Government of Assam

Assam Inland Water Transport Development Society (AIWTDS),

CONSULTANCY SERVICES FOR ENVIRONMENTAL AND SOCIAL ASSESSMENT STUDIES FOR ASSAM INLAND WATER TRANSPORT PROJECT (Part of NW-2 & NW-16)

Assam Inland Water Transport Project [P157929]

Draft Final Environmental Impact Assessment Phase-I (EIA)

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Abbreviation

APCL	Assam Ports Company Limited
ASCL	Assam Shipping Company Limited
AIWTDS	Assam Inland Water Transport Development Society
AIWTP	Assam Inland Water Transport Project
AoI	Area of Influence
BDU	Best Designated Use
CBO	Community Based Organizations
CE	Chief Engineer
CIFRI	Central Inland Fisheries Research Institute
CPCB	Central Pollution Control Board
CV	Curriculum Vitae
CWC	Central Water Commission
DBFOT	Design Build Finance Operate and Transfer
DIWTA	Directorate of Inland Waterway Transport Assam
DPR	Detailed Project Report
EA	Environmental Assessment
ECoP	Environmental Codes of Practice
EDC	Eco-Development Committee
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EIC	Engineer-In-Chief
EMF	Environmental Management Framework
EMIS	Environmental Management Information System
EMP	Environmental Management Plan
EMMP	Environmental Management & Monitoring Program
EOT	Extension of Time
ESE	Environmental, Social and Economic
ESHS	Environmental, Social, Health and Safety
FA	Financial Analyst
FBS	Fixed Budget Selection
FD	Finance Department
FRI	Forest Research Institute
FTP	Full Technical Proposal
GB	Governing Body
GC	General Consultant
GCC	General Conditions of Contract
GIS	Geographic Information System
GoA	Government of Assam
JFMC	Joint Forest Management Committee
ID	Institutional Development
IR	Inception Report
IRS	Indian Register of Shipping
ITC	Instructions to Consultants
IUCN	International Union for Conservation of Nature
IWAI	Inland Waterways Authority of India
IWT	Inland Waterways Transport
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association

IPP	Indigenous Peoples Plan
JV	Joint Venture
LAD	Least Available Depth
LCS	Least Cost Selection
LU	Land Use
LT	Long Term
MIS	Management Information System
MoEF& CC	Ministry of Environment, Forests and Climate Change
MPR	Monthly Progress Report
NGO	Non-Governmental Organization
NPV	Net Present Value
NW	National Waterway
O&M	Operation and Maintenance
PIA	Project Influence Area
PIANC	Permanent International Association of Navigation Congress
PIU	Project Implementation Unit
PGC	Project Guidance Council
PPP	Public Private Partnership
QAP	Quality Assurance Procedure
QBS	Quality Based Selection
QC	Quality Control
QCBS	Quality Cum Cost Based Selection
QPR	Quarterly Progress Report
RAP	Resettlement Action Plan
RE	Resident Engineer
RET	Rare Endangered and Threatened Species
RFCTLAR&R	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement
RFP	Request for Proposals
RH	Risk Assessment & Hazard
SA	Social Assessment
SCC	Special Conditions of Contract
SEESA	Strategic Environmental, Economic and Social Assessment
SIA	Social Impact Assessment
SMC	Safeguard Monitoring Consultant
SMF	Social Management Framework
SMP	Social Management Plan
SPCB	State Pollution Control Board
SPMG	State Project Management Group
ST	Short Term
STP	Simplified Technical Proposal
TSC	Technical Supervision Consultant
TL	Team Leader
TNA	Training Needs Analysis/Assessment
TQM	Total Quality Management
TORs	Terms of Reference
TSDF	Treatment, Staorage and Disposal Facility
VR	Village Road
WB	World Bank
WS	Wildlife Sanctuary

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Chapter 1 : Introduction

1.1 Preamble

Brahma means the “God of creation” as per Hindu mythology and “putra” refers to son, so Brahmaputra means the son of creator God. It is the only river in India bearing a male name. The river is around 2,900 km long and is considered as one of the longest rivers in the world. With an annual discharge of around 19,800 CBM per second (100,000 CBM per second during flood) at its mouth, the river Brahmaputra is the fourth biggest river in terms of discharge. The river originates in the “Angsi glacier” of the Himalayas in China and flows through the North East Indian state of Assam to join with the Ganges and Meghna rivers in Bangladesh before emptying into the Bay of Bengal.

Brahmaputra is navigable for most of its length in India. The government of India realized its immense navigational potential and declared it as the National Waterway-2 (NW2) in 1988 between Sadiya and Dhubri. Recent years have encountered a modest spurt in the growth of river cruises with the advent of the cruise ship.Inland Water Authority of India (IWAI) is responsible for maintaining River Brahmaputra’s navigational channel with the required draft.

It has set up terminal facilities for loading and unloading at strategic locations like Dhubri, Pandu, and temporary facilities at Jogighopa, Silghat, Neamati and Dibrugarh. Pandu (Guwahati) aredeveloped, which serve as multi modal transport hub in the entire North East region.

The cargo movements through NW2 include coal from Meghalaya, fly ash from Farakka to various destinations in the Northeast. Limestone for cement plants, petroleum products from Numaligarh refinery, bitumen from Haldia, food grains from Kolkata, fertilisers, building material and bamboo are also transported through water way.

The Inland Water Transport departments of both the state and central governments of India are very keen to realize NW2’s full potential for cargo and passenger transportation. River tourism is another key potential area which can hugely contribute to the economy of the North Eastern states.

National waterways is cost efficient, and is an environment-friendly mode of transport. The development of national waterway as a supplementary mode would enable diversion of traffic from over-congested roads and railways. This will ensure enormous gains in terms of economic growth, livelihood generation and prosperity, leading to political and social stability.

The Government of Assam (GoA) has taken up a Project titled ‘Assam Inland Water Transport Project (AIWTP)’ to improve the quality of inland water transport services and integrate high quality passenger and vehicle ferry services in river Brahmaputra. Assam Inland Water Transport Development Society (AIWTDS) has been formed by the GoA under Transport Department to implement the Project. The Project is conceptualised to promote Inland Water Transport as eco-friendly, economic and convenient mode of transport and is likely that the project will help in regional & economic development of Assam and nearby states in providing better connectivity and access to the hinterland.

To modernize IWT in Assam, the World Bank is assisting the GoA through a phase-wise project, which includes up gradation of ferry Infrastructure, Fleet Modernization, institutional capacity development etc. for 11identified Terminal / Jetty / Landing points locations in Phase I. Approximate project cost would be 150million USD for entire investment. However, AIWTDS propose to develop & modernize terminal infrastructure initially at three locations i.e. Gateway Guwahati Ghat, North Guwahati Ghat&AphalamukhGhat. Apart from development of terminals in these locations, 20 vessels (10 numbers of 100-pax & 10 numbers of 50-pax vessels),with all

modern amenities to meet safety, security & environmental standards will be purchased. Upgradation of 'Crew Training Centre (CTC)' which is under the IWT Assam as well as to introduce an incentivization scheme named 'Jibondinga' for private boat owners & operators to purchase new vessels and to upgrade existing vessels by certifying those vessels by IRS are also part of the project.

In addition to river terminals, there are number of landing stations along North Guwahati as well as at Majuli corridor, which are very important for people living in the rural and remote areas. The landing stations i.e. Ghats are berthing points, at present, lack proper infrastructure and other essential facilities such as toilets, drinking water, safety features etc. They usually consist of one pontoon with shore connection for embark and debark passenger and cargo. These are very important as they provide transport of food materials, medicines, fuel, commodities etc.

The projected passenger traffice demand at Guwahati in 2020, 2025, 2030 & 2035 is presented in **Table 1-1, 1-2, 1-3 & 1-4** respectively.

Table 1-1: Passenger traffic demand in 2020 (Guwahati)) (passanger per hour)

ID	Name	GGG - North Guwahati Water Bus Line 2	
		Average	peak
1	Guwahati Gateway Ghat (GGG)	215	367
2	North Guwahati	120	215

Table 1-2: Passenger traffic demand in 2025 (Guwahati)) (passanger per hour)

ID	Name	GGG - North Guwahati Water Bus Line 2	
		average	Peak
1	Guwahati Gateway Ghat (GGG)	350	596
2	North Guwahati	190	340

Table 1-3: Passenger traffic demand in 2030 (Guwahati) (per hour)

ID	Name	GGG- North Guwahati	
		average	peak
1	Guwahati Gateway Ghat (GGG)	778	1316
2	North Guwahati	285	511

Table1-4: Passenger traffic demand in 2035 (Guwahati)) (passanger per hour)

ID	Name	GGG- North Guwahati	
		average	peak
1	Guwahati Gateway Ghat (GGG)	1234	2100
2	North Guwahati	480	861

It may be seen that the passenger traffic will be increasing substantially over the years.

The predicted passenger traffic demand at Neamati-Aphalamukh is presented in **Table 1.5.**

Table 1-5: Passenger traffic demand per Ghat 2035 (Neamati - Aphalamukh) (passanger per hour)

ID	Name	Total	
		AADT	Peak
1	Neamati Ghat	493	813
2	Aphalamukh	427	752

Note: Consolidation of Aphalamukh and Kalamabari services to one main line Neamati - Aphalamukh with sailings any 2-3 per hour and direction over 10h/day. Peaks measured will become less extreme (factor 4, but just 4 sailings at line 1 in 2018) and not exceed 50% of AADT traffic at the new main ferry line.

1.2 Project Background

Assam has approximately 1980 Kms of navigable waterways,whichis important for transport purposes. Brahmaputra from Dhubri to Sadiya was declared as NW-2 National Waterway (Sadiya-Dhubri stretch of the Brahmaputra river) Act 1988 (40 of 1988). From Dhubri to Sadiya, the waterway extends for a distance of 891Km. The river Brahmaputra flows down the centre of Assam Valley. It has a number of tributaries such asSubansiri, Jia Bharali, Dihing, BurhiDihing, Disang, Dhansiri, Kopili etc. Important river stations/commercial centers along the river bank in NW-2 are Dhubri, Jogighopa, Pandu/Guwahati, Tezpur, Neamati, Dibrugarh, Sadiya and Saikhowa (Figure 1.1). Pandu /Guwahati is the most important river station on NW-2 and the stretch downstream of Pandu up to Bangladesh Border (260 kms) is the stretch where IWT operation is presently most active (Figure 1.2). Navigation on the Barak River (152 kms) is declared as National Waterway 16 under the National Water Act, 2016. The map of Brmhaputra River in Assam is given in **Figure 1-1** and National Waterway 2 is presented in **Figure 1-2.**

Figure 1-1: Brahmaputra River Map (Assam)

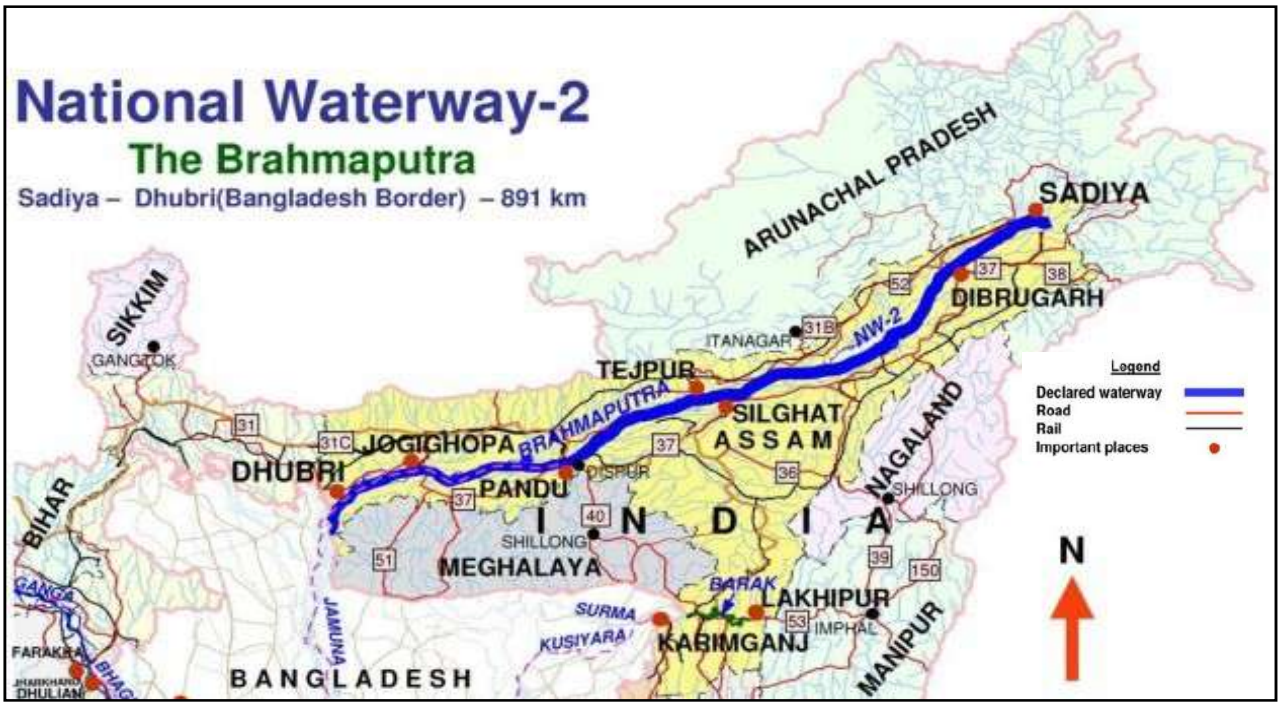


Figure 1-2: National Water Way 2 in Assam State along Brahmaputra River

Ferry services operate on 97 routes designated by the Directorate of IWT. In addition, there are numerous routes, licensed by the local (village) and district councils. Most of the ferry terminals consist of moorings on the bank of the river, which require relocation with changing river conditions.

The facilities built at these terminals are not sufficient to meet the growing demand of traffic volume as they lack facilities for berthing, parking and storage areas, and passenger comfort. The jetty facilities and surrounding areas are highly congested at some locations like South Guwahati, with unorganised commercial and residential developments. There is no space around the current jetty for further expansion.

The Brahmaputra is a braided river system characterizing by high sediment delivery and low sediment throughput. This is caused by its very low gradients making it very sensitive to rapid geometry (boundary and channel) changes, channel baring and flooding. The river layout often changes significantly during and after floods. In places, where the river is narrowed, such as Guwahati, where its width reduces to approximately 1km (and where it reaches its maximum depth of approximately 40m). However, generally, it is 8 to 10km in width and in places 18-20km. These areas contain numerous small islands or chars, some of which are permanently inhabited (Including Majuli Island, the world's largest inhabited River Island).

Between the dry and wet seasons, river water depth varies on Brahmaputra (average 6.74m). High levels are reached between the months of May to September when water velocities are on average 2.80m/sec (10km/hour or 5.4knots). Extreme conditions often cause widespread flooding. The highest velocity recorded is 5.80m/sec (20.88km/h or 11.27knots) while river levels can, in some areas, reach 2.0m over and above the natural bank height (the danger level). Low river levels are experienced between the months of October to March when river velocities are at their lowest - typically 0.71m/sec (2.55km/h or 1.38knots).

Ferry services are provided by the Inland Water Transport (ITW) Directorate of Assam, a State organisation established in 1958; and, by the country boat operators – typically small independent and informal private businesses. Cross-river and Island ferry services are the important mode of transport for a large section of the population, especially rural households in Assam. In year 2012-2013, the ferry trade on the Brahmaputra carried about 4.4 million passengers (approximately 60%

of all the IWT passenger trade in the NE of India), 37,000 tonne of light cargo, 17,000 vehicles, 431,500 motor cycles, 445,000 bicycles, 1,000 carts and 9,500 animals.

Annual growth for passenger traffic since 2007-08 has been over 5%. The IWT Directorate's share of this trade is approximately 38% and annual growth during the same period has been approximately 3%. Most passengers use country boats with annual growth of approximately 6%.

The passengertraffic movement from 2014 to 2018 has more than doubled for Guwahati, Dibrugarh combined as shown in the **Table 1-6**.

Table 1-6: Annual Passenger traffic from 2014-15to 2017-18

Division	Passenger			
	2014-15	2015-16	2016-17	2017-18
Guwahati	42,27,716	44,35,897	41,60,780	67,06,980
Dibrugarh	19,22,662	23,21,536	19,88,949	95,68,648

Source: ISDP Reports for AIWTP

The above statistics suggest that there is urgent need of improvement in passenger ferries. It has been observed that the present number of the ferries isnot able to support the increase passenger traffic. Moreover, the annual flood also leads to changes in the terminal locations. The ferries that are being deployed currentlyalsorequireupgradation.

The Environmental Impact Assessment (EIA) studies for the proposed AIWTP are carried out in accordance with applicable WB, National, and Assam state Government requirements on environmental, health and safety management. This report outlines the requirement for the proposed developments, a description of the proposed scheme, details of consultations undertaken, the key sensitivities and impacts. With the above background, the project has been conceptualised. Summary of the project in first phase is given below:

Sl. No.	Project Coverage	Features
1.	Develop & Modernise Three Terminals	a. Gateway Guwahati Ghat b. North Guwahati Ghat c. AphalamukhGhat
2.	Procurement of environmental friendly & safe vessels	a. 10 nos. of 100 – pax b. 10 nos. of 50 – pax
3.	Retrofitting of selected existing public (government owned) vessels	a. 19 nos of vessels
4.	Upgrdation of Crew Training Centre	Infrastructure Development
5.	Implementation of 'Jibondinga' scheme	New and / or upgradation of private boats

The locations of terminals in Bramhaputra River are shown in the map in **Figure-1-3**.

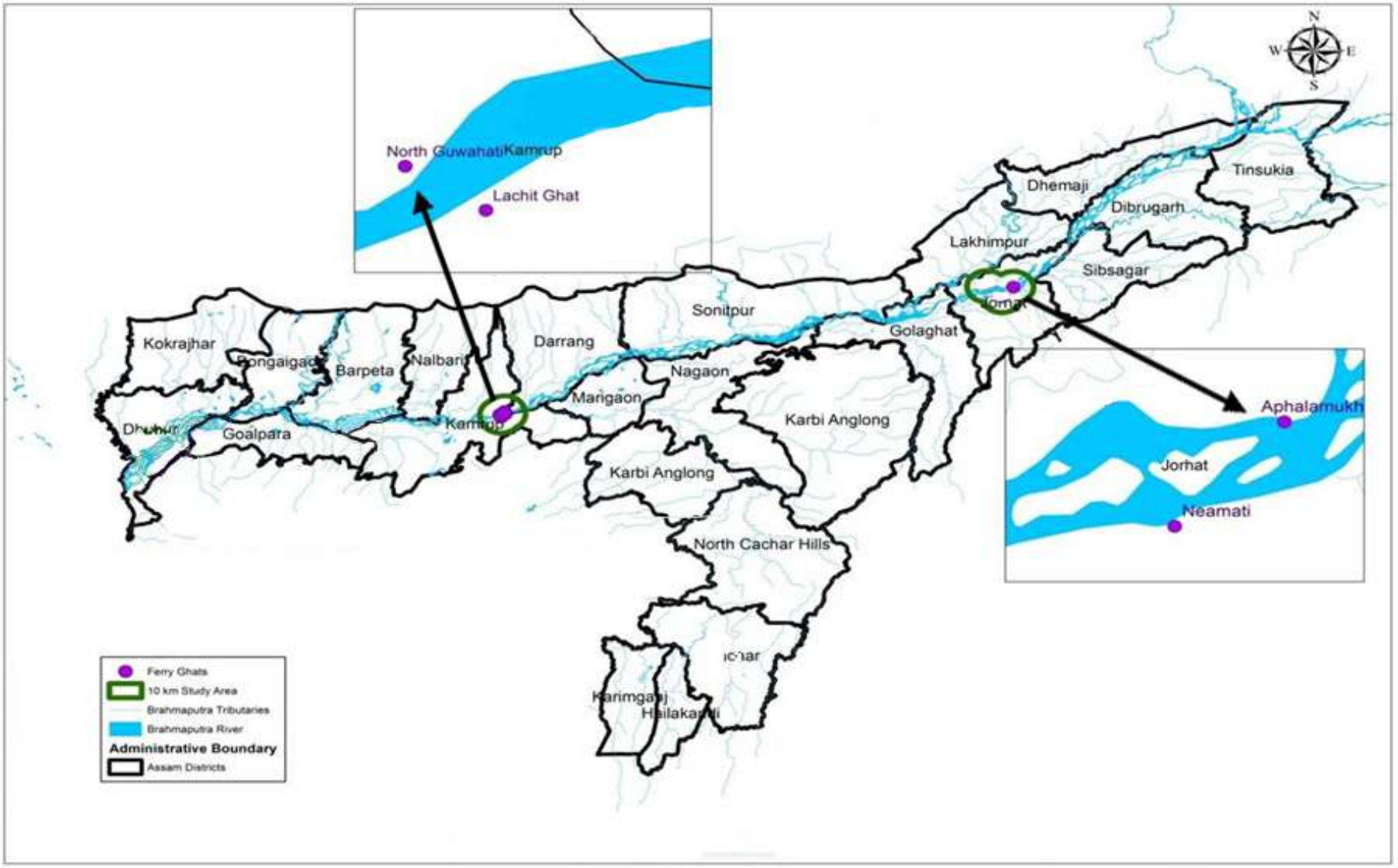


Figure 1-3: Location Map of 03 Terminals / Ghats / Landing Points for development of ferry services in Assam for Phase-I

1.3 Project Development Objective (PDO)

The Project Development Objectives (PDOs) are to (a) improve passenger ferry infrastructure and services in Assam and (b) improve the institutional capacity and framework for inland water transport in Assam.
The PDO will be measured by seven PDO indicators given below. These indicators are further detailed in Results Framework in section VI of this document.

Passenger Ferry Infrastructure and Services

- Ferry service hours available in a day - on project supported ferry routes
- Percent women users of ferries during peak hours
- User satisfaction (on access, safety, quality of services, facilities etc) disaggregated by gender on project supported ferry routes

Institutional Capacity and Framework

- Regulation of IWT operations in Assam strengthened
- Unbundling public sector operations from industry regulations
- Enhanced IWT sector capacity on safety and modern technologies
- Establishing an emergency response system including a search and rescue unit

1.4 Project Components

The project is supported by an Investment Project Financing (IPF) of US$88 million, which includes a financing of US$53 million based on achievement of DLIs. The project will support ferry infrastructure and services (terminals and vessels), institutional reforms, consultancies/analytical studies, training and capacity building, goods including information and communication technology equipment, and development of software applications for safe and efficient management of the sector.

The project activities are organized under the following four components collectively intended to tackle the regulatory, operational, and infrastructure challenges of the sector.

Component 1: Institutional, regulatory and safety strengthening (estimated cost US$21 million)

This component will include the following:

a. Technical Assistance: (i) Carrying out technical assessments/studies to prepare an integrated state-wide inland water transport (IWT) strategy and investment plan, to mainstream inland water transport and promote multi-modal integration and last mile connectivity; (ii) carrying out environmental and social impact assessments in relation to inland water transport investments financed under the Project; (iii) carrying out studies on weaknesses, institutional requirements and business plans for the IWT sector, to prepare institutional reforms including basic legislation for the strengthening of Assam Inland Water Transport Regulatory Authority (“AIWTRA”) to develop and enforce safety, environmental and economic regulations for the IWT sector; (iv) unbundling shipping/ferry and terminal operations in Assam by establishing and operationalizing the Assam Shipping Company (“ASC”) and Assam Ports Company (“APC”), developing business plans therefor, and providing technical assistance/guidance during the initial years of operations; and (v) undertaking assessment on, and eventually strengthening, the institutional capacity of the Directorate of Inland Water Transport Assam (“DIWTA”) including establishing a new hydrography unit, carrying out job-mapping exercises and developing sector competencies (training and re-skilling)(US$11 million).

b. Safety Management: (i) Assessing, procuring and deploying navigations aids in the Brahmaputra and Barak rivers to allow 24-hours/night navigation services in

the most trafficked routes/crossing points; and (ii) establishing a search and rescue organization, piloting an emergency response system (including developing policies and procedures, procuring equipment and setting up/supporting management and operation teams), and improving existing systems for emergency preparedness for natural disasters and climate change(US$10 million).

Component 2: Fleet safety improvements and modernization (estimated cost US$25 million)

This component will include the following:

a. "Jibondinga" incentive scheme: Implementing the "Jibondinga" incentive scheme retrofitting of existing vessels and/or new vessel acquisition by private boat/ferry operators through the provision of Matching Grants(US$10 million).

b. Procurement of New Vessels and Retrofitting of Existing Public Vessels: (i) Procuring approximately twenty (20) passenger ferries for ASC, with capability for carrying motorcycles and cargo, as well as providing longer haul services; (ii) retrofitting existing vessels operated by DWITA and/or ASC; and (iii) repurposing old pubic vessels for the provision of alternative (non-transport) critical public services (e.g. mobile clinics, schools, libraries, etc.)(US$15 million).

Component 3: Improvement in terminal infrastructure (estimated cost US$55 million)

This component will support the following:

a. Provision of Priority Terminals and Repair Facilities: Designing and constructing approximately three (3) priority mid- to large-size terminals and repair facilities in congested river crossings, as per standard modular designs for scalable infrastructure adaptable to rural and urban areas and following the "working with nature" approach (US$40 million).

b. Provision of Smaller Terminals: Designing and constructing at least four (4) small and mainly rural terminals, as per standard designs for modular and scalable infrastructure adaptable to rural and urban areas (US$15 million).

Component 3 will provide standard designs for modular and scalable infrastructure that can be adapted for other urban and rural ferry terminals. It also includes ancillary infrastructure such as road access, terminal buildings, and other amenities for the differently abled, women, children, old, and infirm.

Component 4: Project management support (estimated cost US$9 million)

This component will support implementation of the above three components and provide for costs on project preparation, implementation, coordination, and monitoring and evaluation (M&E). An important element of the component would support capacity augmentation and policy support on climate mitigation and adaptation through consultancies, knowledge events, staff training, and so on.

The activities supported under the component specifically include- Providing support for Project implementation, coordination, monitoring and evaluation, through: (i) establishing and ensuring the operability of AIWTDS, including the provision of training, staffing, office modernization and equipment; (ii) ensuring the operability of the AIWTRA, including the provision of training, staffing, office and equipment; (iii) providing technical assistance and management support, including hiring the services of the General Consultant and the Independent Verification Agency; (iv) carrying out Project audits; and (v) setting up monitoring and evaluation systems(US$9 million).

Geo-Coordinates of the proposed 3 Ghats in Phase-I of the Project is given in **Table1-8.**

Table 1-7: Geo-Coordinates of the proposed 3 Ghats in Phase-I of the Project[1]

Ghats	North Bank		Ghats	South Bank	
	Latitude	Longitude		Latitude	Longitude
AIWTDS Division, Guwahati District					
North Guwahati	26.1869	91.72157	Guwahati Gateway Ghat	26.17993	91.734282
AIWTDS Division, Dibrugarh District					
Aphalamukh	26.91587	94.299388			

1.5 Objective of EIA study

Theactivities related to implementation and development of infrastructure facilities under this project is likely to cause environmental & social impacts. Attempts have been made to identify potential impacts for activities and measures suggested to be incorporated in the design as feasible. These measures will be further updated once design aspects are fully finalised.

The objectives of the EIA study include:

- Identification of potential environmental components due to project activities
- Assessment of possible environmental impacts during stages of implementation of the project (construction or operation phase)
- Mitigation measures in accordance with World Bank's operational policies, WB Guideline, MoEF&CC Notification & Guidelines
- Environmental Management Plan as per EMF & their effective implementation
- Incorporate environmental consideration during design

The EIA report is prepared for Phase I locations. Phase I locations include 2 Ghats in Guwahati Division i.e. GGG on South Bank at about 100m upstream of Existing GGGof the Brahmaputra River and North Guwahati Ghat on North Bank of the Brahmaputra River and 1 Ghat in Dibrugarh Division i.e. AphalamukhGhat on North Bank of Brahmaputra River. Rest identified Ghats will be studied for EIA in next phase.

1.6 EIA Methodology

This project is classified as **Category "A"** operations under the World Bank environmental screening procedures, specified under its operation policy 4.01. The Environmental Impact Assessment study has been undertaken for all the proposed components of the project to identify the environmental and social issues associated with the project. The environmental impact assessment is carried out in line with World Bank Operational Policies, IFC EHS Guidelines for Ports, Harbours, and Terminals, IFC General Guidelines for EHS, MoEF&CC EIA Guidelines for Ports and Harbours and Environment Management Plan prepared for the project.

Broad methodology followed to carry out EIA is outlined below:

- Literature survey
- Field survey to establish existing baseline environmental status of all relevant parameters
- Public consultation
- Interaction with NGOs, IWT, AIWTDS
- Identification and prediction of Environmental impact
- Collection of secondary data
- Analysis of project activities and alternatives
- Review of environmental legal framework and relevant guidelines
- Mitigation measures to minimise environmental impacts

[1] This has been finalized in joint site visit held on January, 2019 in presence of management representatives of WB, AIWTDS and key consultants of the project including ISDP, Design DPR, EIA-SIA.

- Environmental Management Plan
- Risk Assessment and Disaster Management Plan

Topo-sheets and Google maps are used for the geographical analysis. Since it is having strong interface with aquatic ecology, larger emphasis is given for primary data collection with regard to zooplanktons, phytoplankton, fishes, and aquatic fauna. Establish sampling, and observation techniques are applied for this assessment. Influence area is considered for this project is 500 m, 2 km and 10 kms in line with the screening study recommendations and TOR. The influence area is assessed based on different project activities. Details of the parameters studied in each zone are given below;

500 m radius: All the parameters of environmental, socio-economy and cultural importance are studied within this zone.

2 km radius: All the parameters of environmental, socio-economy and cultural importance are studied within this zone also.

10 km radius: Parameters studied under this zone include environmental sensitive locations as notified by GoI, land use, socio-economy, and geology, seismicity & drainage pattern.

Appropriate tools and techniques are used to identify and predict the magnitude of the impacts. Suitable mitigation measures are suggested based on the intensity of the impacts identified for both offshore and onshore activities. The Environmental Management and Monitoring Plan with institutional responsibilities is also prepared to ensure effective implementation of the mitigation measures proposed. As per EIA Notification, 2006 by MOEF&CC, at present, the project components, like development of terminals & jetties do not require environment clearance. However, environment clearance may be required for the activities like borrowing of earth which should be taken by the respective contractor. Additionally, NOC/Permissions are required to be obtained for specific activities like setting up Batch Mix Plant,Hot Mix Plant, DG Sets, STP from respective agencies as indicated under legal and administrative framework. All permissions will have associated conditions thatwillbecomplied by contractors / AIWTDS. None of these permissions require detailed environmental impact assessment. However; findings of this EIA and proposed mitigation measures would be useful in obtaining these permissions.

1.7 Data Collection

Secondary data is collected with focus on sensitive receptors like religious places, habitat areas, noise, air quality, water quality (ground and surface water both), soil, biodiversity (terrestrial and aquatic both). The primary data are collected through baseline environmental monitoring, conducted by NABL andMoEF&CC accredited Laboratory.

1.8 Public Consultation

Consultations are held focusing on air quality, noise effect, water supply, drainage, aquatic and terrestrial flora and fauna, physical cultural resource of importance, environmental sensitive ecosystems or areas that may be affected by the project. Formal institutional level public consultation and informal meetings with local villagers and those who are likely to be affected due to the proposed projects are organized to determine potential environmental and socio-economic impacts. Interactions are also held with NGOs and concerned government officials. According to ‘OP 4.01: Environmental Assessment’ of World Bank, thefollowing conditions applies to the proposed subprojects.

Public consultation to be carried out with the project affected groups and local non governmental organizations (NGOs) about the project's environmental aspects to take their views into account. The stage consultations are;

(a) Shortly after environmental screening and before the terms of reference for the EA are finalized;

(b) After EMF preparation and
(c) Once a draft EIA report is prepared.

Amongst these first two stages i.e. screening scoping in Guwahati and EMF stage consultations in Guwahati and Dibrugarh are conducted and presentedin Chapter 5. EIA stage consultation will be carried out at district level once EIA will be approved from World Bank.

1.9 Structure of EIAReport

Chapter 1: Introduction: This chapter describes project framework, objective and background including the need of the project.

Chapter 2: Administrative and Legal (Regulatory) Framework: This chapter deals with the identification & listing of applicable legislations and applicable administrative framework. It also provides screening of applicable operational policies of World Bank and other international practices and guidelines.

Chapter 3: Project Description: This chapter describes the various project components incorporated in the overall Project for development.

Chapter 4: Alternative Analysis: The alternatives that are considered have been summarised together with selection of the preferred option.

Chapter 5: Stakeholder Consultation: This chapter highlights the process followed for the public consultation carried out with the various stakeholders.

Chapter 6: Current Environmental Scenario: This chapter describes the baseline environmental status in and around the project sites.

Chapter 7: Assessment of Impacts and Mitigation Measures: This chapter presents summary environmental baseline condition and linked identification with magnitude of anticipated potential impact for each environmental and cultural resource.

Chapter 8: Additional Studies: The present chapter gives details of the study of accretion, erosion / deterioration, risk assessment, Occupational health & safety and disaster management plan w.r.t. the proposed project.

Chapter 9: Environmental Management Plan and Environmental Monitoring Programme: This chapter provide the details on the management plans and the institutional mechanism required along with resources required for effective implementation of the proposed mitigation measures and the monitoring framework essential during construction as well as operation period.It also highlights the institutional mechanism aswell as capacity building needs for the implementation. The chapter also sepcifies environmental monitoring programme.

Chapter 10: Summary and Conclusion: This chapter provide the summary of findings and concluding remarks.

Chapter 11: References

Chapter 2 : Administrative and Legal (Regulatory) Framework

India has well defined institutional and legislative framework for environmental protection. The legislations cover all components of environment viz. air, water, soil, terrestrial and aquatic flora and fauna, natural resources, and sensitive habitats. India is also signatory to various international conventions and protocols. The environmental legislations in India are framed to balance between development and environment. World Bank has also defined its Environmental and Social Safeguard Operational Policies. This assessment is about the applicability of above laws and regulations, conventions, protocols and safeguards.

The national environmental legislations are broadly discussed here. The MoEF&CC, Central Pollution Control Board (CPCB), Dept. of Env. & Forest, GoA and State Pollution Control Board, Assam (SPCB) together form the regulatory authorities for implementation of provisions of environmental legislations. Other Ministries/Statutory Bodies/Departments responsible for ensuring environmental compliance and granting various clearances includes State Dept. of Environment, Regional Offices of MoEF&CC and State Forests/Wildlife Departments are also discussed.

2.1 Applicable National Environmental Legislations

Screening has been done to identify the legislations applicable to the project. GoI Regulations applicable to the project are given in **Table 2-1** and legislations framed for vessels plying in inland waterways by IWAI and MOS, GoI are given in **Table 2-2**. All the legislations are covered in EIA as per the requirement. AIWT Project will be adhered to the National regulations and state regulatory requirements.

Table 2-1: Environmental Legislations Applicable to the Project

Name	Key Objective	Applicability	Type of permit and stage of applicability	Administrative Authority and indicative time frame for grant of permission	Responsibility
Water Prevention and Control of Pollution) Act, 1974, Amendment there of	To prevent and control water pollution.	Applicable. It is applicable for the projects having potential to generate effluent during any stage of the project. Effluents are expected to be generated during both the construction and operation phase of the project	Consent to Establish (CTE)&Consent to Operate (CTO)	SPCB	CTE should be taken by Contractor for disposal of sewage during construction. Compliance to the conditions mentioned in the CTE should be done by Contractor CTE/CTO for each proposed facility under the project should also be obtained by contractor along with CTE / CTO under Air Act. AIWTDS should ensure the conditions specified in CTO/CTE are complied with
Air (Prevention and Control of	To prevent and control Air pollution	Applicable Emission is expected	Consent to Establish (CTE) before	SPCB	Contractor, should obtain CTE for setting up each

Name	Key Objective	Applicability	Type of permit and stage of applicability	Administrative Authority and indicative time frame for grant of permission	Responsibility
Pollution) Act, 1981, 1987 The Air (Prevention & Control of Pollution) Assam Rule, 1991, framed under Air (Prevention & Control of Pollution) Act, 1981		during construction, operation of DG, vessels etc.	construction &Consent to Operate (CTO) after commissioning		facility, batching plant, hot-mix plant, DG set as prior to its establishment from SPCB CTO should be taken by contractor for batching plant, hot-mix plant & quarry site as required prior to operation and it should be renewed before the expiry of permit. Contractor to comply CTE & CTO conditions. Contractor should also obtain CTE/CTO for each proposed facility under the project before its handover. Contractor and AIWTDS should ensure to comply with the conditions as mentioned in CTO
Environment Protection Act-1986 and Rules (2000) there under	To protect and improve overall environment.	It is an umbrella Act for environmental safeguard related to the project.	Environment Clearance if the construction is more than 20,000m^2	MoEF&CC& SEIAA / SEAC	AIWTDS/ Contractor for obtaining environmental clearances as applicable.
EIA Notification 14th Sep 2006 and amendment till date	Environmental mitigation measures incorporated at planning stage	However, EIA Notification 2006 does not classify terminals/jetties / floating terminals on river or dredging in the river as a project requiring environmental clearance. The applicability of this legislation should be reassessed periodically from the concerned authority during	Construction stage for EC for borrowing earth as applicable		Contractor should also be responsible for EMP implementation. All the construction materials such as sand, stone chips, earth to be sourced from the agency having valid Environmental Clearance

Name	Key Objective	Applicability	Type of permit and stage of applicability	Administrative Authority and indicative time frame for grant of permission	Responsibility
		IWT project development and implementation stages to ensure conformity with changes in the regulations if any. Borrowing of earth for road construction as may be required will require prior environment clearance under mining category.			
Noise Pollution (Regulation and Control Act) 2000 and amendment till date	Ambient Noise Standards for different areas and zones	Applicable due to generation of noise during construction and operation stage	No permits issued under this act	District Administration & Police	Contractor and AIWTDS to ensure compliance to Ambient Noise Level Standards.
Hazardous & Other Wastes (Management and Trans boundary Movement) Rules, 2016	Proper handling storage and disposal of hazardous waste.	Applicable. Project has potential to generate hazardous waste (Used Oil) during both construction and operation phase.	Authorization	SPCB	Contractor should obtain authorization for handling used oil generated from vehicles, DG, vessels should be collected and stored properly. This should be periodically sold to authorised recyclers.
MSIHC Rules, 1989 Chief Controller of Explosives,	Usage and storage of hazardous material	Applicable only for storage of highly inflammable liquids like HSD/LPG above regulatory quantity	Specific permit is required for storage of Fuel. Also, precautions defined under the material safety datasheets should be followed for use of hazardous substances listed under the schedules of	Factory Inspector	Contractor and AIWTDS. Compliance to the rules should be ensured

Name	Key Objective	Applicability	Type of permit and stage of applicability	Administrative Authority and indicative time frame for grant of permission	Responsibility
			Rules. Safety audit and other requirements should have to be complied if storage quantity exceeds the regulated threshold limit		
The Bio Medical Waste Management Rules, 2016	Proper management of Bio Medical Waste.	Applicable for the disposal of bio-medical waste from first aid centres.	Permit is required from SPCB to comply with the handling and disposal requirements of the rule and SPCB Requirement	SPCB	AIWTDS should dispose all such waste through authorised common facility
Construction and Demolition Waste Management Rules, 2016	To manage the construction and demolition waste	Applicable to all those waste resulting from Construction, remodelling, repair & demolition of any civil structure.	Approval required from local authorities.	Local Authorities.	Contractor and AIWTDS. Compliance should ensure proper collection of C & D waste and handover to agency authorised by Municipal Corporation
E-Waste (Management) Rules, 2016	To manage the E-waste but not covering lead acid batteries and radioactive waste	Applicable as desired of life electronic gadgets will be generated from office, vessels etc.	No permit. Annual Report to be submitted to SPCB	SPCB / Local Body	Proper storage and handing over to authorised E-waste Dismantler / Recycler
Plastic waste Management Rules, 2016	To manage the plastic waste generated	Applicable Rule applies to every waste generator, local body, Gram Panchayat, manufacturer, importers and producer.	No authorization to be obtained. Waste management and minimization to be done. Fee to be paid to local bodies, if applicable	Local Bodies	Contractor and AIWTDS. Plastic waste should be segregated and handover to Local Body or Authorised recyclers / Cement Plant for co-processing or Works Dept. for road construction.
The Batteries (Management and Handling) Rules 2010	To regulate the disposal and recycling of lead acid batteries	Applicable Applicable for disposal of used lead acid battery if likely	No specific registration required.	SPCB	Contractor and AIWTDS. Compliance to the rules should be ensured. Proper

Name	Key Objective	Applicability	Type of permit and stage of applicability	Administrative Authority and indicative time frame for grant of permission	Responsibility
		to be used in any equipment during construction and operation stage			collection, buy-back system with Battery Manufacturer.
Solid Waste Management Rule, 2016	Proper management of domestic waste	Applicable	Pay user fee as applicable	Local Authority /Contractor	AIWTDS / Contractor Segregate waste at source. Proper Collection. Biodegradable for compost. Non-biodegradable to urban Body.
Fly Ash Notification, 2009 & 2016	Utilisation of fly ash from coal based Thermal Power Plant (TPP)	Applicable. No permit required	SPCB	SPCB	Contractor should use fly ash for low lying area filling and use fly ash bricks, if located within 300 km from TPP
The Motor Vehicle Act 1988& Rules	To enforce standards for vehicular pollution.	Applicable	All vehicles used during construction and operation will need to comply with the provisions of this act.	State Transport Authority	Contractors to ensure that all vehicles plying should have PUC certification
Forest Conservation and Wildlife Protection Legislation					
The Forest (Conservation) Act, 1980 and amendments The Forest (conservation) Rules 1981 and amendments till date	To protect forest by restricting conversion of forestareas into non-forested areas and deforestation	Forest area is not identified in the project area, so no conversion is applicable. Permission required for tree cutting	Forest Clearance / Permission for tree cutting.	Forest Department, DFO, Assam NOC should be obtained from forest department (DFO) prior tree cutting. All the conditions mentioned in NOC should be complied with.	Not Applicable
Biological Diversity Act, 2002	Conservation of biological diversity, sustainable use of its components.	Not Applicable	No permit issued under this Act.	National Biodiversity Authority and State Biodiversity Board	Not Applicable
Wild Life Protection Act, 1972, 1993	To protect wildlife through notifying National Parks and Sanctuaries and eco-sensitive zones	Not Applicable as the project sites are not located in the defined sensitive zones	Wildlife clearance	Chief Conservator Wildlife, Wildlife Wing, Forest Department, MoEF&CC	Not applicable

Name	Key Objective	Applicability	Type of permit and stage of applicability	Administrative Authority and indicative time frame for grant of permission	Responsibility
Safety and Other Related Legislations					
Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996	Chemical Accident Response	Applicable. The project will involve handling of hazardous chemical during both construction and operation above the regulatory quantity.	Permits issued under this act	Central, State & District Crisis Group Chief Inspector ofFactories, Assam	AIWTDS &Contractor
Public Liability and Insurance Act 1991	To provide immediate relief to victims in case of an chemical accident	Applicable if the project will involve storage of chemicals (HSD) beyond the threshold limit during construction/operation	Owner of project should take out insurance policies	Deputy Commissioner (DC) of the concerned districts. In case of proposed development during phase-I investment, DCs from Kamrup. Kamrup (metro) &Majuli districts.	AIWTDS & Contractor
Explosive Act 1884 & Explosive Rules, 2008	Safe transportation, storage and use of explosive material	Applicable as fuel will be stored at Maintenance in project development area Terminals	Permission for storage and usage of explosive or flammable materials	Chief Controller of Explosives	AIWTDS & Contractor
Petroleum Rules, 2002	Use and Storage of Petroleum products	Applicable as storage of HSD/LPG or any other petroleum product may be required for the project purpose	License to store petroleum beyond prescribed quantity.	Chief Controller of Explosives/DC	Contractor / AIWTDS. Compliance to the rules should be ensured
The Gas Cylinder Rules 2004	To regulate the storage of gas / possession of gas cylinder more than the exempted quantity	Applicable if contractor store more than the exempted quantity of gas cylinder.	License to store gas cylinder more than the regulated quantity	Chief Controller of explosives	Contractor. Compliance to the rules should be ensured
Ancient Monuments and Archaeological Sites and Remains Act, 1958	Conservation of notified Archaeological monument	Not Applicableas no such notified Archaeological monument are existing	No objection certificate	Archaeological Dept. GoI, Indian Heritage Society and Indian National Trust for Art and Culture Heritage	Not Envisaged

Name	Key Objective	Applicability	Type of permit and stage of applicability	Administrative Authority and indicative time frame for grant of permission	Responsibility
				(INTACH).	
Guidelines for evaluation of proposals / requests for ground water abstraction for drinking and domestic purposes in Notified areas and Industry / Infrastructure project proposals in Non-notified areas, 2012	To regulate extraction of ground water for drinking and domestic purpose	Applicable if ground water is extracted	No objection certificate	Central ground Water Authority/Board &MoEF&CC	Contractor / AIWTDS should obtain NOC from CGWA/CGWB be ensured by AIWTDS and contractor

Table 2-2: Regulations Applicable on Vessels Plying in Inland Waterways

Name	Key Requirements	Applicability
Prevention of Collision on National Waterways Regulations, 2002	Preecautions required for vessels and crew members	Applicable for all the vessel plying in IWT
National Waterways, Safety of Navigation and Shipping Regulations, 2002	Ensuring safety during navigation on the national waterways	Applicable for all the vessel plying in IWT
The National Waterway Act, 1982	Regulation and development of rivers for navigation	Applicable for all the rivers under IWT
New Inland Vessel Act, 2015 & Rules Under IV Act	Economical and safe transportation through inland waters	Applicable for all the vessel plying in IWT

2.2 World Bank Policies and Requirements

The World Bank has published a number of Safeguard Policiesand Guidelines to ensure that all possibleimpacts are taken care of by implementing mitigation measures in the proposed project.

The applicable WB safeguard policies are described below.

2.2.1 Environmental Assessment (OP/BP 4.01)

The World Bank requires environmental assessment (EA) ofsupportedprojectsto achieve environmentally sound and sustainable developmental goal. The Bank Policy OP/BP 4.01 considers that EA is a process whose breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the proposed project. EA evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. EA takes into account the natural environment (air, water and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples and physical cultural resources); and trans-boundary and global environmental aspects. The Bank Policy also envisages that the borrower Government is responsible for carrying out the project.

World Bank's operational policy 4.01 (OP 4.01) categorize the project into Category A, B & C on the basis of nature and extent of the impacts anticipated. Scope of Environmental assessment studies depends on the category of the project, defined below.

Category A - Projects with significant environmental impacts and requiring a full Environmental Assessment (EA),

Category B - Projects with moderate environmental impacts and requiring a lesser level of environmental assessment,

Category C - Projects which require no environmental analysis as the impact potential is marginal

Proposed Project involves augmentation of navigation capacity of existing IWT by developing various facilities like terminals, jetties, navigation aids etc.The project is likely to impact quality of life, livelihood, terrestrial and aquatic ecology, air quality, water quality, economy, noise levels etc. The anticipated impacts are both positive and negative but will be significant. Thus the project is classified as Category A as per WB policy and therefore, environment and social assessment study is required.

2.2.2 Natural Habitats (OP 4.04)

The Policy highlights the importance of conservation of natural habitats that protect the environment. The Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats and their functions. The Bank also supports, and expects borrowers to apply a precautionary approach to natural resource management to ensure environmentally sustainable development. Furthermore, the Bank promotes the rehabilitation of degraded natural habitats. The Bank does not support projects that involve significant degradation of critical natural habitats.

2.2.3 Forests (OP/BP 4.36)

This Policy recognize the need to reduce deforestation and promote sustainable forest conservation and management in reducing poverty. The Bank believes that forests are very much essential for poverty reduction and sustainable development irrespective of their location in the world. The Bank assists borrowers with forest restoration activities that maintain or enhance biodiversity and ecosystem functionality. The Bank also assists borrowers with the establishment and sustainable management of environmentally appropriate, socially beneficial, and economically viable forest plantations to help meet growing demands for forest goods and services. The Bank does not finance projects that, would involve significant conversion or degradation of critical forest areas or related critical natural habitats. Furthermore, the Bank does not finance projects that contravene applicable international environmental agreements.

2.2.4 Physical Cultural Resources (OP 4.11)

This policy addresses physical cultural resources, which are defined as movable or immovable objects, sites, structures, groups of structures, and natural features andl andscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban orrural settings, and may be above or below ground, or under water. Their cultural interest may be at the local, provincial or national level, or within the international community. The Bank assists countries to avoid or mitigate adverse impacts on physical cultural resourcesfrom development projects that it finances. The impacts on physical cultural resources resulting from project activities, including mitigating measures, may not contravene either the borrower's national legislation, or its obligations under relevant international environmental treaties and agreements.

2.2.5 Environment, Health and Safety Guidelines

The Environment, Health, and Safety (EHS) Guidelines stipulates sound practices by adopting technology at reasonable costs. There are also industry specific EHS guidelines. The guidelines

that are relevant to the project is EHS Guidelines for Ports, Harbour and Terminals, and EHS Guidelines for Shipping.

