habitat along with on- going conservation effort if any to be studied. C. Noise level and vibration study. D. Physiographic and soil study. E. Study of soil quality and type of soil to be covered. F. Seismicity of the area. G. Examination of socio economic environment in the project area covering land use, demographic features, Agriculture & forestry and fisheries, transportation, mineral resources, industrial situations, aesthetic & tourism, cultural resources, energy potential, presence of sensitive receptors, socio-economic profile of project affected person in details, health status of the population.	Description of environment covering the following points (Baseline environment in 10 km area surrounding the project site) in Chapter 3. A. Physical environment components in section 3.5 to 3.16. B. Biological environmental components in section 3.17. C. Noise level and vibration study in section 3.9. D. Physiographic and soil study in 3.16 E. Study of soil quality and type of soil to be covered. F. Seismicity of the area in 3.5.3. G. Examination of socio economic environment in the project area in section 3.18.
4.	**Anticipated environmental impacts & mitigation measures including the following** A. Construction activities and rating of impact. B. Anticipated environmental impact C. Impact related road safety D. Endorsement of private lands, demolition of structures	Anticipated environmental impacts & mitigation measures in Chapter 4

	E. Disruption of recreational & transport related activities across the river including immediate banks. F. Loss of vegetation. G. Disturbance of faunal and floral habitat. H. Impact on endangered and protected faunal species and their conservation plan. I. Deterioration of air quality along the modelling study, wind erosion. J. Increase noise & construction material pile and modelling noise emission during construction. K. Deterioration of surface water, ground water, soil and sediment quality. L. Disruption of road traffic and examine present and future traffic and transport facilities for the area should be analysed and measures for preventing traffic congestion and providing foster trouble free system. M. Erosion risk assessment. N. Health, safety, hygiene, etc. of construction workers. O. Land use & social impacts. P. Assessment of impacts. Q. Road safety issues R. Key Operational stage impacts including air quality and emission and prediction of pollutant correction, based on proposed traffic data, etc., and noise quality prediction, sound exposure level dispersion, noise barriers, etc. S. Commutative induced environmental impact. T. Environmental enhancement measures. U. Climate change risk and adaptation for bridge	
5.	**Analysis of alternatives (Technology & Site)** A. Description of each alternative B. Summary of adverse impacts of each alternative C. Mitigation measures proposed for each alternative and D. Selection of alternative	Analysis of alternatives (Technology & Site) in Chapter 5.
6.	**Environmental Monitoring Programme** A. Technical aspects of monitoring the effectiveness of mitigation measures (including Measurement methodologies, frequency, location, data analysis, reporting schedule, emergency procedures, detailed budget & procurement schedules).	Environmental Monitoring Programme in Chapter 6.

	B. Monitoring programmes during construction and post-construction with particular emphasis on air (ambient air quality, Noise) and water.	
7.	**Additional Studies** such as Risk analysis and Disaster Management Plan, Hazard assessment, Risk analysis, Onsite emergency response and preparedness plan for construction workers, Emergency response procedure, Emergency Mock Drill procedures, flood level of the River at Guwahati, etc.	Additional Studies in Chapter 7 and 10.
8.	**Project Benefits:** Tangible and non-tangible benefits from the project implementation.	Project Benefits in Chapter 8.
9.	**Environmental Cost-benefit Analysis.**	Environmental Cost-benefit Analysis in Chapter 9.
10.	**Environmental management Plan (EMP)** during pre-construction, construction and operation stages. occupational health and safety, Cost of EMP, along with a description of the administrative aspects of ensuring that mitigative measures are implemented and their effectiveness monitored, after approval of the EIA Report.	Environmental management Plan (EMP) in Chapter 10.
11.	**Summary and Conclusions**	Summary and Conclusions in Chapter 11.
12.	**Disclosures of Consultants engaged**	Disclosures of Consultants engaged in Chapter 12.