The policies are summarised in **Table 2-3.**

Table 2-3: Environmental Safeguards Policies relevant forAIWT Project

Name	Key Requirements	Project Applicability	Remarks	Management Plans
OP 4.01 Environmental Assessment	Ensures sustainability and environmental feasibility of the project. Projects are classified into A, B & C category depending on the nature and extent of the impact.	Applicable	Project classified as Category A considering nature of activities and impacts	Environment Management Plans including guidelines and management plans for tree plantation, waste management, Emergency response and budgetary provision for development of EHS management system and Responsible carrier Programme.
OP 4.04 Natural habitats	Ensures conservation of natural habitats and discourages disturbance of nay natural habitat due to project development by recommending adoption of alternative method/route/approach or adopting management measures	Applicable	Triggered for Gangatic dolphins, Tortoise habitat.	Environment Management Plan
OP 4.36 Forests	Ensures that project activities do not disturbs/interfere with the forest, forest dwellers activities, fauna and flora of the forest. Prevents and discourages deforestation and impacts on rights of forest dependent people.	May be triggered for Forest Triggers for tree cutting	Forest area is not identified in the reconnaissance visits. All the sites are confirmed for the forest areas from the relevant sources like forest departments in the respective districts. Tree cutting is not involved.	--do -
WBG Environmental, Health and Safety (EHS) Guidelines (general)	The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an	Applicable	This guideline applies to facilities or projects that generate emissions to air at any stage of	Projects with significant sources of air emissions, and potential for significant impacts to

Name	Key Requirements	Project Applicability	Remarks	Management Plans
	environmental assessment		the project life-cycle	ambient air quality, prevent or minimize impacts
WBG sector-specific EHS guidelines for Jetty, Harbours and Terminals.	The EHS Guidelines for ports, Harbours, and Terminals are applicable to marine and freshwater jetties, harbours, and terminals for cargo and passengers.	Applicable	The following section provides a summary of EHS issues primarily associated with jetty and terminal construction and operations, along with recommendations for their management as part of a comprehensive environmental management system for a given project	Jetties and terminals to be selected through a systematic, documented environmental assessment process that includes rigorous consideration of siting and alternatives, their direct and indirect environmental impacts

2.3 Relevant International Environmental Convention

The relevant international conventions applicable for the project are summarised in **Table 2-4.**

Table 2-4: Relevant International Conventions

Name	Key Requirements
Guideline, Standard and recommendations as published by Environmental Committee of PIANC	International Maritime Dangerous Goods Code (IMDG Code) Dredging Management Practices for the Environment (WG 100-2009) Dredging Material as a Resources (WG 104-2009) Environmental Impact Assessments of Dredging and Disposal Operation (WG 10-2006) Biological Assessment Guidance for Dredged Material (WG 8-2006) Ecological and Engineering Guidelines for WetlandRestoration in relation to the Development, Operation and Maintenance of Navigational Infrastructure (WG 7-2003) Management of Aquatic Disposal of dredged material (WG 1-1998) Dredged Material Management Guide 1997. Guidelines for sustainable Inland Waterways and Navigation WG 6-2003 Environmental guidelines for aquatic, near shore and upland confined disposal facilities for contaminated dredged material WG 5-2002 Dredging the environmental facts-where to find what you need to know? PIANC-IADC-WODA brochure-2001 Environmental management framework for ports and related industries WG 4-1999 Dredging: the fact WODA brochure-PIANC-IADC-CEDA IAPH1999
International Maritime Organization	Initial Assessment of Environmental Effects of Navigation and Infrastructure Projects (WG 143 -2014) Sustainable Waterways Within the Context of Navigation and Flood

Name	Key Requirements
Conventions	Management(WG 107 -2009) Climate Change and Navigation (TG3 -2008) International Labour Organization (ILO) Code of Practice for Safety and Health in Ports (2005); General Conference of the International ILO Convention concerning Occupational Safety and Health in Dock Work, C-152, (1979) General Conference of the ILO Recommendation concerning Occupational Safety and Health in Dock Work, R-160 IMO Code of Practice for Solid Bulk Cargo (BC Code) International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk (IBC Code) International Code for the Safe Carriage of Grain in Bulk (International Grain Code) Code of Practice for the Safe Loading and Unloading of Bulk Carriers (BLU Code) International Maritime Dangerous Goods Code (IMDG Code)
IFC, World Bank Group	General Environment Health & Safety Guidelines Environment Health and Safety Guidelines for Ports, Harbours and terminals
MARPOL Convention	The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. The MARPOL Convention was adopted on 2 November 1973 at IMO. The Protocol of 1978 was adopted in response to a spate of tanker accidents in 1976-1977. As the 1973 MARPOL Convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent Convention. The combined instrument entered into force on 2 October 1983. In 1997, a Protocol was adopted to amend the Convention and a new Annex VI was added which entered into force on 19 May 2005. MARPOL has been updated by amendments through the years. The Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes six technical Annexes. Special Areas with strict controls on operational discharges are included in most Annexes. Annex I:Regulations for the Prevention of Pollution by Oil (entered into force 2 October 1983) Covers prevention of pollution by oil from operational measures as well as from accidental discharges; the 1992 amendments to Annex I made it mandatory for new oiltankers to have double hulls and brought in a phase-in schedule for existing tankers to fit double hulls, which was subsequently revised in 2001 and 2003. Annex II: Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered into force 2 October 1983) Annex III: Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (entered into force 1 July 1992).

Name	Key Requirements
	Annex IV: Prevention of Pollution by Sewage from Ships (entered into force 27 September 2003) Contains requirements to control pollution of the sea by sewage; the discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewagetreatment plant or when the ship is discharging comminuted and disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land; sewage which is not comminuted or disinfected has to be discharged at a distance of more than 12 nautical miles from the nearest land. Annex V: Prevention of Pollution by Garbage from Ships (entered into force 31 December 1988) Deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of; the most important feature of the Annex is thecomplete ban imposed on the disposal into the sea of all forms of plastics. Annex VI: Prevention of Air Pollution from Ships (entered into force 19 May 2005) Sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances; designated emission control areas set more stringent standards for SOx, NOx and particulate matter. A chapter adopted in 2011 covers mandatory technical and operational energy efficiency measures aimed at reducing greenhouse gas emissions from ships.
Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter, 1972 (London Convention)	Article I Contracting Parties shall individually and collectively promote the effective control of all sources of pollution of the marine environment, and pledge themselves especially to take all practicable steps to prevent the pollution of the sea by the dumping of waste and other matter that is liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea. Article II Contracting Parties shall, take effective measures individually, according to their scientific, technical and economic capabilities, and collectively, to prevent marine pollution caused by dumping and shall harmonize their policies in this regard.

2.4 Environmental Standards & Guidelines

Project involves various activities, which may interfere with various environmental components. Thus it is required to control those activities so as the concentration of pollutant in environment should not exceed its assimilation capacity. MOEF&CC, GOI has notified standards under EP Act, 1986 for disposal of effluents and quality of surface water body, which should be complied with. Suggested list of standards is listed below and given in detail at **Annexure-2.1**

- Standards for discharge of effluent in inland surface water bodies and Marine Coastal Areas (Source: G.S.R 422 (E) dated 19.05.1993 and G.S.R 801 (E) dated 31.12.1993 issued under the provisions of E (P) Act 1986)
- Classification of Surface water Bodies on basis of Quality (Source: Guidelines for Water Quality Management-CPCB, 2008)
- Water Quality Standards for Coastal Waters, SW-IV & V-Harbour and Navigation & controlled waste disposal (EIA Guidance Manual for Ports & Harbours, MoEF&CC, GoI)
- Standards for permissible level of water quality indicators (Source: Assessment of the Environmental Impact of Port Development, United Nations, New York, 1992)
- Permissible limit for off-shore dumping of dredged material (Source: Assessment of the Environmental Impact of Port Development, United Nations, New York,1992)
- Criteria for harmful bottom sediments (Source: Assessment of the Environmental Impact of Port Development, United Nations, New York, 1992)
- Approximate Quantity of Suspended Sediments Generated by Dredging or Dumping Operations (Source: Assessment of the Environmental Impact of Port Development, United Nations, New York, 1992)

2.5 Public consultation and disclosure requirements by World Bank

According to 'OP 4.01: Environmental Assessment' of World Bank, thefollowing conditions applies to the proposed subprojects.

Consultations: Public consultation to be carried out with theproject affected groups and local nongovernmental organizations (NGOs) about the project'senvironmental aspects to take their views into account. Various stages of consultations are;

(a) Shortly after environmental screening and before the terms of reference for the EA are finalized;
(b) After EMF preparation and
(c) Once a draft EA report is prepared.

Amongst these first two stages i.e. screening scoping in Guwahati and EMF stage consultations in Guwahati and Dibrugarh are conducted and presented in Chapter 5. EIA stage consultation will be carried out at district level once EIA will be approved from World Bank. Accordingly, the reports will be revisedincorporating the findings and recommendations of the EIA stage consultations.

For Category A project, thedraft EA report is placed in public domain for comments and observations.

Chapter 3 : Project Description

The project is focused on improving ferrying of cross-river passengers in Assam and seeks to use the opportunity to establish a tenable foundation for development of a modern IWT sector in Assam. The long absence of adequate policy response and piecemeal investments in IWT in the state (as also nationally) has resulted in a somewhat unorganized and poor condition for the sector, which is not predisposed to a linear scale-up. Despite the odds, however, Assam manages to provide ferry services to about 9 million people annually, usually along with their vehicles, livestock, or goods. Supporting the functioning but ill-equipped IWT sector therefore requires a more granular approach encompassing a range of supply- and demand-side factors. As such, the project is guided by a binding philosophy that admits wider and even incremental interventions as long as they contribute to strengthening institutions and planning, operational efficiency and safety, and importantly, sustainability. The project has four components collectively intended to tackle the regulatory, operational and infrastructure challenges of the sector including one component supporting project management.

3.1 Project Components

Component 1: Institutional, regulatory and safety strengthening (estimated cost US$21 million)

This component will have two subcomponents.

a. **Sector planning, design and rollout, operationalization of new Regulatory Authority (RA), business planning and operationalization of Assam Shipping Company (ASC) and Assam Ports Company (APC), including remuneration of staff/specialists hired at the RA, ASC, APC, and Assam Transport Policy; modernization of crew training center and training of staff to fulfill new roles in the restructured industry(US$11 million)**

The subcomponent has essentially provided for technical assessments/studies to form the basis for sector-level strategic plans and institutional reforms. An ISDP for water transport in the state is being prepared. The exercise involves preparing a water transport strategy for Assam and an investment plan to help mainstream water transport in the state including multimodal integration and lastmile connectivity. Studies on EIA and SIA are also being undertaken.

Complementing the investments in infrastructure, the project aims to strengthen the Assam IWT sector through a supportive institutional framework. A wide-ranging consultancy on the Institutional Strengthening and Business Plan (ISBP) is assigned to study the system weaknesses in detail and develop prescription for more effective institutions. In doing so, the study has already provided the basic legislation for an independent IWT RA to carry out the safety, environmental, and economic regulation of the sector (shipping, ports, and shipbuilding). An important emphasis of the subcomponent while assessing sector laws and regulations is particular attention to safety regulations for vessel and passenger movement, even more specifically for women and children. Recently, the bill has been passed by the state in November 2018 for establishing an independent RA for IWT. The operationalization and salaries cost of the RA will be financed under this subcomponent through the life of the project.

Further, the operational and commercial functions of the government's shipping operations and terminal services have been decided to be vested in two new companies: the ASC and the APC respectively. The two new corporations will be constituted under the Companies Act (2013) and subject to rigors of the market. The ISBP will develop a business plan for the two companies and guide them through the initial period of independent operation. The incremental operational cost and salaries cost of the ASC andthe APC will be financed under this subcomponent for the first three years after incorporation of these companies. The water transport strategy will assist the

state in developing a water transport policy with a broad road map for future investments that promote a more balanced modal mix, improved modal integration, mainstreaming of IWT, and better climate adaptability/resilience and emission reduction.

Another important element supported under the component is sector capacity. The capacity of institutions needs to improve to deliver roles effectively in the upgraded sector. The consultancy studying institutions (ISBP) will undertake a detailed assessment of capacity-building needs of DIWTA staff from the point of view of their professional development, re-skilling, and job mapping needs. In particular, developing or consolidating capacity to undertake regular surveys, charting of the river, and recording and analysis of data, which in turn helps institutionalize knowledge on river navigation, is of immense importance. The project therefore proposes to establish aHydrography Unit under the DIWTA of IWT Assam. The component would also support modernizing the CTC, embedding the Lighthouse India Initiative.

b. **Safety management: river navigation aids, night navigation technology on some routes, and emergency response system (policy, procedures, vessels, and equipment) (US$10 million)**

The subcomponent would draw on national/international experience in assessing appropriate aids to navigation, procurement, and deployment to allow 24-hour services/night navigation on the most vulnerable, trafficked routes, or crossing points. Beginning with pilots at 2–3 crucial locations, deployment of navigation aids will be scaled up based on the investment strategy for the sector.

An important objective will be to support the establishment of a Search and Rescue Unit; or pilot an emergency response system (policy, procedures, equipment, and management); and improve systems for emergency preparedness including climate and natural disasters. The emergency mechanism to respond to expected climate risks would involve advance weather information systems, which would help better schedule inspections to ensure resilience of old/new structures to climate change pressures and improve and integrate emergency evacuation procedures into operations.

Component 2: Fleet safety improvements and modernization (estimated cost US$25 million)

This will include financing of the two subcomponents.

a. **GoA incentive scheme (known as Jibondinga) to assist industry transition to the new regulatory regime; it is designed to help retrofit existing but acceptable vessels with modern marine engines and safety equipment and support scrapping and replacement of unsafe or obsolete private vessels with new vessels (US$10 million)**

The objective of supporting an incentive scheme is to ensure safe, secure, and sustainable transport and to encourage investment in modern shipping technology including adoption of more efficient, greener, and safer technologies, through review of fiscal and other barriers affecting quality of boat construction and maintenance. The GoA has prepared a draft proposal entitled '*Jibondinga*' - boat for livelihood, which provides incentive both for retrofitting of existing vessels (so long as they are found riverworthy) as well as acquisition of new vessels. The scheme considers special incentives to encourage women entrepreneurs and women SHGs. Vessel design and specifications for procurement and retrofitting will be standardized to have better regulation as well as for ease of repair and maintenance. However, the incentive scheme is designed to assist industry transition to the new regulatory regime beginning with direct support on retrofitting existing but acceptable vessels with modern marine engines and safety equipment. Subsequently, a market-based financing framework will be developed to support the scrapping and replacement of unsafe or obsolete private vessels with new vessels, the expected capital cost and financing requirements for which will need much deeper assessment. But it will be a high borrowing amount for private boat operators, and due to the small-scale business (small and medium enterprises /micro, small, and medium enterprises) nature of many operators with a weak balance sheet and insignificant personal collaterals, accessing financing from commercial sources remains extremely

difficult. Further, due to lack of familiarity and high-risk perception, commercial banks may also not be willing to lend to private operators with vessels as collaterals, thus further limiting access to long-term financing. Without an affordable cost of financing, the private operators would not be able to upgrade to new and safer vessels and eventually not participate in the program, thus affecting the overall development objective. The component will therefore provide for a detailed analysis to assess financing requirements and structure a government program that mitigates the risk perception of commercial banks and increases access to financing for private boat operators to procure new vessels.The component will identify suitable interventions needed by the Government through design of appropriate incentive mechanisms specifically targeting increasing private participation in vessel purchases and operations. Both IBRD loans and guarantees will be contemplated and structured in a way to meet this objective in subsequent projects, which may include a combination of government incentive and/or IBRD loans and guarantees to be structured through a financial intermediary (a domestic commercial bank or financial institution) to provide loans at competitive financing terms to private boat operators.

b. **Procurement of new vessels for the Assam Shipping Company and retrofitting of existing public vessels (US$15 million)**

To begin with, the project is assisting the GoA to procure 20 passenger ferries with the capability of carrying motorcycles in two sizes. One ferry can carry 50 passengers and 25 motorcycles while the other can carry 100 passengers and 50 motorcycles. Allowance has also been made for carrying substantial amount of hand-carried cargo in line with local customs and practices. To ensure substantially improved stability, the two-wheelers will be carried below the gunwales of the vessels. The vessels will be built to the rules of a major classification society to ensure that they are both robust and safe. The vessels are intended for operation as ferries across the river.

Simultaneously, the project has initiated condition surveys of the existing government fleet, hull and machinery, and deck and outfit items for their suitability, impact stability (for the area of operation), loading, and other conditions. Select vessels may be retrofitted. This will also include measures to ‘green’ the vessel fleet, including adoption of good waste management practices. A few medium-speed shallow draft roll-on/roll-off (Ro-Ro) passenger/cargo catamarans for selected major traffic routes are also planned for procurement.

The project would also like to improve connectivity/access to basic services for many islands, villages, and far-off chars by using additional floating stock which is customized to specific needs. Discussion with the district administration and local governments during early preparation missions, particularly to the upper reaches of Brahmaputra (Dibrugarh, Jorhat, and Majuli), had revealed serious connectivity constraints to basic public services such as health and education for numerous small islands and remote chars. These have had profound impacts on health (high maternal and infant mortality), education, jobs, and trade. For example, many inhabited islands do not have medical facilities and people have to travel to other nearby bigger towns to access services, which become critical during emergencies and disasters. For this, the project plans to use the existing government fleet, which may no longer be suited for intensive passenger ferrying but could be usefully converted into mobile clinics, schools/library, and for other such important services. These vessels will be suitably retrofitted and customized to their intended use.

Component 3: Improvement in terminal infrastructure (estimated cost US$55 million)

This component will support development of improved and technically designed/engineered ferry landings at feasible locations along the Brahmaputra in Assam. The project will finance the activity under two subcomponents.

a. Provision of priority terminals including repair facilities (US$40 million)

In particular, this subcomponent will finance the design and construction of few priority terminals at identified busy crossings (such as Guwahati and Majuli). The infrastructure improvements/designs will in particular adopt a ‘working with nature’ approach which ensures that project objectives are

satisfied in a way that places natural ecosystem at center stage, thereby making solutions non-damaging and sustainable (limit dredging, use portable/modular infrastructure design adaptation for landing stations to enhance climate change resiliency, low draft vessel designs, and so on). The developments would offer opportunities for ecotourism development, rejuvenating the river waterfront and integrating quality ferry terminals in the urban context.

b. Provision of smaller terminals at other locations (mainly rural routes) (US$15 million)

This subcomponent will provide standard designs for modular and scalable infrastructure that can be adapted for other urban and rural ferry terminals. It also includes ancillary infrastructure such as road access, terminal buildings, and other amenities for the physically challenged, women, children, the elderly, and the infirm.

Component 4: Project management support (estimated cost US$9 million)

This component will support implementation of the above three components and provide for costs on project preparation, implementation, coordination, and M&E. This will include establishment and operation of the AIWTDS and financing of the attendant project operating costs (project staffing, consultancies, training, office modernization/equipment, and other operational costs); the IVA; audit; and M&E systems. An important element of the component would support capacity augmentation and policy support on climate mitigation and adaptation through consultancies, knowledge events, staff training, and so on. These initiatives will help the state develop the knowledge and capacity to deal with and address risks associated with climate induced extreme events.

The activities supported under the component specifically include the following:

Providing support for Project implementation, coordination, monitoring and evaluation, through: (i) establishing and ensuring the operability of AIWTDS, including the provision of training, staffing, office modernization and equipment; (ii) ensuring the operability of the AIWTRA, including the provision of training, staffing, office and equipment; (iii) providing technical assistance and management support, including hiring the services of the General Consultant and the Independent Verification Agency; (iv) carrying out Project audits; and (v) setting up monitoring and evaluation systems.

The total cost of the project is estimated at US$110 million. The IBRD support is estimated at US$88 million while the GoA share will be US$22 million. From the IBRD US$88 million, US$1.4 million will finance repayment of the Project Preparation Advance (US$1.2 million) and the capitalization of the front-end fee (US$0.2 million). The remainder of the loan will be disbursed pursuant to regular IPF procedures (US$33.6 million) and results-based lending procedures (US$53 million) for the financing of the same eligible expenditures. The disbursement of the results-based portion of the loan will be contingent on the satisfactory achievement of DLIs and their associated results.

Project cost and financing are summarised in **Table 3-1.**

Table3-1:Project Cost and Financing (US$, million)

Project Components	Project Cost	IBRD Financing	% IBRD Financing
1. Institutional, regulatory, and safety strengthening	21.0	16.8	80
2. Fleet safety improvements and modernization	25.0	20.0	80
3. Improvement in terminal infrastructure	55.0	44.0	80
4. Project management support	8.8	7.0	80

Front-end fees	0.2	0.2	
Total project costs	110.0	88.0	

Summary of infrastructe development in these ghats are presented in **Table3-2, 3-3** and **3-4**.

Table 3-2: Summary of the Infrastructure at Guwahati Gateway Ghat / Landing point

Sl. No.	Ghat Name	Proposed Components	Area Required [m²]/ Area required in phase 1	No. of Passenger[2]		
				hour /peaks	average	Considered for Planning
1.	Guwahati Gateway Ghat	At Berth		2100	1234	1150
		Ticket Counter	24/12			
		Administration & Security	67/67			
		Passenger Waiting Area	1143/439			
		Parking Area	644/247			
		Toilet Facilities	134/67			
		STP Facilties	12/6			
		Total	2012/832			
		Landside Delivery Parking	35/35			
		Total	35/35			
		Structural Dimension	(m)			
		Design Depth	1.9(39.53)			
		Maximum Height Difference	8.75			
		Access Bridge Width	8			
		Berthing Length (Phase 1)	170			
		Add. Berthing Length (Phase 2)	180			

Table 3-3: Summary of the Infrastructure at North Guwahati Ghat / Landing point

Sl. No.	Ghat Name	Proposed Components	Area Required [m²]/ Area required in phase 1	No. of Passenger[3]		
				hour /peaks	average	Considered for Planning
1.	North Guwahati Ghat	Ticket Counter	12/12	861	480	455
		Administration & Security	39/39			
		Passenger Waiting Area	253/253			
		Parking Area(two-wheeler)	143/143			
		Toilet Facilities	67/67			
		STP Facilties	10/5			
		Total at Berth	514			
		Landside Delivery Parking	35/35			
		Total	35			
		Structural Dimension	(m)			
		DesignDepth	1.7(39.33)			
		Maximum Height Difference	8.75			
		Access Bridge Width	6			
		Berthing Length (Phase 1)	85			

Table 3-4: Summary of the Infrastructure at Aphalamukh Ghat / Landing point

Sl.	Ghat Name	Proposed Components	Area Required	No. of Passenger[4]

[2] Considering Traffic Demand in 2035
[3] Consdering Traffic Demand in 2035
[4] Considering Traffic Demand in 2035

No.			[m²]/ Area required in phase 1	hour /peaks	average	Considered for Planning
1.	AphalamukhGhat	At Berth				
		Ticket Counter	12	752	427	400
		Administration & Security	39			
		Passenger Waiting Area	248			
		Parking Area(two-wheeler)	140			
		Toilet Facilities	67			
		Parking Area (light vehicles)	187.5			
		Total	693.5			
		Landside				
		Delivery Parking	35			
		Parking Area (light vehicles	375			
		Total	410			
		Structural Dimension	(m)			
		Design Depth	1.7 (39.73)			
		Maximum Height Difference	11.89			
		AccessBridge Width	6			
		Berthing Length	130			
		STP Facilties	50			
		Total	1153.5			

3.2 Planning considerations for Terminals

3.2.1 Access Bridges to Jetty and Ferry

The minimum dimensions of platforms shall be followed. The considerations for the width of the access bridge are made in accordance to the German standard RASt 06 – “Directives for the Design of Urban Roads”. This design situation has been chosen to provide enough space for chatting and waiting pedestrians, with simultaneous passing of other pedestrians.

3.2.2 Site geotechnical details

The river bed is mainly sandy devoid of supportive rocky structures hence is favourable for the construction of piles. Detailed soil investigation is carried out to ascertain the soil conditions.

3.2.3 Number and types of utility services required

The facility shall be designed taking into account of utility services required like electric supply, fresh water supply, sewage treatment plant / Septic tank, telephone connectivity, Wi-Fi connectivity options etc.

3.2.4 Aids to Navigation

In order to facilitate safe navigation, necessary equipments shall be installed in the terminals as well as vessels.

3.2.5 Length of the jetty

The length of the jetty is designed such that sufficient draft is available for the launches and catamarans, while berthing.

3.2.6 Safe embarkation and disembarkation for passengers

The floating pontoons will serve to provide stability to passengers embarking or disembarking from a ferry vessel. There will be nearly suitable berthing slots, leading to a high utilization and minimum congestion. This design is also such that passengers do not have to jump over vessels to get into their vessel.

3.2.7 Turning Circles at Access Bridges

Due to the current cross-rivertransport of four wheelers (in Neamati-Aphalamukh Ferry route) &two wheelers(in Guwahati- North Guwahati ferry route), it is necessary to ensure the access of those two wheelers to the future berth. This envisaged access requires a consideration of the turning circles of vehicles.

3.2.8 Access to ferry services

The terminal and jetty is so designed that handicap and old customers wanting to use the ferry services can do so without any trouble.

3.2.9 Facilities for Passengers at Terminals

3.2.9.1 Waiting Area

A waiting area with sufficient seating arrangement shall be provided in the passenger terminal. Sufficient number of electrical points shall be provided for phone/laptop charging purposes. The Consultant has therefore made provisions to provide seating within the waiting area for only 50% of the passengers.

3.2.9.2 Toilets

The toilet facilities with septic tanks will be constructed in passenger waiting areas. It will be designed so that physically challenged passengers can also use. Separate changing rooms and toilets shall be provided for the operating staff. Separate toilet facilities will be provided to gents, ladies and physically handicapped passengers. Baby care room will also be provided.

3.2.9.3 Parking Area at Berth

A parking area will be provided for passenger cars / two wheelers at the identified places. This shall also serve as the “Assembly Point” in case of emergencies. According to the mentioned traffic count it is necessary to provide parking areas for 35 % of the passengers. For waiting passengers especially if ferry departure times are set early in the morning or late in the evening it is anticipated that the terminal operator allows mobile salesman for drinks / snacks / mobile phone cards / etc. within the described area.

3.2.9.4 Approach Roads to Jetty connected to main roads of the City / Village

Access road bridges to jetty shall be constructed to connect the existing PWD roads in all the three locations selected for initial phase of development. However, length of these roads is in between 100-250m in length with sufficient land available for this purpose.

3.2.9.5 Passenger berth design, layout and functional planning layout

The jetty shall consist of a fixed passenger terminal. This area shall consist of the ticketing booths, seating areas and amenities like toilets. This area shall also house all the machinery rooms for the services provided on the jetty in addition to a security control room/watch tower. The passenger terminal shall lead to a fixed piled walkway in turn leading to the floating berths. This walkway shall be bifurcated for outgoing and incoming passengers. Only passengers with tickets for boarding vessels or exiting passengers shall be allowed on to this walkway. The fixed walkway shall lead to the boarding area consisting of floating berths. The floating berths shall be moored with the help of underwater mooring system.

3.2.9.6 Power supply and Illumination

Power supply is required for the area illumination, buildings and the utility services. Level of illumination in the jetty and the terminal area shall be minimum 30 lux. Source of supply and the conveyance of the same to the site will be planned and estimated. Such supply, if not ensured uninterrupted, captive generator back up have to be proposed.50 / 75 / 100 kva silent DG set will be installed for back up facility on jetty.

3.2.9.7 Water Supply

Potable water will be required for the vessel and the user on land. Requirement of vessel shall be met at the terminals. Requirement of largest vessel is 1,000ltrs. Source of Potable water facility has been considered from the municipal supply as far as possible to avoid the ground water extraction in all the Terminals

Potable water will be required for the terminal amenities. The potable water for the terminal amenities is assumed to be delivered by tanker trucks. The tanker trucks should unload the water at the entrance of the pier structure through a pipe system which runs down to the berth instead of driving down to the berthing area. This water supply pipe system could be equipped with adequate pumps for the low hydrological gradient between entrance and berth during flood season. The required amount of water and pump capacity will be determined during the preparation of DPR.

3.2.9.8 Drainage

System design shall consider the Intensity of rainfall 50 mm/hr with 10 minutes inlet time and 90% imperviousness for estimating the runoff rates for design of drainage systems of the backup area. Out fall of the storm water drains will be into the river directly.

3.2.9.9 Solid waste

Solid waste arising from the vessels,vessel maintenance and terminal operation will be addressed in the project execution and O & M stage.Necessary infrastructure such as colour coded bins shall be provided to segregate & collect solid waste and will be evacuated daily.

3.2.9.10 Fire Fighting

The fire protection systems and other safety measures shall comply with relevant local regulations and the requirements of the local authorities. The systems shall generally be as per the recommendation/ guidelines of TAC and / or relevant IS code & NBC.

3.2.9.11 Medical Emergency Preparedness

The terminal amenities should also provide a first aid station and trained staff to handle medical emergencies at the pier.

3.2.9.12 Communication

Terminal operation office shall have the proper communication to track the vessel operation. In addition, for the user, kiosk with charging facility & payphone may also have to be provided for the emergency purpose.

3.2.9.13 CCTV & Public Address System

CCTV provision is required to keep an eye on terminal operation, monitoring of high risk area, ensure the overall safety and possessions of all individuals. System is required to cover the jetty area, user movement area, gate area of the terminal. Public Address System is required mainly to announce the operating issues of the terminal apart from safety issues. System coverage is required the jetty area, user movement area, gate area of the terminal.

3.3 Planning considerations for Maintenance Area

Maintenance area should be ensured through maintenance cars for minor repairs at the terminal structures and other tasks of janitorial services. These cars should be able to drive down to the berthing area during non operational hours and be operated from the corresponding base of operation. If a base of operation could not be setup and the implementation of a maintenance area at the berth becomes necessary, the maintenance cars become redundant and the terminal maintenance should be executed from the maintenance staff of the terminal. The maintenance area itself is proposed for maintenance and simple repair works of equipment and ferries. As already mentioned, it is necessary to prevent the contamination of the river through leakage of oil or other pollutants. Due to this, the surface water needs to be drained through an oil separator. It should be noted, that a maintenance pontoon is redundant if a base of operation could be established in a separate and protected area nearby.

3.3.1 Office

At least 1 office shall be considered for operation and storage keeper department. The offices shall at least be equipped with workstation, cupboard and visitor sitting place.

3.3.2 Fuelling Station

Compact Fuel Stations with all necessary equipment are proposed on the Jetty in maintenance area. Fuelling facility is necessary for bunkering the vessels presently, mobile equipment used for fuelling vessels. In Guwahati, division Pandu Port area is identified for the maintenance and fuelling facilities whereas in Dibrugarh it is proposed at NeamatiGhat in agreement with IWAI.

3.3.3 Sewage Treatment

Estimation of the sanitary sewage flow shall be 80% of water supply. Flow will be routed to a Package Treatment Plant. The capacity of the sewage treatment plant (STP) will be arrived by calculating the quantity of efflux to be treated per day. The effluent quantity is arrived by assuming 85% of the water consumption. All the sewage generated in the vessels will be treated in STP at maintenance area. 20% of the treated water will be lost in the process and the rest can be used for flushing and landscaping. The modular STP shall be located in the machinery room and recycled water shall be provided for flushing purposes in all toilets. The STP shall collect toilets sewage. The sewage from berthed boats/vessels can be collected via dedicated pipe running to the STP or by portable vacuum collecting units to take out waste and dispose of it. PVC pipes will be employed to carry water to STP and water back to overhead tanks for flushing and fire fighting.

3.3.4 Recommended Supportive Components for passenger Jetty / Terminals

3.3.4.1 Zero Waste Ghat

Integrated waste management system can be implemented on the Ghats. Solid waste will be segregated and collected separately and will be disposed of through local authorities. Plastic may be banned in the area. Swachata Abhiyan can be taken up with the help of local authority. More importance will be given to aesthetics and hygiene. No vessels will be allowed to discharge its waste in river during navigation or berthing. Vessels should follow MARPOL guidelines for management of solid waste.

3.3.4.2 Renewable energy

Solar lighting system can be taken into consideration to save conventional energy consumption.

- GHG Solar Panels on Pontoons
- Solar lights on approach roads, approach bridges, garden areas, public areas

In Assam State 9months of sunny days are available. Hence there is high potential of solar energy , which can be used for the external and internal lighting in terminals.

3.3.4.3 Noise Deterrent Devices

There are certain region close to the proposed terminals and ferry navigation path which are rich in underwater ecology including the gangetic dolphins. The project during the construction and operation phase of the project is to provide noise control system. A deterrent devise is a mechanical instrument that generates ultrasonic signals to keep the dolphins away from the activity area. These devices could be helpful in other project activities as well like during maintenance dredging.

3.4 Vessel Specifications

In Phase 1, 10 vessels of 50 Pax capacity and 10 vessels of 100 pax capacity are decided to be procured. The vessel specifications relevant to the environment are summarised in **Table 3-5.**

Table 3-5: Vessel Specification

Sl No.	Salient Features	50 Pax / 100 Pax Ferry -Technical requirements
1.	Main Engine	1. Engines are to be compliant to latest applicable requirements of IMO/MARPOL for inshore and inland waterways vessels. 2. Engine will be fuel combusion efficient, so as to minimise the emission.
2.	Fresh Water Capacity	1200 ltrs capacity fresh water tank Provision of separate piping for fresh water and sanitary toilet fittings to be catered.
3.	Passenger facilities	Provisions of separate bio-toilets for Male & Female to be provided.
4.	Life Saving Equipment And Firefighting Appliances	Following items to be provided in accordance with requirements of Class I vessel as per Model Rules for Inland Vessels October 2013 (under IV Act) :- 1. Life raft or buoyant apparatus 2. One life jacket each for all crew and passengers 3. Life jacket for child, for 10% of total no. of persons certified to carry 4. Life buoys as per length (4/6/8 No.) 5. All boats shall have headlights, search lights, hand torches and emergency lanterns. 6. Every lifesaving appliance provided as per provisions of these rules shall be meeting the Technical requirements contained in the International Life Saving Appliances Code and type approved by MMD or Competent Authority of the State. 7. All life-saving appliances shall be properly stowed as per the approved plan and maintained/serviced as per the requirements of International Life Saving Appliances Code. 8. Fire pump, Portable fire extinguisher, automatic emergency lighting, automatic fire fighting arrangements in engine-room and accommodation are to be provided as per Class requirement.
5.	Generator	DG with accoustic enclosure shall be fitted.
6.	Corrosion Protection	1. Zinc anodes for corrosion protection are to be provided. Further, TBT Free anti fouling paints for hull below the waterline to be provided. 2. Painting scheme used shall be of high grade and in conformance with standard marine practices, with 5 years Manufacturer's guarantee.
7.	Acoustic Insulation	Acoustic insulation in the machinery space for noise control operation is to be provided as per national standards for noise limits.
8.	Painting and Finishes	1. The finish of the ferry shall be appropriate for use as a passenger boat. 2. The hull shall be coated with approved quality fresh water anti-fouling compound and/or weather resistant paint depending on location. 3. Theme branding of the ferry shall be carried out by the supplier in consultation with the Client. A minimum of three (3) themes shall be submitted for the approval of the Client.
9.	Pollution Control	Arrangement for leak proof evacuation of used oil and sewage shall be provided.

3.5 Training Centre

The Crew Training Centre of Inland Water Transport Department, Assam was established in the year 1968 to impart training to all concerns at all levels. More than 2000 crews have passed out from this centre so far. The Crew Training Centre of IWT, Assam is the only onein the entire North-Eastern Region.

It is proposed to upgrade the existing training centres. The centre will be utilised to develop navigation skill. This will also help in creating environmental awareness among the crew members and general public.

3.6 Landscaping and Beautification

The open space available beyond built up area shall be utilised for landscaping and beautification including plantation to improve the aesthetics.

3.7 Jibondinga Scheme

Jibondinga scheme is proposed by AIWTDS is a beneficiary scheme for private boat owners. Financial assistance will be provided to procure new vessels under IWT Assam.The scheme also include renovate and refurbish such boats to meet the specifications. All these boats are proposed to be certified by Indian Registrar of Shipping (IRClass) and will fulfill all the required safety / security and environmental guidelines.

3.8 Dredging

Dredging is usually an essential element when it comes to development of maritime berthing facilities, when an adjustment of the flow cross-section and/ or the river bed profile is required as a result of proposed interventions. Dredging can also easily affect the flow and the shape of the cross-section in rather unstable river regimes and dredging measures are rather unstable recurrent activities. It will be general approach to minimize the dredging requirements to the necessary minimum, as to keep the river bed profile at its best equilibrium.

The Brahmaputra River carries one of the world's highest sediments loads with strong affects to the regions ecology and agriculture. Beneath the sedimentation of suspended sediments during dry season, the river shows steady shifting of existing sandbanks during flood season due to the high flow velocities. All the dredged materials shall be disposed in the river since the river bed sediments are not contaminated. Dredging volume assessment for all the three priority locations during construction and operation stages are given below (*Source- AIWTP Draft Feasibility Report*) -

Table 3-6: Indicative Assessment of Dredging during Construction Stage

Sl. No.	Location	Volume (m3)
1	Guwahati Gateway Ghat	69,720
2	North Guwahati	12417
3	Aphalamukh	7823

Note: Assuming 0.5m water depth is prevailing at berthing line with continuous slope developing towards main navigation channel

Table 3-7: Assessment of Maintenance Dredging during Operation Stage

Sl. No.	Location	Volume (m3/yr)
1	Guwahati Gateway Ghat	41,832
2	North Guwahati	7450
3	Aphalamukh	4694

Note: Assuming 0.5m water depth is prevailing at berthing line with continuous slope developing towards main navigation channel and yearly siltation rate is 60%

3.9 Sewerage Treatment Plant

GGG Ghat: An area of 12x 6 m has been proposed for sewerage treatment plant in GGG Ghat. An area of 12x6 m should be reserved on existing DIWTA land for putting up the modular sewerage treatment plant but not on terminal deck.

North Guwahati: An area of 10x 5 m has been proposed for sewerage treatment plant in North Guwahati Ghat. An area of 10X5 m should be reserved on existing DIWTA land for putting up the modular sewerage treatment plant but not on terminal deck.

Aphalamukh: An area of 10X5m has been proposed for sewerage treatment plant in Aphalamukh. An area of 10X5 m should be reserved on existing DIWTA land for putting up the modular sewerage treatment plant but not on terminal deck.

3.10 Labour Requirement

Details of labour requirement for each ghat has been given below-

Table 3-8: Details of Labour Requirement at Each Ghat (Phase-1)

Component	Details	Numbers of labour
Piling Works	2 team X 20 personnel	40
Concrete Works	2team X 20 personnel	40
Steel Fabrication Works	3 teams X 20 personnel	60
Building and Miscellaneous Works	-	50
Total Labour Force at any Given Instance		**190 (+/- 10%)**

The construction camp shall be constructed temporariliy during the construction stage by the contractor considering the provision recommended in Envrionmental Code of Practice-17 (Refer **Annexure- 7.1)**

3.11 Project Benefits

Inland Waterways Transport (IWT) is a competitive alternative to road and rail transport, offering an economical, sustainable and environment friendly mode of transport.

The major benefits from the project are outlined below:

- Infrastructure requirement for inland transport is less compared to road and rail.
- Less congestion and potential for expansion.
- Improved infrastructure for better public convenience.
- Enhance the traffic volume
- Have greater positive impact on socio-economy of the area
- Improve the safety and environment aspects
- Comfortable passenger vessels with all amenities
- Higher quality ferry service with wider transport network
- Will support the increasing traffic volume by more systematic and timely operation
- Minimum impact on existing environmental status
- Improve connectivity to many regions / areas.

As per an estimate, 1 horse power can carry 4,000-kilogram load in water compared to 150 kilograms and 500-kilogram load by road and rail respectively. In one study, it is estimated that 1 litre of fuel can move 105 ton-km by inland water transport whereas the same amount of fuel can move only 85 ton-km by rail and 24 ton-km by road. By air, it is even less. The higher energy efficiency of IWT compared to road haulage contributes to less fossil fuel consumption and therefore to less emission of CO_2, NOx, SO_X and PM. CO_2 emissions from different public transport is given in **Table 3-6.**

Table 3-9: CO_2 Emissions From Public Transport

Type of vehicle	kg CO_2/km	kg CO_2/km/person
Scooter	0.03	0.015
Motorcycle	0.04	0.020
Three wheeler(petrol)	0.11	0.028
Three wheeler(diesel)	0.13	0.033
Three wheeler(CNG)	0.1	0.025
Passenger car(petrol)	0.103	0.021
Passenger car(diesel)	0.117	0.023
Passenger car(CNG)	0.06	0.012
LDV	0.307	0.038
MDV	0.593	0.030
HDV	0.737	0.011
Ferry boat	0.5	0.003

It is clearly evident from the table that though the emissions in kg CO_2/ km for ferries are high then other vehicles. However, CO_2/km/person is 0.003 kg is the minimum.

Chapter 4 : Alternative Analysis

4.1 Introduction

Analysis of alternatives is an analytical comparison of the operational effectiveness, costs and environmental and social risks of proposed development options. This helps to analyse the options critically in relation to its impacts on physical, social and biological environment. For this project, alternative analysis has been made for three considerations, i.e. strategic, planning and technology consideration

Strategic Consideration

This analysis enables us to justify that why and how much the project is viable. A comparison is made for "With" & "Without" project scenario for the physical, social and biological environments. This helped in assessment and comparison of the potential impacts on these environments in both the scenario. The scenario having minimal impact is recommended for selection. This has helped us to find the benefit of development of the project. Detailed analysis is given below in **Table 4-1**.

Table 4-1: Alternative Analysis- "With & Without Project Scenario"

Feature	Without Project	With Project
Need of IWT	Southern Bank of Brahmaputra in Assam is more urbanised with supportive developments as compared to North Assam. People have to depend on south region of Assam for higher education, trading, jobs, medical facilities etc. This is increasing the pressure on Urban Guwahati region. .	North Guwahati / Majuli Island Connectivity will be improved and financial / educational / health status can be improved with the development of IWT in Guwahati by enhancing the North Guwahati with more urbanised and facilitated South Guwahati Despite having the potentials as a planned city so as to lessen the burden of overpopulated Guwahati, North Guwahati which is alsohaving historical importance, natural beauty and tourism potential could be a big revenue generator. It is very much important to have connectivity between North Guwahati-Guwahati. While addressing the issue there is high demand of up gradation of ferry services between Guwahati and North Guwahati Majuli Island being tourist attraction famous for its satras, handicrafts and environmental settings will be well connected to the main lands. It will improve tourism and revenue generation.
North and South regionConnectivity	The connectivity problem between Guwahati and North Guwahati has remained for decades. There are two possible routes for connection between North Guwahati and GGG. One is by road and one is through inland water transport. By Road (Sarai Ghat Bridge) it takes 40	Inland watertransport takes only 10 mins from North to South Guwahati. There has been long public demand to upgrade ferry services in Brahmaputra to connect the city with its southern and northern arm.A large number of people, students, office goers,

Feature	Without Project	With Project
	to 45 mins to travel. Existing transport system from Majuli is solely dependent on inland water transport from two of its Major ghats/ terminal- Kamalabari&Aphalamukh to the main land with Neamati as common landing stations. However, two temporary landing stations are developed in both Kamalabari (Majuli) &NeamatiGhat for Ro-Ro ferry services.	patients, traders and others depend on the ferries or bhootbhooti (mechanized boats) plying between Guwahati and North Guwahati. In case of Majuli, the commuters from this river island solely dependent on inland water transport to commute to towns such as Jorhat in southern bank of Brahmaputra
Status of Transportation Infrastructure	There is no direct railway network. To access railway transportation, commuters from North Guwahati need to travel either by road bridge over Brahmaputra or inland water transport to the south bank. In case of Majuli river island (Aphalamukh), commuters dependent solely on IWT to reach Jorhat town (nearest railway station). These existing transport infrastructures are not sufficient. However, recently a ropeway project connecting North Guwahati to the main city centre of Guwahati is proposed. Also, there is a proposal of construction of a bridge, connecting North Guwahati to the main city by the State Public Works Department.	In the current scenario, roads of Assam are highly congested.No better connectivity of north and south Land Banks of the Assam State due to lesser bridge infra on Brahmaputra river and longest distances if travelled by Road. Hence Ferry services are very needed to be upgraded as per the demand. NeamatiGhat plays an important role in local the economy.It is the nodal point for crossing to Majuli, islands and can connect travellers to the Northern Bank as well. Considering the travelling time by road, public in general prefer to travel by ferry. No other transport facility is available for the people on Majuli Island to cross Brahmaputra River. With the implementation of IWT and night navigation, travel time would be reduced. To provide facility for the passengers from Airport to Ferry location near North Guwahati within 2 km is very good option which can be time saving against 1 hour traveling to Guwahati City by road. GGC will create good connectivity from City and Airport to other destinations on North and South Bank. IWT mode will lead to reduction in congestion on roads. Infrastructure development for waterway involves comparatively lesser expenditure than required for developing railway& road network.
Current facilities at Ferry station locations	Existing jetty locations have following inadequacy i) Passenger Waiting Area, ii) Parking Area iii) Toilet facilities, iv) Access to Public Road. Absence of	The project aims to improve passenger and vehicle accessibility across the Brahmaputra with improvedinfrastructure and ferry

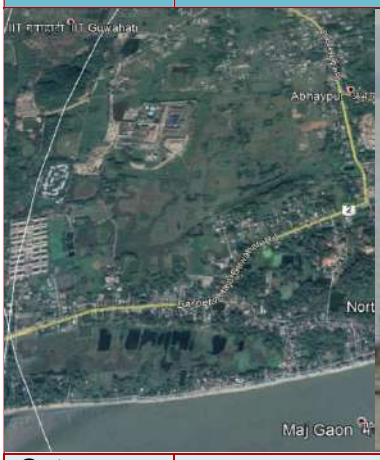
Feature	Without Project	With Project
	rescue team with equipped vessel is another limitation observed.The restricted land holding, owned by the AIWTDS at the jetty location, appears as impediment in jetty improvement or expansion. The continual river bank erosionrestricts the expansion.	vessels. It also aims to improve the institutional framework and strengthen the state institutions that administer, regulate and provide inland water transport. The ferry lines and the terminal shall be operated by skilled professionals. Establishment of maintenance and repair facilities and equipment will improve the vessel condition.
Physical Environment	GHG emission from other mode of transport is very high in comparision to Inland Water Transport.	There will be overall reduction in GHG emissions in IWT as this mode is energy efficient
	Ambient Air Quality is affectedby emission from vehicles and rail. There will be increase transportation by rail/road, which is likely to detoriate the air quality more significantly. Infrastructure development for road/rail transport will also have fugitive emission.	As IWT is more energy efficient, the emissions through exhaustswill be reducedsignificantly. Air quality in terminals will improve because of mitigative measures and plantation.
	Water Quality: Construction of more roads to fullfil traffic demand will result in more paved surfaces, there by rising the surface run-off (which may also be contaminated with oil and grease-accidental or used oil/grease) causing pollution of water bodies and land. Presently, waste and wastewater management in operating terminals are not adequate, thereby risk of water contamination is high.	Water Quality: There are number of activities during construction as well as operational phase of IWT implementation, which have been identified for causing water pollution and mitigation measures have been integrated in the project.With the wastewater treatment system and following zero discharge concept, residual impacts are considered to be marginal.
	Loss of agricultural land and top soil: The continual expansion of railway and road network to meet the additional freight & passenger transportation warrant additional acquisition of productive agricultural land and loss of top soil. Soils are also sourced by digging burrow pits.	Loss of agricultural land and top soil: Land requirement is minimal. Land requirement is much less than the land required for road & railway projects.
	Material Sourcing: Materials such as soil, steel, cement etc required for construction of road/railway are fairly large as compared to IWT.	Material Sourcing: The material requirement is comparatively lesser than required for maintenance and expansion of road & railway.
Terrestrial & Aquatic ecology	Terrestrial Ecology: The expansion of road & railway network to increase the freight transportation may involve cutting of large nos. of trees and/or impacting the forest areas, affecting the terrestrial ecology. Also the existing road crosses various Eco sensitive zones & forest areas and expansion of such roads will have greater	Terrestrial Ecology: Impact on Terrestrial ecology is limited to project sites.Some of the impacts during construction are temporary in nature. The impact on terrestrial ecology during operation phase will be addressed to minimise its magnitude.

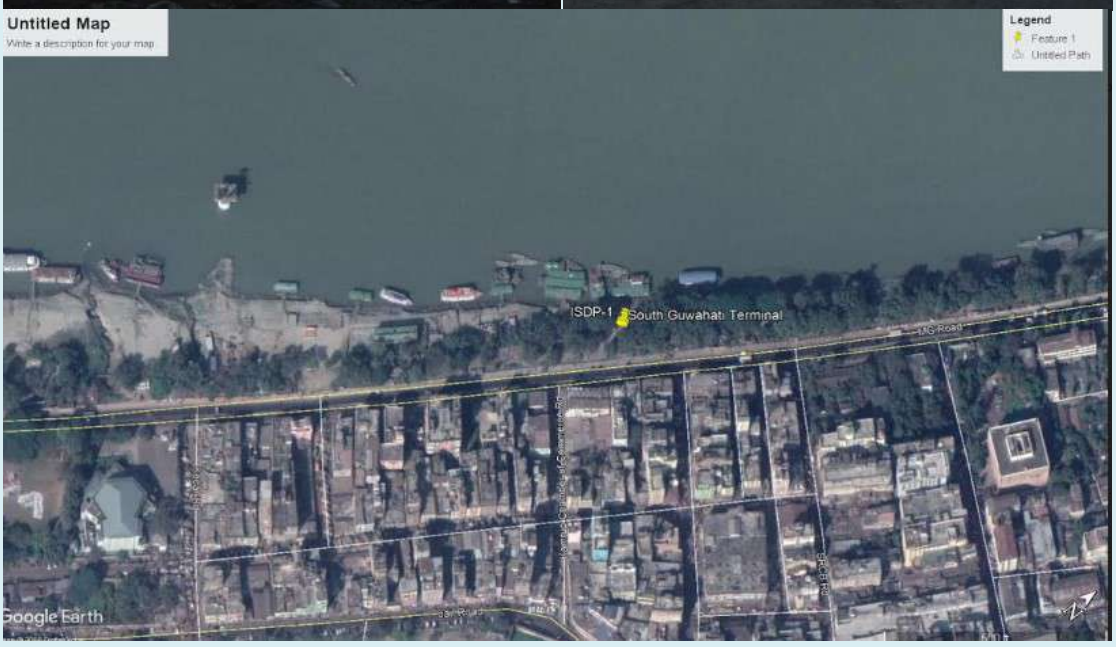
Feature	Without Project	With Project
	impact on terrestrial ecology.	
	Aquatic ecology: Road/railways running along IWT on river Brahmaputra and Barak at various locations. Expansion of these bridges & construction of new bridges will have significant impact on aquatic ecology.	Aquatic Ecology: Development of off-shore structures, ferry operations and dredging activities has significant impact on aquatic ecology which requires to be managed adequately to minimize the impact.

Analysing both the scenarios for above mentioned criteria, it is concluded that "With Project Scenario" is beneficial for all physical, biological and social environment when compared to "Without Project Scenario". However significant impact is anticipated on water and aquatic ecology in "With Project" scenario for which mitigation and management plans are prepared. Site specific observations with advantages and disadvantages on existing environment are presented in **Table 4-2**.

Table 4-2: Site Specific Observations

Development Site Location	Site Specific Findings	Advantages	Disadvantages	Remarks
North Guwahati **(On North Bank of Brahmaputra)**	• Ghat is muddy flat land. • As per record average 1000 Passenger/day travel from Ghat. • Water quality analysis reflects high turbidity • Basic Infra is lacking for passengers like ramp, approach paved roads, ticket house, security, toilet facilities, waiting area, special provision for ladies and elderly people, parking area etc. • Temporary ramp and access roads are risky especially during rainy season. • Ghat is highly eroded due to flood with silt deposits. • Lack of solid waste management system • Water-pollution due to improper management of waste and sewage • Encroachment near the proposed access road and existing PWD road.	Environment Considerations: • No tree cutting is associated. • The proposed land required for the project is government land and under possession of IWT. • Site is open sandy with no settlement except some encroachment. • Site is accessible through existing PWD road • Settlements located are at app. 300m from proposed terminal activities.Thus minimal impact due to project activities. • Locally available raw material (sand) for construction • Site is not part of or close to any eco-sensitive location • Availability of land required for supportive infrastructure.Availability of sufficient depth for berthing & movement of ships and thus minimum dredging is required	Environment Considerations: • Gangatic Dolphins which is Schedule-I species as per Wildlife Act, 1972 are existing in this stretch of river 2.5 km upstream of the site in North east direction near UmanandaGhat and 3 km near Kacheri Ghat • Approach from city roads to the Ferry Ghat is not developed. In rainy season the passengers face problem. • Site not directly connected to any public paved road at present. • River banks and bed are required to be protected from erosion & scouring.	• Site is selected on the basis of existing facilities and socio-economic and environment considerations • No major environment, social or design issue associated • All the negative impacts listed are manageable with proposed environment & social management plans.

Development Site Location	Site Specific Findings	Advantages	Disadvantages	Remarks
				
Gateway Guwahati Ghat (GGG) (On South Bank of Brahmaputra)	• Ghat is muddy flat land. • As per record daily average 800 Passenger travel from Ghat. • Infrastructure facilities like passenger waiting area, toilets, parking area areprovided. • Toilet waste not treated and directly release into river • Laboratory testing of the water quality confirmed the turbidity and contaminated nature of the water. • Lacking of ramp, approach paved roads etc. • Temporary bamboo ramps / structures which are big problem during rainy season. • Solid waste is dumped and scattered on site.	Environment Considerations: • No tree cutting is associated since land requirement is limited to access road to the terminal development at riverbank. • Site is open sandy with no development in nearby areas. • Small encroachments are observed • High siltation is recorded • Site is with IWT Assam. • Site is accessible by MG Road and city roads which are already developed. • Settlements located at an app. Distance of 400 m from site thus minimal impact due to project activities. • Locally available raw material (sand) • Site is not part of or close to any eco-sensitive location • Availability of land required for berthing and supportive infrastructure.	Environment Considerations: • Gangatic Dolphins which is Schedule 1 species as per Wildlife Act, 1972 are existing in this stretch of river 1.5 km upstream of the site in North east direction near UmanandaGhat and 2 km near Kacheri Ghat • Approach from city roads to the Ferry Ghat is not developed. In rainy season the passengers face problem. • Site not directly connected to any public paved road to MG road	• No alternatives assessed as site already selected and land already with IWT Assam. Anticipated impact on Dolphin and Aquatic ecology due to vessel movement is analysed to be low as boat movement will be regulated at speed of 5kmph. • No major environment, social or design issue associated • All the negative impacts listed are manageable with proposed environment & social management plans thus no major drawbacks associated with the site

Development Site Location	Site Specific Findings	Advantages	Disadvantages	Remarks
	    			
Aphalamukh Ghat (On North Bank of Brahmaputra)	• Erosion hazard posed by the river Brahmaputra is very serious in Majuli (about 35.00 % of its present area has already been eroded in the last few decades). However, erosion control measures with concrete spur by Water resource	Environment Considerations: • No tree cutting is associated. • Site is open sandy with no development upto 200mts • Agricultural land parcels are existing surrounding both the Ghats	Environment Considerations: • Gangatic Dolphins which is Schedule 1 species as per Wildlife Act, 1972 are exists in this stretch of river. • Also during site visit through ferry in	• Site is already selected and land already with WRD. Anticipatedimpact on Dolphins and Aquatic ecology due to vessel movement is considered.

Development Site Location	Site Specific Findings	Advantages	Disadvantages	Remarks
	department on both side of the AphalamukhGhat is under process. • Dolphins were spotted during field visit • There is no records of erosion near the ghats in last 10 years is confirmed during consultation with local people and as per the IWT records. • Ghat is located in sandy and flat terrain area • Land is owned by government of Assam except private ownership of three plots. • Ghat has existing infrastructure facilities such as Ticket counter, passenger waiting area, maintenance, vehicle parking area • Has access to the public road system. • Ghat is connected through unpaved road. There are temporaryshops around the approach road. Existing Ghat has land available for future development. • Passengers have to go on pontoons by temporary bamboo ramps / structures which are big problem during rainy season. • Solid waste is dumped and scattered on site.	• High siltation is recorded • Site is with WRD. • Aphalamukh Ghat Site is accessible by NLK Road and village roads which are already developed. • Settlements are far away from AphalamukhGhat • Locally available raw material (sand / concrete / steel) • Site is not part of or close to any eco-sensitive location • Availability of land required for berthing and supportive infrastructure.	river dolphins are seen at Aphalamukh Ghat area • Approach from city roads to the Ferry Ghat is not developed. In rainy season the passengers face problem. • Site not directly connected to any public paved road at present. • Highly eroded ghats with silt deposits	• All the negative impacts listed are manageable with proposed environment management plans thus no major drawbacks associated with the site • Erosion control measures are required

Aphalamukh Ghat

Development Site Location	Site Specific Findings	Advantages	Disadvantages	Remarks

4.1.1.1 Environmental Design parameters

Following two major aspects shall be considered during design to reduce environmental impacts:

a) Maintenance dredging*:*The design team has proposed that the terminal or berthing area to be located inside the river which would be close to the least available depth.

b) Mitigation of submerged construction parts*:* In order to reduce the damage risk of the structures and increase the life, minimum underwater construction will be taken up.Most of the design structure shall be floating or mechanically adjusted above water level.

4.1.1.2 Ferry Concept

A. Principles

The ferry concept for the proposed project is based on the following principles:

1. Simple and robust so that ease of managing the systems
2. Ferries and berthing facilities would be standardised to increase reliability and to ease maintenance.
3. The banks and river channels tend to change their profile which might require shifting of landing locations. So, mobile structure is envisaged
4. Skilled personnel and sufficient technical installations will facilitate the required level of maintenanceservices of vessels.
5. Ferry system has to comply with the existing applicable guidelines/legislations.
6. Maintenance dredging, if any, would be planned based on river channel condition.

B. Vessel Performance Requirement & Ferry Types

Three different standard of ferry designs are being proposed. All ferry types follow thesame design principle: Twin hull ferry platform with superstructure (containing a seating area)and a wheelhouse at the bow and an open deck for staying passengers, bikes and vehicles tobe stowed transversely to the ferries' longitudinal axle at the stern.

For the hull configuration of all ferry types and sizes the catamaran type is being proposed dueto advantages with regard to safety because one hull or most of the at least three hullchambers/segment, per hull, will remain intact in case of impacts. Space on board and stability(safety) as well as manoeuvrability and redundancy of the propulsion engines are decisiveadvantages of catamarans when speed maximization is not an issue as it is in this case. Themaximum sailing speed for all types should be 10 knots (12 knots max. trial speed) in order to provide timely and reliable sailing schedules even if required to cope with a river current of maximum 5 knots at monsoon times under worst navigational conditions.

C. Safety, health & environmental considerations

The proposed catamaran vessel design is unsinkable and cannot capsize. Each hull consistsof at least three separate sections with separators. Each vessel furthermore is equipped with two engines. As to engine and hull design, acoustics simulations need to be considered by the vessel design engineers in detail to prevent for generation of frequencies disturbing or irritating the population of the Brahmaputra dolphins. This is an improved consideration while present vessels did not take regard on this aspect as all.

All vessels will be equipped with life jackets for all passengers, and with safety and rescue basis like e.g. fire extinguishers, water pumps, emergency signalling rockets and automated radio alerts in case of incidents like engine standstill, water contacts on board above tolerance etc.

Furthermore sufficient washrooms, separated sections by gender, and for persons who need specific attention, as well as freshwater and sewerage and oil water emulsions tanks are to beimplemented at each of the vessel accordingly. Bunkering and dealing with all substances and waste strictly will follow the “no environmental impact” principle and hence needs to be supported by the designs of vessels accordingly.

Litter boxes on board and regular emptying of the same into Ghat based waste containers willbe implemented, ideally followed by effective penalisation schemes for violators when leavinglitter inadequately on board or throwing any substances – liquid or solid - into open waters[5].Bunkering capacity of the vessels shall be provided for 7 days of operations and by double hull protected tanks to prevent for spills or leakages during bunkering and in the event of an accident.

The bunkering capacity implemented for water and fuel will allows for uninterrupted operationsbut also necessitates the ferries to report latest once a week to the regional Base of Operations with professional, spill protected and drop recovering bunker facilities for refuelling. The process for lubricant supply is alike. Taking fresh water, and delivery of waste water/sewage, oil residuals or oil-water emulsions in return shall take place sole and only at the Base of Operations for control and treatment, too.

D. Operational Considerations

The ferry concept relies on the following additional considerations.

- Cleaner and safe technologies. One engine in each hull, running on (preferably sulphur free) diesel. Diesel catalysts to clean exhaust from dust, NOx, particles, and noise capturing are compulsory. The engines are charging a battery set to bridge small electricity consumption during daytime when engines are off. The winches for shifting the ferry are powered also out of the batteries, re-loaded via generation during sailing;

[5] Monitory fine or banning from entering waters for a certain period

- Electricity on board is only needed to start the engines, to run the winches, for lighting and engine control and communication.
- Solar panel installations may be considered to support energy generation but should be subject of vessel design. It shall be noted that solar panel power generation on board is an extra not required for safe, efficient and effected waterway transport navigation (but for smart environmental considerations);
- High levels of Operational Performance. All ferries should feature adequate communications equipment to enable ship to ship and ship to shore communication. Additional Automatic identification system (AIS) should be installed on all vessels to help IWAI operated control centres to coordinate vessel traffic and to intervene;
- Sustainable Vessel Management. The vessels should be serviced at suitable locations (e.g. at IWAI Port at Pandu in the Guwahati Metropolitan Area). Here refuelling (bunkering), supply with freshwater and disposal of waste water and solid waste as well as cleaning and repairs should take place.

E. Ferry Vessel Types

With the following standard ferry types almost all traffic requirements will be met:

- Type 1: Rural and secondary urban lines passenger standard ferry (all districts): 50 passengers plus 2-wheelers or human muscle driven carts with a maximum draft of 0.5m. Maximum number of passengers: 100; devices and safety equipment and sanitary installations to be dimensioned accordingly. Two engines. Standard active navigational aid and SAR communication and AIS equipment including double backup emergency power supply. Key vessel parameters: Length: 20m, Beam: 8m, Draught: 0.5m, Free board: 0.7 m, maximum sailing speed: 10kn;
- Type 2.1: Urban passenger standard ferry (Guwahati area). 200 passengers plus 2-wheelers or human muscle driven carts. Maximum draught of 0.7m. Engine and sanitary and aids to navigation as well as for the case of emergency as per Type 1. Maximum permissible number of passengers: 300, devices and safety equipment and sanitary installations to be dimensioned accordingly. Standard active navigational aid and SAR communication and AIS including double backup emergency power supply. Key vessel parameters: Length: 30m, Beam: 12mm, Draught: 0.7m, Free board: 0.7m, Sailing speed: 10kn;
- Type 2.2: Multipurpose passenger and car standard ferry (e.g. Neamati – Majuli): 150 passengers plus a small number of cars / pickups up to 2 -2.5 tons max total weight each plus 2-wheelers or human muscle driven carts. Maximum draught of 0.7 m. Maximum permissible number of passengers: 250, devices, safety equipment and sanitary installations are to be dimensioned accordingly. Standard active navigational aid and SAR communication and AIS equipment including double –backup emergency power supply. Almost same hull, engine and equipment as Type 2.1. Key vessel parameters: Length:30m, Beam: 12m, Draught: 0.7m, Free board: 0.7m, maximum sailing speed: 10kn;
- Express ferry: Special vessels, e.g. Guwahati Airport Express Ferry, shall be considered as per Type 1 but with enhanced speed, advanced passenger facilities, luggage storage compartment instead of 2-wheeler spaces, and high standard washrooms or a lounge section on board. Berthing and ship/shore facility requirement remains the same as for Type 1 standard catamaran ferry, with same vessel parameters except that vessel sailing speed shall be designed for 15km subject of further investigations.
- Well-equipped IRS certified Vessels will be procured of 50 pax and 100 pax capacity in Phase I

In addition to the ferry vessels, a multipurpose service craft shall be allocated at least at themain base of ferry operations. This multipurpose craft shall serve as tugboat and service craftforwater-

borne construction or maintenance works, laying and shifting of buoys and tons incombination with a service vessel, for small scale dredging, if required, by an excavator with extended reach. The service vessel will carry the dredged material for proper dumping at identified sitessuitable for this purpose. The multipurpose service craft also shall be equipped with fire combat and Safety and Rescue (SAR) first aid facilities to efficiently help in case of emergencies.

F. Berthing Facilities

Vessel berthing facilities need to provide berthing space for each vessel to berth or departalwaysat any time safely and as scheduled. The required berthing capacity is a function of length, mooring facilities, and dominations of berth to percent for congestions hindering smooth and safe passenger or vehicle flows during disembarkation and embarkation process. The number and the size of the berths, therefore, need to be sufficient to serve for handling of the number and the sizes and the traffic volume to be handled per ship and per the number of ships to be served per hour. The number of berths required hence depends on the number and size of vessels calling at a ghat simultaneously. It is assumed, that the length of a berth is 5 m longer that the length of the vessel demanding berthing accommodation. The berths furthermore must support safe entering and leaving of vessels at any water level condition and hence have to be designed as floating equipment, i.e. most cost efficient as pontoons. The pontoons shall be designed to provide for almost same distance and gradient when entering or leaving ships via the vessel-site provided access ramps.

The berthing system consists of 5 different types of pontoons:

- Pontoon type 1: 60m length, i.e. suitable for simultaneous berthing of one type 1 /type 1 express ferry vessel (20m length plus 5 m safety distance) plus one type 2 (types 2.2 or 2.2) ferry vessel with a berthing length requirement of 35 m length
- Pontoon type 2: 50m length, i.e. suitable for simultaneous berthing of two type 1 /type 1 express ferry vessels (20m vessel length plus 5 m safety distance = 25m * 2)
- Pontoon type 3: 25m length, Single pontoon for berthing of one type 1/type 1 express ferry vessel type or one small leisure ship at one time
- Pontoon type 4: 35 m length, Single pontoon for berthing of one type 2 (type 2.1 or type 2.2) ferry vessel for single berthing of one type 1 ferry vessel
- Pontoon type 5: 70 m length for berthing of one large and one small leisure ship at one time, or for berthing of two type 2 (type 2.1/2.1) ferry vessels

Any required berthing capacity shall be able to be composed by adding and combining the above standard pontoons. Since standard units shall be implemented the cost per unit are able to be minimized. Same for the pontoon fixations, at least for the movable devises.

G. Vessel maintenance facility

The vessels will be periodically maintained so that no problems will be faced during the operation of ferry. Besides preventive maintenance, over hauling will also be taken up. This will be located at Pandu, existing maintenance facility. The unit will be upgraded with adequate tools and skilled manpower.

4.1.1.3 Ferry Ghat Concept

Ferry Ghat is based on a modular concept, which may allow multiplication at other suitable locations, minimizing design and implementation efforts. Based on the overall forecast covered under the detailed engineering studies, Ghat capacity parameter have been elaborated as displayed below.

Accordingly recommended berth(s) lengths are determined for the Guwahati (GGG and North Guwahati) and Dibrugarh (Aphalamukh)corridor as displayed below.

Table 4-3: Type and Number of Pontoons

ISDP Ghat			No and type of pontoons per Ghat					
Sl. No.	District Name	Name of Ghat	Type 1	Type 2	Type 3	Type 4	Type 5	Length inTotal (m)
1.	Guwahati	Gateway Guwahati Ghat (GGG)	3	2			1	350
2.		North Guwahati		1	1			75
1-3		All Ghats	3	4	2	6	1	425
1.	Dibrugarh	Aphalamukh				3		105
1-2		All Ghats	0	1	0	7	1	105

4.1.1.4 Fixed / floating Pier or Jetty Structure Construction

The limited place at the proposed locations and the high fluctuation of water level and shore line are placing high demands on the pier structures. According to the Terms of Reference the berthing structure must be designed as single berth floating platform. Due to this the access structure could be design as fixed or floating construction. Both design concepts show some positive and some negative aspects.

The main Positive aspects are listed below.

- **Fixed construction**
  - Requires less maintenance
  - They are more buoyant and flexible.
  - Easy to step on to and off of from your boat.
  - They do not submerge during storms.
  - Floating docks move with your boat.
  - They are most suited for significant vertical water movement.
  - Easy installation is inherent with floating boat docks.
  - They are recommended by the navy and coast guard in hurricane territory.
- **Floating construction**
  - Requires more maintenance
  - Can withstand heavier loads
  - Can withstand strong tidal flows and currents
  - More user friendly for the elder citizen due to its stability
  - Is less noisier in moving waters
  - Lasts longer than floating docks

The main negative aspects are listed below.

- **Fixed construction**
  - Pollution and wear during flood season
  - During flood season occurs a larger contact area with the water and simultaneous higher flow velocities
  - Disproportional rise of lateral forces with high demands on foundation structure
  - Due to the fixed access points, a vertical displacement could occur between access construction and vessel/pontoon
  - Foundation on poorly supporting soils
- **Floating construction**
  - Length variation of access ramps due to changing water levels
  - Secure anchoring during flood season
  - Loads should be equilibrated
  - Safety against leakage through ship impact

Due to the already mentioned limited place and the fluctuation of river depth and water level it is necessary to implement the terminal amenities directly into the pier structure. These amenities must be completely protected from flooding during operation and should be as near as possible to the berthing area. If the pier structures are designed as a completely floating construction, the terminal amenities could be implemented directly to the berthing area e.g. at pontoons. On the other hand, if the access structure is designed as fixed structure, the terminal amenities could be implemented at a platform on access point level.

4.1.1.5 Single Berth Floating Platform

- **Advantages:**
  - Most flexible design with regard to water depth
  - Can be assembled onshore and towed to the final position
  - Can be easily towed back for maintenance
- **Disadvantages:**
  - Might have larger wave induced motions that may impact the rotor, tower and blades
  - Complex structure to manufacture
  - Requires comparably large amounts of steel
  - Might be more subject to corrosion and ice-loads since much of the structure is closer to the water surface
  - Large facilities for onshore assembly required (dry-dock)

4.1.1.6 Fixed Reinforced Floating Platform

- **Advantages:**
  - Low structural mass and material usage
  - Can be assembled onshore and towed to the final position
  - Few moving parts (no active ballast required)
  - Excellent stability
  - Lower fatigue loads in tower and blades than semi-submersible structures and lower fatigue loads in the tower base than Spar-Buoys
  - Simple structure to inspect
    Few active systems and components
- **Disadvantages:**
  - High loads on the mooring and anchoring system
  - Concerns about the lifetime of tendons
  - Difficult installation process, due to inherent instability during the towing
  - Often requires specialised installation vessels
  - Less developed concept for wind energy applications

The limited place at the proposed locations and the high fluctuation of water level and shore linearеplacinghighdemandsonthepierstructures.According to the Terms of Reference the berthing structure must be designed as single berth floating platform. Due to this the access structure could be design as fixed or floating construction.

Chapter 5 : Stakeholder Consultation

Participatory consultation is both an essential criteria and important strategy for an integrated environmental and social analysis of the project design. The purpose of the stakeholder consultation is to identify the views of local communities, relevant institutional and other stakeholders on the project.This also facilitates identification of any environmental components, for which mitigation measures may be undertaken to minimize any adverse impacts. “Public consultation” refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impacts of the project or activity are ascertained.

Consultation is a two-way process or dialogue between the project authority and its stakeholders. Consulting stakeholders entails an implicit “promise” that, their views will be considered during the decision-making process. The feedback received during the consultation process are analysed and addressed appropriatelyby incorporating them in project design and proposed mitigation measures.

5.1 Requirements and Scope of Stakeholder consultation

The consultation process has been conceived, planned, and initiated with the following key objectives:

- To provide key project information and create awareness among various stakeholders about project intervention;
- To share the Terms of Reference of the current EMF and EIA;
- To have interaction for primary and secondary data collection from project beneficiaries, affected, and other stakeholders;
- To identify environmental and social issues relevant to the project sites
- To establish mechanism for the resolution of social and environmental problems at local and project level;
- To involve project stakeholders in an inclusive manner
- To receive feedback from stakeholders on mitigation measures to address the environmental and social impacts of the project.

5.2 Stakeholder Consultation Stages

As per the World Bank Mandate, the stakeholders consultation is to be conducted at various stages of the project viz., at screening, scoping stage, EMF stage, Draft EIA stage . Consultations

with the key stakeholders will be carried out throughout the Project life. These include consultations and liaison with communities and other stakeholders during the construction phase and also extensive consultations with the grass-root as well as institutional stakeholders during the EIA studies. Theconsultationframework for the project is presented in **Table 5-1**.

Table 5-1: Consultation Framework

Stakeholder	Objective/Purpose	Responsibility	Timing
Communities and other stakeholders	Information dissemination; Public relation; confidence building; awareness about risks and impacts; minimizing conflicts and frictions.	E&S Cell of AIWTDS & EIA Team	Pre - Construction phase
Communities and other stakeholders	Sharing EIA TOR	E&S Cell of AIWTDS and EIA team	During scoping stage of EIA
	Information dissemination; Public relation; confidence building; awareness about risks and impacts; minimizing conflicts and frictions.	E&S Cell of AIWTDS and EIA team	During scoping stage of EIA
	Sharing of EMF	E&S Cell of AIWTDS and EIA team	During EMF Stage
	Dissemination of information on project and its key impacts and proposed mitigation measures; soliciting views, comments, concerns, and recommendations of stakeholders	E&S Cell of AIWTDS and EIA team	During EIA study (once draft EIA is available)
Communities and other stakeholders	Awareness about risks and impacts; minimizing conflicts .	E&S Cell, AIWTDS; Contractors	Construction phase
Consultations with communities	Liaison with communities and project beneficiaries	E&S Cell of AIWTDS	Operational phase

5.3 Identification of Stakeholders

Stakeholder consultationsencompass all major activities concerning the project vis-à-vis environmental issues.

At initial stage, the stakeholders are identified for consultation. Inland waterway commuters, residents of livingon the bank of the Brahmaputra river and around the jetty location, are the prime stakeholders.They are actively or passively influenced by the jetty vis-à-vis IWT. Ferry operators, Fishermen, local amenity service providers, commercial establishments arealso important stakeholders. Non-Government Organisations working in the field of Social and Environmental management contribute significantly in the consultation process. State WRD, Assam is a major stakeholder since all the Ghats are exposed to floods and erosion. Other concerned Govt. Departments play important role in providing secondary data/information.

5.3.1 Local business associations

Local business associations have interest on IWT, as the project willpromote commercial activities.People ferry their products for selling.

5.3.2 Regulators, transport network providers, and regional and local panning bodies

Key stakeholders are also people associated with the transport network which includes government and private ferry operators.Inland water transport in stateisregulated by IWT. Local bodies like Panchayat or Municipal Corporation, Guwhati are also key stake holder. Other Govt. Departments such as Water resources, Revenue, Transport, Commerce are also important stakeholders.

5.3.1 Key Findings of the public Consultations

The stakeholders and community, by and large, appreciated the project. The concern of the participants was mainly focused on improvement of terminals, safety and security of passengers, livelihood, dredging and environmental issues. The summary of points discussed in the consultation meetings are presented in **Table 5-2**.

Table 5-2: Summary of Public Consultations

Stakeholders Type	Concerned raised	Responses and mitigation measures
Shopkeepers	• Shopkeepers opined in favour of the project but they want that the launch Ghat are improved with more facilities such as toilets, sufficient space for shops, parking, sitting area • They expressed that the project will increase their business opportunities and new venture of business will be opening after completion of the project.	• Toilets and drinking water facilities are included in the design of terminals. • The designs of terminals will also include shops/kiosks and while leasing out these shops, priority will be given to the affected communities.
Physically Challenged People	• There is no special facility for the disabled people in the ferry terminals and vessels. • Wheel chair and bed facilities are available only for patients and for emergency situation. • There are no doctors permanently on duty. Physically Challenged People persons want proper safety and security in terminal and ferry. Disabled persons do not know the facilities about river transports. • Most of the people think that road transport is easier than river transport especially for the physically challenged persons as they cannot swim. They want separate space/seat for them in the ferry and easy boarding facility such as smooth way, wheel chairs, etc. • If such facilities are provided for the physically challenged people then they may comfortably use the river transport.	• The designing of terminals will be addressing the issue.

Stakeholders Type	Concerned raised	Responses and mitigation measures
Fishermen	• They want modern signalling system and safety and security during fishing. Some time, they are to face trouble from pirates or some politically influenced persons who force them to pay money for fishing. They welcomed the project but requested to keep in mind about fish moving routes and fishing areas during dredging so that their livelihoods will not be affected.	• Navigational signals will be provided along the channels. • Spawning areas of fish, migratory routes and commercial areas for fishing will be avoided for dredging and dredged material disposal
Launch and Ferry Workers	• Launch and ferry workers expressed their appreciation of the project. • They are concern about dredging and signalling system in the river routes as there were some incidents of collision of vessels. Improved signalling system may prevent such accidents. • They want sufficient Personal Protective Equipment (PPE) for their safety in the launch and other water vessels. PPE can also be available for the passengers	• Safety signal system are included in the project planning.Navigation routes will be scientifically decided and monitored • PPEs will be provided

5.4 Institutional Stakeholders Consultations

Institutional stakeholders' consultation was conducted during screening and scoping stage on 8th October 2018 as per the ToR. The objective of institutional stakeholder's consultation was to inform all relevant stakeholders of the proposed scheme, to identify available information/data, and environmental issues and concerns. Presentations were made, highlighting the project components, its benefits and mitigation measures proposed for addressing environmental and social problems.The important stakeholders participated in the event include:

- Directorate of Fisheries, Meen Bhawan, Gopinath Nagar, Guwahati - 781016
- Directorate of Tourism, Station Road, Guwahati - 781001
- Member Secretary, Assam Pollution Control Board, Bamunimaidam, Guwahati - 781021
- PWD /PMGSY, Ground Floor, Block B, Assam Secretariat Dispur, Guwahati - 781006
- Irrigation Department, Chandmari, Guwahati - 781 003
- Deputy Director of IWAI, Pandu Port Complex, Pandu, Guwahati - 781012
- Scientist, Central Inland Fisheries Research Institute, ICAR-CIFRI Regional Center, HOUSEFEED Complex, Dispur (Last Gate), Guwahati-781006
- Assam Science ,Technology & Environment Council, Bigyan Bhawan, Near IDBI Building, G.S. Road, Guwahati-781005
- Guwahati University, Gopinath Bordoloi Nagar, Jalukbari, Guwahati - 781014
- Merchant Navy, 12, Janapath Ln, South Sarania, Ulubari, Guwahati - 781007
- General consultants
- GMC, Panbazar, Guwahati – 781001
- Tata Institute Of Social Science, Tetelia Road, Assam Engineering College Campus Jalukbari, Guwahati - 781013
- Guwahati IIT, Surjyamukhi Road, North, Amingaon, Guwahati - 781039
- ASTC, Paltanbazar, Guwahati-781008
- KPMG, Advant Navis Business Park, 5th & 6th Floor, Tower A, Plot No. 07, Sector 142, Noida Express Way, District Gautam Budh Nagar
- Senior Engineers Forum Guwahati (NE Region), BeltolaBasistha Road, Guwahati - 781028
- Wildlife Institute of India (WII), Aaranyak, Samanwoy Path Survey, P.O. Beltola Guwahati - 781028.

- Brahmaputra Board, NH37, Basishta, Guwahati, Assam 781029
- village council (gram Panchayat) (At Project areas)
- Local fisherman (Project Areas)
- Operators (Project Areas)
- Traders (Project Areas)

The major Comments/Suggestions and responsesaresummerised in **Table 5-3**. Advertisement in Newspaper in local and English language, Attendance sheets, Letters communicated to stakeholders are enclosed in **Annexure 5-1**.

Table 5-3: Summary of Institutional Stakeholders Consultation

Comments/Suggestions	Remarks / Reply
• The presentation is more generalized and not to the point and specific • More points should be included in the parameters for screening because location wise they are diversified.	The presentation is prepared for the screening and scoping. The main objective was to receive the comments from participants which can be taken into consideration for EIA studies. EIA will bein Public domain covering site specific details.
Following points are to be addressed • Green engineering equipmentsare to be fitted (like solar engine, water jet engine etc.) • Bio toilet for water pollution control • All ferry services may be declared as pollution free zone. • Community participation. • River water protection by using Bio digesterseptic tank for toilet waste	• All the sustainable solutions like green engine, solar light panel, STP with zero discharge system, closed fuelling system will be implemented for pollution free operations at Ghat locations. These are already taken into considerations. • Proper solid waste management at Ghat will be implemented with community participations. • Policy and protocols will be displayed at public domain for information.
Safety of aquatic animals should be given priority	Ecology and biodiversity will be studied in detail during EIA. Accordingly, the management plan will be prepared which will be strictly implemented during construction and operation phase.
The river banks are prone to erosion. The river terminal/ Ghats should be designed considering this aspect. Otherwise people have to suffer and business will be hampered.	Will be considered in designing of the terminals
• Sustainable garbage management. • Protect erosion of permanent structure with proper plantation. • Pollution management/ control by proper way • Protection of river fauna. • Protection of bank erosions with plantation • Pollution control of river water. • Attention for oil spillage, garbage disposal etc.	• Eco-friendly Erosion Control measures like Geo-tube embankment, piling up the geo-bags, Geo-textile Embankments etc. after feasibility will be implemented. • All the sustainable solutions like green engine, STP with zero discharge system, closed fuelling system will be implemented for the pollution free operations. • Proper solid waste management at Ghat locations will be implemented with community participations. • Safety aspects will be covered as per the MORPOL, IWAI, EHS Ports protocols. • Plantations will be taken up in consultation with concerned departments
• What happens to the flora being displaced? • How will it keep fauna like Dolphin & fish away? • In case of an oil spill what is the preparedness • Suggestions: An integrated understanding	• Appropriate protocols and procedures will be prepared for conserving flora • Necessary protective gadgets will be installed the vessels so that Dolphin and other aquatic animals are not affected • Oil spill disaster management plan will be part of EIA

Comments/Suggestions	Remarks / Reply
of the endemic species found at the location.	• Suggestion noted and will be covered in EIA report
Methodology of assessment of "Aquatic Biodiversity" needs to be properly explained.	• Aquatic biodiversity will be studied in greater detail in EIA and appropriate mitigation measures will be suggested
Implementation of MARPOL **Annexure I to VI**	MARPOL implementation plan will be prepared and will be incorporated in EIA report.
• The Baseline survey regarding the environment may kindly be provided. • The EIA must come up with clear comments on how to go for preparation of EMP • Water quality issues in the terminal are to be adressed. • Sourcing of construction materials from nearby areas (of Ghats) are of concern. Thus, alternative arrangements must be suggested.	• Will be covered in EIA. • EMP with implementation plan and responsibility matrix with costing will beincorporated in EIA report. • Water quality issues at the terminal will be addressed and mitigation plan will be prepared. • Noted. Construction material management plan will be prepared
• What are the parameters you have studied in water quality analysis? • How you address the problem • What are the parameters you have studied in air quality parameter? • Do you study the flood? • How many samples you have studied for each location	• Parameters for air and water quality studied are as per TOR given by World Bank. • We will carry out qualitative and quantitative baseline and impact assessment for all parameters and accordingly suggest mitigation measures. Sufficient number of sampling will be done for representative environmental quality assessment of the project sites. • Flood management is already covered in the EIA scope.
• Is the analysis of alternative was done during environmental screening exercise. If yes,then what is the criteria matrix?	Covered in Screening and scoping report.
• How will be river ecosystem affected if the ferry will start? • How new ferrys will lead to sustainable development?	• River ecosystem will be studied during EIA and conservation measures will be taken • MARPOL implementation plan will be prepared and will be incorporated in safety aspect of EIA report. • Erosion control plans will be prepared and implemented after technical feasibility
• This project might effect upon river ecosystem will be disrupted by this project what will be the measures regarding this? • If the number of ferry Ghats increase. So river water bodies will be polluted by the oil spillage. How are you looking after this? What will be the measures? • Ferries can be the cause of Shoreline erosion.	
• How is the increased no. of ferries going to affect the river ecosystem, as well as the surrounding areas(near the Ghats)	
• Environment becomes the home of Biotic and Abiotic species. So, if inland water transports will cheapest sources of transportation but if we see in other side. It will be the sources of pollution to the water. So, my comment is that how we can control the pollution of the water.	
• IWTD may operate hybrid vessels to minimize water pollution • Hybrid- Electric + Solar Diesel + Electric	This will be taken into consideration during finalisation of vessel design

Comments/Suggestions	Remarks / Reply
• They may sought for Govt. assistance (found central+ state as these version scheme and Govt.) to provide fund to control pollution.	

It can be noted from the above discussions that the stakeholders have shown their concern for aquatic ecology of the river. The water quality and oil spillage are also major environmental concern. All the issues will be taken into consideration during detailed EIA study and complied with best mitigation measures.

5.4.1 Public Consultation in EMFStage

Stakeholder consultations were conducted on 4thFebruary 2019 in Guwahati Circuit house and at. Aphalamukh Gram Panchayat Office on 7th, February, 2019 Findings from EMF study and TOR were discussed in the forum. The important stakeholder's invited at Guwhati include:

- Member Secretary, Assam Pollution Control Board, Bamunimaidam, Guwahati - 781021
- Deputy Director of IWAI, Pandu Port Complex, Pandu, Guwahati - 781012
- General consultants
- GMC, Panbazar, Guwahati – 781001
- DPR Consultant for IWT project
- GMDA, Ropeway Project

The important stakeholders, invited at Aphalamukh Gram Panchayat Office are:

- AJYCP, President
- AASV, President
- village council (gram Panchayat) (At Project areas)
- Local fisherman (Project Areas)
- Traders (Project Areas)
- Ferry Users

Important Comments/Suggestions made during Public consultation at Guwhati and Dibrugarh are presented in **Table 5-4** and **Table 5-5**respectively

Table 5-4: Summary of Stakeholder Consultation (EMF Stage), Guwhati

Comments/Suggestions	Remarks / Reply
• Energy saving practices should be implemented • Detailed EMP and costing should be prepared • EMP should be implemented and monitored during construction and operation stage • STP should be installed and monitored on Terminals for its operations • Solar energy should be thought of at terminals • Night navigation should be improved • All the environmental concerns should be considered in design of terminals by DPR consultants • Training requirements should be considered in EMF	• All the sustainable solutions like green engine, solar light panel shall be installed • Proper solid waste management at Ghat locations will be implemented with community participations. • Mechanism for review and monitoring of implementation of EMP will be established • Night navigation improvement is already considered by PP in the project • Training requirements are already considered at different stages of the project. • All the identified environmental issues will be considered during design of terminals and vessels

Table 5-5: Summary of Stakeholder Consultation (EMF Stage), Dibrugargh

Comments/Suggestions	Remarks / Reply
• Day to day ferry service should be introduced • Night Navigation should be improved • People have to take Dead Body from Jorhat to Majuli. But at present no such facility is available. People have to wait for ferry service to carry dead body. So it is requested to have facility on ghat for dead bodies. • Waste generation and its management should be taken care of. Zero discharge facilities should be implemented. • Employment can be improved in the IWT. Suitable and required training should be provided to the localsforskill development. • Toilet facilities along with bio-septic tank which are not available at present should be constructed • Incremental facilities should be considered during design as the passengers have increased in the past few years. As the Majuli is main attraction of tourists, all necessary facilities should be made available on Ghat. • At present no facility like waiting room, toilets, parking is available	• Noted and will taken care of • Night navigation is already considered in the proposed project • Noted. This should be implemented by the local authority. • Zero waste disposal is already considered in the project terminals • Employment will be definitely improved in IWT sector. Also training centres and facilities are already considered in the project • Toilet facilities, bio-septic tanks, solar energy at terminals, etc. are considered in the project design

5.4.2 Stakeholders meeting on Environment and Social Impact Assessment (E&SIA) in Draft EIA & SIA stage

Stakeholders meeting was conducted on 22nd July 2019 at Milan Sangha, Kamalabari, Majuli Guwahati. The public were informed that a state of the art terminal will be constructed at Aphalamukh which will have all the modern facilities in built and sought co-operation of all concerned Stakeholders for its success implementation. Findings from EIA study and TOR were also discussed in the forum. The important stakeholder's invited at the meeting are:

The important stakeholders, invited at Kamalabari, Majuli are:

- **Sri. Virendra Mittal, IAS, State Project Director**
- **Sri. Dhrubajyoti Das, ACS, Addl. SPD and Director, IWT**
- **Shri. Rahul Chandra Das, ACS, Dy. State Project Director**
- **Sri. Deba Prasad Misra, ACS, Deputy Commissioner, Majuli District**
- **Shri. Manik Sarma, Advisor, AIWTDS**
- **Sri. Rupankar Choudhury, Environmental Expert, AIWTDS**
- **Sri. Ghana Kanta Nath, Retd,Principal.**
- **Sri. Padmadhar Pegu, Retd. Professor**
- **Dr. Ananda Hazarika, Asst.Professor, Dept. of Geography, Majuli College**
- **Sri. Jagat Hazarika President, AJYCP Majuli District**
- **Sri. Pabitra Goswami, Advisor, AASU, Majuli**
- **Sri. Kishori Mohan Paul, Retd. Teacher and ManagingEditor of 'Majuli News' & amp;**
- **Smti. Subhadra Saikia Bora, Retd. Teacher and President, Mahila Zila Samiti, Majuli**
- **Sri. Phanidhar Tahu, Retd. Principal**

- **Sri. Aditya Dutta,President, AKRSU,Majuli**

Some of the Photographs of the Workshop




Important Comments/Suggestions made during stakeholder meeting Kamalabari, Majuli are presented in Table 5-6.

Table 5-6: Summary of Stakeholder meeting (Draft E &SIA Stage) at Majuli

Sl No	Name of the Person	Queries/ Suggestions	Remarks
1	Sri. Ghana Kanta Nath, Retd. Principal.	He raised the issue that as South Guwahati and North Guwahati have been considered for construction of terminal, than why at Jorhat-Majuli only one side has been considered for the construction of the terminal and suggested that both the ghats should be taken up. He also requested that a detailed study should be conducted for road connectivity from all corners for the uninterrupted movement of commuters from Kamalabari to Aphalamukh as Kamalabari is the busiest place.	The feasibilty study for other ghats including Kamalabri is under progress and will be taken up.
2	Sri. Padmadhar Pegu, Retd. Professor	He suggested that Ro- Ro service should be operational round the year and should not be stopped.	It is not within the scope of this project. However, the matter has been addressed by Director, IWT Assam who was also present in the Stakeholders'

Sl No	Name of the Person	Queries/ Suggestions	Remarks
			Meeting.
3	Dr. Ananda Hazarika, Asst. Professor, Dept. of Geography, Majuli College	First of all he thanked the GoA of Assam for initiating to construct a state of the start terminal at Aphalamukh. He informed that since 1962 Neamati – Kamalabari Ghat has played a pivotal role for the commuters of Majuli. But due to technical conditions as Aphalamukh has been considered the embankment between Haldabari – Besamari which is the lifeline of Majuli would have to bear tremendous pressure of heavy movement of vehicles for trespassing construction materials having an adverse impact on the present road condition for which due precautionary measures should be taken from the concerned authority. He is involved with various NGOs working in the bio-diversity. Based on his experience in this field he suggested that aquatic environment surrounding Aphalamukh Ghat area should be surveyed properly to reduce impact due to the project on aquatic ecology.	Separate Biodiversity study was carried out for all the ghats along with an exclusive dolphin study. Mitigation measures during construction and operation stages has been provided in the EIA & EMP report.
4	Sri. Jagat Hazarika President, AJYCP Majuli District	Welcomed the decision of GoA for construction of Terminal. He enquired about the impact of project on the erosion and precautionary measures should be taken care. He informed that due to heavy rainfall almost 10 days ferry services were called off for which the local commuters had to suffer immensely for day to activities. He suggested that if possible during HFL ferry services may be resumed only for passengers without any vehicles to avoid any calamities as it could be observed that boats with goods vehicle were moving.	Mitigation measures for soil erosion during construction and operation stages has been provided in the EIA & EMP report.
5	Sri. Pabitra Goswami, Advisor, AASU, Majuli	He informed that mere construction of terminal at Aphalamukh would not serve the purpose the people of Majuli also need the upgraded Kamalabari terminal to be taken up on priority basis. He also informed that District Administration has taken various initiatives for the people of Majuli during the flood for transportation. He also informed that inspite of the construction of the terminals at Majuli, the bridge form Jorhat to Majuli is the top priority for the 1 lakh people of Majuli for which representation to the Union Govt. has already been given from their end. He informed that Ro- Ro service which is stopped	The feasibility study for other ghats including Kamalabari is under progress and will be taken up.

Sl No	Name of the Person	Queries/ Suggestions	Remarks
		now should be operational round the year and should start at the earliest. He also enquired when the construction of terminal work would be started and the timely completion of the same should be ensured.	
6	Sri. Kishori Mohan Paul, Retd. Teacher and Managing Editor of 'Majuli News' & 'Majulr Dapon' local daily.	He informed that as Aphalamukh has been selected for construction of the terminal the local commuters will have to bear the expenses of the journey from Kamalabari to Aphalamukh on daily basis and so Kamalabari terminal should also be taken up at the earliest. He also informed that movement of heavy vehicle has already disturbed the day to day life of the inhabitants which should be taken care of by the concerned authority at the earliest. The bridge is the outmost priority than Rail and Air connectivity.	The feasibilty study for other ghats including Kamalabari is under progress and will be taken up.
7	Smti. Subhadra Saikia Bora, Retd. Teacher and President, Mahila Zila Samiti, Majuli	She informed that during the travelling by ferry it has been observed separate facility for toilets etc. are found to lacking in the ferry. She requested due care should be taken for providing a dedicated modern ferry with facilities for Women, Pregnant Women and children to take care of the emergency needs and the same provisions should be available in the new terminal building. She also requested to take up the matter of construction of the terminal at Kamalabari on priority basis and welcomed the move for construction of the terminal.	Both the ferries and terminal under this project are of modern one with the facilities of sitting area, separate toilets for male and female, First Aid facilities etc. The feasibility study for other ghats including Kamalabari is under progress and will be taken up.
8	Sri. Phanidhar Tahu, Retd. Principal	He informed that interest of small business man and cultivators should be taken care of during the construction.	All the project affected person will be suitably compensated as per the Land Acquisition law.
9	Sri. Aditya Dutta, President, AKRSU, Majuli	Aphalamukh Spur is damaged in some places so in view of the same ferry service with night navigation should be started at the earliest.	The issue of night navigation has already been taken up with the concerned authority.

Chapter 6 : Current Environmental Scenario

6.1 Introduction

The existing environmental baseline conditions in line with Term of reference are described in this chapter.

6.2 Study Area

The study area is defined as the area over which the potential direct and indirect impacts of the proposed development are expected.

500metres radius from project site is considered as direct impact zone and 10km radius from project site is considered as indirect impact zone.Primary& secondary data are collected for various environmental components of the study area to establish the baseline environmental status.

The study area of North Guwhati which includes both off-shore and on-shore are shown in Google map (500 metres radius) & topographic (10 Km radius) in **Figure 6.1**&**6.2**. Similarly, study area of Gateway Guwhati Ghat is shown in maps in **Figure 6-3** and **6-4**. Study Area of Aphalamukh Ghat is presented in **Figure 6-5** and **6-6**.

Figure 6-1: Study Area– North Guwahati (500mt Radius from Project Site)

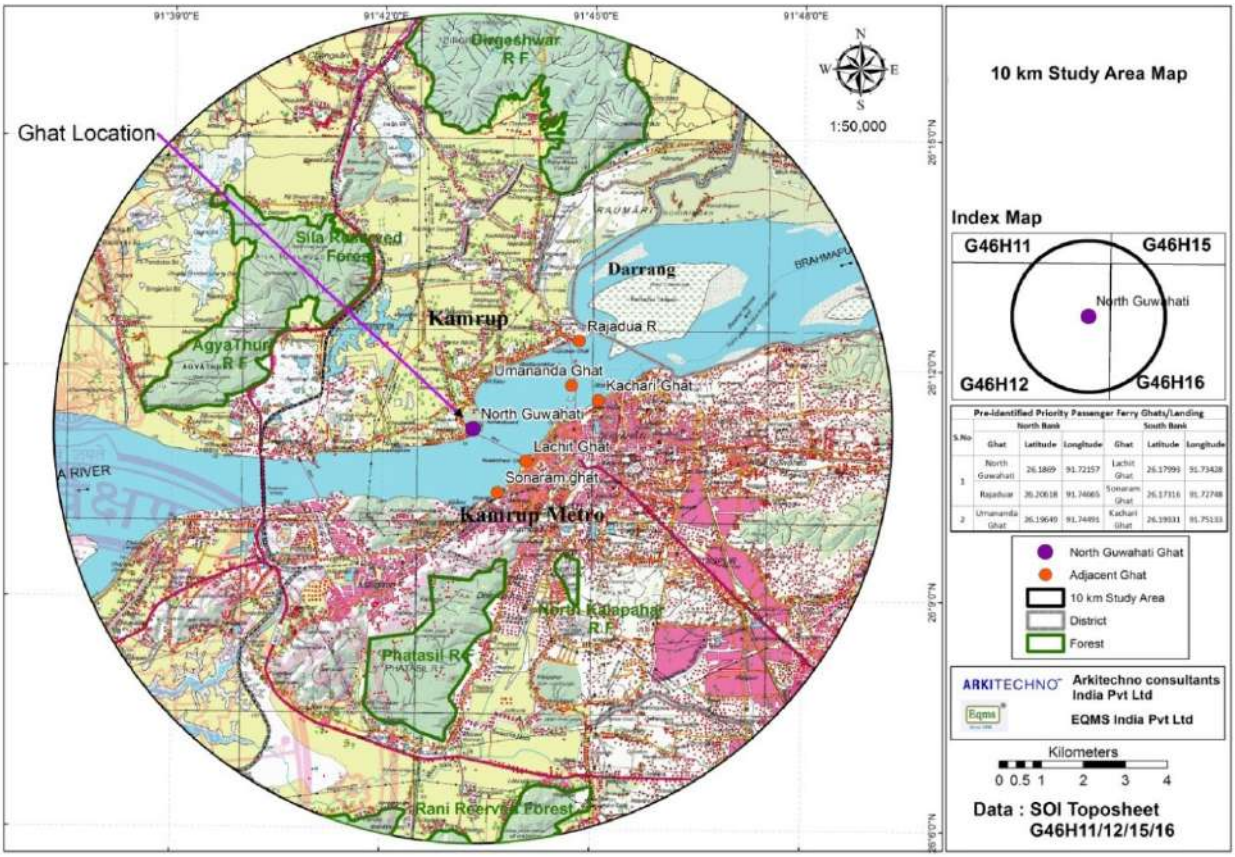


Figure 6-2: Study Area– North Guwahati (10km Radius from Project Site)

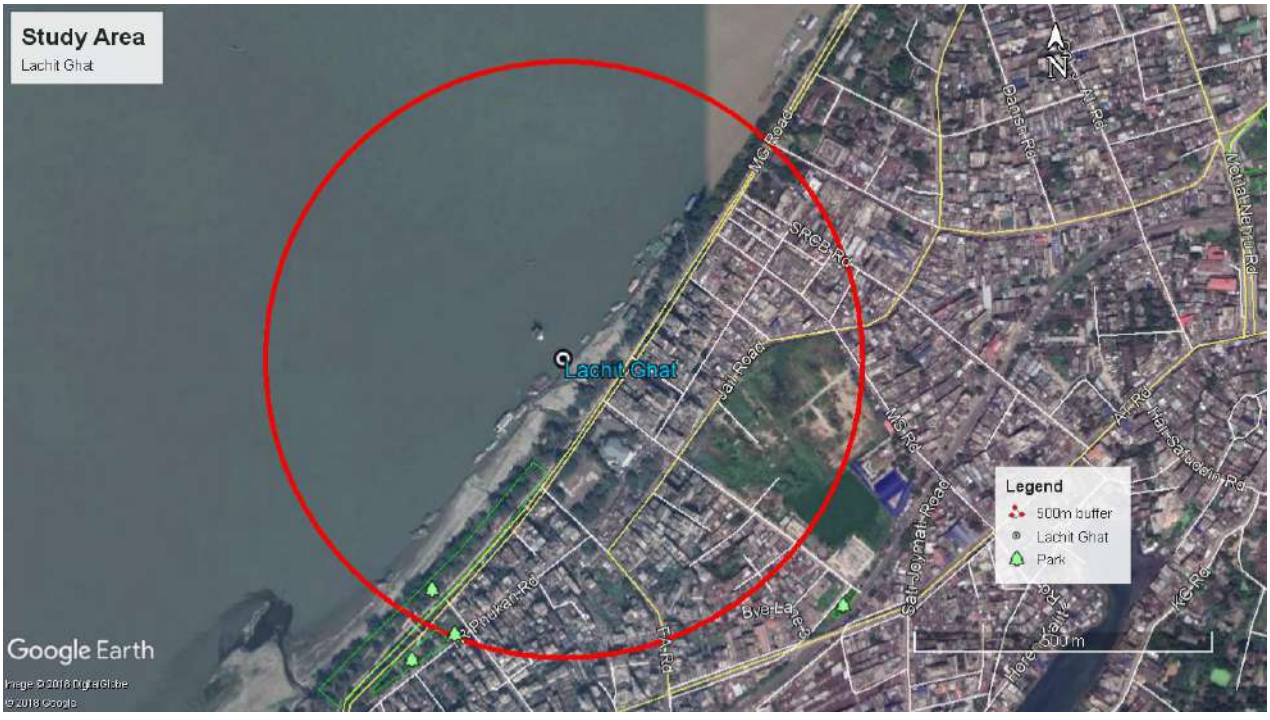


Figure 6-3: Study Area– Gateway Guwahati Ghat (GGG) (500mt Radius from Project Site)

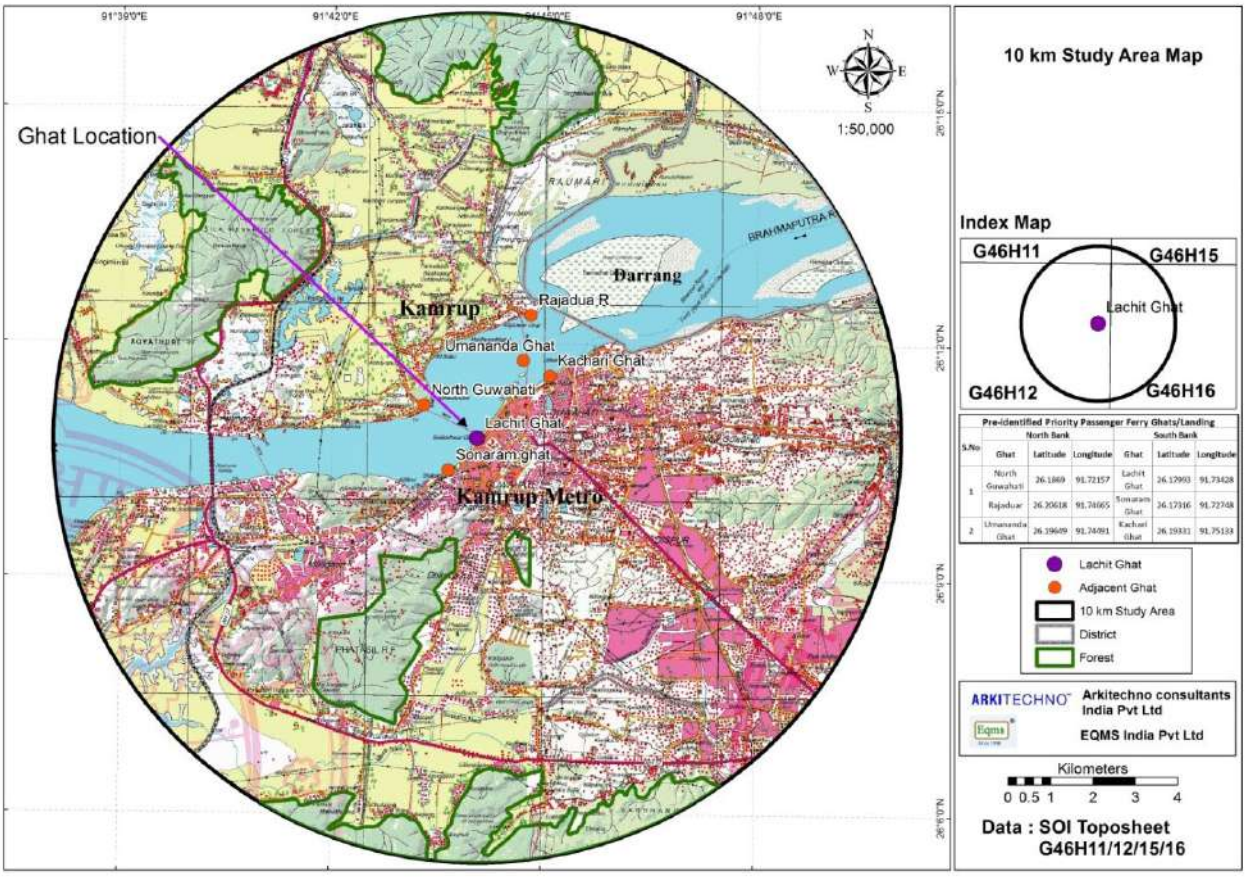


Figure 6-4: Study Area– Gateway Guwahati Ghat (GGG)(10km Radius from Project Site)

Figure 6-5: Study Area– Aphalamukh Ghat (500mt Radius from Project Site)

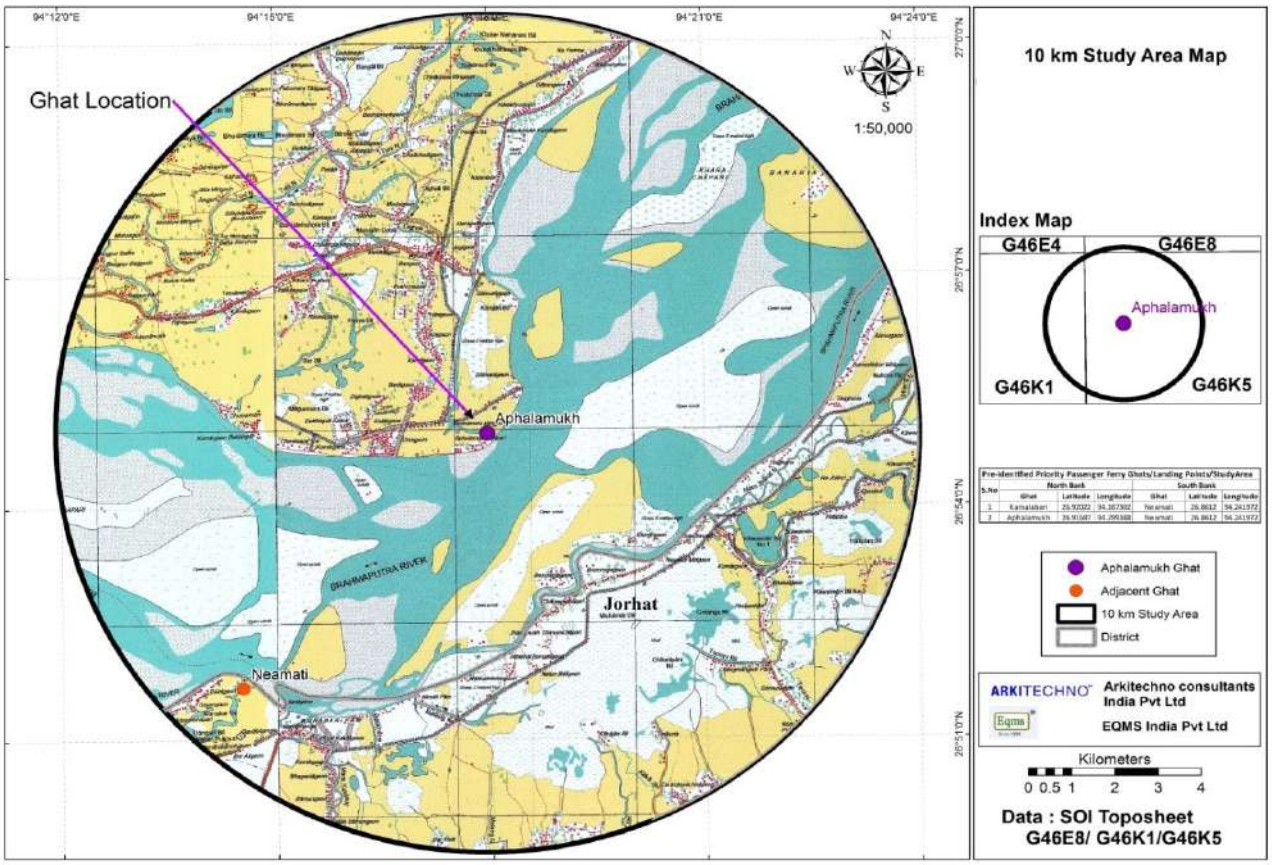


Figure 6-6: Study Area– Aphalamukh Ghat (10km Radius from Project Site)

6.3 About Brahmaputra River

Brahmaputra River system is characterized by high water discharge.Brahmaputra valley has an average width of 80 km. It is bounded by Arunachal Pradesh, Bhutan i.e. lower range of Himalayas in the North, Arunachal Pradesh in the East, Nagaland and hills of Meghalaya in the South and plain area of various states in the west including Assam.Apart from the Brahmaputra, a large number of tributaries, originating from the Lower range of Himalayas, Nagaland hills, Pataki range and Meghalaya join the Brahmaputra after traversing through the basin.

All the tributaries of the valley are rain fed. Heavy precipitation from June to September is experienced. All those tributaries experience number of floods of the tributaries. The tributaries are namely Subansari, Ranganadi, Dikrong, Buroi, Borgong, Jiabharali, Dhansiri(North), Puthimari, Manas, Beki, Aie, Sonkosh are the main tributaries on the North while the Noadehing, Buridehing, Desang, Dikhow, Bhogdoi, Dhansiri (South), Kopili, Kulshi, Krishnai, Dudhnai, Jinjiram are main on the South Bank of the river Brahmaputra.

The mean annual rainfall over the entire catchment including Tibet and Bhutan is about 2500 mm. The rainfall in Brahmaputra basin is mainly due to South West monsoon and out of total annual rainfall 85% occurs during the monsoon months from May to September, besides the valley gets a good amount of rainfall in the month of April and May due to thunderstorm activities which account for flood during heavy rain in June, When the soil is already saturated and river bank in full stage.

Lateral shifting of river

It is reported that in the vicinity of Majuli Island, about 25 % of the total river length from the upper end, the Brahmaputra has migrated southward by at least 25 km since about 250 years ago.

Other sources mention a present average rate of southward migration of 10 meters per year (or 1 km per century). A general tendency to migrate southward is explained as being due to the larger quantities of bed sediment delivered by north bank tributaries. Individual channels of the multiple-channel system shift frequently and rapidly during flood events.

- **River Gradient**

The river slope of Brahmaputra in its upper reaches can be described as steep for a river of its size. Between source and Kobo the slope is approximately 270 cm/km. This steep slope suddenly flattens when the river enters Assam valley. Between Kobo and Dibrugarh ,the slope is about 26 cm/km. Between Dibrugarh and Neamati the slope further flattens and is indicated to be around 18 cm/km, further flattening between Neamati and Guwahati to 12 cm/km.

- **Width**

The overall width and the range in width of the Brahmaputra are truly remarkable. The width between outer banks ranges from as low as 1.2 km at one nodal point to 18 km or more at one or two sections. Individual low-water channels can have widths of up to 1 km or so.

- **Depths and Water Level**

Under ordinary flow conditions, maximum depths of main channels with respect to adjacent islands or floodplain areas are typically in the range of 10 to 20 meters, tending to increase in the downstream direction. Rises in water level from low water to high flood stages are around 8 meters. At certain locations where flow impinges on hard banks or artificial structures to produce local scour holes, depths can exceed 50 meters.

- **Average discharges**

The long-term average discharge of the Brahmaputra increases through Assam from about 8,500 to 17,000 cubic meters per second. The distribution of flow through the year is quite uneven, most of the flow volume being carried during the monsoon season from May to October. The largest average monthly discharges at Pandu, about two-thirds of the river distance through Assam, are around 36,000 cubic meters per second for the months of June and July.

- **Flood discharges**

In many rivers, maximum flood discharges over a period of a day or less greatly exceed average discharges over a year or over a month, but in the Brahmaputra the ratio of flood to average discharges is relatively modest. Over the approximately 700 km length through Assam, 10-year peak discharges increase from roughly 25,000 to 75,000 cubic meters per second, and 100-year peaks from roughly 30,000 to 90,000 cubic meters per second. Comparing these flood discharges with the previously quoted mean discharges, it can be seen that 100-year flood peaks are only four to five times greater than long-term mean flows – a rather low ratio on a global scale.

6.3.1 Sediment Transport

Sediments in the valley through Assam are predominantly either floodplain deposits created by the Brahmaputra itself, or alluvial fan deposits created by tributaries emerging from the mountains and hills onto the floodplain. The riverbed consists mainly of fine and medium sand, and the floodplain deposits of silt and fine sand. Because sediment tends to accumulate in and adjacent to the river channel system, the center of the valley is apparently higher than the outer margins of the floodplain – that is, the river is somewhat perched. Such a feature tends to encourage extensive lateral shifting of the channel system in major flood or earthquake events.

For the Brahmaputra, this unmeasured component is believed to represent a significant fraction of the total sediment transport, probably in the range of 5 to 15 percent. Morphologically, it is the most significant fraction, because it is closely associated with bank erosion and the deposition of bars and chars.

The long term mean transport is believed to increase through Assam from 250 million metric tons per year at the eastern end to 500 million metric tons per year at the western end. At Pandu, about two-thirds of the distance through Assam, the mean transport is reported as approximately 400 million metric tons per year, and the average rate for June through September as 60 million metric tons per month, or 2 million metric tons daily. With a long-term mean water discharge at Pandu of

approximately 16,000 cubic meters per second (1,380 million metric tons daily), the average suspended sediment concentration in the water works out to about 800 parts per million by weight. During the monsoon period, the average concentration doubles to about 1,600 parts per million.

The sediment load of the Brahmaputra River is significant when compared to the rivers of theregion (Mahanta et al., 2004) leading to high turbidity values. Sediment load in rivers generallyraises the channel bed and thus leads to flood during monsoon. Sediments in rivers generally come with the surface runoff from the degraded watersheds. In the Brahmaputra, bed sediment load consists essentially of sand, and wash load consists of silt and clay. Available measurements of river sediment transportreport suspended sediment load, which contains the entire wash load and also, in high-flow conditions, the finer fraction of the bed sediment load.

6.3.1.1 Baseline Environental Status

Environmental monitoring was carried out to understand the baseline status. Various environment monitoring, conducted in the study area with parameters & frequency have been summarised in the **Table 6-1**.

Table 6-1: Baseline Survey

Environmental Feature	Parameters Recorded	Duration and Frequency	Apparatus used	Remarks
1. Ambient Air Quality	• PM 10 and PM 2..5 • Sulphur dioxide (SO_2) • Oxides of nitrogen (NO_X) • Carbon Monoxide (CO) • Pb (Lead) • NH_3, • C6H6, BaP, • Arsenic & Nickel.	• At 3 locations at each Ghat within study area for one season • Sampling locations are decided as per the wind direction and activities Frequency: 24 Hourly sampling (Day & Night time) to be done on twice in a week basis for one season (except monsoon period)	High Volume Sampler	• SO_2(as per IS-5182) Part – II) – 1969) • NO_X(as per IS-5182 (Part VI)-1975) • CO (as per IS-5182 (Part X) 1975) • Lead (as per IS: 12074)
2. Noise Level	• Max Noise Level (L max) • Min noise level (Lmin) • Maximum hourly Leq • Minimum hourly Leq • Day time Leq value (6 am to 10 pm) • Day time Leq value (10 pm to 6 am)	At 3 locations in the study area at each Ghat. Each location, noise monitoring has been conducted continuously over a period of twenty four hours Frequency: 24 continuous hours of Hourly sampling (Day & Night time)	Noise level meter	Measurement of "A weighted" sound level continuously using noise level meter for one day in each survey locations as per the CPCB approved method IS: 4954.
3. Surface Water	Physical parameters: pH, Temp., DO, Conductivity, Colour (Hazen Units), Turbidity & Salinity, Chemical parameters: TSS, TDS, Alkalinity, Hardness, COD, NO3, PO4, Cl, SO4, Na, K, Ca,	Surface Water Quality at 2 locations at each Ghat Frequency: One time for two season i.e. dry and wet i.e. Pre and Post Monsoon Seasons	Relevant apparatus used as per codes	Parameters like pH, temperature and dissolved oxygen are measured in-situ. Analysis of the samples as per the standard methods for examination of

Environmental Feature	Parameters Recorded	Duration and Frequency	Apparatus used	Remarks
	Mg, Mn, Zn, Hg, Pb, Cu, Arsenic, Silica, Oil & grease, Phenolic compounds, Residual Sodium Carbonate. Biological parameters: Total Coliform. Aquatic biota like phytoplankton, zooplanktons			water and wastewater published by APHA et.al. and relevant IS codes (IS:2488 :Part I to V)
4. Ground Water	Physical parameters: pH, Temp., DO, Conductivity, Colour (Hazen Units), Turbidity &Salinity, Chemical parameters: TSS, TDS, Alkalinity, Hardness, BOD, COD, NO3, PO4, Cl, SO4, Na, K, Ca, Mg, Mn, Zn, Hg, Pb, Cu, Arsenic, Silica, Oil & grease, Phenolic compounds, Residual Sodium Carbonate. Biological parameters: Total Coliform.	Ground water Quality at 3 locations at each Ghat Frequency: One time for two season i.e. dry and wet	Relevant apparatus used as per codes	Grab samples collected from wells / bore wells / hand pumps present on the adjacent to the Ghat location
5. Soil and riverbed /riverbanksediment analysis (Composite samples shall be prepared based on at least 3 replicates from each location.)	Bulk Density, Colour, Texture, Soil Type, pH, EC,N, P, K. as well as presenceof pollutants or heavymetals such as PCBs, POPs, hydrocarbons, and heavy metals such as arsenic, cadmium, mercury, lead, nickel, etc.	3 soil samples in the study area at each Ghat location Frequency: One time for one season	Analysis in Atomic Absorption Spectrophoto-meter (AAS)	Sampling and analysis as per standard methods and procedures prescribed in IS:2720 and ASTM
6. Aquatic & Terrestrial Ecology	Trophic Status, Primary Productivity, Species diversity & densities of Phyto& Zooplanktons, Benthic Organism (Benthos, Macro-benthos), Fish and Macrophytes, Shannon Weiner Diversity Index, IUCN Red List status; national or state / regional protection status.	River for Aquatic Ecology at Ghat Locations Terrestrial Ecology at Ghat Locations Secondary data collection for PA, WLS, Forest, Land use Frequency: One time	-	-

Environmental Feature	Parameters Recorded	Duration and Frequency	Apparatus used	Remarks
	Identification of Schedule-1 species nearby each sub project site. The Brahmaputra River Basin is one of the active breeding & natural habitat for Gangatic Dolphin. A comprehensive study of the Gangatic Dolphin in the River Brahmaputra(near the proposed Ghats / landing points for development of terminals) includes but not limited to occurrence, active breeding sites, etc. to be carried out and incorporated in the EIA report under aquatic ecology study.			

The monitoring stations of three terminals i.e GGG, North Guwahati and Aphalamukh, covered under the project are shown in Maps in **Figure 6-7, 6-8** and **6-9** respectively.

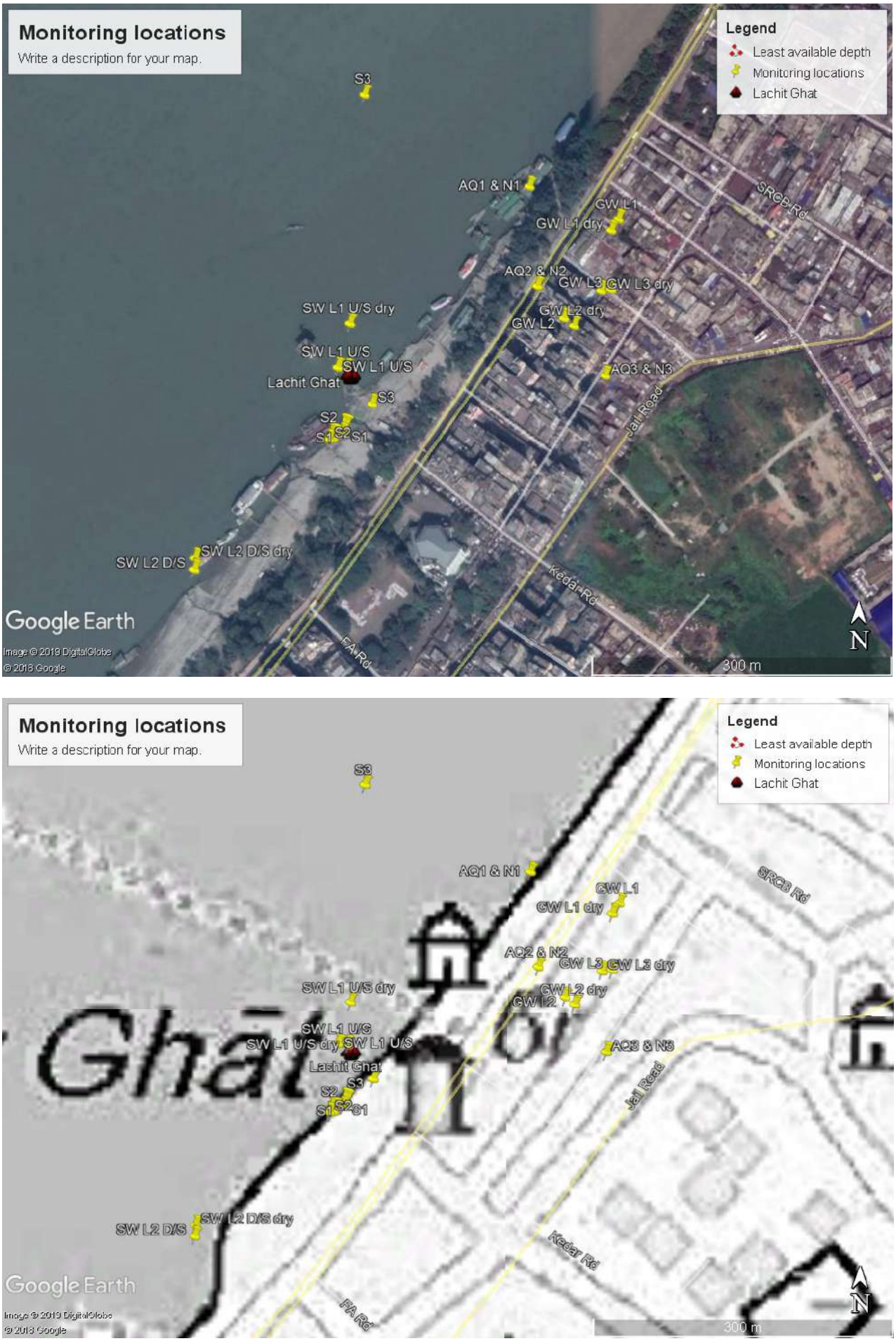


Figure 6-7: Environmental Monitoring Locations – Gateway Guwahati Ghat (GGG)

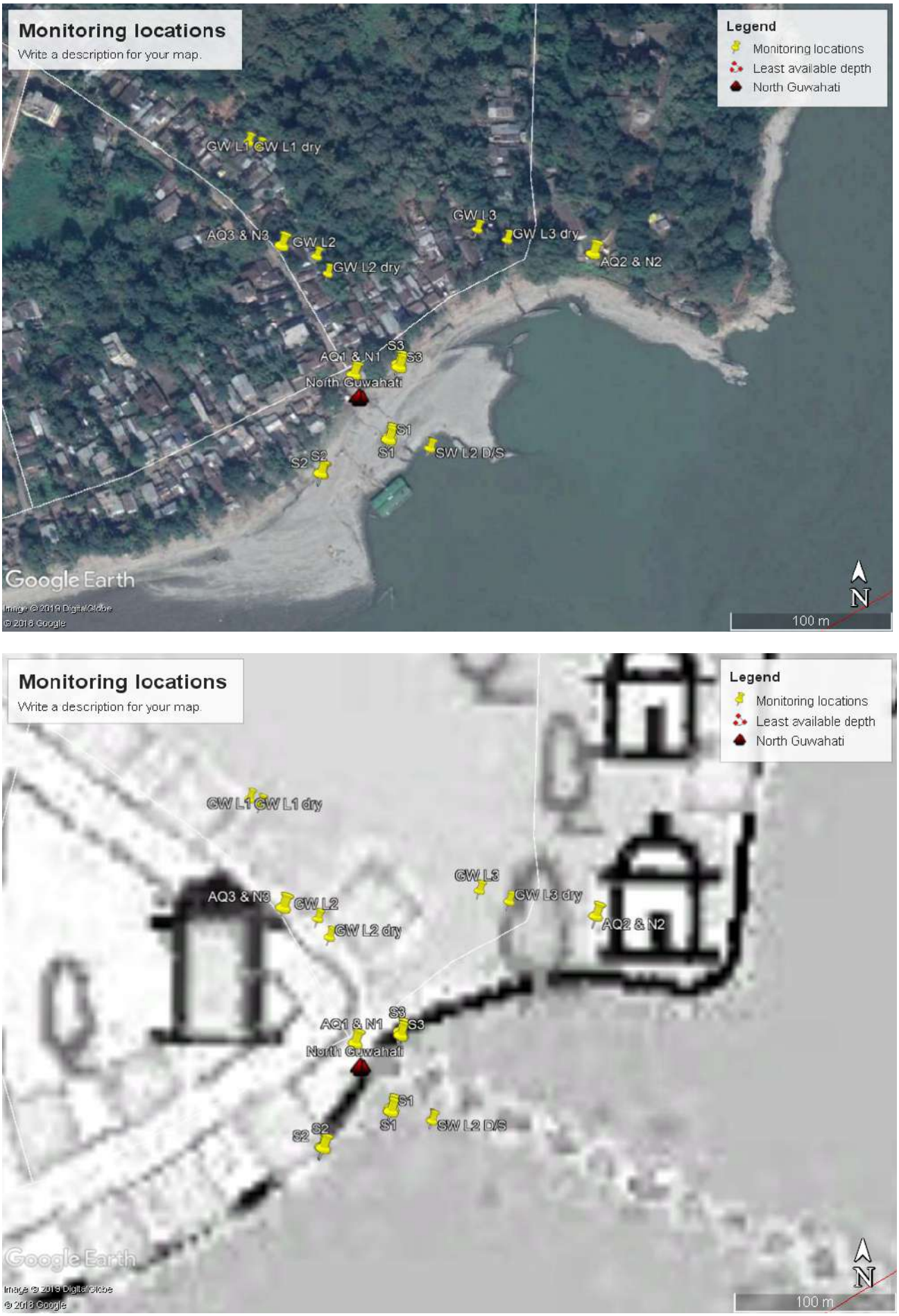


Figure 6-8: Environmental Monitoring Locations – North Guwahati Ghat

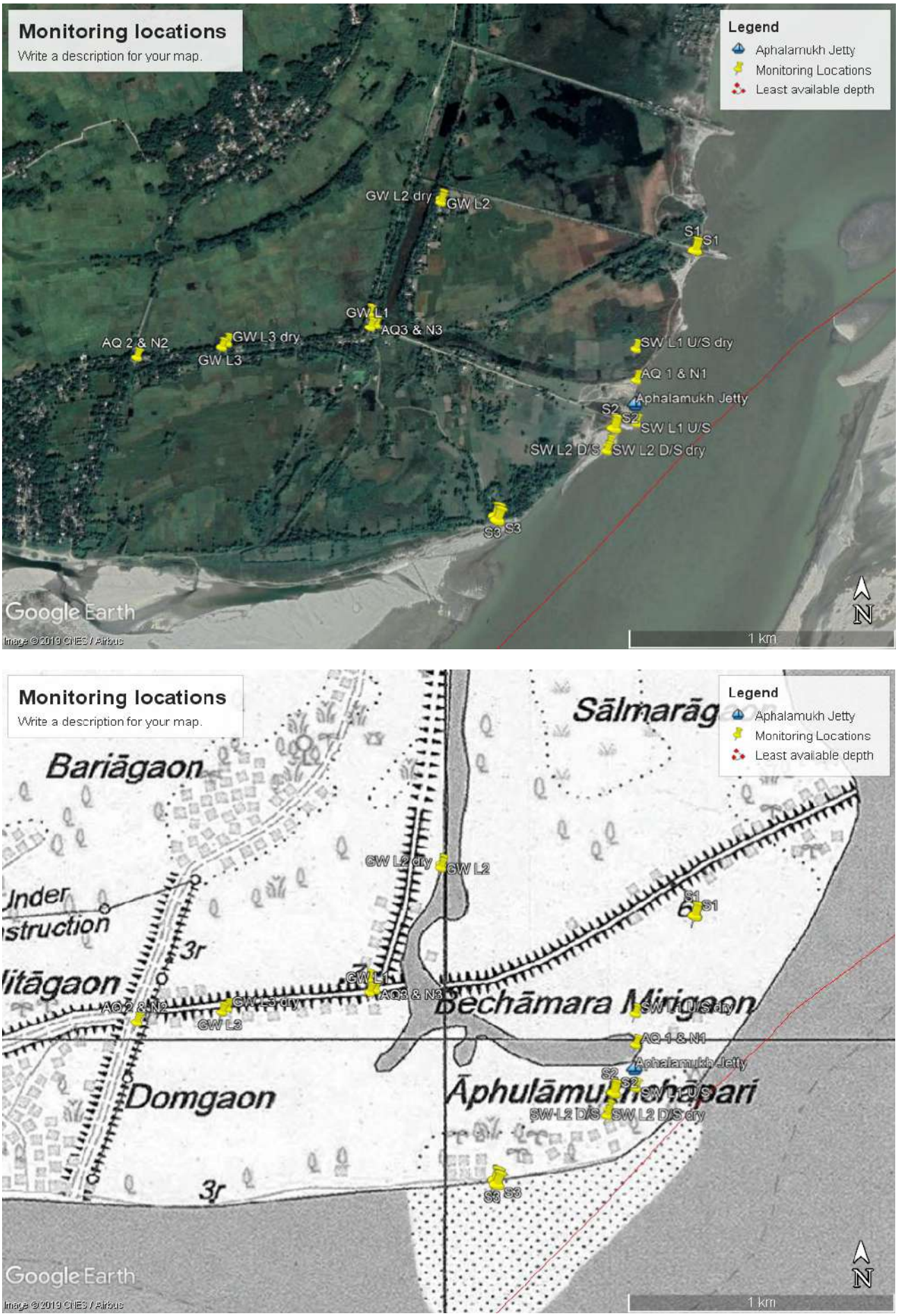


Figure 6-9: Environmental Monitoring Locations – Aphalamukh Ghat

6.4 Physiography

The Brahmaputra Valley has a uniform level alluvial Plain interspersed with low elevated hillocks scattered along the banks of the Brahmaputra River. These hillocks are the outliers of the Meghalaya or Shillong plateau and extend from the Tezpur and Karbi Hills of the Central Assam Plain as far west as Dhubri. Besides, these isolated hillocks that expose Archaen gneisses and occasional outcrops of Tertiary sandstones along the northern periphery, the entire region is covered by alluvial deposits of recent and Sub-Recent origin. The alluvial fans formed by the coarse alluvial debris in the northern fringe of the Valley have given rise to semi-tame conditions where water percolates down resulting in wet soil and dense forest. In the South Brahmaputra plain the meandering course of the tributaries is conspicuous only in the eastern part where there are numerous beels and oxbow lakes. The most physical characteristic of the Brahmaputra is that the river itself is highly braided due to its gradient. As a result, there are number of Chars or riverine islands.

6.5 Land Use Pattern

The objective of assessing the land use details of the area is to know the existing land use pattern of the area and enable one to know about the land that can be used for the proposed development activities in the study area. It also enables to envisage the scenario emerging due to the increase in demand for land with increase in population and the impacts arising due to the interface with the various project activities. Land use / Land cover maps are prepared for the study area using GIS Maps / Toposheet. The Study Area Map is depicted in **Figure 6-1** to **6-6**.

- **Satellite data:** The Indian Remote Sensing satellite data RESOURCESAT-2, LISS III is used for the analysis of Land Use and Land Cover around 10 km of the study area.
- **Topographical maps**: The Survey of India Toposheets/OSMs on 1:50,000 scale covering study area is used for the preparation of Base Map, Drainage Map of the study area.

Methodology

The land use / land cover map is prepared by adopting the interpretation techniques of the image in conjunction with collateral data such as Survey of India topographical maps and census records. Image classification has been done by using visual interpretation techniques and digital classification using ERDAS image processing 10.0 software and ARC/GIS 10.0 software. The various activities for preparation of LULC include pre-processing, rectification, enhancements and classifying the satellite data for assessing the change in land use land cover due to proposed developmental activities.

Flowchart showing the methodology adopted for land use/land cover mapping is provided below in **Figure 6-10.**

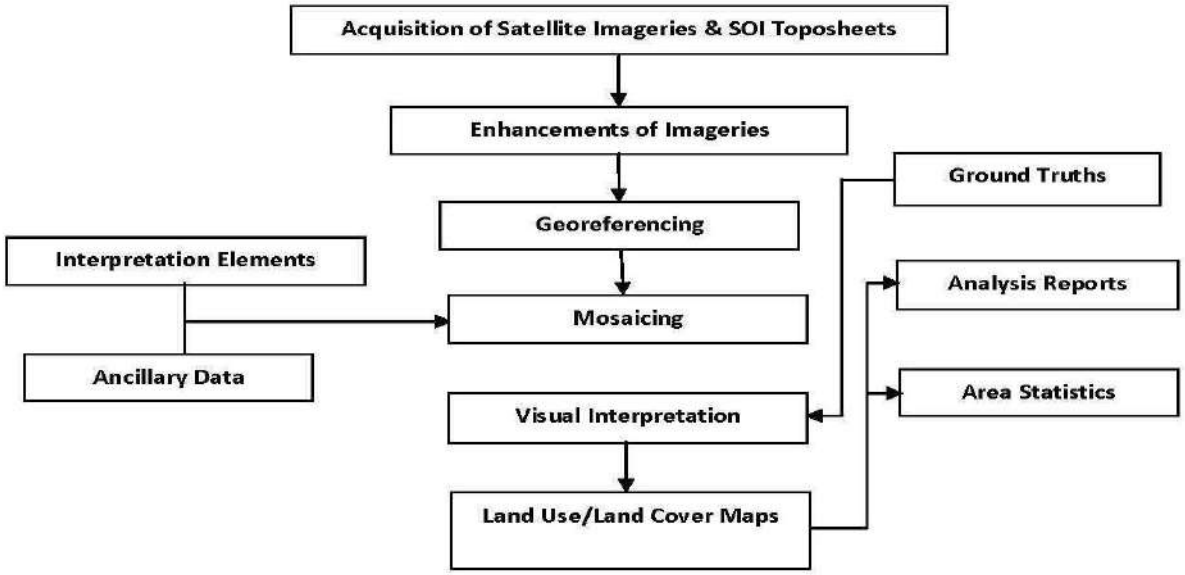


Figure 6-10: Flowchart showing the methodology adopted for land use/land cover mapping

The land use land cover study is done through digital image processing and visual interpretation technique to generate output of Land use / Land cover map around the 10 Km radius of proposed project are prepared for study area on 1:50,000 scale.

6.5.1 Land Use / Land Cover (LULC) for Gateway Guwahati Ghat (GGG)

The land use and land cover map surrounding the project siteGateway Guwahati Ghat (GGG) is provided in **Figure 6-11** and the LULC map around the 10 Km radius of proposed project is provided as **Figure 6-12**.Land use pattern of project sites GGG, is given in **Table 6-2**.

Table 6-2: Land Use/Land Cover Gateway Guwahati Ghat

Land Use/Land Cover	Area (Ha)	Area (Sq Km)	Area Percentage
Agricultural Crop Land	2609.15	26.09	8.31
Fallow Land	4647.21	46.47	14.79
Settlement	5893.36	58.93	18.76
Forest	8697.39	86.97	27.68
Open Scrub/Grazing Land	3744.54	37.45	11.92
Wetland	1336.30	13.36	4.25
Water body	488.91	4.89	1.56
River	2779.55	27.80	8.85
Sandy Area	1218.88	12.19	3.88
Total	**31415.31**	**314.15**	**100.00**

The study area comprises of agricultural land of about 2609.15 ha (8.31%) including fallow land 4647.21 ha (14.78%). Settlements in the study area cover an area of 5893.93 ha (18.76%) approximately. Forest in the study area comprises of about 8697.39 ha (27.68%) and Open Scrub / Grazing Land of about 3744.54 ha (11.92%). Study area has 488.91 ha (1.56%) of water bodies and 1336.3 ha (4.25%) of wetland. River and Sandy area covers an area of 2779.55 ha (8.85%) and 1218.88 ha (3.88%) respectively.

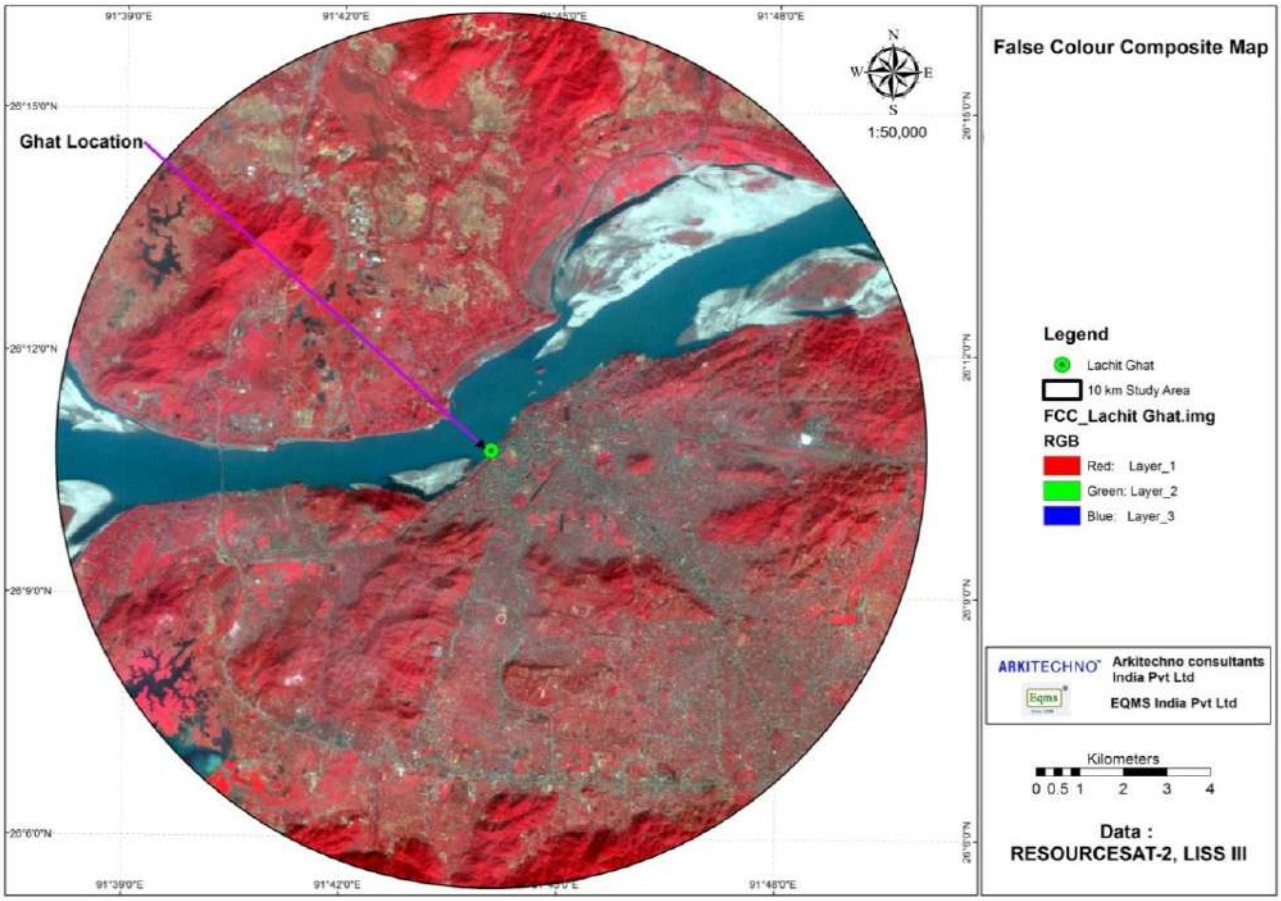


Figure 6-11: 10 Km radius False Color Composite Satellite Map

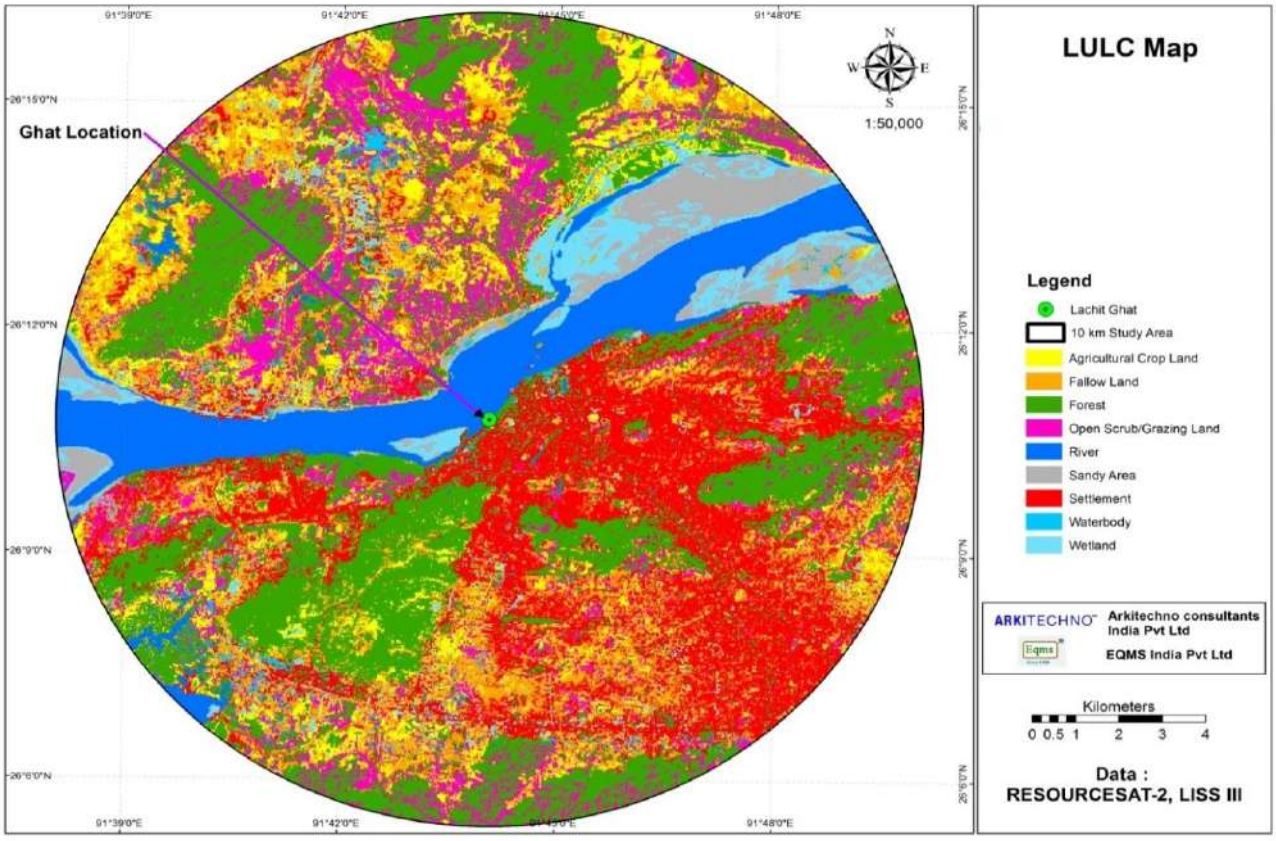


Figure 6-12: Land Use / Land Cover Map of Study Area (10 Km Buffer)

6.5.1.1 LULC for North Guwahati Ghat

The land use land cover study map surrounding the project sifor North Guwahati Ghat is provided in **Figure 6-13** and the LULC map around the 10 Km radius of proposed project is provided as **Figure 6-14**.Land use pattern is given in **Table 6-3.**

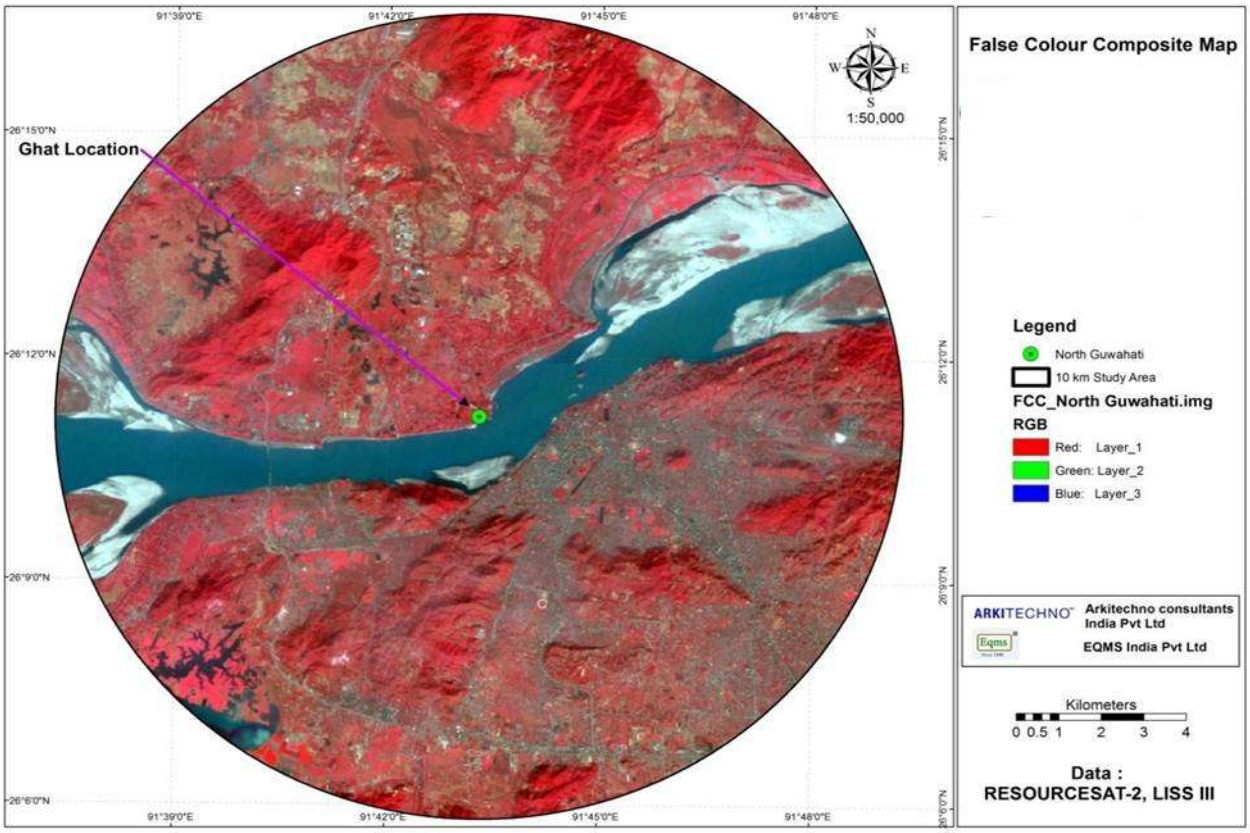


Figure 6-13: 10 Km radius False Color Composite Satellite Map

Table 6-3: Land Use/Land Cover North Guwahati Ghat

Land Use/Land Cover	Area (Ha)	Area (Sq Km)	Area Percentage
Agricultural Crop Land	2898.31	28.98	9.23
Fallow Land	4831.11	48.31	15.38
Settlement	5352.45	53.52	17.04
Forest	8306.39	83.06	26.44
Open Scrub/Grazing Land	3793.12	37.93	12.08
Wetland	1449.65	14.50	4.62
Waterbody	540.06	5.40	1.72
River	2988.73	29.89	9.51
Sandy Area	1251.17	12.51	3.98
Total	**31410.98**	**314.11**	**100.000**

The study area comprises of agricultural land of about 2898.31ha (9.23%) including fallow land 4831.11 ha (15.38%). Settlements in the study area cover an area of 5352.45 ha (17.04%) approximately. Forest in the study area comprises of about 8306.39 ha (26.44%) and Open Scrub / Grazing Land of about 3793.12 ha (12.08%). Study area has 540.06 ha (1.72%) of water bodies and 1449.65 ha (4.62%) of wetland. River and Sandy area covers an area of 2988.73 ha (9.51%) and 1251.17 ha (3.98%) respectively. The land cover pattern and the respective coverage are given in **Table 6-3** above.

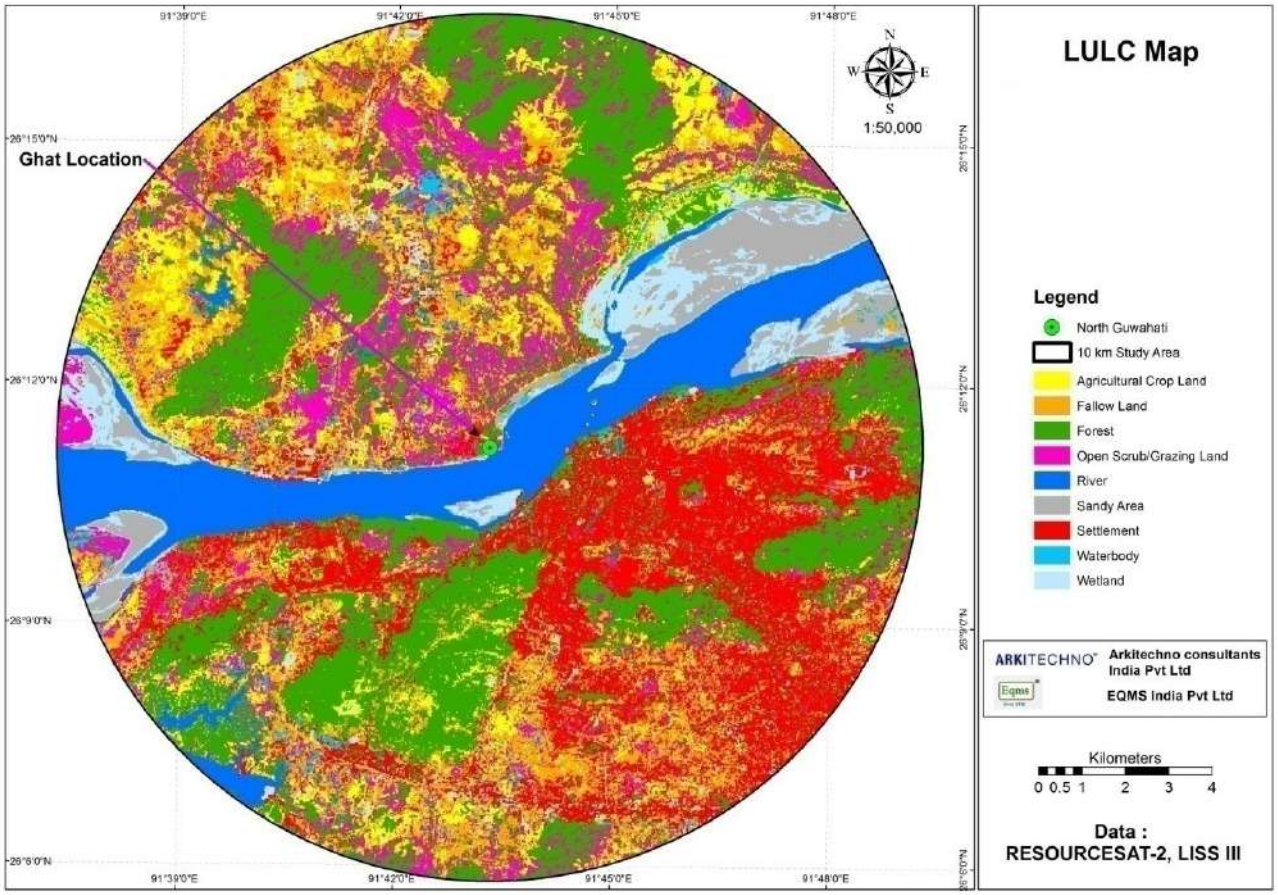


Figure 6-14: Land Use / Land Cover Map of Study Area (10 Km Buffer)

6.5.1.2 LULC for AphalamukhGhat

The land use land cover map of study area on 1:50,000 scale is analysed. Also, a 10 Km radius False Colour Composite satellite map surrounding the project site is provided in **Figure 6-15** and the LULC map around the 10 Km radius of proposed project is provided as **Figure 6-16**.Land use pattern is given in **Table 6-4.**

Table 6-4: Land Use/Land Cover Aphalamukh Ghat

Land Use/Land Cover	Area (Ha)	Area (Sq Km)	Area Percentage
Agricultural Crop Land	6332.83	63.33	20.17
Fallow Land	2748.29	27.48	8.75
Settlements	64.72	0.65	0.21
Open Land	606.44	6.06	1.93
Open Scrub/Grazing Land	6107.67	61.08	19.44
Wetland	1788.57	17.89	5.70
River/Waterbody	3743.02	37.43	11.92
Vegetation	2759.74	27.60	8.79
Sandy Area	7252.62	72.53	23.09
Total	**31403.91**	**314.04**	**100.00**

The study area comprises of agricultural land of about 6332.83 ha (20.17%) including fallow land 2748.29 ha (8.75%). Settlements in the study area cover an area of 64.72 ha (0.21%) approximately. Vegetation in the study area comprises of about 2759.74 ha (8.79%) and Open Scrub/Grazing Land of about 6107.67 ha (19.44%). Study area has 1788.57 ha (5.70%) of wetland. River including waterbody and Sandy area covers an area of 3743.02 ha (11.92%) and 7252.62 ha (23.09%) respectively. The land cover pattern and the respective coverage are given in **Table 6-4** above.

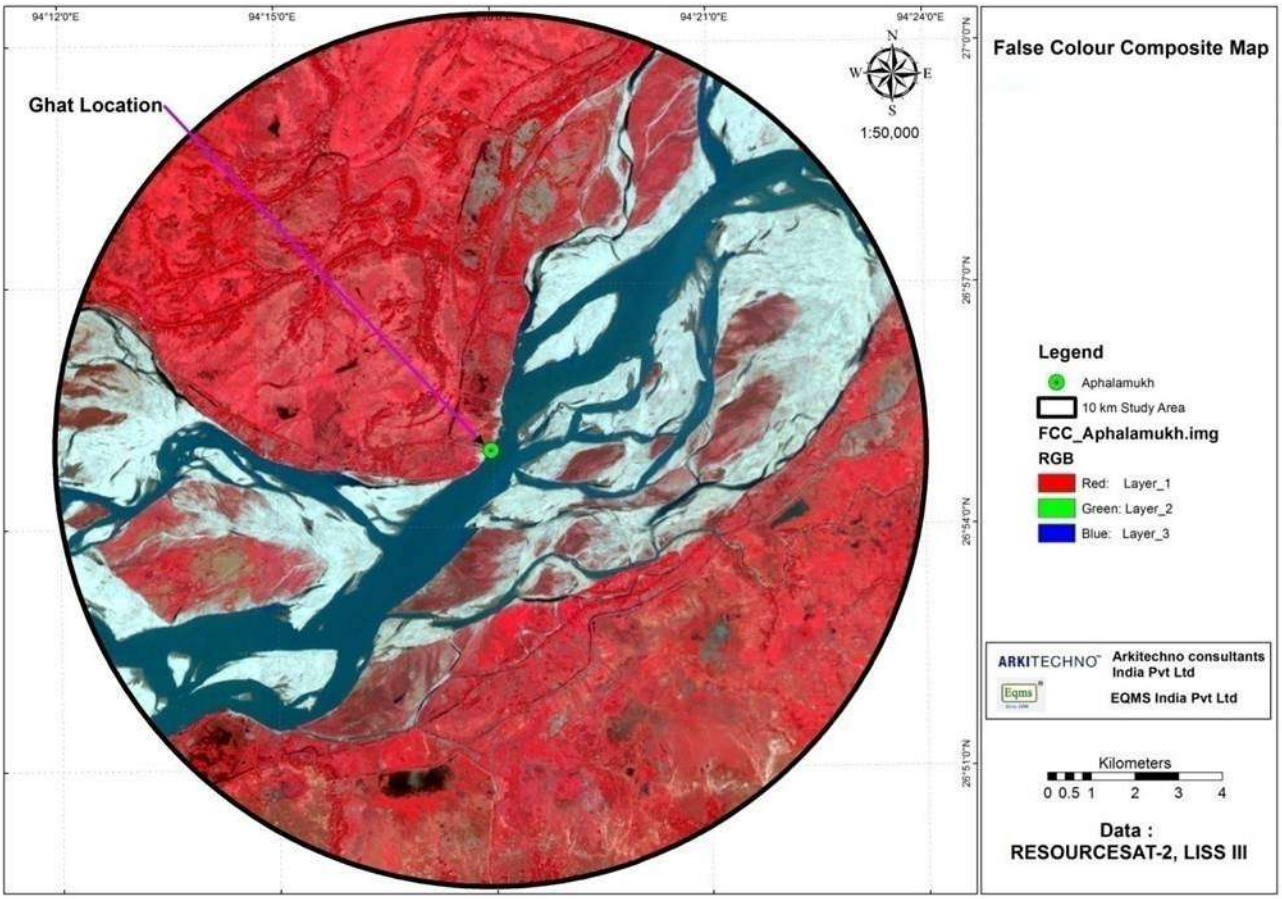


Figure 6-15: 10 Km radius False Color Composite Satellite Map

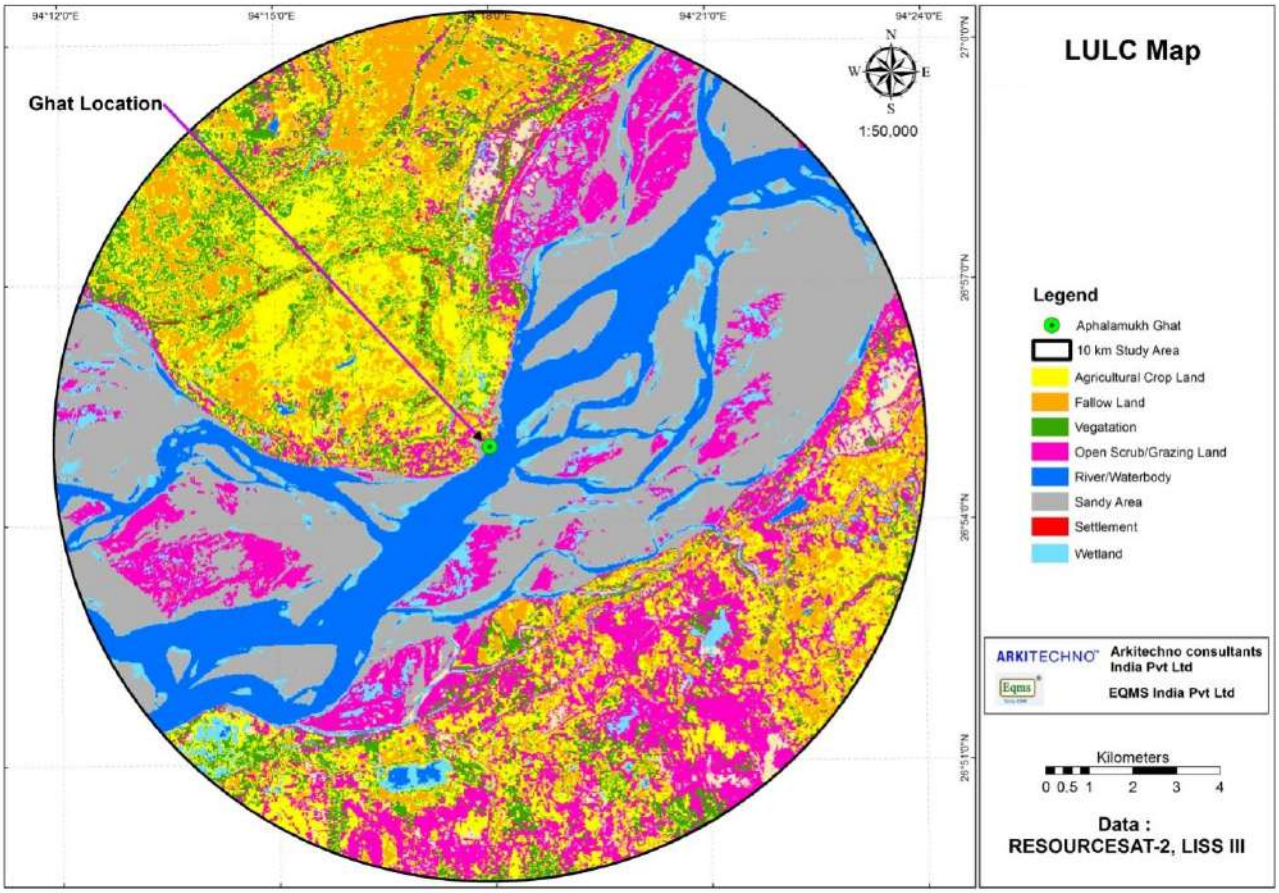


Figure 6-16: Land Use / Land Cover Map of Study Area (10 Km Buffer)

6.6 Water Environment

Water is one of the most important natural resources. Water is not only one of the most essential commodities of our day-to-day life, but also plays a crucial role in economic and social development. The term "water quality" is defined as "those physical, chemical or biological characteristics of water by which the user evaluates the acceptability of water". Drinking water standards give the level of a pollutant that is acceptable. The surface and ground water quality are monitored in the study area.

The sampling locations with date of sampling for two seasons are depicted in **Table 6-5.**

Table 6-5: Water Sampling Locations

Sl. No.	Location/ Ghat	Test position	Dates of sampling of Surface Water	Co-ordinate		Dates of sampling of Ground Water	Co-ordinate	
				Latitude	Longitude		Latitude	Longitude
1	Gateway Guwahati Ghat (GGG)	Stn -1	10.08.2018 27.11.2018	26.180425	91.734249	10.08.2018 27.11.2018	26.181275	91.736854
		Stn-2 (D/S)		26.178326	91.732722		26.180422	91.736489
		-		-	-		26.180735	91.736758
2	North Guwahati	Stn-1 (U/S)	20.08.2018 08.12.2018	26.180024	91.734225	20.08.2018 08.12.2018	26.187424	91.720845
		Stn-2 (D/S)		26.18562	91.721985		26.186648	91.721345
		-		-	-		26.186857	91.722458
3	Aphlamukh Ghat	Stn-1 (U/S)	25.08.2018 06.12.2018	26.917245	94.298862	25.08.2018 06.12.2018	26.918489	94.288653
		Stn-2 (D/S)		26.913648	94.297748		26.922458	94.291418
		-		-	-		26.917445	94.283241

Bramhputra river water quality has been monitored by Central Pollution control Board (CPCB). Water quality analysis data of 2011 at different locations in Assam state is given in **Table 6-7**. As per Monitoring data of CPCB, pH, DO and Total Coliforms meet the water quality criteria (C) for drinking water source after conventional treatment and disinfection at most of the monitoring locations except samples at Jogijhoga. The BOD ranges from 0.3 to 9.2 mg/l. The maximum BOD was recorded at Brahmaputra at Kherghat. Faecal Coliform ranges from 0 to 1500 MPN/100 ml at Sualkuchi. Total coliform ranges from 0 to 15000 MPN/100 ml at Jogijhoga. This may be due to domestic wastewater discharge from urban bodies.

Central Pollution Control Board guidelines are available to evaluate the water quality of river for its best designated use. The same are given **Annexure 2-1**.

Surface water samples were collected from the upstream and downstream of the proposed terminals/ jetty / landing points. The sampling locations are given in **Table 6-6.** Samples were collected in month of August,2018 and December, 2018. The water samples were analysed for Physico-chemical and bacteriological parameters. The lists of parameters along with test methods are given in **Table6-1**. The results of samples are compared with CPCBs criteria of classification of river water. Water quality results at Gateway Guwahati Ghat (GGG), North Guwahati and Aphlamukh Ghat presented in **Table 6-7 & 6-8** respectively.

Table 6-6: Brahmaputra River water quality at different locations in Assam [6]

Sl. No.	Locations	Temp °C			DO mg/l			pH			Conductivity µS/cm			BOD mg/l		
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
1	Brahmaputra at Kherghat	18	28	23.3	6.8	9	7.9	7	7.6	7.3	91	175	128	0.3	9.2	2.6
2	Brahmaputra at	18	28	23.2	6.2	8.8	8.4	6.7	7.7	7.3	94	197	148	0.5	3.8	2.1

[6] **(Source: Status of water quality report in 2011 CPCB)**

Sl. No.	Locations	Temp °C			DO mg/l			pH			Conductivity µS/cm			BOD mg/l		
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
	Dibrugarh															
3	Brahmaputra at Nimatighat	17	28	23.8	4.4	7.5	6.4	6.1	7.6	7.1	71	205	151	0.3	3	1.5
4	Brahmaputra at Dhenukhapahar	19	29	24.3	7.1	8.9	7.7	6.8	8.5	7.5	112	210	152	0.8	4.1	2.1
5	Brahmaputra at Pandu	18	30.2	25.4	6.4	8.8	7.3	6.9	7.9	7.3	108	238	159	0.5	2.7	1.5
6	Brahmaputra at Jogijhoga	18	32	26.8	5.7	8.2	7	6.6	7.6	7.2	68	194	194	1	4.1	2.3
7	Brahmaputra at Kacharighat	19	30	25.3	5.9	8.4	7	7.2	7.9	7.5	206	156	156	0.7	3.8	17
8	Brahmaputra at Chandrapur	19	31	26.4	6	9	7.4	7.1	7.8	7.4	202	153	153	0.4	3.4	1.9
9	Brahmaputra at Sualkuchi	20	29	26	6.5	8.6	7.8	7	7.8	7.3	209	169	169	0.8	1.6	1.1
10	Brahmaputra at Dhubri	21	32	27.4	6.5	7.2	6.9	6.7	7.8	7.2	188	147	147	1.1	2	1.6

Sl. No.	Locations	Nitrate mg/l			Fecal Coliform mg/l			Total Coliform mg/l		
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
1	Brahmaputra at Kherghat	0.1	0.21	0.13	0	360	180	300	2800	1149
2	Brahmaputra at Dibrugarh	0.1	0.3	0.14	0	360	142	300	9300	1561
3	Brahmaputra at Nimatighat	0.1	0.2	0.12	0	700	124	1	3500	780
4	Brahmaputra at Dhenukhapahar	0.1	0.3	0.16	0	1100	160	0	2900	982
5	Brahmaputra at Pandu	0.1	0.3	0.15	0	1100	386	300	3500	1545
6	Brahmaputra at Jogijhoga	0.1	0.3	0.13	0	730	154	300	15000	2225
7	Brahmaputra at Kacharighat	0.1	0.17	0.12	0	360	220	360	1500	740
8	Brahmaputra at Chandrapur	0.1	0.17	0.12	0	300	200	0	730	363
9	Brahmaputra at Sualkuchi	0.1	0.3	0.16	0	1500	600	300	4300	1837
10	Brahmaputra at Dhubri	0.1	0.1	0.1	0	300	200	300	1500	720

Table 6-7: Surface Water Quality – Guwahati Corridor Ghats

Sl. No.	Parameter / Sampling Date	Unit	Gateway Guwahati Ghat (GGG)				North Guwahati Ghat			
			Aug-18		Dec-18		Aug-18		Dec-18	
			Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
1	Temperature	°C	22.5	20.6	23.6	22.8	23.6	24.1	21.5	25.8
2	Colour	Hazen	36	31	25	47	26	28	32	29
3	Electrical Conductivity	µS/cm	376.2	385.1	380.4	378.4	400.1	408.2	379.8	404.6
4	Turbidity	NTU	22	18	8	28	8	9	14	10
5	Salinity	PPT	0.08	0.08	0.07	0.09	0.09	0.09	0.08	0.1
6	pH Value @ 25ºC	--	7.3	7.5	7.2	7.4	7.3	7.6	7.1	7.4
7	Total Hardness (as CaCO3)	mg/l	98.2	96	102	110	112	116	94	116
8	Dissolved Oxygen	mg/l	6.6	6.2	6.6	6.8	6.4	6.3	6.3	6.8
9	BOD for 3 days @ 27°C	mg/l	2.2	2.6	2.8	3.2	2.4	2.4	2.2	2.8
10	COD	mg/l	14	10	20	26	18	14	24	20
11	Chloride (as Cl)	mg/l	45	43	41	49	51	53	47	57
12	TSS	mg/l	28.6	32.9	25.6	56.2	36.2	34.1	41.9	36.5
13	TDS	mg/l	244.53	248.6	213	219	222	232	218	216
14	Calcium (as Ca)	mg/l	27.55	26.93	28.6	30.86	31.42	32.54	26.37	32.54
15	Magnesium (as Mg)	mg/l	7.15	6.99	7.4	8.02	8.16	8.45	6.85	8.46
16	Copper (as Cu)	mg/l	0.033	0.036	0.035	0.039	0.039	0.035	0.034	0.038
17	Manganese (as Mn)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
18	Sulphate (as SO4)	mg/l	22.7	23.6	18.8	17.7	24.5	26.9	21.6	26.8
19	Nitrate (as NO3)	mg/l	4.58	5.01	3.26	3.08	4.44	4.58	3.95	5.14
20	Phosphate (as PO4)	mg/l	0.21	0.26	0.56	0.48	0.36	0.39	0.74	0.39
21	Phenolic Compound (as C6H5OH)	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
22	Mercury (as Hg)	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
23	Silica (as SiO2)	mg/l	0.19	0.25	0.15	0.23	0.22	0.29	0.14	0.25
24	Arsenic (as As)	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
25	Sodium (as Na)	mg/l	30.1	36.2	28.2	30.8	35.1	36.6	32.5	36.8
26	Potassium (as K)	mg/l	1.9	2.3	1.8	2.2	2.6	2.1	2.1	2.8
27	Lead (as Pb)	mg/l	0.14	0.2	0.15	0.19	0.17	0.18	0.15	0.14
28	Zinc (as Zn)	mg/l	6.3	6.9	2.5	4.1	4.9	4.8	8.2	5.8
29	Residual Sodium Carbonate	meq/l	1.1	1.3	1	0.9	1.2	1.3	0.5	1.3
30	Oil and Grease	mg/l	<5	<5	<5	<5	<5	<5	<5	<5
31	Total Alkalinity (as CaCO3)	mg/l	76	80	84	96	92	98	75	96
32	Total Coliform	MPN/100ml	>1600	>1600	>1600	>1600	>1600	>1600	>1600	>1600

Table 6-8: Surface Water Quality – Dibrugarh Corridor Ghats (Aphalamukh)

Sl. No.	Parameter / Sampling Date	Unit	Aphlamukh Ghat			
			Aug-18		Dec-18	
			Upstream	Downstream	Upstream	Downstream
1	Temperature	°C	23.4	23.1	21.6	21.8
2	Colour	Hazen	25	26	18	26
3	Electrical Conductivity	µS/cm	348.9	352.8	356.3	342.9
4	Turbidity	NTU	21	17	12	22
5	Salinity	PPT	0.08	0.08	0.07	0.07
6	pH Value @ 25ºC	--	7.5	7.4	7.1	7
7	Total Hardness (as CaCO3)	mg/l	106	100	112	114
8	Dissolved Oxygen	mg/l	6.6	6.3	6.3	6
9	BOD for 3 days @ 27°C	mg/l	2.4	2.2	2.2	2.8
10	COD	mg/l	14	12	10	18
11	Chloride (as Cl)	mg/l	49	41	39	43
12	TSS	mg/l	36.1	30.9	32.1	32.9
13	TDS	mg/l	226.78	229.32	231.59	222.88
14	Calcium (as Ca)	mg/l	29.73	28.06	31.42	31.98
15	Magnesium (as Mg)	mg/l	7.73	7.29	8.16	8.31
16	Copper (as Cu)	mg/l	<0.03	<0.03	<0.03	<0.03
17	Manganese (as Mn)	mg/l	<0.05	<0.05	<0.05	<0.05
18	Sulphate (as SO4)	mg/l	23.9	25.1	20.3	19.2
19	Nitrate (as NO3)	mg/l	4.59	3.18	4.62	3.66
20	Phosphate (as PO4)	mg/l	0.51	0.42	0.65	0.57
21	Phenolic Compound (as C6H5OH)	mg/l	<0.001	<0.001	<0.001	<0.001
22	Mercury (as Hg)	mg/l	<0.001	<0.001	<0.001	<0.001
23	Silica (as SiO2)	mg/l	0.36	0.28	0.23	0.21
24	Arsenic (as As)	mg/l	<0.001	<0.001	<0.001	<0.001
25	Sodium (as Na)	mg/l	32.6	30.1	24.1	24.6
26	Potassium (as K)	mg/l	2	2.3	1.5	1.6
27	Lead (as Pb)	mg/l	<0.01	<0.01	<0.1	<0.1
28	Zinc (as Zn)	mg/l	3.9	3.9	2.3	2.9
29	Residual Sodium Carbonate	meq/l	1.2	1.3	1.2	1
30	Oil and Grease	mg/l	<5	<5	<5	<5
31	Total Alkalinity (as CaCO3)	mg/l	62	56	78	94
32	Total Coliform	MPN/100ml	>1600	>1600	>1600	>1600

The river water quality meets the Best Designated Use (BDU) Class C criteria of CPCB. Parameters i.e pH & DO which meets A class criteria of CPCB. Observed values of Chloride, Sulphate, Nitrate, calcium & Magnesium & metals are well within the acceptable limit of IS 10500 Drinking water standards except turbidity.

Turbidity values are observed in the ranges of 8 to 28 NTU. Highest turbidity (28 NTU) observed at downstream site of Gateway Guwahati Ghat (GGG)in Dry. The observed values of parameters analysed for during wet and dry season are well within the limit of IS 10500 standards.

6.6.1 Ground Water Quality

Ground water samples were collected at 3 different location of the proposed terminals/ jetty / landing points.

The sampling locations are given in **Table 6-9**. Samples were collected in the month of August 2018 and December 2018. The water samples were examined for physico-chemical parameters and bacteriological parameters. The lists of parameters along with test methods are given in **Table 6-1**. The results of samples are compared with IS 10500:2012 Standards.

6.6.1.1 Gateway Guwahati Ghat

The ground water analysis results are depicted in **Table 6-9** to **6-11**.

Table 6-9: Ground Water Quality -Gateway Guwahati Ghat (GGG)

Sl. No.	Parameter	Unit	Acceptable limit IS 10500	Permissible Limit	Gateway Guwahati Ghat (GGG)					
					Wet Season (August 18)			Dry Season (December 18)		
Sample Code					GW1	GW2	GW3	GW1	GW2	GW3
1	Temperature	°C	-	-	25.1	24.4	24.9	26.3	26.5	25.9
2	Color	Haze n	5	15	<5	<5	<5	<5	<5	<5
3	Electrical Conductivity	µS /cm	-	-	208.9	210.6	215.4	228.6	231.5	238.4
4	Turbidity	NTU	1	5	<1	<1	<1	<1	<1	<1
5	Salinity	PPT	-	-	0.03	0.03	0.03	0.04	0.04	0.04
6	pH Value @ 25ºC	--	6.5-8.5	No relaxation	6.88	6.93	6.9	6.84	6.78	6.59
7	Total Hardness (as $CaCO_3$)	mg/l	200	600	108	112	112	98	98.6	100
8	Dissolved Oxygen	mg/l	-	-	<0.1	<0.1	<0.1	1.3	1.2	1.1
9	BOD for 3 days @ 27°C	mg/l	-	-	<2	<2	<2	<2	<2	<2
10	COD	mg/l	-	-	<10	<10	<10	<10	<10	<10
11	Chloride (as Cl)	mg/l	250	1000	19	19	21	23	21	23
12	TSS	mg/l	-	-	<5	<5	<5	<5	<5	<5
13	TDS	mg/l	500	2000	135.78	136.9	140.01	148.59	150.47	154.96
14	Calcium (as Ca)	mg/l	75	200	30.3	31.42	31.42	27.49	27.66	28.06
15	Magnesium (as Mg)	mg/l	30	100	7.87	8.16	8.16	7.14	7.19	7.29
16	Copper (as Cu)	mg/l	0.05	1.5	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
17	Manganese (as Mn)	mg/l	0.1	0.3	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
18	Sulphate (as SO_4)	mg/l	200	400	12.5	10.3	14.4	11.5	12.7	10.9
19	Nitrate (as NO_3)	mg/l	45	No relaxation	1.65	1.23	1.48	1.59	1.36	1.99
20	Phosphate (as PO4)	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
21	Phenolic Compound (as C6H5OH)	mg/l	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
22	Mercury (as Hg)	mg/l	0.001	No relaxation	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
23	Silica (as SiO2)	mg/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
24	Arsenic (as As)	mg/l	0.01	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
25	Sodium (as Na)	mg/l	-	-	5.8	5.6	6.9	6.6	5.6	5.5
26	Potassium (as K)	mg/l	-		<1	<1	<1	<1	<1	<1
27	Lead (as Pb)	mg/l	0.01	No	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Sl. No.	Parameter	Unit	Acceptable limit IS 10500	Permissible Limit	Gateway Guwahati Ghat (GGG)					
					Wet Season (August 18)			Dry Season (December 18)		
				relaxation						
28	Zinc (as Zn)	mg/l	5	15	0.57	0.45	0.61	2.3	2.9	2.9
29	Residual Sodium Carbonate	meq/l	-	-	0.9	0.9	1.1	0.6	0.6	0.9
30	Oil and Grease	mg/l	-	-	<5	<5	<5	<5	<5	<5
31	Total Alkalinity (as $CaCO_3$)	mg/l	200	600	18	20	20	20	24	24
32	Total Coliform	MPN/ 100ml	Shall not be Detectable		Absent	Absent	Absent	Absent	Absent	Absent

Table 6-10: Ground Water Quality - North Guwahati Ghat

Sl. No.	Parameter	Unit	Acceptable limit IS 10500	Permissible Limit	North Guwahati					
					Wet Season (August 18)			Dry Season (December 18)		
Sample Code					GW4	GW5	GW6	GW4	GW5	GW6
1	Temperature	°C	-	-	25.1	24.4	24.6	25.9	26.5	25.3
2	Color	Hazen	5	15	<5	<5	<5	<5	<5	<5
3	Electrical Conductivity	µS/cm	-	-	196.3	205.9	199.1	212.8	208.6	209.6
4	Turbidity	NTU	1	5	<1	<1	<1	<1	<1	<1
5	Salinity	PPT	-	-	0.03	0.03	0.03	0.03	0.03	0.03
6	pH Value @ 25ºC	--	6.5-8.5	No relaxation	6.96	6.6	6.87	6.92	6.99	6.89
7	Total Hardness (as $CaCO_3$)	mg/l	200	600	112	104	114	112	104.2	110
8	Dissolved Oxygen	mg/l	-	-	<0.1	<0.1	<0.1	1.3	1.2	1.3
9	BOD for 3 days @ 27°C	mg/l	-	-	<2	<2	<2	<2	<2	<2
10	COD	mg/l	-	-	<10	<10	<10	<10	<10	<10
11	Chloride (as Cl)	mg/l	250	1000	19	17	21	17	19	19
12	TSS	mg/l	-	-	<5	<5	<5	<5	<5	<5
13	TDS	mg/l	500	2000	127.59	133.83	129.41	138.32	135.59	136.24
14	Calcium (as Ca)	mg/l	75	200	31.42	29.17	31.98	31.42	29.23	30.86
15	Magnesium (as Mg)	mg/l	30	100	8.16	7.58	8.31	8.16	7.6	8.01
16	Copper (as Cu)	mg/l	0.05	1.5	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
17	Manganese (as Mn)	mg/l	0.1	0.3	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
18	Sulphate (as SO_4)	mg/l	200	400	13.6	11.2	11.9	13.5	14.4	14.1
19	Nitrate (as NO_3)	mg/l	45	No relaxation	1.36	1.25	2.01	2.69	1.59	1.98
20	Phosphate (as PO_4)	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
21	Phenolic Compound (as C6H5OH)	mg/l	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
22	Mercury (as Hg)	mg/l	0.001	No relaxation	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
23	Silica (as SiO_2)	mg/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
24	Arsenic (as As)	mg/l	0.01	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
25	Sodium (as Na)	mg/l	-	-	6.5	5.9	6.6	8.9	6.2	7.7
26	Potassium (as K)	mg/l	-		<1	<1	<1	<1	<1	<1
27	Lead (as Pb)	mg/l	0.01	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
28	Zinc (as Zn)	mg/l	5	15	0.96	0.54	0.84	3.9	3.6	3.1
29	Residual Sodium Carbonate	meq/l	-	-	1.1	0.8	0.9	0.8	0.8	0.9
30	Oil and Grease	mg/l	-	-	<5	<5	<5	<5	<5	<5
31	Total Alkalinity (as $CaCO_3$)	mg/l	200	600	20	24	18	18	20	18
32	Total Coliform	MPN/ 100ml	Shall not be Detectable		Absent	Absent	Absent	Absent	Absent	Absent

Table 6-11: Ground Water Quality – Aphalamukh Ghat

Sl. No.	Parameter	Unit	Acceptable limit IS 10500	Permissible Limit	AphlamukhGhat					
					Wet Season (August 18)			Dry Season (December 18)		
Sample Code					GW13	GW14	GW15	GW13	GW14	GW15
1	Temperature	°C	-	-	25.9	26.1	25.1	25.6	25	25.2

Sl. No.	Parameter	Unit	Acceptable limit IS 10500	Permissible Limit	AphlamukhGhat					
					Wet Season (August 18)			Dry Season (December 18)		
2	Colour	Hazen	5	15	<5	<5	<5	<5	<5	<5
3	Electrical Conductivity	µS/cm	-	-	196.3	202.3	198.4	223.9	220.9	228.4
4	Turbidity	NTU	1	5	<1	<1	<1	<1	<1	<1
5	Salinity	PPT	-	-	0.04	0.04	0.04	0.04	0.04	0.04
6	pH Value @ 25ºC	--	6.5-8.5	No relaxation	6.89	6.6	6.92	6.92	6.7	6.87
7	Total Hardness (as $CaCO_3$)	mg/l	200	600	118	96	102	114	102	108
8	Dissolved Oxygen	mg/l	-	-	<0.1	<0.1	<0.1	1.2	1.1	1.3
9	BOD for 3 days @ 27°C	mg/l	-	-	<2	<2	<2	<2	<2	<2
10	COD	mg/l	-	-	<10	<10	<10	<10	<10	<10
11	Chloride (as Cl)	mg/l	250	1000	21	23	23	21	19	23
12	TSS	mg/l	-	-	<5	<5	<5	<5	<5	<5
13	TDS	mg/l	500	2000	127.59	131.49	128.96	145.5	143.58	148.46
14	Calcium (as Ca)	mg/l	75	200	33.1	26.93	28.62	31.98	28.62	30.3
15	Magnesium (as Mg)	mg/l	30	100	8.6	6.99	7.43	8.31	7.43	7.87
16	Copper (as Cu)	mg/l	0.05	1.5	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
17	Manganese (as Mn)	mg/l	0.1	0.3	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
18	Sulphate (as SO_4)	mg/l	200	400	10.5	12.7	12.1	11.6	14.3	12.5
19	Nitrate (as NO_3)	mg/l	45	No relaxation	1.65	1.54	2.01	2.6	3.3	2.9
20	Phosphate (as PO_4)	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
21	Phenolic Compound (as C6H5OH)	mg/l	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
22	Mercury (as Hg)	mg/l	0.001	No relaxation	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
23	Silica (as SiO_2)	mg/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
24	Arsenic (as As)	mg/l	0.01	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
25	Sodium (as Na)	mg/l	-	-	6.9	5.5	8.2	12.6	10.6	12.1
26	Potassium (as K)	mg/l	-		<1	<1	<1	<1	<1	<1
27	Lead (as Pb)	mg/l	0.01	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
28	Zinc (as Zn)	mg/l	5	15	0.49	0.58	0.61	2.9	3.9	2.1
29	Residual Sodium Carbonate	meq/l	-	-	0.9	0.8	1	0.8	0.8	0.9
30	Oil and Grease	mg/l	-	-	<5	<5	<5	<5	<5	<5
31	Total Alkalinity (as $CaCO_3$)	mg/l	200	600	20	18	18	24	30	32
32	Total Coliform	MPN/ 100ml	Shall not be detectable		Absent	Absent	Absent	Absent	Absent	Absent

Observations:

Physico-chemical characteristics of the ground water samples were compared with prescribed drinking water standard, i.e. IS: 10500. All the parameters are within the permissible limits of drinking waterr prescribed Standard (IS: 10500).

6.7 Climate and Hydrometeorology

The climate of the project area is sub-tropical in nature. There are four distinct seasons. The monsoon and the dry seasons are prominent. The southwest monsoon lasts from June to September. Almost 90% of the annual rainfall occurs during this timeframe. The northeast monsoon: extending from November through to March defines the cool dry season of winter. Only occasional rainfall occurs, associated with weak cyclonic disturbances. The transition from monsoon to the dry season of October-November is fairly smooth, marked by declining temperatures, humidity and storm frequency. This season is associated with variable convectional storm that occasionally produces severe cyclonic storm events. Mean daily temperatures in the

project area are fairly constant between the months of April to September in the order of 25^0C. From October onwards, temperatures begin to decline.

Mean daily temperatures reach a minimum of about 18^0C in January, occasionally dropping in some cold years below 10^0C. In April, maximum daily temperatures often exceed 35^0C. Rainfall in the early and late monsoon periods is highly variable.

Meteorology contain following parameters which include

- Wind Direction
- Temperature
- Humidity
- Precipitation

6.7.1 Wind Direction& Wind Velocity

Wind is air in motion relative to the earth's surface. Its principal characteristics are its direction, speed, and gustiness or turbulence. Wind direction and speed are usually measured and expressed quantitatively. Wind speeds & direction are of primary importance in the diffusion and transport of atmospheric pollutants. Wind direction is ordinarily expressed as the direction from which the wind blows. Windrows diagram is drawn with meteorological data collected from IMD & presented in **Figure 6-17** and**6-18** for Guwhati and North Guwhati respectively.

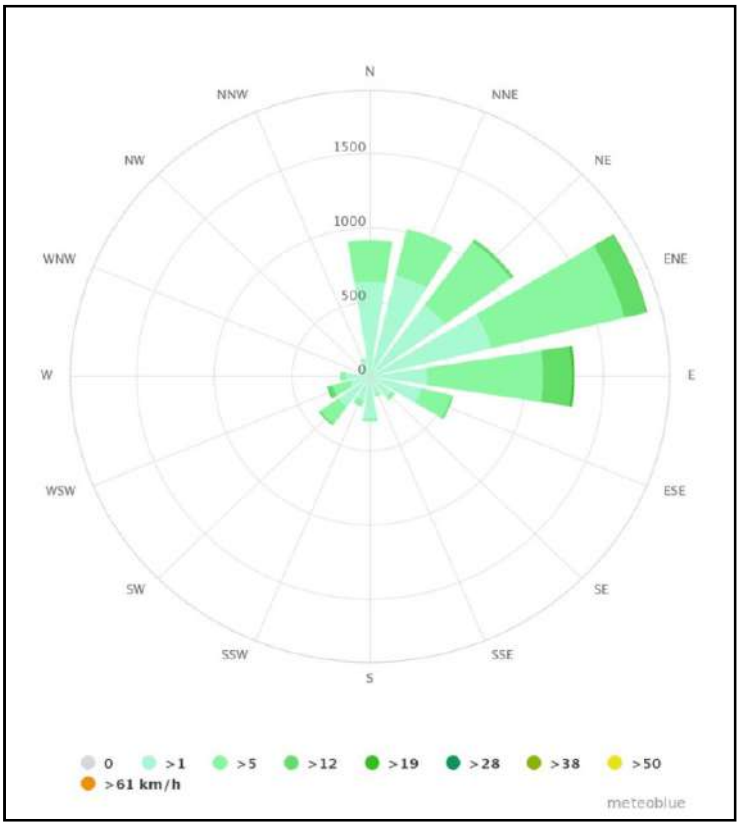


Figure 6-17: The wind rose for Guwahati

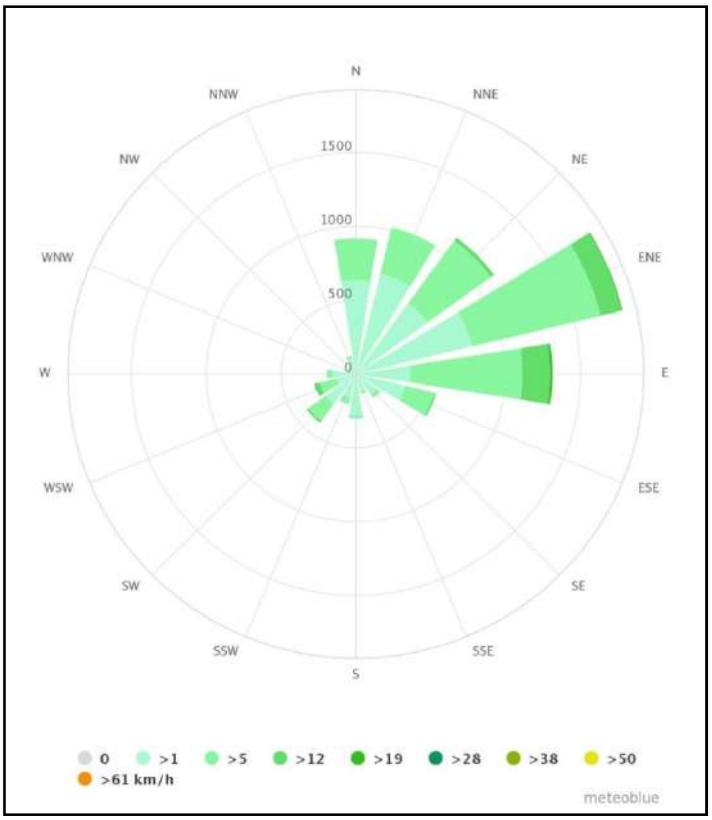


Figure 6-18: The Wind rose for North Guwahati

The wind rose for Guwahati shows how many hours per year the wind blows from the indicated direction. It is observed from wind rose diagram of Guwahati that the predominating Wind direction is from east-northeast to west-southwest (WSW).

6.7.2 Humidity

Humidity is an indicator of water vapor content of air. Humidity includes: absolute humidity, relative humidity, specific humidity, mixing ratio, and dew point. Relative humidity is one of the humidity measurements of the atmosphere. Humidity and Climate percentage from 2009 to 2018of Guwahati and Neamati are given in **Figure 6-19** and**6-20** respectively.

Guwahati

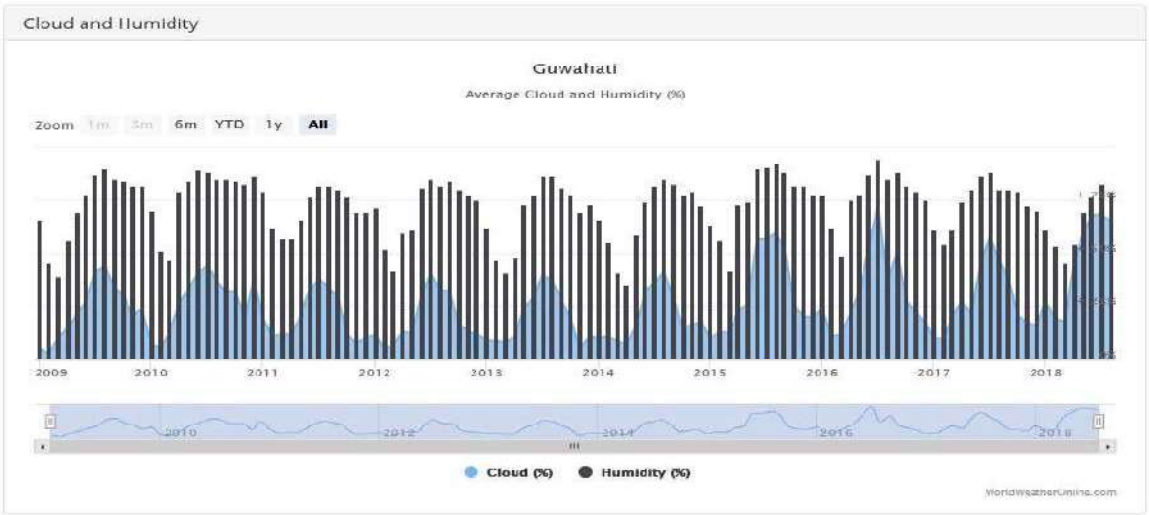


Figure 6-19: Humidity Guwahati

Neamati

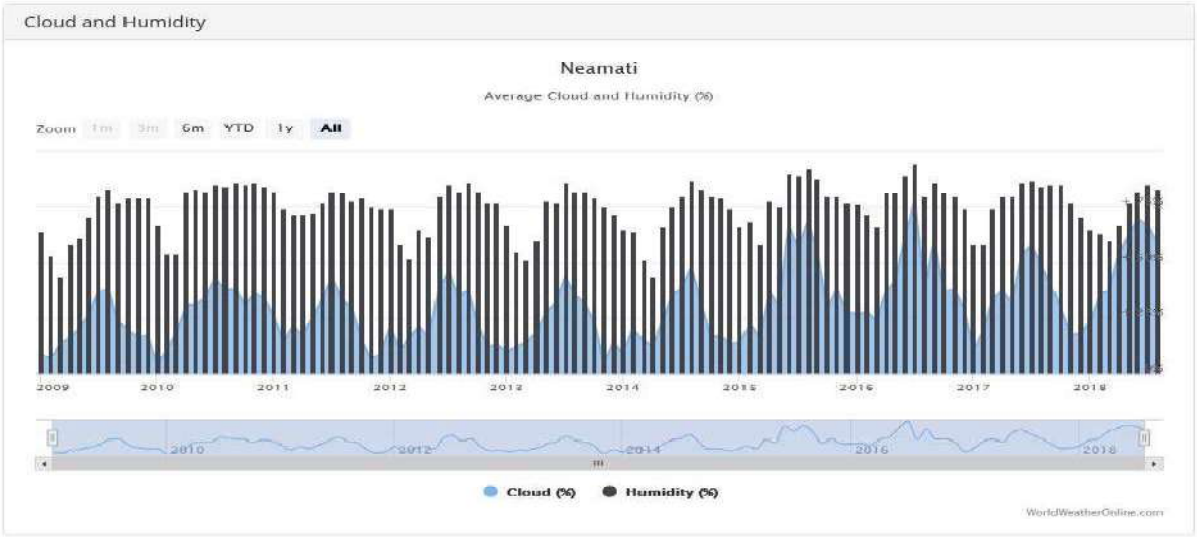


Figure 6-20: Humidity Neamati

It may be seen that monsoon season has the highest humidity level. The humidity percentage increase with cloud.

6.7.3 Rainfall

6.7.3.1 Guwahati Region

Guwahati district maximum precipitation observed duringJuly, while minimum precipitation observed in month of January.The annual average rainfall in the area is about 1722mm. However, it varies from year to year.Maximum (250mm) precipitation occurs during July.

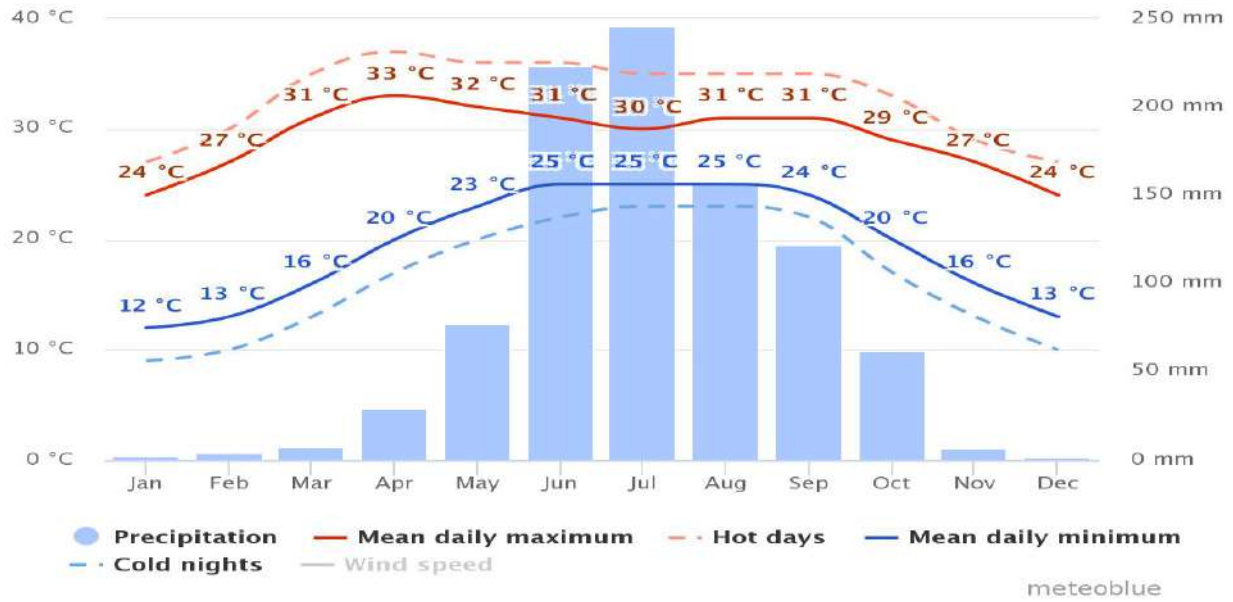


Figure 6-21: Average monthly temperature and precipitation of Guwahati

6.7.3.2 North Guwahati Region

In North Guwahati district maximum precipitation observed in July month which is 246mm,while minimum precipitation observed in month of January which is 3mm. The mean daily maximum temperature of North Guwahati district were observed in April month which is 33°C, and the mean daily minimum temperature of same district were observed in January and December which is 12°C.

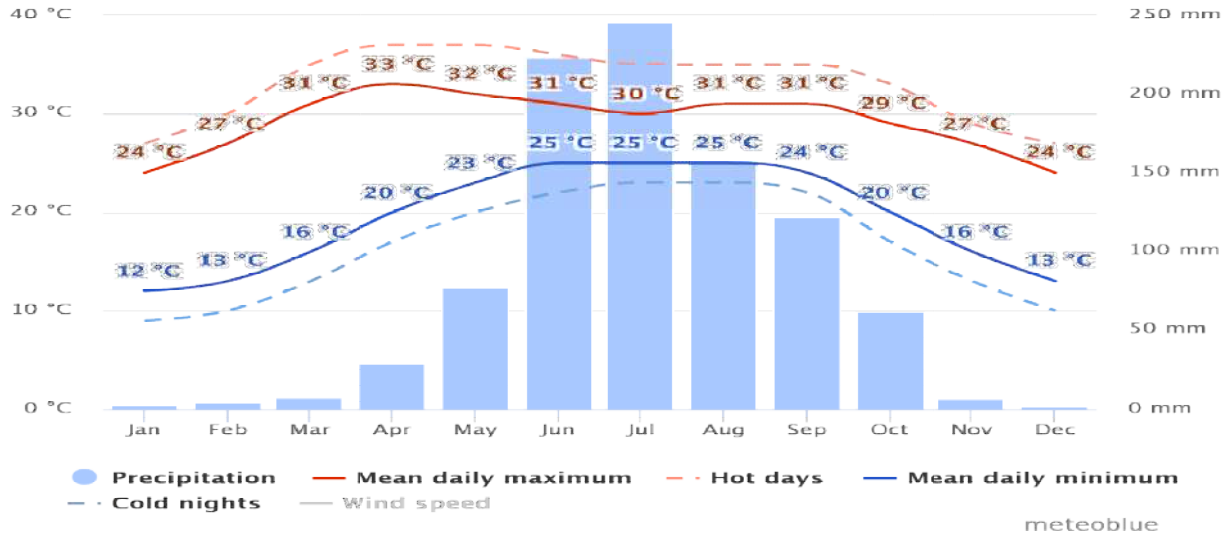


Figure 6-22 : Average temperatures and precipitation of North Guwahati

6.7.3.3 Neamati (Majuli Corridor)

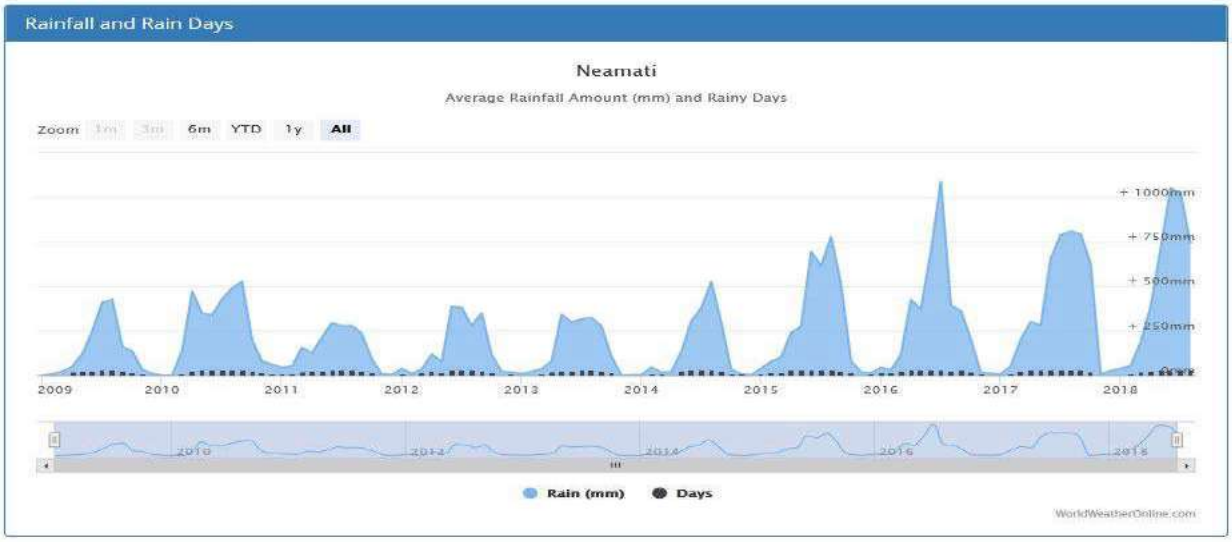


Figure 6-23: Precipitation at Neamati (Majuli Corridor)

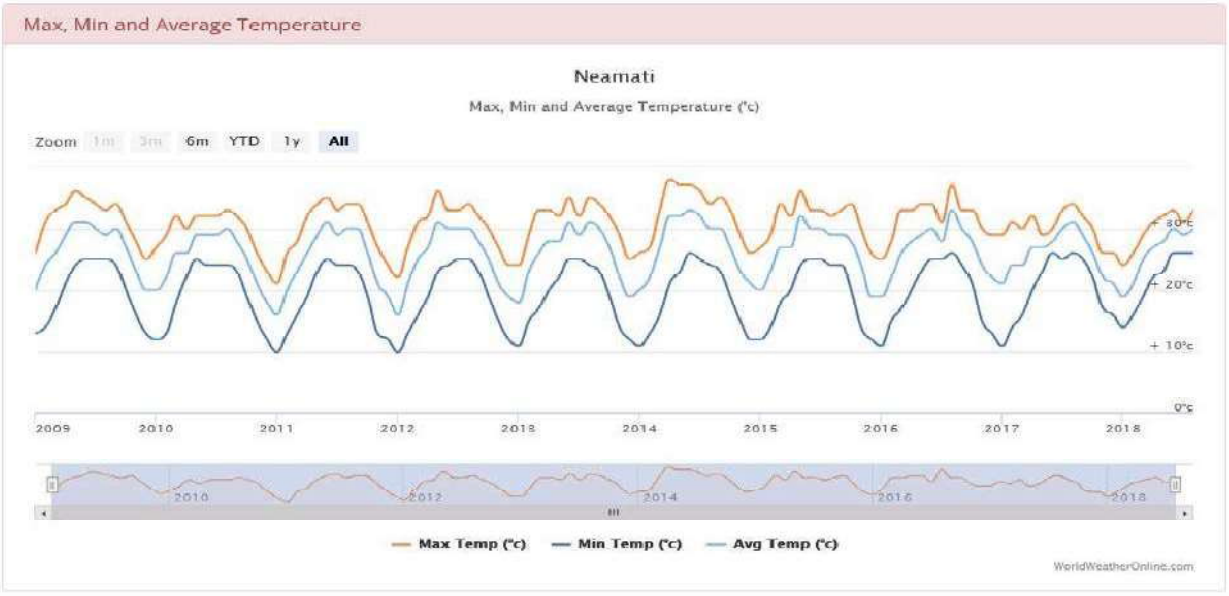


Figure 6-24: Temperatures Neamati (Majuli Corridor)

Table 6-12: Summary of Mateorological Conditions (Wind speed, Rainfall, Temp & Humidity)

Location	Wind Speed	Rainfall/Precipitation	Temperature and Humidity
Guwahati Corridor	• Prevailing Moderate with average wind velocities of 5 m/s and average gusts up to 10 m/s. The seasonal variations are limited. • Higher gusts and wind velocities occurredduring2018	• Monthly precipitation from 0 to750 mm. • Rainy seasons from May to October • Dry season is from November to April with a monthly precipitation between 0 to 200 mm	• Average temperatures between approx. 20°C and 35°C. During summer, the temperature exceeds 35°C and does not fall below 25°C. During winter the temperature ranges between 12°C and 25°C. • The average humidity is approx 40 % during dryseason and exceeds 75 % during the rainy season
Dibrugarh Corridor (Neamati)	• Moderate wind conditions (breeze conditions) with average wind velocities of 4-5 m/s and average gusts up to 7.5 m/s • Seasonal variations are limited to slightly increased velocities during the 2nd quarter.	• Monthly precipitation from 0 to750 mm. • Rainy season from May to October. • The dry season lasts from November to April with a monthly precipitation between 200 mm and 0 mm.	• Average temperature between approx. 20°C and 35°C. During summer, the temperature exceed 35°C and does not fall below 20°C. During winter dry season,the temperature ranges between 10°C and 25°C. • The average humidity is approx 40 % during dry season and exceeds 75 % during the rainy season.

6.8 Air Environment

Meteorological conditions vary seasonally and play a very important role in dispersion of air pollutant in the atmosphere. The air emission from the project may be line sources (vessels, road traffic etc.) or stationary source (DG). The existing ambient air quality data are important baseline condition so that impact due to the project activities can be assessed. Ambient air quality of a particular area depends on the emission sources, both fugitive as well as stationary. Line sources such as vehicle & vessel movement also contribute to air pollution. As observed during the field survey, no major industrial activities are existing near the proposed terminal / Ghats.

Ambient air quality monitoring was conducted in the study area of the proposed project sites during August –September, 2018. Monitoring was conducted for PM10, PM2.5, SO_2, NOx, CO, O_3, NH_3, Pb, Ni, As, Benzene & BaP and compared with National Ambient Air Quality standards (NAAQS,2009), notified under EP Act, 1986 by MOEF&CC. Three monitoring stations were located within 5.0 km radius of eachsitesfor baseline air quality of the area. The monitoring was carried out following CPCB guideline. The locations of the monitoring stations were decided on the basis of land use and predominating wind direction.

The locations of ambient air quality monitoring stations are given in **Table 6-13**.

Table 6-13: Ambient Air Quality Monitoring Locations

Sl. No.	Location/Ghat	Monitoring Station	1st test in the week (Date)	Co-ordinate		2nd test in the week (Date)	Co-ordinate	
				Latitude	Longitude		Latitude	Longitude
1	Gateway Guwahati Ghat (GGG)	1st	06.08.18	26.181658	91.736031	10.08.18	26.181658	91.736031
		2nd	06.08.18	26.180770	91.736119	10.08.18	26.180770	91.736119
		3rd	06.08.18	26.179979	91.736806	10.08.18	26.179979	91.736806
2	North Guwahati	1st	05.08.18	26.186032	91.721504	09.08.18	26.186032	91.721504
		2nd	05.08.18	26.186761	91.722987	09.08.18	26.186761	91.722987
		3rd	05.08.18	26.186794	91.721051	09.08.18	26.186794	91.721051
3	AphlamukhGhat	1st	30.08.18	26.916146	94.298873	03.09.18	26.916146	94.298873
		2nd	30.08.18	26.916940	94.279801	03.09.18	26.916940	94.279801
		3rd	30.08.18	26.918091	94.288910	03.09.18	26.918091	94.288910

The locations of Ambient Air Quality Monitoring stations are shown in Map of the study area in **Figures 6-7, 6-8** and **6-9.**

6.8.1 Ambient Air Quality

The ambient air quality monitoring was carried out for Particulate Matter (PM10& PM2.5), Sulphur dioxide (SO_2), Oxides of Nitrogen (NOx), CO& all parameters as per NAAQS,2009. Sampling was carried out on 24hourly twice a week for one week. Ambient Air Quality Monitoring data for Gateway Guwahati Ghat (GGG), North Guwahati Ghat (NGG) and AphatamukhGhat (AG) are presented in **Table 6-14, 6-15**and**6-16** respectively. The ambient Air Quality of three proposed terminals for all the parameters are graphically presented in **Figure 6-25, 2-26**and **6-27**. It may be seen from the air quality monitoring result that it meets the National Ambient Air Quality Standard, notified under EP Act, 1986 with respect to all parameters.

Table 6-14: Ambient Air Quality – Gateway Guwahati Ghat (GGG)

Sl. No.	Parameters	Station-1	Station-2	Station-3	NAAQ Standard
Monitoring - 06-08-2018					
1	Particulate Matter (PM10) µg/m^3	70.3	53.9	65.2	100
2	Particulate Matter (PM2.5) µg/m^3	40.2	31.5	35.6	60
3	Sulphur Dioxide (SO_2) µg/m^3	10.6	7.5	9.6	80
4	Nitrogen Oxides (NOx) µg/m^3	13.9	9.3	11.4	80
5	Carbon Monoxide (CO) µg/m^3	0.25	<0.1	0.15	4
6	Ozone (O3) µg/m^3	<10	<10	<10	100
7	Ammonia (NH3) µg/m^3	<20	<20	<20	400
8	Lead (Pb) µg/m^3	<0.06	<0.06	<0.06	1.0
9	Nickel (Ni) µg/m^3	<0.6	<0.6	<0.6	20
10	Arsenic (As) µg/m^3	<0.44	<0.44	<0.44	6
11	Benzene (C6H6) µg/m^3	<1	<1	<1	5
12	Benzo(a)Pyrene (BaP) µg/m^3	<1	<1	<1	1
Monitoring - 10-08-2018					
1	Particulate Matter (PM10) µg/m^3	70.3	53.9	65.2	100
2	Particulate Matter (PM2.5) µg/m^3	40.2	31.5	35.6	60
3	Sulphur Dioxide (SO_2) µg/m^3	10.6	7.5	9.6	80
4	Nitrogen Oxides (NOx) µg/m^3	13.9	9.3	11.4	80
5	Carbon Monoxide (CO) µg/m^3	0.25	<0.1	0.15	4
6	Ozone (O3) µg/m^3	<10	<10	<10	100
7	Ammonia (NH3) µg/m^3	<20	<20	<20	400
8	Lead (Pb) µg/m^3	<0.06	<0.06	<0.06	1.0
9	Nickel (Ni) µg/m^3	<0.6	<0.6	<0.6	20
10	Arsenic (As) ng/m^3	<0.44	<0.44	<0.44	6
11	Benzene (C6H6) µg/m^3	<1	<1	<1	5
12	Benzo(a)Pyrene (BaP) ng/m^3	<1	<1	<1	1

**NAAQ (National Ambient Air Quality Standard as per 18*

Table 6-15: Ambient Air Quality – North Guwahati Ghat

Sl. No.	Parameters	Station-1	Station-2	Station-3	NAAQ Standard
Monitoring - 05-08-2018					
1	Particulate Matter (PM10) µg/m^3	69.6	52.9	63.4	100
2	Particulate Matter (PM2.5) µg/m^3	38.1	30.2	33.5	60
3	Sulphur Dioxide (SO_2) µg/m^3	8.6	5.4	7.6	80
4	Nitrogen Oxides (NOx) µg/m^3	12.1	9.9	10.6	80
5	Carbon Monoxide (CO) µg/m^3	0.21	<0.1	0.19	4
6	Ozone (O3) µg/m^3	<10	<10	<10	100
7	Ammonia (NH3) µg/m^3	<20	<20	<20	400
8	Lead (Pb) µg/m^3	<0.06	<0.06	<0.06	1.0

Sl. No.	Parameters	Station-1	Station-2	Station-3	NAAQ Standard
9	Nickel (Ni) µg/m^3	<0.6	<0.6	<0.6	20
10	Arsenic (As) µg/m^3	<0.44	<0.44	<0.44	6
11	Benzene (C6H6) µg/m^3	<1	<1	<1	5
12	Benzo(a)Pyrene (BaP) µg/m^3	<1	<1	<1	1
Monitoring - 9-08-2018					
1	Particulate Matter (PM10) µg/m^3	67.9	51.6	62.4	100
2	Particulate Matter (PM2.5) µg/m^3	39.6	31.5	34.8	60
3	Sulphur Dioxide (SO_2) µg/m^3	8.9	5.7	7.9	80
4	Nitrogen Oxides (NOx) µg/m^3	12.8	8.6	11.4	80
5	Carbon Monoxide (CO) µg/m^3	0.22	<0.1	0.17	4
6	Ozone (O3) µg/m^3	<10	<10	<10	100
7	Ammonia (NH3) µg/m^3	<20	<20	<20	400
8	Lead (Pb) µg/m^3	<0.06	<0.06	<0.06	1.0
9	Nickel (Ni) µg/m^3	<0.6	<0.6	<0.6	20
10	Arsenic (As) ng/m^3	<0.44	<0.44	<0.44	6
11	Benzene (C6H6) µg/m^3	<1	<1	<1	5
12	Benzo(a)Pyrene (BaP) ng/m^3	<1	<1	<1	1

**NAAQ (National Ambient Air Quality Standard as per 18*

Table 6-166: Ambient Air Quality – Aphalamukh Ghat

Sl. No.	Parameters	Station-1	Station-2	Station-3	NAAQ Standard
Sample Collected - 30-08-2018					
1	Particulate Matter (PM10) µg/m^3	64.9	51.4	58.7	100
2	Particulate Matter (PM2.5) µg/m^3	36.1	28.5	32.6	60
3	Sulphur Dioxide (SO_2) µg/m^3	11.9	6.6	10.4	80
4	Nitrogen Oxides (NOx) µg/m^3	15.8	10.2	14.7	80
5	Carbon Monoxide (CO) µg/m^3	0.19	<0.1	0.17	4
6	Ozone (O3) µg/m^3	<10	<10	<10	100
7	Ammonia (NH3) µg/m^3	<20	<20	<20	400
8	Lead (Pb) µg/m^3	<0.06	<0.06	<0.06	1.0
9	Nickel (Ni) µg/m^3	<0.6	<0.6	<0.6	20
10	Arsenic (As) µg/m^3	<0.44	<0.44	<0.44	6
11	Benzene (C6H6) µg/m^3	<1	<1	<1	5
12	Benzo(a)Pyrene (BaP) µg/m^3	<1	<1	<1	1
Sample collected - 03-09-2018					
1	Particulate Matter (PM10) µg/m^3	65.6	52.7	59.1	100
2	Particulate Matter (PM2.5) µg/m^3	36.9	29.4	33.1	60
3	Sulphur Dioxide (SO_2) µg/m^3	12.2	6.9	10.8	80
4	Nitrogen Oxides (NOx) µg/m^3	14.8	9.5	13.2	80
5	Carbon Monoxide (CO) µg/m^3	0.17	0.1	0.15	4
6	Ozone (O3) µg/m^3	<10	<10	<10	100
7	Ammonia (NH3) µg/m^3	<20	<20	<20	400
8	Lead (Pb) µg/m^3	<0.06	<0.06	<0.06	1.0
9	Nickel (Ni) µg/m^3	<0.6	<0.6	<0.6	20
10	Arsenic (As) ng/m^3	<0.44	<0.44	<0.44	6
11	Benzene (C6H6) µg/m^3	<1	<1	<1	5
12	Benzo(a)Pyrene (BaP) ng/m^3	<1	<1	<1	1

**NAAQ (National Ambient Air Quality Standard as per 18*

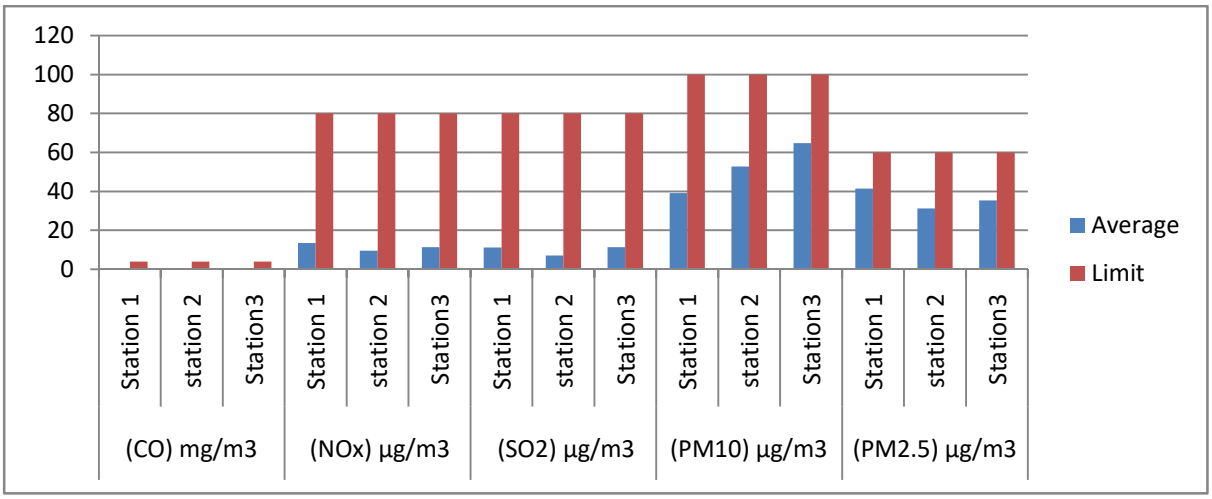


Figure 6-25: Graphical Presentation of Air Quality– Gateway Guwahati Ghat (GGG)

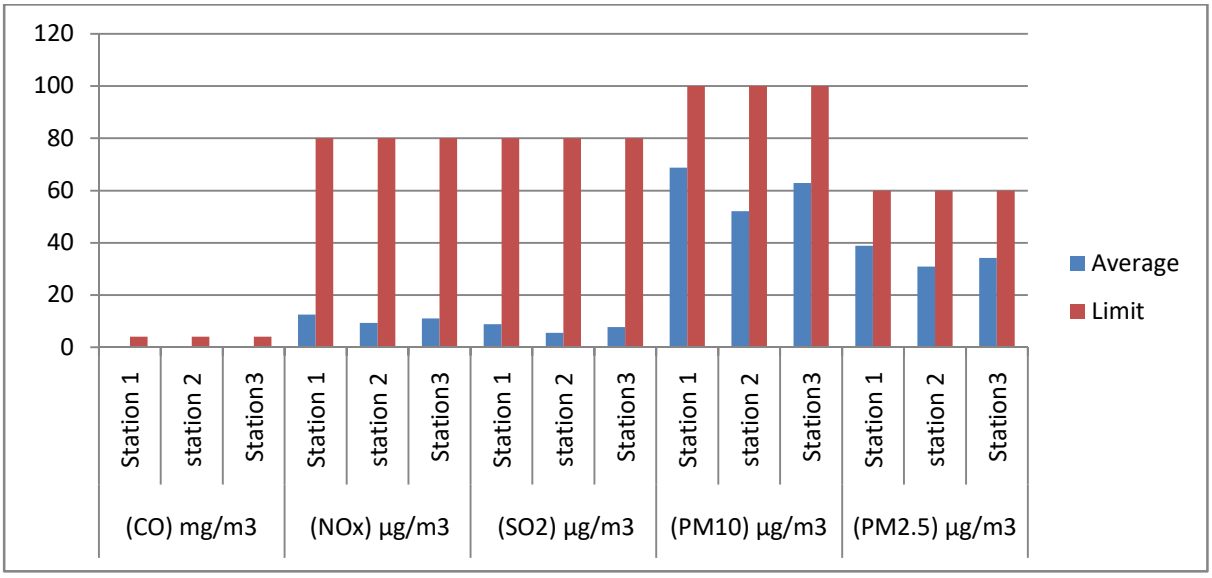


Figure 6-26: Graphical Presentation of Air Quality Results – North Guwahati Ghat

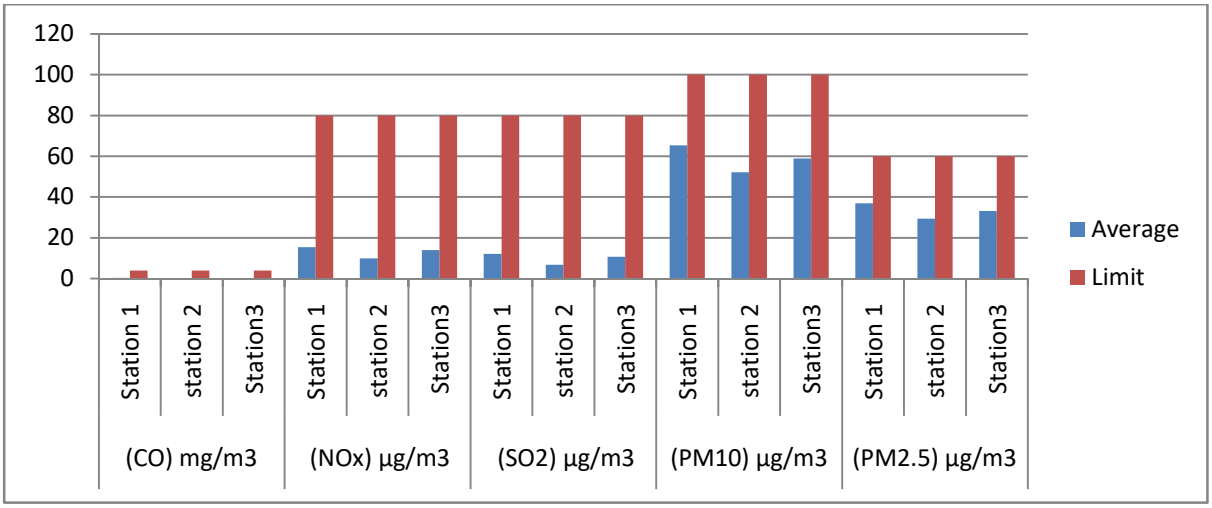


Figure 6-27: Graphical Presentation of Air Quality Results – Aphalamukh Ghat

It may be seen that ambient air quality in all locations are well with in the NAAQMS with respect to all parameters. The areas under study do not have major air polluting industries. The major source of air pollution in these areas are vehicular traffic. However in GGG and North Guwahati Ghat area, marginal contribution to air pollution is from domestic sources. The major air pollutants expected are PM10, PM2.5, SO_2, NOx, CO and therefore graphically presented. The other

parameters are observed to be well withinn the prescribed limit and can be used for future reference.

6.9 Noise

Noise is an important environmental component likely to have some impact due to project development.

Ghats are surrounded with habitations and shops. Sensitive lunits like School and Masjids are located within vicinity of 500 m from Ghat. Existing noise levels in three project sites were monitored for 24 hrs. Monitoring was conducted at three locations in each site by using Sound Level Meter. Noise level was monitored for day time (06.00 AM to 10.00 PM) and night time (10.00 PM to 06.00 AM) for comparison with the standard.

Table 6-17: Noise Monitoring Locations

Sl. No.	Location	Station	Dates of Monitoring	Co-ordinate	
				Latitude	Longitude
1	Gateway Guwahati Ghat (GGG)	1st	08.08.18	26.181658	91.736031
		2nd	08.08.18	26.180770	91.736119
		3rd	08.08.18	26.179979	91.736806
2	North Guwahati	1st	06.08.18	26.186032	91.721504
		2nd	06.08.18	26.186761	91.722987
		3rd	06.08.18	26.186794	91.721051
3	AphlamukhGhat	1st	02.09.18	26.916146	94.298873
		2nd	02.09.18	26.916940	94.279801
		3rd	02.09.18	26.918091	94.288910

Noise level monitoring result for Gateway Guwahati Ghat, North Guwahati Ghat and AphalmukhGhat are presented in **Figure 6-28, 6-29**and **6-30** respectively.

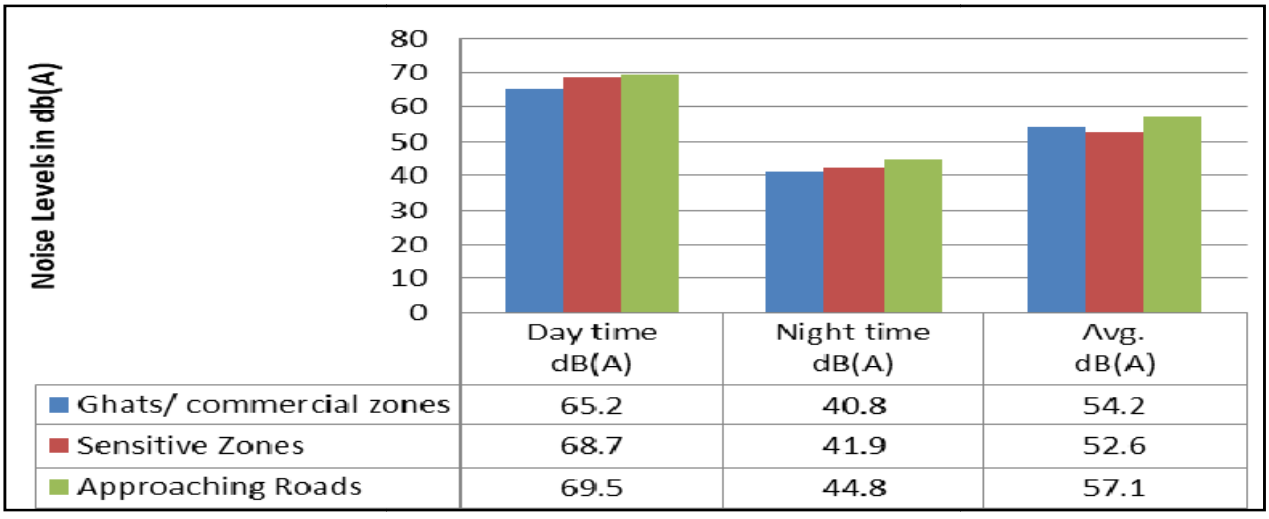
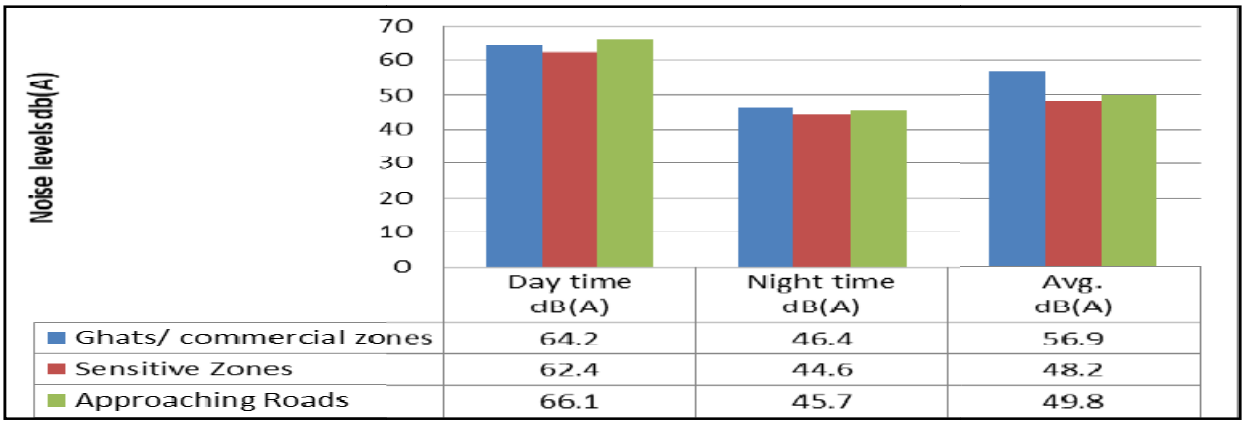


Figure 6-28: Graphical representation of Noise Levels-Gateway Guwahati Ghat (GGG)

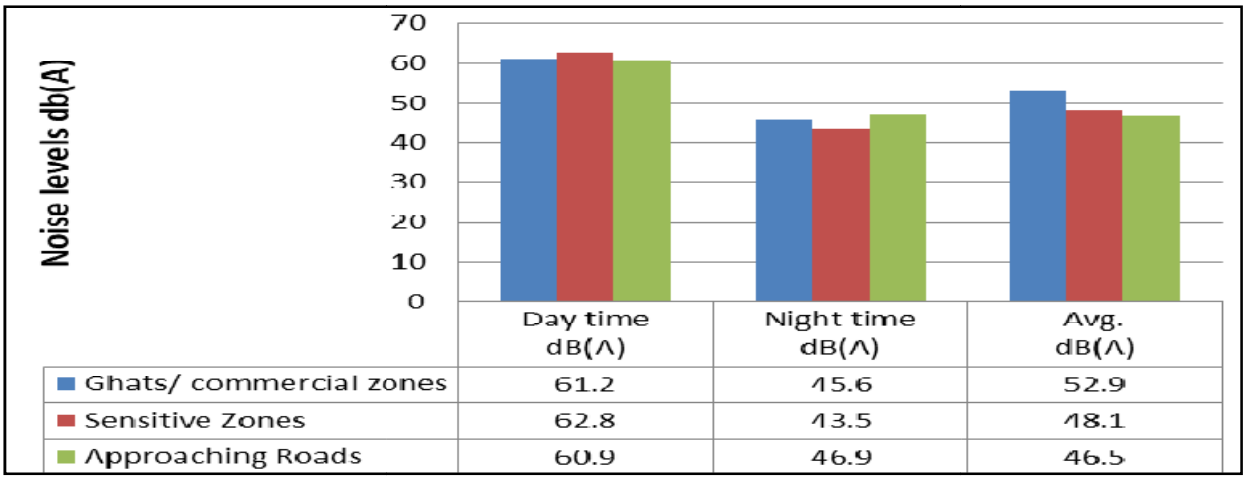
Table 6-18: Ambient Air Quality Standards in respect of Noise

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



	Day time dB(A)	Night time dB(A)	Avg. dB(A)
Ghats/ commercial zones	64.2	46.4	56.9
Sensitive Zones	62.4	44.6	48.2
Approaching Roads	66.1	45.7	49.8

Figure 6-29: Graphical representation of Noise Levels – North Guwahati Ghat



	Day time dB(A)	Night time dB(A)	Avg. dB(A)
Ghats/ commercial zones	61.2	45.6	52.9
Sensitive Zones	62.8	43.5	48.1
Approaching Roads	60.9	46.9	46.5

Figure 6-30: Graphical representation of Noise Levels – AphalamukhGhat

The noise monitoring results show that the day and night time noise level at all locations meet the norms for commercial zone. However, the noise level exceeds the standard (45 dBA) during day time for residential zone. The major source of the noise in the study area is vehicular movement as well as commercial activities. The ambient noise quality standards in respect of noise are 75, 65, 55 and 50 dB (A) Leq in daytime and 70, 55, 45 and 40 dB (A) Leq during nighttime for industrial, commercial, residential and silence zone respectively. **The environmental monitoring results is given in Annexure 6.1.**

6.10 Ecology and Biodiversity

Ecology & biodiversity study is an important aspect of EIA. Existing status covers the following:

- Study of the ecology & biodiversity (Terrestrial & Aquatic) of the project area along with identification of Rare, Endangered & Threatened (RET) species if any.
- Identification of Protected areas/Ramsar sites.
- Identification of IBAs near project influence areas.
- Identification of breeding ground of Fishes & Avifauna near project locations.

Based on the findings and project activities, adequate measures are to be taken for safeguard of ecology. Study is carried out in 10 km radius of proposed terminals and also stretches of river. The biological environment includes terrestrial and aquatic ecosystems. The animal and plant communities co-exist. Hence changes if any in the status of flora and fauna are an elementary requirement of Environmental Impact Assessment studies.

Biodiversity refers to the variety and variability of species of plants, animals and micro-organisms. Rich biodiversity is an indicator of a healthy ecosystem.

Status on followings are important:

- Floral & Faunal diversity both Aquatic & Terrestrial
- Phyto & Zoo Planktons, Benthos
- Sub-tidal habitats in the direct footprint of additional structures

A detail dolphin study was conducted during the dry season (March 2019) and wet season (August 2019) for entire stretch of River Brahmaputra & Barak. The findings of the study are given in Table 6-19 A & B and the detail dolphin study reports are provided in Annexure-6.3.

Table 6-19 A: Dolphin Status Around Project Sites (Dry Season)

Sl. No.	Routes/Site Name	Longitude	Latitude	Nos. of Dolphin Sighted
1	Neamati to Aphalamukh Ghat (Spotted near Aphalamukh Ghat)	94.29839	26.91219	4
2	Guwahati Gateway Ghat to North Guwahati (Spotted near Umananda Ghat)	91.74617	26.19768	4
			Total	**8**

Table 6-20 B: Dolphin Status Around Project Sites (Wet Season)

Sl. No.	Routes/Site Name	Longitude	Latitude	Nos. of Dolphin Sighted
1	Neamati Ghat	94.25379	26.85860	7
2	Aphalamukh Ghat	94.29542	26.89695	10
			Total	**17**

It has been observed that 4 dolphins during dry season and 17 dolphins during wet season have been spotted at Neamati-Aphalamukh ferry route and 4 dolphins during dry season at Guwahati Gateway Ghat (South Guwahati)- North Guwahati Ferry Route.The presence of dolphins in Lachit Ghat (South Guwahati) and North Guwahati Ferry Route cannot be ruled out during wet season because of their constant movement due to the nature and condition of the river.

Secondary Data on Dolphin presence around project sites:

Secondary data on presence of dolphin in Brahmaputra were collected from earlier study. Data with respect to project sites Guwahati and Aphalamukh are presented in **Table 6-20.** Dolphin Conservation Management Plan as secondary data is given in **Annexure 6.2.**

Table 6-21: Secondary Data on Dolphin presence around project sites

Sl. No	Ghats	Dolphin Occurrence	Location of sighted area	Dolphin No			
				Calf	Sub-adult	Adult	Total
1.	Guwahati	Yes	N26011/239//; E 91044/365	-	-	1	1
			N26010/981//; E 91044/175//	-	1	2	3
			N26010/610//; E 91042/587//	-	1	2	3
			N26010/699//; E	-	-	3	3

Sl. No	Ghats	Dolphin Occurrence	Location of sighted area	Dolphin No			
				Calf	Sub-adult	Adult	Total
			91041/066/				
2.	Aphalamukh	No	-	-	-	-	
3.	Neamati	Yes	N26051/841//; E 94014/656//	-	1	2	3

Source: Conservation of Gangatic dolphin in Brahmaputra river system, India, Dr. Abdul Wakid, 2004

It may be seen from Table 6-20 that dolphins have been sighted in the study area of Guwahati. No dolphin was sighted at Aphalamukh area. However dolphins have been spotted during the recent dolphin surveys conducted for this EIA study, which confirms the presence of dolphin in three project sites. Dolphin sighting depends on many factors such as river condition, availability of food, water depth etc.

6.10.1 Ecological Profile of Gateway Guwahati Ghat (GGG) & North Guwahati Ghat

Gateway Guwahati Ghat and North Guwahati Ghat are located on either side of the banks of river Brahmaputra. The study area of GGG and North Guwahati Ghat are also overlapping. It has been observed that the ecological profile for both the project sites are almost same. The same species have been observed in both the project sites, except the quantum of forest coverage under the study area.

6.10.1.1 Terrestrial Ecology (Flora & Fauna)

A. Forest:

Guwahati falls within the biogeographic Zone - Brahmaputra Valley of India. Guwahati is situated in district Kamrup which has 1432 sq. km of forest area, comprises of 69 sq.km of very dense forest, 609 sq.km of moderately dense forest and 754 sq. km of open forest. The forest type in the Guwahati region is Tropical Moist Deciduous type forests.

- **Forest in Study Area:**

There are four reserved forest areas present within the study area in Gateway Guwahati Ghat and five reservee forest ares present within the study area in North Guwahati Ghat. The details are presented in **Table 6-21** and **Table 6-22** respectively. The forest in the study area are Sal forest and mixed deciduous forest. Sal is the dominant species associated with Ajar (Lagerstoemia species), Ghugra (Schimawallichii), Paruli (Stereospermumprsonatum), Haldu (Adina cordifolia), Sam (Artocarpus sp.), Bor (Ficus sp.), Uraim (Bischofiajavanica), Gomari (Gmelina arborea), Teetachampa (Micheliachampa), Poma (Toona ciliate). In mixed forest the common trees observed are Ghugra (Schimawallichii), Tectonagrandis, Paruli (Stereospermumprsonatum), Haldu (Adina cordifolia), Sam (Artocarpus sp.), Bor (Ficus sp.), Uraim (Bischofiajavanica), Gomari (Gmelina arborea).

Table 6-22: Forest Area in Study Area – Gateway Guwahati Ghat

Sl. No.	Type of Forest	Direction from site	Distance in Km
1.	Sila R.F.	NW	4.9
2.	Divgeshwar R.F.	N	7.4
3.	Phatasil R.F.	S	1.9
4.	Kalapahar R.F.	SE	1.92

Table 6-23: Forest in the North Guwahati Ghat Study Area

Sl. No.	Forest	Direction from Site	Distance in Km
1	Sila R.F.	NW	4.6
2	AgyaThur R.F.	NW	4.9

Sl. No.	Forest	Direction from Site	Distance in Km
3	Divgeshwar R.F.	N	6.1
4	Phatsil R.F.	S	6
5	Rani R.F.	S	9

a. Flora within 500 mts radius:

The flora present in 500 m area, is further categorised as below;

Vegetation in proposed terminal site: Proposed site is open sandy, No trees are present on the proposed land. Few herbs like Ipomeasps. Parthenium and grass species are observed.

Vegetation in 500 m radius area of proposed terminal site; The common trees observed within one km are gulmohar (Delonix regia), banyan tree (Ficusbenghalensis), siris (Albizzia sp.), bakain (Melia azedarach), kadamba (Bauhinia malabarica), bakain (Melia azedarach), sissoo (Dalbergia sissoo), imli (Tamarindusindica), rubber tree (Ficuselastica), amaltas (Crassia fistula), semal (Bombax ceiba), Jamun (Eugenia jambolana), coconut (Cocos nucifera) and Bmboo etc . The herbs and shrubs observed in the area are lantana (Lantana camera), Pragmites (Pragmiteskarkar), congress grass (Parthenium hysterophorus), dub grass (Cynodondactylon), jimson weed (Datura stramonium), barnyard grass (Echinochloa crus galli), Johnson grass (Sorghum halepense), Echinochloacolona, chick weeds (Ageratum conyzoides), and green giant (Alocasia sp.).

b. Flora in Buffer zone of 10 km

The 10 km study area covers urban settings, riparian flora, forest and agrian ecosystem. In urban areas the common vegetation observed along the road side, parks, gardens and other open areas. The common trees observed in urban areas are gulmohar (Delonix regia), Supari (Areca catechu), banyan tree (Ficusbenghalensis), siris (Albizzia sp.), bakain (Melia azedarach), kadamba (Bauhinia malabarica), bakain (Melia azedarach), sissoo (Dalbergia sissoo), imli (Tamarindusindica), rubber tree (Ficuselastica), bamboo, amaltas (Crassia fistula), semal (Bombax ceiba), Jamun (Eugenia jambolana), coconut (Cocos nucifera) etc. The herbs and shrubs observed in the area are lantana (Lantana camera), Pragmites (Pragmiteskarkar), congress grass (Parthenium hysterophorus), dub grass (Cynodondactylon), jimson weed (Datura stramonium), barnyard grass (Echinochloa crus galli), Johnson grass (Sorghum halepense), Echinochloacolona, chick weeds (Ageratum conyzoides), and green giant (Alocasia sp.)

c. Riparian Flora:

The river bank vegetation (within 10 km upstream and 10 km downstream of the proposed terminal), ecologically termed as riparian is highly dynamic vegetation. River's riparian zone acts as a bridge between terrestrial and aquatic habitat. These areas are represented by a particular type of vegetation that grows along the sides of rivers bank. General tree species observed are Anthocephalus indicus, Semecarpusanacardium, Albizialebbek, Dalbergiastipulacea, Lagerstroemia speciosus and Bombax ceiba. Albizia lucida, Artocarpuslakoocha, Alstoniascholaris, Cedrelatoona, Dalbergiaassamica, Pterospermumacerifolium the herbs and shrubs observed are Ageratum conyzoides, Alocasiaodora, Justicia adhatoda, Justicia japonica, Panicum auritum, Phlogacanthuscurviflorus, Polygonum auriculatum, Saccharum ravennae, Sidarhombifolia, Solanum nigrum, Urenalobata etc.

d. Agrian Ecosystem:

Agro ecosystem is defined as a spatially and functionally coherent unit of agricultural activity. About 8.31% study area falls in this category

The list of plant species observed in the study area is presented in **Table 6-23**.

Table 6-24: List of flora in Study Area

Sl. No.	Scientific Name	Local Name	Family	Core zone	Buffer zone
Trees					
1	*Acacia auriculiformis*	Akashmoni	Fabaceae	+	+
2	*Acacia catechu*	Khair	Fabaceae	-	+
3	*Acacia nilotica*	Babul	Fabaceae	+	+
4	*Adina cordifolia*	Karam	Rubiaceae	-	+
5	*Aegle marmelos*	Bel	Rutaceae	+	+
6	*Albizzia lebbek*	Siris	Mimosaceae	+	+
7	*Albizzia odoratissima*	Jung siris	Mimosaceae	-	+
8	*Albizzia procera*	Safed Siris	Mimosaceae	+	+
9	*Anogeissuslatifolia*	-	Combretaceae	-	+
10	*Areca catechu*	Supari	Arecaceae	+	+
11	*ArtocarpusHitrophyllum*	Kathal	Moraceae	-	+
12	*Azadirachtaindica*	Neem	Meliaceae	+	+
13	*Bauhinia variegata*	Kachnar	Caesalpiniaceae	-	+
14	*Bischofiajavanica*	Uraim	Phyllanthaceae	-	+
15	*Bombax ceiba*	Semal	Bombacaceae	+	+
16	*Boswellia serrata*	Salia	Burseraceae	-	+
17	*Buchnanialanzan*	Piar	Anacardiaceae	-	+
18	*Butea monosperma*	Palas	Fabaceae	-	+
19	*Cassia fistula*	Dharanj/Amaltash	Caesalpiniaceae	+	+
20	*Cocus Nucifera*	Nariyal	Arecaceae	+	+
21	*Cordia dichotma*	Bahuar	Ehertiaceae	-	+
22	*Dalbergia sissoo*	Sheesham	Fabaceae	+	+
23	*Delonix regia*	Gulmohar	Fabaceae	-	+
24	*Eugenia jambolana*	Jamun	Myrtaceae	-	+
25	*Ficusbengalensis*	Bar	Moraceae	+	+
26	*Ficuselastica*	Ruber	Moraceae	-	+
27	*Ficus religiosa*	Pipal	Moraceae	+	+
28	*Gmelina arborea*	Gamhar	Verbenaceae	+	+
29	*Holopteleaintegrifolia*	Chilbil	Ulmaceae	-	+
30	*KydiacalycinaRoxb.*	Puda	Malvaceae	-	+
31	*Lagerstoemiaparviflora*	Sida/Dauli	Lythraceae	-	+
32	*Mangiferaindica.*	Aam	Anacardiaceae	+	+
33	*Phoenix sylvestric*	Khajur	Arecaceae	+	-
34	*Pongamiapinnata*	Kranj	Fabaceae	+	+
35	*Pterocarpus marsupium*	Piasal	Fabaceae	-	+
36	*Schimawallichii*	Ghugra	Theaceae	-	+
37	*Shorearobusta*	Sal/ SaKhua	Depterocarpaceae	+	+
38	*Stereospermumprsonatum*	Paruli	Bignoniaceae	-	+
39	*Tectonagrandis*	Saguan	Verbenaceae	+	+
40	*Terminalia arjuna*	Arjun	Combretaceae	+	+
41	*Terminalia bellirica*	Bahera	Combretaceae	-	+
42	*Terminalia tomentosa*	Asan	Combretaceae	-	+
43	*Toona ciliate*	Pooma	Meliaceae	-	+
44	*Zizyphusmauritiana*	Ber	Rhamnaceae	+	+
Shrubs					
1	*Asparagus racemosus*	Satawar	Liliaceae	+	+
2	*Agave americana*	Rambas	Asparagaceae	-	+
3	*Calotropis gigantea*	Akaon	Asclepiadaceae	+	+
4	*Carissa carandas.*	Kanwar	Apocynaceae	-	+
5	*Cannabis sativa*	Bhang	Cannabaceae	+	-
6	*Casiaalata*	-	Fabaceae		
7	*Catharanthus roseus*	-	Apocynaceae		
8	*Datura metal*	Dhatura	Solanaceae	+	+
9	*Dichrostachyscinerea*	-	Mimosaceae	-	+
10	*Cyperusrotundus*	-	Cyperaceae	+	+
11	*FlacourtiaRamontchi*	Salpani	Flacourticeae	-	+
12	*Indigoferapulchela*	Jirhul	Fabaceae	+	+
13	*Ipomoea carnea*	-	Convolvulaceae	+	+
14	*Lantana camara*	Putus	Verbenaceae	+	+
15	*Phoenix acaulis*	Khejur	Arecaceae	+	+

Sl. No.	Scientific Name	Local Name	Family	Core zone	Buffer zone
16	*Randiadumetorum*	Mowar	Rubiaceae	+	+
17	*Thespesia lampas*	Ban kapasi	Malvaceae	-	+
18	*Vitex negundo*	Sindwar	Verbenaceae	+	+
19	*Bougainvillea spectabilis*	Voganvila	Victaginaceae	+	-
20	*Zizyphusoenoplia*	-	Rhamnaceae	-	+
21	*Ricinus communis*	Arandi	Euphorbiaceae	+	+
Herbs					
1	*Achyranthes aspera*	Chirchiri	Amaranthaceae	-	+
2	*Aervalanata*	-	Amaranthaceae	+	+
3	*Ageratum conyzoides*	-	Asteraceae	+	+
4	*Alternanthera sessilis*	-	Amaranthaceae	-	+
5	*Boerhaviadiffusa*	-	Nyctaginaceae	+	+
6	*Cassia tora*	Chakor	Fabaceae	+	+
7	*Elephantopusscaber*	-	Asteraceae	-	+
8	*Euphorbia hirta*	-	Euphorbiaceae	+	+
9	*Hygrophila spinosa*	-	Acanthaceae	-	+
10	*Justicia procumbens.*	-	Acanthaceae	-	+
11	*Leonotisnepataiefolia*	-	Lamiaceae	-	+
12	*Mimosa pudica*	-	Mimosaceae	+	+
13	*Parthenium histerophorus.*	-	Asteraceae	+	+
14	*SidaacutaBurm.*	-	Malvaceae	+	+
15	*Sidarhombifolia*	-	Malvaceae	+	+
16	*Solanum nigrum*	Makoi	Solanaceae	+	+
17	*Solanum surattense*	-	Solanaceae	+	+
18	*Sphaeranthus indicus*	-	Asteraceae	-	+
19	*Tridaxprocumbens*	-	Asteraceae	-	+
20	*Xanthium strumarium*	-	Asteraceae	+	+
Grasses and Climbers					
1	*Vetiveriazizanoides*	Khus-Khus	Poaceae	+	+
2	*Apludavaria*	Dudhiasauri	Poaceae	-	+
3	*Arundinellasetosa*	Jharu/Motaminjhar	Poaceae	-	+
4	*Bambusaarundinaceae*	Bara bans	Poaceae	-	+
5	*Cymbopogon martini*	-	Poaceae	-	+
6	*Cynodondactylon*	Dhoob	Poaceae	+	+
7	*Dendrocalamusstricus*	Bans/Bamboo	Poaceae	+	+
8	*Eulaliopsisbinata*	-	Poaceae	-	+
9	*Heteropogoncontortus*	Kher/Sauri	Poaceae	+	+
10	*Imperata cylindrical*	-	Poaceae	-	+
11	*Saccharum munja*	Munj	Poaceae	-	+
12	*Mukiamaderaspatana*	Bilari	Cucurbitaceae	-	+
13	*Abrusprecatorius*	Karjani	Fabaceae	+	+
14	*Acacia pinnata*	Arar	Mimisaceae	-	+
15	*Butea parviflora*	Cihut	Fabaceae	+	+

Note: + denotes present and – denotes absent

The listed as well as observed floral species has been cross-checked with the Red Data Book of Indian Plants (Botanical Survey of India). No endangered, vulnerable, rare and/or critical floral species has been found in the core zone and buffer impact zone.

B. Fauna:

a. Fauna (within 500 m zone):

No Reserved/ Protected and other forest land are present within 500 m area of the proposedterminal/ghat site. The land use of 500 m area is mostly, settlement, water body, garden and roads. Due to absence of any forest in this zone the fauna diversity is restricted to common mammal species and amphibian and reptiles. However, few species of avifauna have been observed within this zone. Details of the fauna observed are given at **Table 6-24, 6-25**and **6-26**.

Table 6-25: Mammals within Core Zone of study area

Sl.	Local	Common Name	Scientific Name	Feeding	Schedule

	Name			Status	
1.	Gilahri	Striped squirrel	*Funambulus pennant*	H	IV
2.	Chuha	Field rat	*Bandicotabangalonsis*	H	V
3.	Nevala	Mongoose	*Herpestesedwardsi*	C	IV

H – Herbivorous, C – Carnivorous, O – Omnivorous

Table 6-26: Amphibians and Reptiles Observed within Core Zone of study area

S.No.	Common Name	Scientific Name	Vernacular Name	Family	Feeding Habitat	Schedule
Amphibians						
1	Frog	Rana tigrina	-	-	C	IV
Reptiles						
1	Binocellate cobra	Najanaja	Nag	Elapidae	C	II
2	Common Krait	Bungarus coeruleus	-	Elapidae	C	IV
3	Rat snake	Ptyasmucosus	Dhaman	Colubridae	C	II
4	Forest Lizard	Calotes versicolor	-	Agamidae	C	II

C – Carnivorous

Table 6-27: Avifauna with in Core Zone of the study area

S. No.	Location Name	Dominant Species	
		Common Name	Scientific Name
1.	Near GGG	House Crow Black Drongo Sparrow Spotted Dove Greater Coucal Common Myna Indian Robin Cattle Egret Lapwing	*Corvussplendens* *Dicrurusmacrocerus* *Passer domesticus* *Streptopeliachinensis* *Centropussinensis* *Acridotherestristis* *Saxicoloidesfulicata* *Bubulcus ibis* *Venetlus indicus*

b. Fauna in Buffer Zone

Study area 10 km radius around the project site has water bodies, settlements, hilly terrain and few patches of reserve forests. The wildlife is restricted to forest areas and away from the settlements. These forest patches serve as a habitat for the wild fauna. List of fauna found in the study area is presented in **Table 6-27**and **Table 6-28**.

Table 6-28: Mammals in Buffer Zone of study area

Sl.	Local Name	Common Name	Scientific Name	Feeding Status	Red Data Status
1.	Lomdi	Fox	*Vulpes bengalensis*	C	Least Concern
2.	Gilahri	Striped s squirrel	*Funambuluspennanti*	H	Least Concern
3.	Chuha	Field rat	*Bandicotabangalonsis*	H	Least Concern
4.	Sehi	Porcupine	*Hystrix Indica*	C	Least Concern
5.	Khargosh	Hare	*Lepus nigricollis*	H	Least Concern
6.	Jangli Billi	Jungle cat	*Felischaus*	C	Least Concern
7.	Nevala	Mongoose	*Herpestesedwardsi*	C	Least Concern
8.	Langoor	Langur	*Presliptis entellus*	H	Least Concern
9.	Golden Langoor	Langur	*TrachypithecusGeei)*	H	Endangered
10.	Bandar	Rhesus macaque	*Macaca mulatto*	H	Least Concern
11.	Chamgadad	fruit bat	*Cynopterus sphinx*	C	Least Concern
12	Spotted Dear	Deer	*Axis axis*	H	Least Concern
12	Bay Bamboo Rat	-	*Cannomys badius*	H	Least Concern
13	Bamboo Rat	-	*Rhizomyspruinosu*	H	Least Concern

H – Herbivorous, C – Carnivorous, O – Omnivorous

Table 6-29: List of Amphibians and Reptiles observed in Study Area

S.No.	Common Name	Scientific Name	Vernacular Name	Family	Feeding Status	Red Data Status
Amphibians						
1	Frog	Rana tigrina	-	-	C	Least Concern
2	Indian bull frog	Hoplobatrachustigerinus	-	-	C	Least Concern
Reptiles						
1	Binocellate cobra	Najanaja	Nag	Elapidae	C	Least Concern
2	Common Krait	Bungarus coeruleus	-	Elapidae	C	Least Concern
3	Russell's Viper	Viperarussellis	-	Crotalidae	C	Least Concern
4	Rat snake	Ptyasmucosus	Dhaman	Colubridae	C	Least Concern
5	Forest Lizard	Calotes versicolor	-	Agamidae	C	Least Concern
1	Indian chameleon	Chameleon zegylanicus	-	Chamael-eonidae	C	Least Concern

C – Carnivorous

C. Avifauna

Avifauna is an important part of the ecosystem playing the various roles as scavengers, pollinators, predators of insect, pest, etc. They are also one of the bio indicators of environmental quality. They can be used as sensitive indicators of environmental degradation. The area is inhibited by large numbers of birds like sparrow, egret, dove, drongo and other birds. List of bird species observed in the study area is given in **Table 6-29**.

Table 6-30: Birds in the Study Area

Sl. No.	Common Name	Scientific Name	Schedule as per wild life Protection Act 1972 and IUCN status
1.	Bank Myna	*Acridotheresginginianus*	IV/LC
2.	Baya Weaver	*Ploceusphilippinus*	IV/LC
3.	Black Drongo	*Dicrurusadsimilis*	IV/LC
4.	Blossom headed Parakeet	*PsittaculaCyanocephala*	IV/LC
5.	Ble throated Barbet	*Megalaimaasiatica*	IV/LC
6.	Cattle Egret	*Bubukus ibis*	IV/LC
7.	Crow Pheasant	*Centropussinensis*	IV/LC
.8.	Common Swallow	*Hirundorustica*	IV/LC
.9.	Common Kingfisher	*Alcedoatthis*	IV/LC
10.	Dove	*Streptopeliadecaocto*	IV/LC
11.	Greater cookoo	*Centropussinensis*	IV/LC
12.	Grey backed shrike	*Laniustephronotus*	IV/LC
13.	House Crow	*Corvussplendens*	IV/LC
14.	House Swift	*Apus affinis*	LC
15.	Hoopoe	*Upupa spops*	IV/LC
16.	House Sparrow	*Passer domesticus*	IV/LC
17.	Indian Roller	*Coracias benghalensis*	IV/LC
18.	India Tree Pie	*Dendocittavagabunda*	IV/LC
19.	Indian Ring Dove	*Streptopelia Capicola*	IV/LC
20.	Jungle crow	*Corvusmacrorthynchos*	IV/LC
21.	Jungle Babler	*Turdoidesstriatus*	IV/LC
22.	Koel	*Eudynamysscolopacea*	IV/LC
23.	Kingfisher - White throated	*Halcyon smyrnensis*	IV/LC
24.	Kingfisher - Whitebreasted	*Halcyon smyrnensis*	IV/LC
25.	Little Brown Dove	*Streptopelia senegalensis*	IV/LC
26.	Lesser Goldenbacked Woodpecker	*Dinopiumbenghalensis*	IV/LC
27	Large Pied Wagtail	*Motacillamaderaspatensis*	IV/LC
28	Magpie Robin	*Copsychussaularis*	IV/LC
29.	Mayna - Brahminy	*Sturnus pagodarum*	IV/LC

Sl. No.	Common Name	Scientific Name	Schedule as per wild life Protection Act 1972 and IUCN status
30.	Mayna - Common	*Acridotherestristis*	IV/LC
31.	Mayna - Jungle	*Acridotheresfuscus*	IV/LC
32.	Pied Cuckoo	*Clamatorjacobinus*	IV/LC
33.	Pond Heron	*Ardealagrayii*	IV/LC
34.	Redwattled Lapwing	*Vanellus indicus*	IV/LC
35.	Rose ringed Parakeet	*Psittaculakrameri*	IV/LC
36.	Redvented bulbul	*Pycnonotuscafer*	IV/LC
37.	Spotted Dove	*Streptopeliachinensis*	IV/LC

a. Migratory Birds:

Migratory birds from Siberia visit the area during winter. They arrive at DeeporBeel. The route of migration is north-south direction. These birds arrive in large numbers due to suitable temperature and abundant availability of snails, slugs, fish etc. Local migratory birds from upper Assam migrate to DeeporBeel for breeding and to escape freezing winter. The most notable bird species found in the sanctuary are Kingfisher, Fishing eagles, plethora of ducks, Greater Adjutant Stork, Whistling Teal, Open Billed Stork, Shoveler, Pintail, Garganey and high concentration of Pheasant tail jacanas etc.

D. Migratory Route for wild fauna

As per the govt. records there is no any designated migratory route for terrestrial wild animals in the study area.

6.10.1.2 Aquatic Ecology

Width of river Brahmaputra at proposed terminal is about 1260meters. Aquatic ecology of Brahmaputra River at Gateway Guwahati Ghat (GGG) includes variety of plankton, fishes, benthos. The freshwater ecosystems in study area are Brahmaputra river (lotic), still water bodies (lentic) comprise of Deepor Beel.

The mighty Brahmaputra system constitute the major surface water body, supporting over 200 species of aquatic fauna, including the endangered river dolphin. As per the dolphin study carried by the subject expert during dry and wet season, no dolphin were spotted at Gateway Guwahati Ghat and North Guwahati Ghat. However the dolphins were spotted in the survey route of the study area i.e near Umananda Ghat during dry season. Besides, the secondary data also indicates the presence of dolphins at Guwahati. No Chelonians (turtle) nesting ground were reported and observed in and around proposed terminal site, but as per the secondary data analysis following species of turtles are reported in study area (**Table 6-30**).

Table 6-31: Turtle reported in Study Area

Sl.No.	Common Name	Scientific Name	Red Data Status
1	Indian Roofed Turtle	*Pangshura tecta*	Least Concern
2	South Asian Box Turtle	*Cuoraamboinensis*	Vulnerable
3	Indian Soft-Shell Turtle	*Nilssoniagangetica*	Vulnerable
4	Peacock soft shell Turtle	*Nilssoniahurum*	Vulnerable
5	Indian Flap-shell Turtle	*Lissemyspunctata*	Least Concern

A. Phytoplanktons

Phytoplankton is dominant group of aquatic plants in the radius of Gateway Guwahati Ghat (GGG)terminal. Two samples of Phytoplankton and zooplanktons were collected from the upstream and downstream of the Brahmaputra River with the help plankton net and preserved in formalin. These species were identified under the microscope. In context of phytoplankton composition; bacillariphyceae (diatoms) is dominant and has maximum abundance as compared to cholophyceae and cyanophyceae. Submerged aquatic macrophytes are usually rooted in the

bottom soil with the vegetative parts predominantly submerged. These plants are very important for the process of photosysnthesis in aquatic ecosystem and act as primary producers. Sample for testing of phytoplanktons and zooplanktons were taken from upstream and downstream of Brahmaputra river near proposed terminal site. The list of phytoplankton observed in Brahmaputra river near terminal site is given in **Table 6-31**.

Table 6-32: Phytoplanktons in Study area

Sl.No.	Taxa	Brahmaputra River upstream (10 km upstream)	Brahmaputra River downstream (10 km downstream)
BACILLARIOPHYCEAE			
1.	*Amphipleura*	+	+
2.	*Achnanthes sp.*	-	+
3.	*Asterionella sp.*	+	-
4.	*Bacillaria sp.*	+	+
5.	*Biddulphia sp.*	-	+
6.	*Brebissonia sp.*	+	+
7.	*Ceratoneis sp.*	-	+
8.	*Cymatopleura sp.*	+	+
9.	*Cymbella sp.*	+	+
10.	*Denticula sp.*	-	+
11.	*Diatoma sp.*	+	+
12.	*Epithelmia sp.*	+	-
13.	*Fragilaria sp.*	+	+
14.	*Frustulia sp.*	+	+
15.	*Gomphoneis sp.*	-	+
16.	*Gomphonema sp.*	+	+
17.	*Gyrosigma sp.*	+	+
18.	*Hantzchia sp.*	+	+
19.	*Melosira sp.*	-	+
20.	*Meridian sp.*	+	+
21.	*Navicula sp.*	-	+
22.	*Nedium sp.*	+	+
23.	*Nitzschia sp.*	+	+
CHLOROPHYCEAE			
1.	*Actinastrum sp.*	+	+
2.	*Ankistrodesmus sp.*	+	+
3.	*Centritrachus sp.*	+	+
4.	*Chlamydomonas sp.*	-	+
5.	*Chlorella* sp	+	+
6.	*Chlorococium sp.*	+	-
7.	*Cladophora sp.*	+	-
8.	*Closterium sp.*	+	+
9.	*Coelastrum sp.*	-	+
10.	*Eudorina sp.*	+	+
11.	*Oedogonium sp.*	+	+
12.	*Pedistrum*	+	+
13.	*Pandorina sp.*	+	+
14.	*Mesotaenium*sp	-	+
15.	*Stigecloniums*p	+	-
16.	*Tetradesmus*sp	+	-
17.	*Rhizocloniums*p	+	+
CYANOPHYCEAE			
1.	*Anabaena* sp .	+	+
2.	*Aphanocapsa sp.*	+	+
3.	*Oscillatoria sp.*	+	+
4.	*Microcystis sp.*	+	+

Sl.No.	Taxa	Brahmaputra River upstream (10 km upstream)	Brahmaputra River downstream (10 km downstream)
5.	*Phormidium sp.*	+	+

Note: + denotes Present and – denotes Absent

B. Zooplankton

Zooplanktons are microscopic and motile organism usually present on the surface water. These species are important and act as primary consumers feeds on phytoplankton. The zooplankton of 10 Km stretch (upwards and downwards) of Brahmaputra river near terminal is given in **Table-32**.

Table 6-33: Zooplankton in study area

Taxa		Brahmaputra River upstream (10 km upstream)	Brahmaputra River downstream (10 km downstream)
PROTOZOA			
1.	*Arcella*sp.	+	+
2.	*Chilodonella*sp.	+	-
3.	*Difflugiia*sp.	+	+
4.	*Globigerina* sp.	+	+
5.	*Noctiluca*sp.	+	-
6.	*Paramecium* sp.	+	+
7.	*Vorticella* sp	+	+
ROTIFERA			
1.	*Brachionus*sp.	+	+
2.	*Filinia*sp.	+	-
3.	*Horaella*sp.	+	+
4.	*Keratella*sp.	+	+
5.	*Lecane*sp.	+	-
6.	*Notholca*sp.	+	+
7.	*Rotaria*sp.	+	+
8.	*Testudinella*sp.	+	-
COPEPODA			
1.	*Cyclops sp.*	+	+
2.	*Nauplii*	+	-
CLADOCERA			
1.	*Bosmina*sp.	+	+
2.	*Ceriodaphnia*sp.	+	+
3.	*Cydorus*sp.	+	-
4.	*Daphnia* sp.	+	+
5.	*Diphanosoma*sp.	+	+
6.	*Moina*sp.	-	+
7.	*Simocephalus*sp.	+	-

Note: + denotes Present and – denotes Absent

C. Wetland/ Ramsar Site

Deepor Beel Ramsar site is also located within the 10 km area of the proposed site. Deepor beel is a permanent, freshwater lake. It is a large natural wetland having great biological and environmental importance besides major storm water storage basin for the Guwahati city (Deka and Goswami, 1992). DeeporBeel is the only Ramsar site in Assam and among the third Ramsar site of the north eastern region of India *"DeeporBeel is representative of the wetlands found within the Burma Monsoon Forest biogeographic region"* (Saikia, Kumar Saikia and Bhatta, 2014). DeeporBeel is designed as "Wetlands of International importance" under the *Ramsar Convention on wetlands, 1971* and was declared as Ramsar site in 2002.

Deepor Beel is the rest house for migratory birds and known to be one of the largest aquatic bird's habitats in Assam. In winter season for a single day 19,000 water birds are counted (Mitra, Bezbaruah 2014). DeeporBeel is listed in Birdlife International's list of Important Bird Areas (IBA) for its diversity of bird's habitat. DeeporBeel serves as major fish breeding. List of migratory birds reported in Deeporbeel is presented in **Table 6-33.**

Amchang was declared as wildlife sanctuary on 19th June, 2004. It is located at extreme east of Guwahati City. Deepor Beel & Amchang WS are located at extreme 10km aerial distance from the 'Gateway Guwahati Ghat'. These two places are separated by various anthropogenic activities undertaken by government and other sectors in the Guwahati city. There is no direct impact anticipated from the proposed project activities in Deepor Beel & Amchang Wildlife Sanctuary. Map showing these two location are given below in figure-

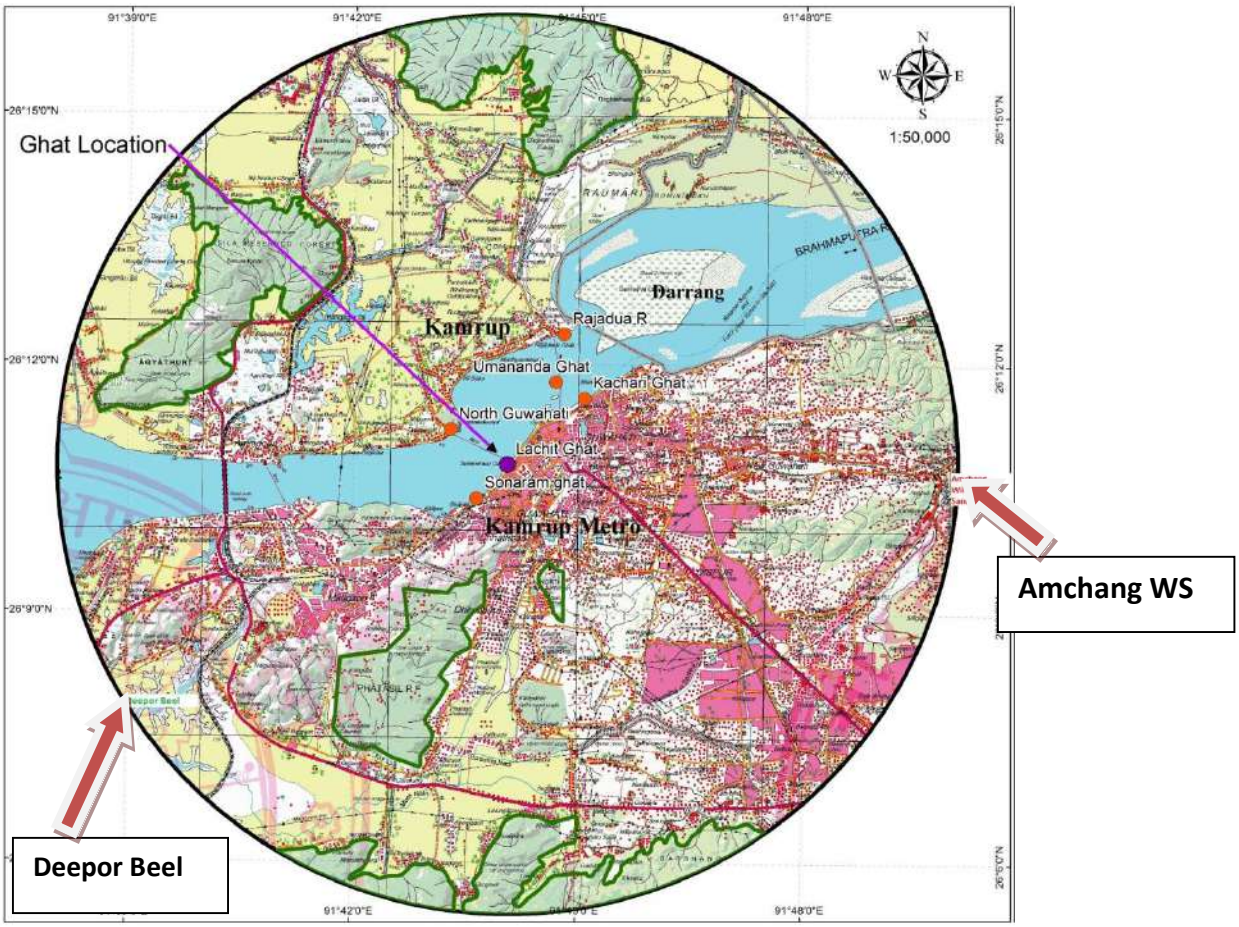


Figure 6-31: Map Showing Deepor Beel & Amchang WS

Table 6-34: Migratory Birds in Deepor Beel

Sl. No	English Name	Scientific Name
1	Spotted Billed Pelican	*Pelecanthusphilippensis*
2	Baers Pochards	*Aythyabaeri*
3	Lesser adjutant strok	*Leptoptilosjavanicus*
4	Greater adjutant strok	*Leptoptilosdubius*
5	Palas Sea Eagle	*Haliaeetus leucogaster*
6	Sibarian crane	*Grus leucogeranus*
7	Greater flamingo	*Phoenicopterus rosens*
8	Northern pintail	*Anus acuta*
9	Ruff	*Philomachuspugnax*
10	Yellow wagtail	*Motacilla flava*
11	White wagtail	*Motacilla alba*
12	Godwall	*Anas atrepera*

Sl. No	English Name	Scientific Name
13	Northern shoveler	*Anas clypeata*
14	Rosy pelican	*Pelecanusonocrotalus*
15	Spotted billed pelican	*Pelecanusphilippensis*
16	Spotted sandpiper	*Actitismacularia*
17	Blue troat	*Lusciniasvecica*

D. Fisheries

Fishes are at the apex in aquatic food chain. The fish population of Brahmaputra river is largely dependent on phytoplankton, zooplankton, periphyton and zoo benthos which form the food chain. The list of fish species reported /observed in the study area is given in **Table 6-34**.

Table 6-35: Fish in Study area

Sl. No.	Scientific Name	Local Name (Assam)	Family
1.	*Labeogonius*	Kurhi	Cyprinidae
2.	*Labeoboga*	Bhangon	Cyprinidae
3.	*Labeorohita*	Rou	Cyprinidae
4.	*Aspidopariamorar*	Boliora	Cyprinidae
5.	*Puntinussophore*	Puthi	Cyprinidae
6.	*Rita rita*	Ritha	Bagridae
7.	*Gagatacenia*	-	Sisoridae
8.	*Glypathoraxsps*	-	Sisoridae
9.	*Nemacheilusbotia*	Botia	Cobitidae
10.	*Nandusnandus*	Mati Kawoi	Nandidae
11.	*Channa punctatus*	Goroi	Channidae
12.	*Channagachua*	Chengeli	Channidae
13.	*Clupisomagarua*	Gorua	Schibeidae
14.	*Anabustestudineous*	Kawoi	Anabantidae
15.	*Colisafasciatus*	Kholihona	Anabantidae
16.	*Mastacembeluspuncalus*	Tora (Spiny eel)	Mastacembelidae
17.	*Mystusvittatus*	Singora	Bagridae

E. Endangered Species (Aquatic Fauna):

Endangered (EN) species is a species which has been categorized by the International Union for Conservation of Nature (IUCN). "Endangered" is the second most severe category for wild populations in the IUCN list after Critically Endangered (CR). Dolphin which is a schedule-I species is reported in Brahmaputra river. No Chelonians (turtle) nesting ground reported in and around proposed terminal site. But as per the secondary data analysis, few species of turtles reported in 10 km study area which are categorised either vulnerable or endangered category. As per the dolphin study carried by the subject expert during dry and wet season, no dolphins were spotted at Gateway Guwahati Ghat and North Guwahati Ghat. However the dolphins were spotted in the survey route of the study area i.e near Umananda Ghat during dry season. Secondary data indicates presence of dolphins at Guwahati. June to August is the active breeding season of almost all aquatic fauna, where as for 'Gangetic Dolphin', february to May is the breeding time.

As per the dry and wet season dolphin survey, dolphins were sighted in dry season near GG Ghat and North Guwahati Ghat route i..e near Umananda Ghat, but during wet season no dolphins were sighted.

Ecological Profile of Aphalamukh Ghat

Aphalamukh Ghat is to be developed on land owned by IWT located along the Brahamaputra river. Ghat is located in sandy and flat terrain area. Ghat is well connected through unpaved road. There

is no vegetation present on the identified land. No tree cutting is required for development of proposed terminal. The ecology of 10 km zone around the project site agrian ecosystem and aquatic ecosystem of Brahmaputra river. Following are discussed.

1. Terrestrial Ecology (Flora & Fauna)
2. Aquatic Ecology (Flora & Fauna)

6.10.1.3 Terrestrial Ecology

A. Forest:

There is no reserved and protected forest present within the 10 km study area. The land use of the 10 km area is agriculture, water bodies and settlement.

B. Flora within 500 m area:

There is no vegetation present on the identified land. No tree cutting is required for development of proposed terminal. However, few herbs and grasses is observed around the ghat area, which may require cutting.

The 500 m area around the terminal site is considered as the core zone. The land use of 500 m area of the terminal is mainly agriculture, open land and water body (Brahmaputra River). The vegetation is restricted along agriculture fields, and other open areas only. The common tree observed in core zone are banyan tree (Ficusbenghalensis), siris (Albizzia sp.), sissoo (Dalbergia sissoo), imli (Tamarindusindica), rubber tree (Ficuselastica), semal (Bombax ceiba), Jamun (Eugenia jambolana), and Bamboo etc. The herbs and shrubs observed in the area are Solanum surrattense, solanum nigrum, lantana (Lantana camera), Ipomeacornia, congress grass (Parthenium hysterophorus), dub grass (Cynodondactylon), datura (Datura metal) etc.

C. Flora of Buffer zone of 10 km

The 10 km study area covers rural settings, riparian flora and agrian ecosystem. In rural areas the vegetation restricted along agriculture fields, road side and other open areas. The common trees observed in urban areas are banyan tree (Ficusbenghalensis), siris (Albizzia sp.), kadamba (Bauhinia malabarica), bakain (Melia azedarach), sissoo (Dalbergia sissoo), Areca nut (Arachis hypogea), Coconut (Cocus nucifera), imli (Tamarindusindica), bamboo, amaltas (Crassia fistula), semal (Bombax ceiba), gulmohar (Delonix regia),Jamun (Eugenia jambolana), etc. The herbs and shrubs observed in the area are lantana (Lantana camera), congress grass (Parthenium hysterophorus), dub grass (Cynodondactylon), datura (Datura stramonium), cannabis sativa, Xanthium strumarium, Nariumindicum, Calotropis procera, Lantana camara, Casiatora, Vitex negundo, Zizyphusmauritiana, Casiaalalta, Canabis sativa, Parthenium grass (exotic species), Argemonmaxicana and few grasses species. The list of plant species observed in the study area is presented in **Table 6-35**.

Table 6-36: List of flora in Aphalamukh Ghat Study Area

Sl. No	Scientific name	Family	Vernacular name
Trees			
1.	*Antidesma acidum*	Euphorbiaceae	Abutenga
2.	*Albizzia lebbek*	Mimosaceae	Siris
3.	*Albizzia odoratissima*	Mimosaceae	Janglisiris
2	*Antidesma bunias*	Euphorbiaceae	Panihelos
3	*Antidesmaghaesembilla*	Euphorbiaceae	Helos
4	*Artocarpus chama*	Moraceae	Sam kothal
5	*Artocarpusheterophyllus*	Moraceae	Kothal
6	*Artocarpuslacucha*	Moraceae	Bohot
7	*Arachis hypogea*	Arecaceae	Areca Nut
8	*Baccaurearamiflora*	Euphorbiaceae	Letekoo

Sl. No	Scientific name	Family	Vernacular name
9	*Bambusa balcooa*	Poaceae	Bholuka bah
10	*Bischofiajavanica*	Euphorbiaceae	Uriam
11	*Bombex ceiba* L.	Bombaceceae	Simalu
12	*Callicarpa arborea*	Verbenaceae	Bonmola
13	*Carallialucida*	Rhizophoraceae	Mahithekara
14	*Caryataurens*	Arecaceae	Sewa
15	*Cassia fistula* L.	Caesalpiniaceae	Sonaru
16	*Chrysophyllumlanceolatum*	Sapotaceae	Bonpitha
17	*Cocus nucifera*	Arecaceae	Coconut
18	*Dendrocalamushamiltonii*	Poaceae	Kakobah
19	*Dalbergia sissoo*	Fabaceae	Sheesam
20	*Delonix regia*	Fabaceae	Gulmohar
21	*Dilleniaindica*	Dilleniaceae	Outenga
22	*Elaeocarpus floribundus*	Elaeocarpaceae	Jalphai
23	*Ficusauriculata*	Moraceae	Moudimoru
24	*FicushispidaVahl*	Moraceae	Katjiadimoru
25	*Ficusracemosa*	Moraceae	Moudimoru
26	*Ficuselastica*	Moraceae	Ruber
27	*Ficus religiosa*	Moraceae	Peepal
28	*Flacourtiajangomas*	Flacourtiaceae	Ponial
29	*Garcinia pedanculata*	Cluciaceae	Borthekara
30	*Garciniacowa*	Cluciaceae	Kujithekara
31	*Garciniakydia*	Cluciaceae	Kujithekara
32	*Garcinia sopsopia*	Cluciaceae	Sosopatenga
33	*Garcinia xanthochymus*	Cluciaceae	Teportenga
34	*Livistoniajenkinsiana*	Arecaceae	Tokow
35	*Mangiferaindica*	Anacardiaceae	Aam
36	*Meynaspinosa*	Rubiaceae	Kotkora
37	*Neolamerckiacadamba*	Rubiaceae	Kadam
38	*Oroxylumindicum*	Bignoniaceae	Bhatghila
39	*Premnalatifolia*	Verbenaceae	Gohora
40	*Prunusjenkinsii*	Rosaceae	Thereju
41	*Saurauiaroxburghii*	Saurauiaceae	Bon pochala
42	*Spondias pinnata*	Anacardiaceae	Amora
43	*Sterculiavillosa*	Sterculiaceae	Udal
44	*Syzygiumcumini*	Myrtaceae	Borjamu
45	*Syzygium jambos*	*Myrtaceae*	*Bogijamu*
46	*Syzygiumfruticosum*	*Myrtaceae*	*Bon Jamu*
47	*Terminalia bellerica*	*Combretaceae*	*Bhumura*
48	*Terminaliacitrina*	*Combretaceae*	*Silikha*
49	*Shorearobusta*	*Depterocarpaceae*	*Sal*
50	*Stereospermumprsonatum*	*Bignoniaceae*	*Paruli*
51	*Tectonagrandis*	*Verbenaceae*	*Sagon*
52	*Terminalia arjuna*	*Combretaceae*	*Arjun*
53	*Terminalia tomentosa*	*Combretaceae*	*Asan*
54	*Toona ciliate*	*Meliaceae*	*Pooma*
55	*Zanthoxylumrhetsa*	*Rutaceae*	*Bazarmoni*
56	*Zizyphusmauritiana*	*Rhamnaceae*	*Bogori*
SHRUBS			
1	*Alpinianigra*	Zingiberaceae	Tora
2	*Ardisiathyrsiflora*	Myrsinaceae	Tolothapoka
3	*Citrus medica.*	Rutaceae	Joratenga
4	*Clerodendrumglandulosum*	Verbenaceae	Nefafoo
5	*Glycosmis arborea*	Rutaceae	Sauldhua
6	*Gnetumgnemon L.*	Gnetaceae	Majarguti
7	*Grewiasapida*	Tiliaceae	Soura

Sl. No	Scientific name	Family	Vernacular name
8	*Kaempferiagalanga*	Zingiberaceae	Gathion
9	*Melastomamalabathricum*	Melastomaceae	Phutkala
10	*Murrayakoenigii*	Rutaceae	Norosingho
11	*Phlogocanthusthyrsiformis*	Acanthaceae	Titaphul
12	*Phlogocanthustubiflorus*	Acanthaceae	Titaphul
13	*Sarcochlamyspulcherrima*	Urticaceae	Mesaki
14	*Solanumnigrum*	Solanaceae	Bhakuritita
15	*Solanum surrattense*	Solanaceae	-
16	*Typha elephantina*	Typhaceae	Maduribon
17	*Vitex negundo*	Verbenaceae	Posotia
18	*Zanthoxylumoxyphyllum.*	Rutaceae	Mejenga
19	*Cannabis sativa*	Cannabaceae	Bhang
20	*Casiaalata*	Fabaceae	-
21	*Datura metal*	Solanaceae	Dhatura
22	*Indigoferapulchela*	Fabaceae	Jirhul
23	*Ipomoea carnea*	Convolvulaceae	-
24	*Lantana camara*	Verbenaceae	Putus
25	*Phoenix acaulis*	Arecaceae	Khejur
26	*Randiadumetorum*	Rubiaceae	Mowar
27	*Thespesia lampas*	Malvaceae	Ban kapasi
28	*Vitex negundo*	Verbenaceae	Sindwar
29	*Bougainvillea spectabilis*	Victaginaceae	Voganvila
30	*Zizyphusoenoplia*	Rhamnaceae	-
31	*Ricinus communis*	Euphorbiaceae	Arandi
HERB			
1.	*Alternanthera sessilis*	Amaranthaceae	Matikaduri
2	*Alternanthera philoxeroides*	Amaranthaceae	Panikaduri
3	*Amaranthus spinosus*	Amaranthaceae	Hatikhutora
4	*Amaranthus viridis*	Amaranthaceae	Khutora
5	*Amorphophalluspaeoniifolius*	Araceae	Olkachu
6	*Centellaasiatica*	Apiaceae	Manimuni
7	*Colocasiaesculanta*	Araceae	Panikachu
8	*Commelinabenghalensis*	Commelinaceae	Konasimolu
9	*Costusspeciosus*	Costaceae	Jomlakhuti
10	*Crassocephalumcrepidioides*	Astereceae	Bon kopahi
11	*Diplazium asperum*	Woodsiaceae	Dhekiasak
12	*Diplaziumesculentum*	Woodsiaceae	Dhekiasak
13	*Duchesneaindica*	Rosaceae	Gorukhis
14	*Drymariadiandra*	Caryophyllaceae	Laijabori
15	*Eclipta alba*	Asteraceae	Kehraj
16	*Hedyotisdiffusa*	Rubiaceae	Bonjaluk
17	*Houttuynia cordata*	Saururaceae	Moshundari
18	*Hydrocotylesibthorpioides*	Apiaceae	Sorumanimuni
19	*Ipomoea aquatic*	Convolvulaceae	Kalmou
20	*Kaempferiagalanga*	Zingiberaceae	Gathion
21	*Lasia spinosa*	Araceae	Sengmora
22	*Leucas plukenetii*	Lamiaceae	Durun
23	*Licuala peltata*	Arecaceae	Jengu
24	*Marseliaquadrifolia*	Marseliaceae	Panitengeshi
25	*Mimosa pudica*	Mimosaceae	-
26	*Monochoriahastata*	Pontederiaceae	Sorumetaka
27	*Nelumbo nucifera*	Nelumbonaceae	Podum
28	*Nypmhaeanouchali*	Nympheaceae	Bhat
29	*Nymphaea pubescens*	Nympheaceae	Bhat
30	*Hedyotisdiffusa*	Rubiaceae	Bonjaluk
31	*Oxalis corniculata*	Oxalidaceae	Sorutengacha

Sl. No	Scientific name	Family	Vernacular name
32	*Parthenium histerophorus.*	Asteraceae	-
33	*Phyllanthus fraternus*	Euphorbiaceae	Bonamlakhi
34	*Phyllanthus urinaria*	Euphorbiaceae	Matiamlakhi
35	*Polygonum chinense*	Polygonaceae	Modhusuleng
36	*Polygonum microcephalum*	Polygonaceae	Modhusuleng
37	*Polygonum perfoliatum*	Polygonaceae	Bagh achur
38	*Portulaca oleracea*	Portulacaceae	Malbhugkhutora
39	*Piper sylvaticum*	Piperaceae	Auni pan
40	*Piper longum*	Piperaceae	Pipoli
41	*Rubusalceifolius*	Rosaceae	Jatulipoka
42	*Rubusellipticus*	Rosaceae	BorJatulipoka
43	*Scopariadulcis*	Scrophulariaceae	Mithapat
44	*Solanum nigrum*	Solanaceae	Pokmou
45	*Solanum torvum*	Solanaceae	Hatibhekuri
46	*Spilanthespaniculata*	Asteraceae	Suhoni
47	*Stellaria media*	Caryophyllacee	Morolia
48	*Vernonia cinerea*	Asteraceae	Sahadevi
CLIMBERS & GRASSES			
1.	*Calamus tenuis*	Arecaceae	Jati bet
2	*Coccniagrandis*	Cucurbitaceae	Belipoka
3	*Deeringiaamaranthiodes*	Amaranthaceae	Methokthoka
4	*Dioscoreabulbifera*	Dioscoriaceae	Gothiaalu
5	*Dioscorea pentaphylla*	Dioscoriaceae	Pasoptiaalu
6	*Paederiafoetida*	Rubiaceae	Bhadailota
7	*Paederia scandens*	Rubiaceae	Bhadailota
8	*Smilexzeylanica*	Smilacaceae	Tikonibaruah
9	*Stenochlaenapelustris*	Blechnaceae	Dhekialota
10	*Stixissuaveolens*	Capparidaceae	Madhoi maloti
11	*Tetrastigmathomsonianum*	Vitaceae	Noltenga
12	*Trichosanthescucumerina*	Cucurbitaceae	Bon dhunduli
13	*Vetiveriazizanoides*	Poaceae	Khus-Khus
14	*Apludavaria*	Poaceae	Dudhiasauri
15	*Arundinellasetosa*	Poaceae	Jharu/Motaminjhar
16	*Bambusaarundinaceae*	Poaceae	Bara bans
17	*Cymbopogon martini*	Poaceae	-
18	*Cynodondactylon*	Poaceae	Dhoob
19	*Dendrocalamusstricus*	Poaceae	Bans/Bamboo
21	*Heteropogoncontortus*	Poaceae	Kher/Sauri
23	*Saccharum munja*	Poaceae	Munj

D. Rare/Endangered/Threatened (RET) Plants

The listed as well as observed floral species has been cross-checked with the Red Data Book of Indian Plants (Botanical Survey of India). No extinct, endangered, vulnerable, rare and/or critical floral species has been found in the core zone and buffer impact zone.

E. Status of Fauna:

a. Fauna (within 500 m zone):

No Reserved/ Protected and other forest land are present within 500 m area of the proposed Aphalamukh terminal / ghat site. The land use of 500 m area is mostly, settlement, water body, garden and roads.Due to absence of any forest in this zone the fauna diversity is restricted to common mammal species and amphibian and reptiles. However, few species of avifauna have been observed within this zone. Details of the fauna observed are given at **Table 6-36**to **6-37**.

Table 6-37: Mammals within Aphalamukh Ghat Core Zone

Sl. No.	Local Name	Common Name	Scientific Name	Feeding Status	Schedule
1.	Gilahri	Striped squirrel	*Funambulus pennant*	H	IV
2.	Chuha	Field rat	*Bandicotabangalonsis*	H	V
3.	Nevala	Mongoose	*Herpestesedwardsi*	C	IV

H – Herbivorous, C – Carnivorous, O – Omnivorous

Table 6-38: Amphibians and Reptiles within Aphalamukh Ghat Core Zone

Sl.No.	Common Name	Scientific Name	Vernacular Name	Family	Feeding Status	Schedule
Amphibians						
1	Frog	Rana tigrina	-	-	C	IV
2	Forest Lizard	Calotes versicolor	-	Agamidae	C	II
Reptiles						
1	Binocellate cobra	Najanaja	Nag	Elapidae	C	II
2	Common Krait	Bungarus coeruleus	-	Elapidae	C	IV
3	Rat snake	Ptyasmucosus	Dhaman	Colubridae	C	II

C – Carnivorous

F. Avifauna

Avifauna is an important part of the ecosystem playing the various roles as scavengers, pollinators, predators of insect, pest, etc. They are also one of the bio indicators of different status of environment and affected by urbanization, industrialization and human interference. They can be used as sensitive indicators of pollution and malfunction of ecosystem. The large part of the study area is under water body (Brahmaputra river) the area is inhibited by large numbers of water birds and other birds. List of bird species observed in the stud area is given in **Table 6-38**.

Table 6-39: List of the Birds observed in the Aphalamukh Ghat Study Area

Sl. No.	Common Name	Scientific Name	Status
1.	Little Grebe	*Tachybaputusruficollis*	Winter Migratory, Common.
2.	Grey Pelican	*Pellcanusphillippensis*	Migratory from adjacent area other than Majuli, Uncommon
3.	Large Cormorant	*Phalacrocorax carbo*	Winter migratory,Uncommon
4.	Little Cormorant	*Pholacrocoraxniger*	Winter Migratory, Common.
5.	Purple Heron	*Ardeapurpurea*	Indigenous, Migratory from adjacent area other than Majuli, Uncommon
6.	Pond Heron	*Ardeolastriatua*	Winter Migratory, Common.
7.	Cattle Egret	*Bubulcus Ibis*	Winter Migratory, Common.
8.	Great Egret	*Ardea alba*	Winter Migratory, Common.
9.	Little Egret	*Egrettagarzetta*	Winter Migratory, Common.
10.	Open Bill Stork	*Anastomusoscitans*	Winter Migratory, Common.
11.	Black Crowned Night Heron	*Noicticoraxnycticorax*	Indigenous, migratory from adjacent area
12.	Lesser Adjutant Stork	*Leptoptilosjavanicus*	Indigenous, Common
13.	Greyleg Goose	*Anseranser*	Winter Migratory, Common
14.	Barheaded Goose	*Answer indicus*	Winter Migratory, Common
15.	Leser Whistling Teal	*Dendrocygnajavancia*	Winter Migratory, Common
16.	Large Whistling Teal	*Dendrocygnabicolor*	Winter Migratory, Common
17.	Ruddy Shelduck Or Brahminy Duck	*Tandornatadorna*	Winter Migratory, Common
18.	Mallard	*Anas platyrhynchos*	Winter Migratory, Common
19.	Cotton Teal	*Nettapuscoromandelianus*	Indigenous, migratory from adjacent

Sl. No.	Common Name	Scientific Name	Status
			area
20.	Pintial	*Anas acuta*	Winter Migratory, Common
21.	Spotbill Duck	*Anas poecilorhyncha*	Winter Migratory, Common
22.	Black Winged Kite	*Elanus caeruleus*	Winter Migratory, Common
23.	Pariale Kite	*Milusmigransgovida*	Winter Migratory, Common
24.	Common Crane	*Grus grus*	Winter migratory,Uncommon
25.	White Breasted Water Hen	*Amaurornisphoenicurus*	Winter Migratory, Common
26.	Purple Moorhen	*Gallinule chloropus*	Winter Migratory, Common
27.	Bronze Wingd Jacana	*Metopidius indicus*	Winter Migratory, Common
28.	Indian Moorhen	*Gallinule chloropus*	Winter Migratory, Common
29.	Redwattled Lapwing	*Vanellusmalabaricus*	Winter Migratory, Common
30.	River Turn	*Sterna aurantia*	Winter Migratory, Common
31.	Black Headed Gull	*Larusichthyaetus*	Winter Migratory, Common
32.	Common Green Pigeon	*Treronphoenicoptera*	Common
33.	Spotted Dove	*Streptopeliachinensis*	Winter Migratory, Common
34.	Red Dove	*Streptopeliatranquebarica*	Winter Migratory, Common
35.	Ring Dove	*Streptopeliadecaoc to*	Winter Migratory, Common
36.	Large Indian Parakeet	*Psittaculaeupatria*	Indigenous, migratory from adjacent area
37.	Koel	*Eudynamysscolopacea*	Indigenous,migratory from adjacent area
38.	House Swift	*Apus afinis*	Winter Migratory, Common
39.	Pied Kingfisher	*Cerylerudis*	Winter Migratory, Common
40.	Small Blue Kingfisher	*Alcedoatthis*	Winter Migratory, Common
41.	White Breasted Kingfisher	*Halcyon smyrnensis*	Winter Migratory, Common
42.	Small Green Bee Eater	*Meropsorientalis*	Winter Migratory, Common
43.	Chestnut-Headed Bee Eater	*Meropsieschenaulti*	Winter Migratory, Common
44.	Small Green Barbet	*Megalaimaviridis*	Indigenous,migratory from adjacent area
45.	Blue-Throated Barbet	*Megalaimaasiatica*	Migratory from adjacent area
46.	Lineated Barbet	*Megalaima lineate*	Migratory from adjacent area
47.	Hoopoe	*Upupa epops*	Migratory from adjacent area
48.	Indian Pied Hornbill	*Anthracocerosmalabaricus*	Indigenous,migratory from adjacent area
49.	Black-Backed Woodpecker	*Chrysocolaptesfestivus*	Migratory, Common
50.	Lesser Golden Backed	*Dinopiumbenghalense*	Migratory, Common
51.	Black Drongo Or King Crow	*Dicrurrsadsimilis*	Winter Migratory, Common
52.	Pied Myna	*Sturnus contra*	Winter Migratory, Common
53.	Jungle Myna	*Acridotheresfuscus*	Winter Migratory, Common
54.	Common Myna	*Scridotherestristis*	Winter Migratory, Common
55.	House Crow	*Corvussleendens*	Indigenous, Uncommon
56.	Jungle Crow	*Corvusmarorhynchos*	Winter Migratory, Common
57.	Black-Headed Oriole	*Oriolusxanthornus*	Winter Migratory, Common
58.	Magpie Robin	*Copychussaularis*	Winter Migratory, Common
59.	Redvented Bulbul	*Pycnonotuscafer*	Winter Migratory, Common

Sl. No.	Common Name	Scientific Name	Status
60.	Red-Whiskered Bulbul	*Pycnonotusjocosus*	Winter Migratory, Common
61.	Greay Tit	*Parus major*	Winter Migratory, Common
62.	Baya Weaver	*Phillippinus*	Common
63.	Black-Breasted Weaver Bird	*Ploceusbenghalensis*	Common
64.	Tree Pie	*Dendrocittavagabunda*	Winter Migratory, Common
65.	Indian Roller	*Coracias benghalensis*	Indigenous, Uncommon
66.	White-Browned Fantal Fly-Catcher	*Rhipnduraaureola*	Indigenous, common
67.	White Wagtail	*Motacilla alba*	Winter Migratory, Common
68.	Grey Wagtail	*Motacillacinerea*	Winter Migratory, Common
69.	House Sparrow	*Passer domesticus*	Indigenous, Uncommon
70.	Spotted Owlet	*Athene brama*	Winter Migratory, Common

a. Migratory Birds:

Eight 'Flyways' have been defined in the world for the migratory birds, especially wading birds. For ducks also, these act as flyways (Flyways are broad corridors or migration routes used by migrating birds). The Brahmaputra River and its long valley stretching from Sadiya to Dhubri is a major route of migratory birds within the 'Central Asia/Indian Flyway'. While the winter visitors' use this flyway to come to Majuli, many fly across to the sea boards. These birds are called 'passage migrants' and these passage migrants use Majuli for resting and stop some time in Nemati and adjoining area during their journey.

Most of the wintering waterfowl throng the beels, channels and ghulis and the main Brahmaputra River. These birds arrive in September-October while after spending the winter in and around Majuli depart by March - April. Small numbers may remain till early part of May. A few migratory species, however, come for breeding during winter. Pallas's Fish Eagle Haliaeetus leucoryphus, which is regarded as a globally threatened bird of prey breeds in small numbers in Majuli. However, there is no any nesting ground of this species is recorded within the proposed Aphalamukh Terminal.

A large number of smaller birds such as warblers, leaf warblers, chats, thrushes, wagtails (locally known as Balimahi) and pipits also winter in Majuli. These birds affect a diverse habitat ranging from countryside to scrub jungle and grassland. Many warblers and leaf warblers are also difficult to identify in the field and hence, often overlooked but they add to the diversity of migratory species. There are also some summer migratory species, mainly cuckoos (locally called Keteki), which are known for their melodious songs.

G. Migratory Route for wild fauna

The study area falls in Aphalamukh and surrounding area and as per the govt. records there is no designated migratory route for terrestrial wild fauna identified with in the 10 km area of the project site. However, the migratory route for avifauna is reported in study area.

6.10.1.4 Aquatic Ecology

This terminal is proposed at Aphalamukh ghat. There is about 10 km width of Brahmaputra River and riparian zone observed very less vegetation due to erosion of banks. Aquatic ecology of Brahmaputra river at Aphalamukh includes variety of plankton, fishes, benthos. Aquatic ecosystem in study area comprises of fresh water ecosystem. The freshwater ecosystems in study area only comprises Brahmaputra river only.

The mighty Brahmaputra system constitutes the major water resources, supporting over 200 species of aquatic fauna, including the endangered river dolphin. No Chelonians (turtle) nesting ground reported in and around proposed terminal site. But as per the secondary data analysis

following species of turtles are reported in 10 km study area, as provided in Table 6-39. As per the dolphin study carried by the subject expert during dry season and wet season, dolphins were spotted at Aphalamukh ghat. However secondary data indicates that no dolphins were sighted at Aphalamukh.The details of recent dolphin surveys for dry and wet season are provided in Table 6.19 A & B and Annexure-6.1 A & 6.1 B respectively.

Table 6-40: Turtle reported in Aphalamukh Ghat Study Area

S.No.	Common Name	Scientific Name	Red Data Status
1	South Asian Box Turtle	*Cuoraamboinensis*	Vulnerable
2	Indian Flap-shell Turtle	*Lissemyspunctata*	Least Concern
3	Keeled box Turtle	*Pyxideamouhotii*	Endangered
4	Black Pond Turtle	*Geoclenyshamiltonii*	Vulnerable
5	Narrow headed soft turtle	Chitra indica	Endangered

A. Phytoplanktons

Phytoplankton is dominant group of aquatic plants in the radius of Aphalamukh terminal. Two samples of Phytoplankton and zooplanktons were collected from the upstream and downstream of the Brahmaputra River with the help plankton net and preserved in formalin. These species were identified under the microscope. In context of phytoplankton composition; bacillariphyceae (diatoms) is dominant and has maximum abundance as compared to cholophyceae and cyanophyceae. Submerged aquatic macrophytes are usually rooted in the bottom soil with the vegetative parts predominantly submerged. These plants are very important for the process of photosynthesise in aquatic ecosystem and act as primary producers. Sample for testing of phytoplanktons and zooplanktons were taken from upstream and downstream of Brahmaputra river near proposed terminal site and the location details provided in **Table 6-40**. The list of phytoplankton observed in Brahmaputra river near terminal site is given in**Table 6-41**.

Table 6-41: Name of Sampling Locations at Aphalamukh Ghat for surface water

S.No.	Code	Location	Source	GPS Coordinates
1	SW-1	Brahmaputra River Upstream of Aphalamukh Terminal site	Stream	26.917087°N 94.300203°E
2	SW-2	Brahmaputra River Downstream of Aphalamukh Terminal site	Stream	26.915044°N 94.298949°E

Table 6-42: List of Phytoplankton's observed in Aphalamukh Ghat Study area

Sl.No.	Taxa	Brahmaputra River upstream of Aphalamukh (10 km upstream)	Brahmaputra River downstream of Aphalamukh (10 km downstream)
BACILLARIOPHYCEAE			
1.	*Amphora sp.*	+	-
2.	*Amphipleura*	+	+
3.	*Achnanthes sp.*	+	+
4.	*Asterionella sp.*	+	-
5.	*Bacillaria sp.*	+	+
6.	*Biddulphia sp.*	+	+
7.	*Brebissonia sp.*	+	+
8.	*Ceratoneis sp.*	-	+
9.	*Coconeis sp.*	+	+
10.	*Cymatopleura sp.*	+	+
11.	*Cymbella sp.*	+	+
12.	*Denticula sp.*	+	+
13.	*Diatoma sp.*	+	+
14.	*Diatomella sp.*	+	+

Sl.No.	Taxa	Brahmaputra River upstream of Aphalamukh (10 km upstream)	Brahmaputra River downstream of Aphalamukh (10 km downstream)
15.	*Epithelmia sp.*	+	-
16.	*Fragilaria sp.*	+	+
17.	*Frustulia sp.*	+	+
18.	*Gomphoneis sp.*	-	+
19.	*Gomphonema sp.*	+	+
20.	*Gyrosigma sp.*	+	-
21.	*Hantzchia sp.*	+	+
22.	*Melosira sp.*	+	+
23.	*Meridian sp.*	+	-
24.	*Navicula sp.*	-	+
25.	*Nedium sp.*	+	+
26.	*Nitzschia sp.*	+	+
27.	*Tetracylus sp.*	+	-
Chlorophyceae			
28.	*Actinastrum sp.*	+	+
29.	*Chlamydomonas sp.*	-	+
30.	*Chlorella* sp	+	+
31.	*Chlorococium sp.*	+	+
32.	*Cladophora sp.*	+	-
33.	*Closterium sp.*	+	+
34.	*Coelastrum sp.*	+	+
35.	*Oedogonium sp.*	+	+
36.	*Pandorina sp.*	+	+
37.	*Mesotaenium*sp	-	+
38.	*Stigecloniums*p	+	-
39.	*Tetradesmus*sp	+	+
40.	*Rhizocloniums*p	+	+
Cyanophyceae			
41.	*Anabaena* sp .	-	+
42.	*Aphanocapsa sp.*	+	+
43.	*Oscillatoria sp.*	-	+
44.	*Microcystis sp.*	+	+
45.	*Anabaena* sp .	+	+

Note: + denotes Present and – denotes Absent

B. Zooplankton

Zooplanktons are microscopic and motile organism usually present on the surface of water. These species are important and act as primary consumers feeds on phytoplankton. The zooplankton of 10 Km stretch (upwards and downwards) of Brahmaputra river near terminal is given in **Table 6-42**.

Table 6-43: List of Zooplankton observed in Aphalamuk Ghat study area

Taxa		Brahmaputra River upstream of AphalamukhGhat (10 km upstream)	Brahmaputra River downstream of AphalamukhGhat (10 km downstream)
PROTOZOA			
1.	*Arcella*sp.	+	+
2.	*Chilodonella*sp.	+	-
3.	*Difflugii*asp.	+	+
4.	*Globigerina* sp.	-	+
5.	*Noctiluca*sp.	+	+
6.	*Paramecium* sp.	+	-
7.	*Vorticella* sp	+	+
ROTIFERA			
8.	*Brachionus*sp.	+	+
9.	*Filinia*sp.	+	-
10.	*Horaella*sp.	+	+
11.	*Keratella*sp.	+	+
12.	*Lecane*sp.	+	-

Taxa		Brahmaputra River upstream of AphalamukhGhat (10 km upstream)	Brahmaputra River downstream of AphalamukhGhat (10 km downstream)
13.	*Notholca*sp.	+	+
14.	*Rotaria*sp.	+	+
15.	*Testudinellasp.*	+	+
COPEPODA			
16.	*Cyclops sp.*	+	+
17.	*Nauplii*	+	+
CLADOCERA			
18.	*Bosmina*sp.	+	+
19.	*Ceriodaphnia*sp.	+	+
20.	*Cydorus*sp.	+	-
21.	*Daphnia* sp.	+	+
22.	*Diphanosoma*sp.	+	+
23.	*Moina*sp.	-	+
24.	*Simocephalus*sp.	+	+

Note: + denotes Present and – denotes Absent

C. Wetland/ Ramsar Site

There is no wetland/ Ramsar Site near this proejct location at Aphalamukh Ghat.

D. Fisheries

Fishes are at the apex in aquatic food chain. The fish population of Brahmaputra river is largely dependent on phytoplankton, zooplankton, periphyton and zoo benthos which establish itself in the form of food chain. The common fishes observed in the study area are Rohu (Labeorohita, Moa (Amblypharyngodonmola), puthi (Puntius sp.), singora (Mystusvittatus), kawoi (Anabustestudineus), goroi (Channa punctatus), karati (Gadusiachapra), punga (Tetradon), chanda (Chanda nama), khalihona (Colisafasciatus, Tora (macrognathus punctatus), Boriala (Aspidopariamorar) etc. The list of fish species reported /observed in the study area is listed in **Table 6-43**.

Table 6-44: List of fish in Study area

Sl No	Scientific Name	Local Name (Assam)	Family
1.	*Labeogonius*	Kurhi	Cyprinidae
2.	*Labeoboga*	Bhangon	Cyprinidae
3.	*Labeorohita*	Rou	Cyprinidae
4.	*Aspidopariamorar*	Boliora	Cyprinidae
5.	*Puntinussophore*	Puthi	Cyprinidae
6.	*Rita rita*	Ritha	Bagridae
7.	*Gagatacenia*	-	Sisoridae
8.	*Glypathoraxsps*	-	Sisoridae
9.	*Nemacheilusbotia*	Botia	Cobitidae
10.	*Nandusnandus*	MatiKawoi	Nandidae
11.	*Channapunctatus*	Goroi	Channidae
12.	*Channagachua*	Chengeli	Channidae
13.	*Clupisomagarua*	Gorua	Schibeidae
14.	*Anabustestudineous*	Kawoi	Anabantidae
15.	*Colisafasciatus*	Kholihona	Anabantidae
16.	*Mastacembeluspuncalus*	Tora (Spiny eel)	Mastacembelidae
17.	*Mystusvittatus*	Singora	Bagridae
18.	*Amblypharyngodonmola*	Moa	Cyprinidae
19.	*Gadusiachapra*	Karati	Clupeideae
20.	*Tetradon* sp.	Punga	Tetraodontidae
21.	*Chandanama*	chanda	Ambassideae

E. Endangered Species (Aquatic Fauna):

Endangered (EN) species is a species which has been categorized by the International Union for Conservation of Nature (IUCN). "Endangered" is the second most severe category for wild

populations in the IUCN list after Critically Endangered (CR). Dolphin which is a schedule-I species is reported in Brahmaputra river. No Chelonians (turtle) nesting ground reported in and around proposed terminal site. But as per the secondary data analysis, few species of turtles reported in 10 km study area which are categorised either vulnerable or endangered category. As per the dolphin survey carried out by the subject expert during dry and wet season, dolphins were spotted at Aphalamukh ghat.

June to August is the active breeding season of almost all aquatic fauna, where as for 'Gangetic Dolphins' at Aphalammmukh Ghat, February to May is the breeding time. But the breeding time may also vary depending upon the mating time and other river conditions.

As per the dry and wet season dolphin survey, dolphins were sighted in Aphalamukh Ghat in both the season, which may reveals the permanent habitat of dolphins at Aphlamukh ghat.

6.11 Soil Quality

Different rock formation occurring in the district has been subjected to various soil forming processes through weathering and transportation during geological ages. Soils normally consist of sand, silt, clay and organic material. They are grouped into three broad categories:

a. Newer alluvial soil,
b. Valley fill/older alluvial soil, and
c. Soils over forest and hilly terrain.

The baseline information about the nature and/or quality of the soils at the Jetty comprises reclaimed land.

Soil is a natural resource and serves as one of the prime requisites of life. Soil supports all agricultural activitiesand the plant growth.Under varying geological conditions, topographical characteristics and agro-climatic situations ,different types of soils are found in the hills, piedmonts, plateaus and plains. The soils of Assam may thus generally be divided into four groups, viz.

- Alluvial soils
- Piedmont soils
- Hill soils
- Lateritic soils.

Soil map of Assam State reveals that the proposed Ghats / Terminal area is coming in alluvial soil zone of the Brahmaputra River. Soil is Sandy loam to silty loam in texture. The alluvial soils are extensively distributed over the Brahmaputra and Barak plain. These soils are very fertile as they are formed from the alluvium deposits by the rivers Brahmaputra, Barak and their tributaries. The alluvial soils of Assam can be further be divided into two sub-types based on some micro differences in character such as – younger alluvium and old alluvium. The younger alluvial soil occurs in an extensive belt of the north-bank and south-bank plains including the active flood plains of the Brahmaputra and the Barak rivers. It is mostly composed of sandy to silty loams and slightly acidic in nature. On the riverbanks it is less acidic and sometimes neutral or slightly alkaline. Soil map of Assam is presented in **Figure 6-31.**

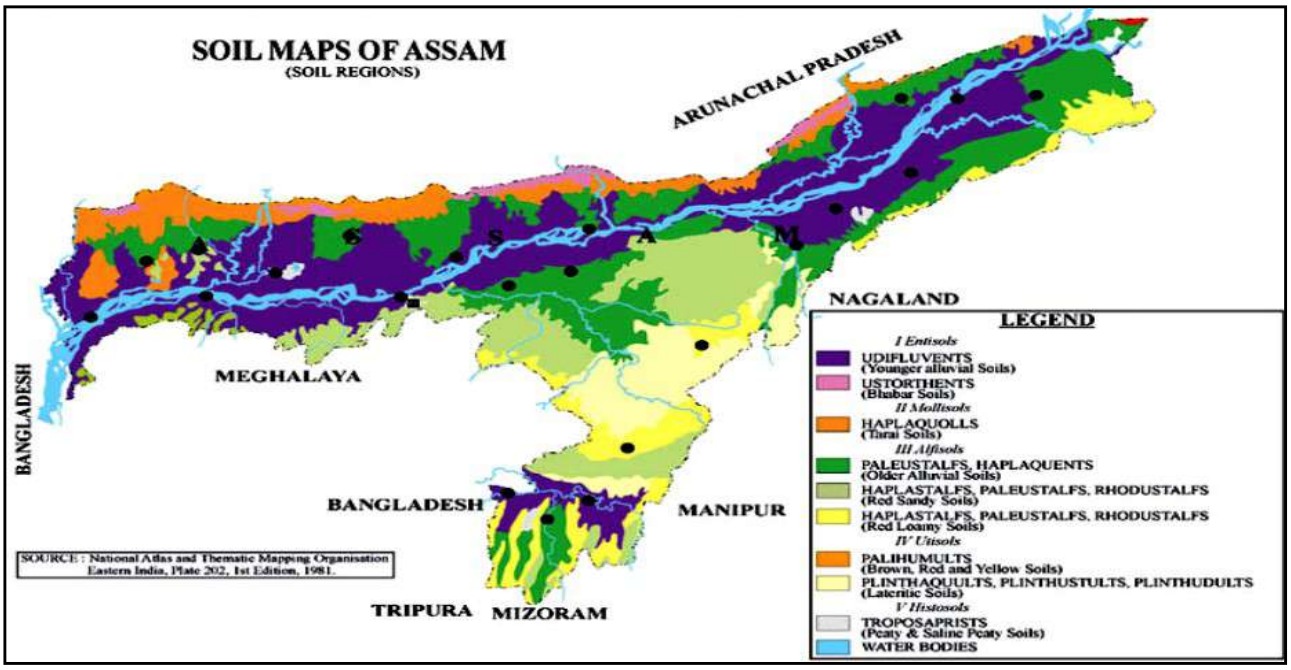


Figure 6-32: Soil Map of Assam

Three samples of soils were collected from each of proposed terminal sites. Locations of sampling points are given in**Table 6-44**.

Table 6-45: Soil Monitoring Locations

Sl. No.	Location/Ghat	Station	Date of Monitoring	Co-ordinate	
				Latitude	Longitude
1	Gateway Guwahati Ghat (GGG)	1st	08.08.2018	26.179464	91.734187
		2nd		26.179392	91.734047
		3rd		26.179711	91.734478
2	North Guwahati	1st	06.08.2018	26.185665	91.721732
		2nd		26.185440	91.721312
		3rd		26.186099	91.721782
3	AphalamukhGhat	1st	02.09.18	26.920648	94.301145
		2nd		26.914328	94.297993
		3rd		26.911114	94.293523

Soils, collected from three proposed terminal siteswere collected and analysed for physical parameters. The soil analysis results of Gateway Guwahati Ghat, North Guwahati Ghat and AphalamukhGhat are presented in **Table 6-45, 6-46**and **6-47**respectively.

Table 6-46: Soil Quality, Gateway Guwahati Ghat (GGG)

Sl.No	Parameter		Unit	Result		
				Station-1	Station-2	Station-3
1	Bulk Density		g/cc	1.22	1.23	1.2
2	Colour		--	GrayishBrown	GrayishBrown	GrayishBrown
3	Texture	Sand	%	14.8	16.2	13.7
4		Clay	%	67.2	69.1	72.4
5		Silt	%	18.0	14.7	13.9
6	Soil type		%	Acidic	Acidic	Acidic
7	pH Value (1:5 V/V)		%	5.98	5.78	5.64
8	Electrical Conductivity		µS/cm	92.2	94.6	88.2
9	Nitrogen (as N)		%	0.017	0.019	0.016

Sl.No	Parameter	Unit	Result		
10	Phosphorus (as P)	%	0.008	0.01	0.007
11	Potassium (as K)	%	0.012	0.016	0.022
12	Arsenic (as As)	%	<0.00001	<0.00001	<0.00001
13	Cadmium (as Cd)	%	<0.001	<0.001	<0.001
14	Mercury (as Hg)	%	<0.00001	<0.00001	<0.00001
15	Lead (as Pb)	%	0.003	0.005	0.006
16	Nickel (as Ni)	%	<0.001	<0.001	<0.001
17	PCB	%	<0.0001	<0.0001	<0.0001
18	POP	%	<0.0001	<0.0001	<0.0001
19	Hydrocarbon (as HC)	%	<0.00001	<0.00001	<0.00001

Table 6-47: Soil Quality, North Guwahati Ghat

Sl. No	Parameter		Unit	Result		
				Station-1	Station-2	Station-3
1	Bulk Density		g/cc	1.24	1.21	1.19
2	Colour		--	GrayishBrown	GrayishBrown	GrayishBrown
3	Texture	Sand	18.5	16.7	15.6	13.7
4		Clay	66.2	68.9	69.2	72.4
5		Silt	15.3	14.4	15.2	13.9
6	Soil type		%	acidic	acidic	acidic
7	pH Value (1:5 V/V)		%	6.02	5.73	5.98
8	Electrical Conductivity		µS/cm	98.4	101.6	103.9
9	Nitrogen (as N)		%	0.021	0.023	0.025
10	Phosphorus (as P)		%	0.012	0.011	0.012
11	Potassium (as K)		%	0.024	0.02	0.04
12	Arsenic (as As)		%	<0.00001	<0.00001	<0.00001
13	Cadmium (as Cd)		%	<0.001	<0.001	<0.001
14	Mercury (as Hg)		%	<0.00001	<0.00001	<0.00001
15	Lead (as Pb)		%	0.003	0.002	0.004
16	Nickel (as Ni)		%	<0.001	<0.001	<0.001
17	PCB		%	<0.0001	<0.0001	<0.0001
18	POP		%	<0.0001	<0.0001	<0.0001
19	Hydrocarbon (as HC)		%	<0.00001	<0.00001	<0.00001

Table 6-48: Soil Quality, Aphalamukh Ghat

Sl. No	Parameter		Unit	Result		
				Station-1	Station-2	Station-3
1	Bulk Density		g/cc	1.15	1.13	1.08
2	Colour		--	GrayishBrown	GrayishBrown	GrayishBrown
3	Texture	Sand	16.9	14.8	16.6	13.7
4		Clay	68.3	67.4	70.3	72.4
5		Silt	14.8	17.8	13.1	13.9
6	Soil type		%	Acidic	Acidic	Acidic

Sl. No	Parameter	Unit	Result		
7	pH Value (1:5 V/V)	%	6.11	5.89	5.74
8	Electrical Conductivity	µS/cm	101.5	103.9	105.6
9	Nitrogen (as N)	%	0.029	0.027	0.031
10	Phosphorus (as P)	%	0.011	0.009	0.010
11	Potassium (as K)	%	0.025	0.024	0.019
12	Arsenic (as As)	%	<0.00001	<0.00001	<0.00001
13	Cadmium (as Cd)	%	<0.001	<0.001	<0.001
14	Mercury (as Hg)	%	<0.00001	<0.00001	<0.00001
15	Lead (as Pb)	%	0.0031	0.0028	0.0024
16	Nickel (as Ni)	%	<0.001	<0.001	<0.001
17	PCB	%	<0.0001	<0.0001	<0.0001
18	POP	%	<0.0001	<0.0001	<0.0001
19	Hydrocarbon (as HC)	%	<0.00001	<0.00001	<0.00001

It has been observed from the soil analysis results that the soil in all three terminals are acidic and is sandy loam. Clay percentage vary between 67.2% to 72.4%. Heavy metals content in the soil are not significant.

6.12 River Bed Sediment Quality

The riverbed sediment is an integral component of the aquatic ecosystem. The sediment may absorb / adsorbnatural and anthropogenic toxic substances from the water. The sedimentquality influences benthic organisms, vegetative communities, and the aquatic food web. Organisms and plants, particularly those living in the sediment, can get effected. Secondary data on sediment quality from IIT, Guwahati was collected for all three proposed terminals. The samples were collected & analysed at IIT, Guwahati during September, 2015 and is relevant for this study. River based sediment analysis results for wet and dry season are presented in **Table 6-48** and **6-49** respectively.

Table 6-49: Riverbed Sediment Quality – Wet Season

Parameters	Unit	GGG	North Guwahati	Neamati	Aphalamukh	OSPAR[7]
Salinity	%	0.021	0.012	0.060	0.014	-
Mg	%	0.295	0.423	0.852	0.379	-
Ca	%	0.179	0.068	0.088	0.084	-
Na	%	0.010	0.012	0.028	0.018	-
K	%	0.099	0.204	0.612	0.414	-
Organic Carbon (TOC)	%	0.223	0.428	0.459	1.172	-
$PO4^{3-}$	%	0.232	0.246	0.482	0.321	-
NO_3	ppm	8.00	37.96	36.28	10.63	-
As	ppm	0.34	0.31	1.32	1.65	30-80
Cd	ppm	0.13	0.12	0.10	0.11	1.0-2.5
Hg	ppm	BDL	BDL	BDL	BDL	0.6-1.0

[7]OSPAR Guidelinesfor Management of Dredged Material

Parameters	Unit	GGG	North Guwahati	Neamati	Aphalamukh	OSPAR[7]
Pb	ppm	0.12	4.56	10.25	8.36	100-120
Cr	ppm	11.38	24.87	45.02	32.90	150-200
Zn	ppm	12.16	34.95	85.68	64.05	250-500
Ni	ppm	56.19	56.84	79.66	33.83	50-100

Source: Field survey, September- October 2015, Brahmaputra River Sediment Quality, Assam, GU BDL- below Detection Limit (Detection Limit: Hg = 5.0 ppb), IIT, Guwahati

Table 6-50: Riverbed Sediment Quality – Dry Season

Parameters	Unit	GGG	North Guwahati	Aphalamukh	OSPAR[8]
Salinity	%	-	-	0.06	0.06
Mg	%	-	-	-	-
Ca	%	-	-	-	-
Na	%	-	-	-	-
K	%	-	-	-	-
Organic Carbon (TOC)	%	0.32	0.67	0.666	0.32
$PO4^{3-}$	%	0.188	0.245	0.217	0.248
NO3	ppm	5.67	2.23	6.675	0.61
As	ppm	15.04	1.34	0.051	4.227
Cd	ppm	0.00	0.00	0.140	BDL
Hg	ppm	0.041	0.041	BDL	0.020
Pb	ppm	16.0	12.6	10.525	204.63
Cr	ppm	18.9	17.5	23.797	66.01
Zn	ppm	59.2	62.4	51.658	251.22
Ni	ppm	21.0	21.1	35.261	18.015

Source: Field survey, September- October 2015, Brahmaputra River Sediment Quality, Assam, GU BDL- below Detection Limit (Detection Limit: Hg = 5.0 ppb),IIT, Guwahati

From the above analysis, it is concluded that the sediment is non-hazardous and not contaminated.

6.13 Demography

The demographic profile of the Guwahati City is given below-

Table 6-51: Demography of Guwahati City

Demographics	Female	Male	Total	National Avg.
Population	461990	495362	957352	1,210,193,422
Sex Ratio	933			940
Literacy Rate	370238 (80.13%)	423122 (85.41%)	793360 (82.87%)	74%
Religious Composition	Hindu	Muslim	Others	Hindus- 79.8% Muslims-14.2% Others-6%
	815499 (84.44%)	119825 (12.45%)	22028 (3.11%)	

Source: Census 2011

[8]OSPAR Guidelinesfor Management of Dredged Material

The Table shows the demographic details of the Guwahati metropolitan city compared to National averages. Literacy rate, shows a better status compared to National average.SC and ST population percentage as low as 7% and 4% respectively.85% of the population belong to Hindu religion. Further, Guwahati has 39% (about 1.7 lakh) population engaged in either main or marginal works. 59% male and 18% female population are working population. 53% of total male population are main (full time) workers and 5% are marginal (part time) workers. Among women, 13% of them are main workers and 5% are marginal workers.

Gateway Guwahati Ghat (South Bank), is in Ward No 02 of Guwahati Municipal Corporation. The total population of this Ward as per 2011 Census data is 16613 persons with 8780 (53%) men and 7833 (47%) women. Sex ratio is 892 and average Literacy rate is 91%.Literacy rate among women is 80.13%. 38% (6317) of the population are engaged in main or marginal works. Work participation rate of men in the ward is 55% and women is 19% .Among men 47% are engaged as main workers and 8% are marginal workers. Among women 14% are main workers and 5% are marginal workers.

Table 6-52: Demographic Profile of North Guwahati:

	Female	Male	Total	National Avg.
Population	5240	5088	10328	1,210,193,422
Sex Ratio	1030			940
Literacy Rate	90.97%	96.51%	93.68%	74%
Religious Composition	Hindus	Muslims	Others	Hindus- 79.8%
	99.52%	0.15%	0.43%	Muslims-14.2% Others-6%

Source: Census 2011

PIA of Aphalamukh

Four villages viz Garamur Jugipathar, Atoi Chuk, Dakhinpat satra and Borboka pathar falls in the PIA of the Aphalamukh Ghat Ghat. The demographic features of these villages as per Census data 2011 are summarised below:

Table 6-53: Project villages (Aphalamukh Ghat)- Demographic profile as per Census 2011

Particulars	GaramurJugipathar			AtoiChuk			Dakhinpatsatra			Borbokapathar		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total No. of Houses	485			78			805			309		
Population	2248	1164	1084	338	167	171	4031	2078	1953	1444	746	698
Sex ratio			931			1024			940			936
Child (0-6)	287	157	130	35	18	17	513	257	256	146	69	67
Sex ratio(0-6)			828			944			996			971
Schedule Caste	1029	530	499	39	16	23	1216	633	583	0	0	0
Percentage SC	45.77			11.54			30.17			0.00		
Schedule Tribe	378	201	177	0	0	0	625	300	325	0	0	0
Percentage ST	16.81			0			15.50			0		
Literacy	1657	926	731	261	137	124	2807	1611	1196	1045	617	428
Literacy%	73.71	79.55	67.44	77.22	80.12	72.51	69.64	77.53	61.24	72.37	82.71	61.32
Total Workers	823	619	204	98	87	11	1745	1119	626	731	421	310
work Parrticipation%	36.6	27.5	9.1	29.0	25.7	3.3	43.3	27.8	15.5	50.6	29.2	21.5
Main Worker	749	585	164	92	84	8	990	842	148	340	252	88
Mainworkers%	91.0	71.1	19.9	93.9	96.6	8.2	56.7	48.3	8.5	46.5	34.5	12.0
Marginal Worker	74	34	40	6	3	3	755	277	478	391	169	222
margin wks%	8.99	4.13	4.86	6.12	3.06	3.06	43.27	15.87	27.39	53.49	23.12	30.37

6.14 Occupation/ Livelihood Patterns Livelihoods

Guwahati Gateway Ghat, Guwahati

Average work participation among sample families is seen as 53 percent, in which the female workforce participation is limited to 6.4 percent only. The Census data (2011) for Assam state shows a better picture of India, where 14.9 percent of urban women and 23.7 % of rural women are in the workforce. Generally the employment status of women shows an austere picture, as they are not earning even when they work hard and are engaged in unpaid domestic work, which increases their economic dependency on men and hence are considered as lower beings.

Guwahati Municipal corporation area is a busy commercial area and 31 percent of the work force finds their livelihood running small business and 6.4 percent of the workers are employed in Private firms. Government employees represent 4.3 percent and teachers by 2.1 percent as detailed in below.

Table 6-54: Occupational Categories Guwahati Gateway Ghat

Occupational category	Total workers	Percentage	Male workers	Female workers
Agriculture sector	2	1.4	2	0
Fisheries sector	1	0.7	1	0
Small business	44	31.2	38	6
Ferry men from village	1	0.7	1	0
Technical workers	2	1.4	2	0
Govt employees (general)	6	4.3	6	0
Private firms	9	6.4	9	0
Teachers	3	2.1	1	2
Professional(Drs, Eng, Sr officers)	1	0.7	1	0
Artisans	0	0	0	0
Retired persons	3	2.1	3	0
Labourers	3	2.1	2	1
Factory workers	0	0	0	0
Total	75	53.2	65	9
Percentage	53.2		46.8	6.4

Marginal representation can be seen in agriculture, fisheries, ferry service, technicians, labourers, and as Professionals, besides few retired persons.

Economic sector composition of the district

The economy of the project district is mainly dependent on agricultural and industrial sector. More than half of its population are engaged in agriculture in order to earn their livelihood. The chief agricultural products in the district are wheat, paddy, coconut, sugarcane, orange, pineapple, lemon, coconut, etc. Every year a huge portion of the revenue comes from the agricultural products in the district. Guwahati refinery and two major tea plantations in the district further alleviates its economy.

North Guwahati-

Occupational pattern of the sample families shows that 40% of the families are engaged in small business, 18% working in private firms, 13% are labourers, 8% engaged in agriculture sector, 7% are technicians, 5% teachers,4% Government employees etc. . Among the work force 79% are men workers and only 21% are women workers, which further contributes to the lower status of women. Table No 3.3.1.4 and Fig No 3.11 clarifies this status.

Table 6-55: Occupational Categories North Guwahati Ghat

Occupational categories	Male	Female	Total	Percentage
Agriculture sector	12	1	13	8
Fisheries sector	0	0	0	0
Doing small business	59	7	66	40
Ferry men	2	0	2	1
Technical workers	11	0	11	7
Govt employees (general)	5	2	7	4
Private firms	14	15	29	18
Teachers	4	4	8	5
Professional(drs, Eng, Senior officials)	3	0	3	2
Artisans	0	0	0	0
Retired persons	3	1	4	2
Construction workers	0	0	0	0
Labourers	18	3	21	13
Factory workers	0	0	0	0
Total	131	33	164	100
Percentage	79	21		

Among the non-working categories 19.3% are children and students below 18 years (12+59 nos.) and remaining are women categorised under house wives without employment.

Major Livelihoods of the Area

The Centre for North East Studies and Policy Research (C-NES) undertook extensive field level surveys in 2005-06 to assess the potential of alternative livelihood for the people inhabiting the banks of the river. From the livelihood patterns of communities in the research it was observed that the basic livelihood pattern in all the areas was subsistent in nature. Except for a few specialized skilled professions, all the communities had agricultural practices as the major livelihood activity. Dairying in fact has been observed as the main stay for the people. The animals are allowed to graze in the open except during the flood period when the animals are temporarily shifted to higher elevations and roads. The villages near to the River are suitable places for animal rearing due to the availability of sufficient fodder. The milk production centres in Kamrup and Kamrup(M) districts occupy a major share in the total milk production in the state.

In the surrounding portion of the proposed Ghats there is no animal grazing or fishing activity done and hence there won't be any impact on such livelihoods during the time of construction works.

The communities at the north bank use the river for various purposes such as for travel, fishing, and as boat operators. There are a few important places of worship, putting North Guwahati in the tourism map. The local vendors at the temples, the priest as well as the private auto rickshaws derive income from the tourists and the deities.

Aphalamukh

Employable category above 18years comprises 588 persons among the total population of 856 persons and the work participation rate among them is 45 percent. When the work participation of women are analysed, it could be seen that only 3 percent women are working and remaining 42% are men. Details are furnished in Table No 6.54**.** The livelihood sectors include mainly 3 areas viz. Agriculture sector (12%), Small business/petty shops (12%) and construction labourers (13%). Majority of women in the villages were seen to be engaged in small works like making pottery,

agricultural activities, garment making, making pickles, drying fish etc, but none of these works are considered as meaningful employment earning for a livelihood and hence they all continue to be dependents and unemployed.

Table 6-56: Occupational Status of Families (Aphalamukh)

Occupational status	Male workers	Female workers	Total workers	Total workers %
Working in agriculture sector	71	0	71	12
Working in fisheries sector	2	0	2	0
Doing small business	65	6	71	12
Ferry men from village	0	1	1	0
Technical workers	8	0	8	1
Govt employees (general)	5	1	6	1
Working in Private firms	14	4	18	3
Teachers	0	2	2	0
Professional(drs, Eng, Senior officials)	0	0	0	0
Artisans	1	0	1	0
Retired persons	3	0	3	1
Construction workers	79	0	79	13
Total	248	14	262	45%
Percentage	42	3	45	

Major Livelihoods of the villages
Major livelihood of these villages includes: 1) Agriculture,2) Horticulture,3) Livestock,4) Fisheries 5) Traditional works which includes boat making and pottery 6) Household business. 7) Forest produce collection etc. Rice, vegetable and mustard were found to be the main produce cultivated in the village. They sell their produce in the nearby market at Rawna Para. Most of the families have livestock and poultry in their home, which is contributing to their food and income. (*Source-International Journal of Interdisciplinary and Multidisciplinary Studies (IJIMS), 2017, Vol 4, No.3,91-96. 91*)

6.15 Health Facilties

GGG Ghat (South Bank): It is located in the heart of the Guwahati which is the capital city of Assam. There are numbers of government & private hospitals including government medical college. Mahendra Narayan Choudhury Hospital is located just opposite side of the road adjacent to the Guwahati Gateway Ghat. It is one of the oldest hospitals with all modern health care facilities. Guwahati Medical College Hospital is in 5km distance from the project location. Proposed AIIMS (All India Institute of Medical Sciences), Guwahati is at 25 km distance by road from the project location. People from different part of the state and other north eastern states of India come for better health care facilities to Guwahati. People from the North Bank of the Brahmaputra River are dependent of IWT services to reach those health care facilities.

North Guwahati: There are numbers few government hospitals and private hospitals including Naryana Hridayalya Hospitals, GNRC, North Guwahati etc. However, people from North Guwahati are highly dependent on IWT services to reach Guwahati for better health care facilities. Proposed AIIMS (All India Institute of Medical Sciences), Guwahati is at approximately 10 km distance by road from the project location.

Aphalamukh: Aphalamukh falls under Majuli district of Assam. There is a Sadar Government hospital in the district along with numbers of primary health care centres. But people from this area mainly dependent on IWT ferry services for better health care facilities at Jorhat town which is located in the opposite bank of the river Brahamputra. There are few ambulance ferry services to carry patients from Aphalamukh area to the Neamati Ghat in the other Bank. The Jorhat town is located approximately at 10km distance from the Neamati Ghat. Jorhat town has numbers of government hospitals including a government medical college and numbers of private sector hospitals.

6.16 Infrastructure (Transportation, Industries, Educational Institutes)

GGG Ghat (South Bank): This area is well connected through road, waterways, railways and airways. Guwahati Railway station is at 1.5 km distance from the GGG Ghat and the Guwahati International Airport is located at 21km distance from the project location.

Guwahati city is hub of industries and educational facilities for the state of Assam as well as for the North Eastern part of India due to its well-connected transport network. There are numbers of designated industrial belt in the city. Fancy Bazar which is just opposite to the GG Ghat is major commercial centre of Assam.

There are numbers of universities, colleges both in government & private sectors in the city to nurture academic need of the entire region in all sectors including basic science, arts, medical science, engineering and other vocational courses. Cotton College University is the premier institute of the region established on 1901 is located at 1km distance from the project site. Guwahati University and Assam Engineering college are located at a distance of approximately 8km from the GGG Ghat. Indian Institute of Technology (IIT) is located at north bank of the River Brahmaputra which can be reached through IWT ferry services in 15 minutes time.

North Guwahati: This area is well connected through road & waterways. However, the people from this area dependent upon waterways and road transport to reach railway stations and Airport in Guwahati.

North Guwahati area has numbers of designated industrial belt where numbers of premier private & public sector companies have established its production unit including Indian Oil Corporation (IOC) LPG Bottling Plant.

The area has numbers of government & private schools and colleges but the people of North Guwahati are dependent on Guwahati city for higher education. However, Indian Institute of Technology (IIT), Guwahati is located at greater North Guwahati area which is an national level premier technical institute.

Aphalamukh: Inland Water transport is the lifeline of transportation for this project area to connect with rest of the state via south Bank since most of the major cities and town are connected through Jorhat via Neamati Ghat from the Aphalamukh. Jorhat town is well-connected though roadways, railways and airways. However, recently the road- connectivity through Lakhimpur is under practice through the North Bank of Majuli. People can reach to the Dibrugarh city through Lakhimpur via Bogibeel Bridge over Brahmaputra River.

There is no major industries in the area. However, the area is famous for its production of local handloom & handicraft items. There are few school and colleges in the area but for higher educational facilities, people from this area is dependent on Jorhat town.

6.17 Public Utilities in the Area

Sewerage System of Area

Guwahati is battling several water contamination related woes thereby polluting the lifeline of Assam - the Brahmaputra River - on a regular basis. This is mainly due to lack of a scientific sewage treatment plant in the city. The city has a network of natural drainage system that carries the sewage of the entire city which ultimately falls untreated at two points – Bharalumukh and Chandrapur – on the Brahmaputra River. One such natural drain is the Bahini River that originates in Meghalaya's Khasi Hills, enters Guwahati on its south-eastern side and flows through densely populated areas like Basistha, Rukminigaon, Mathura Nagar, Dispur, Ganeshguri and along the RG Baruah Road and then meets a major water channel near the state zoo becoming the Bharalu River and joining the River Brahmaputra at Bharalumukh which is approximately 500m downstream of the GGG Ghat.

Recently, the Government of India has approved the Japan International Cooperation Agency (JICA)-assisted Rs 1,178.75 Crores Guwahati sewerage project. The proposed project objective is to provide reliable sewerage services by carrying out construction of sewerage facilities and an extensive network of sewers in South & East Guwahati, thereby considerably improving sanitation and living conditions of people in Guwahati City.

Similarly, there is no proper sewerage system in North Guwahati & Aphalamukh area. The existing network of natural drainage system carries the sewage from this area and ultimately fall untreated to the River Brahmaputra.

All type of solid waste disposal sites in Area

The GGG Ghat falls under Guwahati Municipality Corporation (GMC). GMC looks after the Solid Waste Management activities within its jurisdiction. The collection of house-to-house solid waste from the households and commercial establishments comes under Primary Collection. GMC is divided into 31 wards and there is one NGO each assigned for the job of Primary Collection and Street Sweeping within the respective ward. The NGOs deposit the waste so collected to the nearby secondary collection bins. Guwahati City generates 550 TPD (approx.) solid wastes. The Secondary Collection and Transportation (C&T) is being handled by a fleet of modern compactors, tippers, etc by GMC. The compost plant in Boragaon, Guwahati was commissioned in the year 2010 which uses the Wind Row Composting Technology with the installation capacity of 50 TPD. Presently it produces a 5 TPD of compost daily. The compost plant has been proposed to be augmented from 50 TPD to 200 TPD soon.

At present there is no dedicated solid waste disposal mechanism in North Guwahati & Aphalamukh being located in the rural areas. People use their own system to burry, land-filling process to manage solid waste generated in both these places.

6.18 Cultural Heritage and Archaeological Sites

Kamakhya Temple, Umananda Temple, Navagraha Temple are some of the major cultural heritage and archaeological Sites near GGG Ghat, Guwahati. Umananda temple is nearest to the GGG Ghat. It is the smallest river island located approximately 500m upstream of the project in the River Brahmaputra. Kamakhya Temple is a Hindu temple dedicated to the mighty goddess Kamakhya and is nestled at the top of the Nilachal Hill by the river Brahmaputra. This is one of the most important pilgrimage destination in the city of Guwahati. The temple is nearly 5 kms from the project site. Dol- Govinda Temple is the major cultural heritage site in North Guwahati.

Majuli has been the cultural capital and the cradle of Assamese civilization for the past five hundred years despite the regular devastation, Majuli continues to be home to people and cultures that are quite unique. Being the land of Vaishnavite monasteries and isolated from the mainland urban society, Majuli forms a distinct geographical, social and cultural entity with a peculiar value system. Island has been the hub of Assam Neo Vaishnavite culture since the 15th century, for

which the foundation was laid by Srimanta Shankaradeva and his student Madhadeva. Many monasteries (Satras) were constructed out of them few are still surviving and preserving the colorful culture. These Satras have preserved the dance form, mask making and boat making, and regularly organizes the festivals where almost all people of Majuli are involved in something or the other.

6.19 Major Festivals

Bihu is the major festival of Assam celebrated three times of the year, namely- Rongali Bihu, Bhogali Bihu & Kongali Bihu. This festival is symbolically linked to the cultivation of rice which is the staple food of the state. Rongali Bihu is celebrated in the month of April during the beginning to cultivate rice followed by Kongali Bihu during which rice get matured in the Month of October & Bhogali Bihu in the month of January after the harvesting of rice.

Durga Puja, Raas festival, Diwali, Holi are some other major festivals in the state. Majuli is famous for the “Raas Festival’ during the month of November- December.

6.20 Tourism

River Brahmaputra is famous for river tourism in the state. Apart from this there are some major national park including Kaziranga, Manas, Nameri, Dibru-Saikhowa & Orang National Parks which attract tourist from different parts of India & world. Kamakhya Temple & Umananda Temple are two major tourist destination in Guwahati. Majuli the river island is also an important tourist attraction for its Satra culture which includes Vaishnavite monasteries.

6.21 Spiritual & Other Practices Associated with Waterways of Local

River Brahmaputra is spiritually linked to a large section of people from the region. Hindu mythology symbolizes the Brahmaputra as a Holy River. In the ‘Ashokasthami’ during the month of April, people take holy bath in the river. ‘Chath Puja’ is celebrated in for two days in the river during the month of December.

Chapter 7 : Assessment of Impacts and Mitigation Measures

7.1 Introduction

This chapter describes the environmental impacts that are likely to result from the project activities. The interaction between various project components and environmental elements are being analysed to identify and evaluate impacts. Mitigation measures proposed to be taken to minimize environmental impacts are also discussed. EMF Guideline prepared for the project was referred. Public consultations and observations during field survey of the project sites were important inputs and incorporated in the mitigation measures.

7.2 Environmental Impact Screening

Site visits were conducted to understand the environmental features of the project sites (Proposed passenger terminals at Gateway Guwahati Ghat, North Guwahati Ghat and AphalamukhGhat on river Brhmaputra). Major environmental and social factors were identified as per WB guideline. Major environmental factors, identified are as follows:

- Change in Land use and drainage pattern
- Change in channel hydraulics, and siltation either in-situ or elsewhere along the course of the river
- Impact due to inadequate solid and liquid waste disposal
- Inadequate sanitation, health and safety facilities
- Impact on air Quality due to emission during construction and operational phase of implementation
- Impact on river water quality due to proposed activities
- Impact on noise level
- Impact on environmental aesthetics and cultural values
- Impact on Biological Environment

However on completion of the environmental impact assessment and on he basis of final feasibility report, it has been observed that there will be no change in drainage pattern & channel hydraulics due to the project activites.

Social Factors:

- Land availability/requirement;
- Loss of structures
- Loss of livelihood
- Socio- economic

Annexure 7-1 outlines basic generic construction management Environmental Codes of Practice (ECoPs) which are expected to be broadly applicable to the proposed works, and would be appropriately adapted. Impact assessment and mitigation measures along with management plan are carried out for all the project components.

7.3 Valued Environmental Components

Valued or critical environmental components (VECs) are defined as fundamental elements of the physical, biological or socio-economic environment, including physical features, habitats, wildlife populations (e.g., biodiversity etc) that may be affected by the proposed project.

VECs are environmental and social attributes that are considered to be important in assessing impacts. VECs, identified for this project are climate, aquatic ecology, impact on sensitive species namely Dolphins and Turtles, Water quality, Terrestrial flora (cutting of trees at intervention sites),

Avifauna, ambient noise levels and air quality, dredging etc. Each project activity is analysed for its probable impact on environment and the same is comprehensively assessed.

7.4 Impact Identification

Impacts depend on the nature of the activities to be undertakenat different stages of project implementation viz. design/pre-construction, construction & operation. The following three major activities involved in the project have impacts on environment at different stages

- Construction and operation of civil interventions,
- Maintenance dredging and
- Operation of vessels.

These three activities may not have the same impacts. An interaction matrix has been developed with major project activities and consequent environmental impacts. The same is presented in **Table 7-1**.

Table 7-1: Interaction Matrix of Major Project Activities and Env. Impacts

Environmental Components	Dredging	Pre-Construction/ Construction	Operations
Climate	No	No	No
Micro-climate	Yes	Yes	Yes
Aquatic Ecology	Yes	Yes	Yes
Dolphins & Turtles	Yes	No	No
Water Flow	Yes	No	Yes
Water Quality	Yes	Yes	Yes
Terrestrial Flora / Cutting of Trees	No	Yes	Yes
Avifauna	Yes	Yes	Yes
Ambient Noise Levels	Yes	Yes	No
Air Quality	Yes	Yes	Yes
Land use	No	Yes	No
Water resources	No	Yes	Yes
Social Factors (			

This section identifies the impacts which these three activities will have on these critical environmental parameters. Thereafter, cost-effective but appropriate mitigation measures are proposed to mitigate the impacts and bring the residual impacts within acceptable thresholds. An EMP has been designed to ensure the effective implementation of proposed mitigation measures.

Impacts have been assessed for all the project activities in entire project life cycle for physical, biological and social environmental components. Brief on the various components of the proposed project on which EIA study has been undertaken are discussed.

7.5 Impact due to Maintenance Dredging of channels

The channel depths are expected to vary with seasons and over time as per river morphology. Therefore, periodical dredging to be undertaken to retain the least navigable depth. As dredging activity may lead to a number of impacts on environmental and social aspects, it becomes necessary to adopt the best practice and equipment so that least impact will be envisaged.

Dredging activities may cause negative impacts due to generation of high sediment flows, disturbance of benthic habitat, noise and emission from construction machinery, accidental oil spillage.

Various stages of dredging and potential impacts are summarizing below:

1. Excavation - Excavation is the process of physical removal of the material from river bed. This will be done either hydraulically or mechanically by dredger head. The physical changes take place during excavation are the generation of suspended sediments causing an increase in turbidity, destruction of benthic environment and change in river morphology.
2. Lifting - Lifting is the vertical transportation of the excavated material from the bed. linked to excavation. The physical changes that occur during lifting are the release of suspended sediments during loading.
3. Transportation - Transportation is the process of transferring the excavated material to the designated location. This is done hydraulically through pipeline. The potential impact during transportation is spillage.
4. Management of dredged materials. The dredged materials are to be stored/utilise.

   For construction or low-lying area filling

7.5.1 Dredger types and selection

Selection of proper dredgers is important because of their environmental implications.Typically, Cutter Section Dredgers (CSDs) andTrailing Section Hopper Dredgers (TSHDs) have least effect on turbidity at the dredging site.Grab Dredgers (GD) and Back hoe Dredgers (TSGDs) produce significantly high turbidity near the dredging site in comparison to CSD.

CSDs and TSHDs fluidise the sediments by mixing them with water and pump the sediment. To a designatedlocation. Comparative analysis of types of dredger and their relative performance related to environmental aspects is given in **Table 7-2** and **7-3**.

Table 7-2: Comparative Analysis of Dredgers and Their Environmental Aspects

Type of Dredger	Safety	Accuracy	Turbidity	Mixing	Spill	Dilution	Noise
Suction dredger	+	-	+	-	-	0	+
CSDs	+	+	0/+	0/+	0	0	+
TSHD	+/0	-	-/0	-	0	-	+
Bucket Ladder Dredger	-	+	-/0	0/+	+	+	-
Backhoe Dredger	-	+	-/0	+	+	+	+
Grab Dredger	-	-	-/0	0	+	+	+

+ is better than average, 0 is average and – is below average

Table 7-3: Comparative Analysis of Different Type of Dredgers Related to Environmental Aspects

Attributes	CSD	Hopper Dredgers	Grab / Bucket Dredger	Back hoe Dredger
Type	Hydraulic	Hydraulic	Mechanical	Mechanical
Strata	All type-soil, sandy, silty androcky	Silty and gravel	Silty, gravel, mudand soft rock	Clay & Gravel
Usage	Inland waters	Coastal areas	Coastal waters and inland waters	Shallow waters and confined places

Attributes	CSD	Hopper Dredgers	Grab / Bucket Dredger	Back hoe Dredger
UnderwaterNoise levels at 1m-underwater	172-185 d B	186-188 dB	Less	186-188 dB
Ambient Air Noise LeveldB(A)	100-115dB (A)	100-112dB (A)	115dB (A)	110-118 dB(A)
Suspended Sediment Generationduring dredging(kg/cum)[9]-	Ordinary 4,000 PS1/- 2.2 – 4.5 Ordinary 2,000 PS-0.1 – 0.3	2.4-5.2	0.4-5	--
Suspended SedimentGenerationduringplacementofdredgedmaterial (kg/cum)[10]-	Ordinary 4,000 PS1/- 1.2 – 1.4 Ordinary 2,000 PS-NA	12-203	NA	--

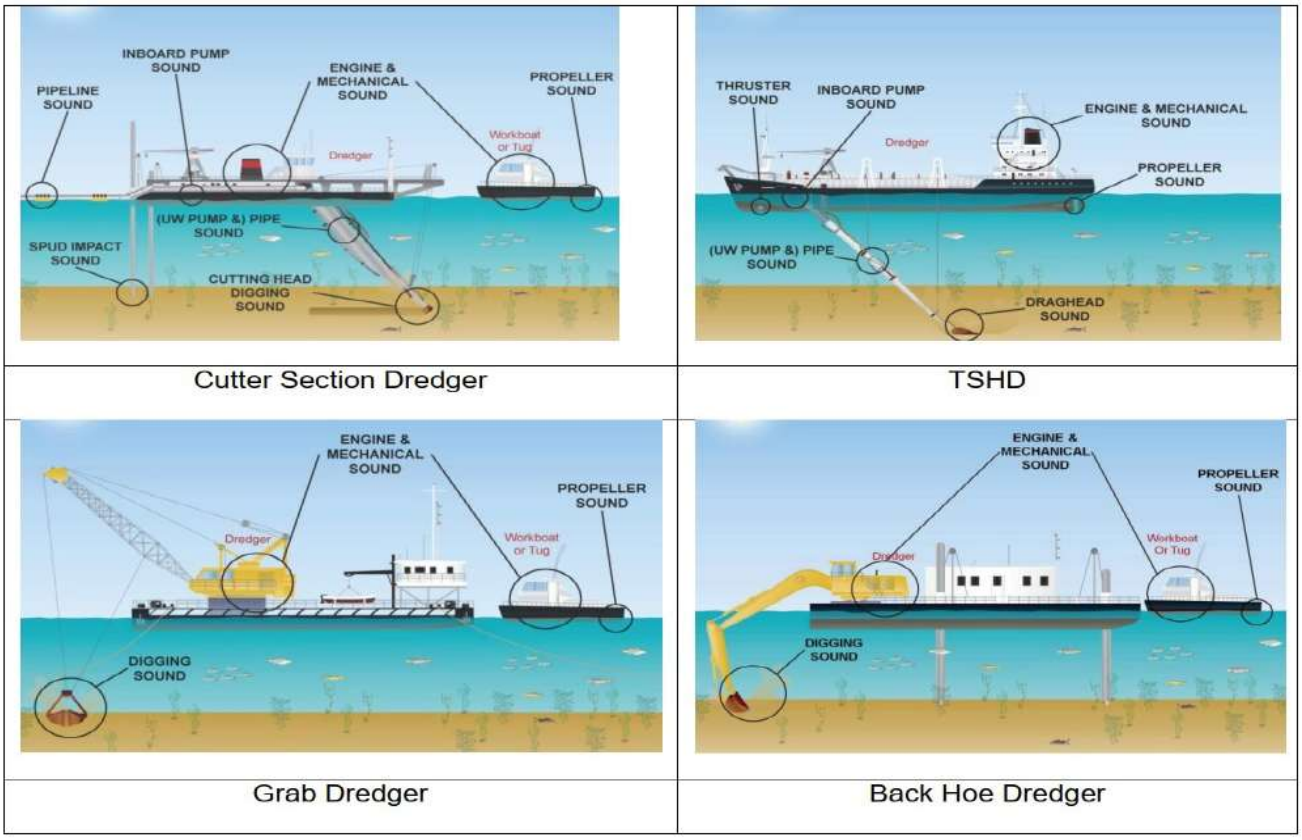


Figure 7-1: Diagrammatic Presentation of Different Type of Dredgers Showing Different Noise Source

The CSD is considered as most preferred option due to least associated environmental Impact and operational feasibility. As per experience, CSD has proved to be the best option and is considered for maintenance dredging planning. CSD (cutter section dredgers) is a hydraulic based system, consists of a centrifugal pump and the suction tube that has cutting mechanism (rotary blade) at the end. The main technique is applied in dredging is that loosening the sand and cutting are done simultaneously, and the dredged material is sucked by the dredging pump and transported through a pipeline.

[9] *Assessment of the Environmental Impact of Port Development, United Nations, New York, 1992*
[10] *Assessment of the Environmental Impact of Port Development, United Nations, New York, 1992*

Disposal of Dredged materials

Disposal of dredged materials can be off-shore or on-shore. Both the type of disposal has its own associated environment and social impacts. Comparative analysis of both the method of disposal is given below in **Table 7-4**.

Table 7-4: Comparative Analysis of Dumping of Dredged Material

Sl. No.	Considerations	Off-shore Dumping	On-shore Dumping
1	Aquatic ecology	Threat to the benthic community due to smothering, impact on habitat of water birds and other aquatic species especially during breeding & spawning seasons.	Comparatively lesser direct impact but requires large no. of vesselmovement for disposal of dredged material on land which again impact the aquatic life
2	Impact on land	Nil	Requires large area of waste land which can be used for disposal of the dredged spoil
3	Water Pollution	Release of sediments while placement operation. No overflowexpected as CSDs are being used	Ground water pollution anticipated, in case sediments are toxic and stored in unlined/unpaved pits
4	Cost	Less	More
5	Photograph of disposal through CSDs		

It is recommended that only off-shore (within River) disposal of dredged materials should be undertaken. This dredged material should be disposed to land in control manner only when the dredged spoil is toxic or contaminant.

7.5.2 Impact due to dredging activities

Dredging is required for the navigation, jetty construction at the proposed terminal and berths. Dredging at these locations would release fine sediments, which would eventually be dispersed before depositing either temporarily or permanently on the river bed. Periodical maintenance dredging requirementsto maintain the water depth.

7.5.2.1 Impacts on Aquatic Ecology

Impact on aquatic ecology is assessed as given in the following section:

A. Changes in Diversity of Benthic Habitat:

During dredging,the range of flora and fauna in the river bed sediments are likely to be adversely affected. The sediment organisms are dredged and removed along with the sediments, may even cause mortality of benthic organisms. However, re-colonizationof habitats after dredging may take some time though the benthic organisms are essential components for river health as being ingredients of the aquatic food chain. Faster recoveries have been observed in finer sizes sediments and of less saline character.

It may be pertinent to point out that the habitat loss caused may not have significant on the river ecology because the maintenance dredging is confined to maintaining least available depth of the Brahmaputra River. Dredging activity will not have significant impact on the larger aquatic animals such as fishes, dolphins, turtles etc.These organisms normally move away from the dredging spots because of the disturbances. Mortality of these aquatic species due to dredging is not anticipated. It also facilitates the movement of these aquatic species as enough space is available to avoid any injury from vessel movements.

7.5.2.2 Air Pollution

Combustion of fuel oil in dredging equipment release air pollutants into the atmosphere. These contaminants impact local air quality and temporary in nature. Since existing air quality is well below the standard, no significant impact is envisaged. Moreover, the dredged materials will be in wet condition, therefore fugitive dust emission is ruled out.

7.5.2.3 Noise pollution

Noise during dredging operations may disturb the aquatic life. Behavioural disturbance criteria for Dolphins & turtles from any continuous noise exposures are 177 dB and 150 dB respectively. However, noise generation during dredging operations is of order of 160-180 dB for CSD category of dredgers. As per U.S. Fish and Wildlife Service (USFWS), sensitivity level for injury in fishes is 186 dB for fish size of >2gm and 183 dB for <2gm. Thus, the dredging operations noise will not cause any injury to the fishes. Also it is likely that fishes and aquatic fauna will move away from the source of disturbance.Since, the dredging activity is for a limited period, the aquatic fauna will come back after the disturbance is over.

The standards and criteria for Off-shore and On-Shore Disposal of Dredged Material are presented in **Annexure 7-2**. **Annexure 7-3** is for Estimated Suspended Sediments Generation Standards from Dredging and Dumping operations. No specific standards are defined in India for disposal of dredged material. If dredged material is toxic / harmful then these sediments should either be disposed off in landfill or in River. No specific standards are defined in Indiafor disposal of dredged material. If dredged material is toxic / harmful then these sediments shouldeither be disposed off in landfill or in Water body.

Mitigation Measures

- Dredging plan including timeframe to be prepared for each stretch before initiating dredging activity;
- Dredging operations will not be carried out during the breeding and spawning season of the valued aquatic species which is from June to August (Monsoon season);
- Dredging if required to be taken at critical stretches (Turtle and Dolphin sensitive areas) then dredgers would be provided with turtle and Dolphin deflectors.
- Measures like bubble curtains or agitation water will be carried out prior to carrying out dredging operations so as to drive away the aquatic fauna. Bubble Curtain also proved to be potential sediment management control tool.
- Contractors need to submit SOPs and action time chart with risk management plan prior to any dredging work. Dredging sub-contractor should follow the defined safety procedures to avoid accidents and spills, and AIWTDS will ensure that other vessel users are provided with adequate information and instruction to avoid conflict with the dredgers.

As per the secondary data, riverbed materials are not found to be contaminated. Hence, AIWTDS decided that all the dredged materials shall be disposed off-shore based on the secondary data on chemical quality of the riverbed.

7.6 Impact and Mitigation Measures-Construction Stage

Impacts on various environmental components during construction activities are identified and mitigation measures are suggested so that impact can be minimised.

7.6.1 Meteorology and Climate

The project construction work will be taken up so that the existing trees will be conserved and cutting of existing trees will be avoided.This will be also considered during designing of lay out. Further the project involves only reconstruction of terminals. The storage of construction materials and debris from the demolition of structures may occupy some areas in the project influence area and thus may cause some changes in the micro climate. However, this is very nominal and is temporary in nature

Mitigation Measure:

The storage of construction and debris generated from demolition activities shall be stored in a specified location with proper covering. It is preferred if the storage area can be created in an open space so that it does not hinder any kind of traffic movement and shall be at least 50-100m away from the river. Since the construction activities will be for a small area, the impact on climate will be marginal.

Land Use Pattern:

The land around the proposed terminal sites are already under the jurisdiction of IWT and therefore there is no change in land use. However, land use may marginally change if commercial activities will be increasing in the area because of the project development.

7.6.2 Construction Materials

The excavation of quarries and borrow pits, used for obtaining rocks, soil and aggregate materials for the construction passangerterminalsandother construction items proposed under this project will be sourced from outside. Project activities do not include quarrying.Materials such as sand cement, steel rods and other materials would be required during construction..

Mitigation Measures:

The construction materials such as sand, clay, aggregates etc. shall be sourced from the agencies having Environmental Clearance for mining of minor minerals under EIA Notification, 2006. Use of Fly ash-based construction materials will be preferred.

7.6.3 Cultural and Heritage Resources:

Along the ghats there are some cultural resources like temples, mosques. None of the cultural properties will be affected. However, during construction stage some impacts are anticipated like:

- Temporary diversion of access towards cultural resources, temples;
- Safety issues to devotees during the construction stage various construction activities. etc.
- Chances of vibration impact to these cultural resources during the construction work;

Mitigation Measure:

- Adequate diversion signs shall be displayed in the access route for the devotees towards these cultural heritage and temples.
- Warning signs shall be given if there is any large excavation work done or scaffoloing put thereof.
- Night time construction shall be avoided and proper lighting shall be given in the construction areas as well as in the access route of the devotees during the evening/night time to avoid any accidents.

The site of piling work shall be carefully selected to avoid any vibration related impact to these temples/religious structures etc. along the ghat. Vibration damper shall be used to minimize the impact of vibration to cultural resources as felt suitable.

7.6.4 Loss of Structures

The project construction work may require clearance of various structures along the banks. The debris generated from the structures may get disposed into the river.

Mitigation Measure:

Prior to clearance of structures, all the affected persons shall be properly compensated to get relocated at a suitable place (as per the plans given in the SIA report). The debris generated from the structures will be disposed at a suitable location or shall be reused in the sub-base of the road construction work proposed in the project.

7.6.5 Generation of Dust (Air Pollution):

There would not be any crushing activities at the project sitesand hence chances of fugitive emission is negligible. Though the project does not involve huge construction activities, still the activities have the potential for generation of dust during the following activities:

- Demolishing the old structure (buildings and structures);
- Land levelling and ground clearance;
- Movement of vehicles carrying construction materials;
- Construction materials handling (Loading, unloadling, transfer, mixing etc)

Mitigation Measure:

- All construction material transport vehicles will be covered. Storage of raw material and construction debris will be covered with tarpaulin at all construction sites..
- Periodic water sprinkling in all haul site roads.
- Masks and other PPE would be provided to people working in high dusty area.
- Loading and unloading of construction materials will be carried out at designated locations in the respective projects wherein the provisions of water fogging/sprinkling to prevent fugitive dust emission will be practised.
- Construction vehicle, machinery & equipment would be regularly serviced and maintained and the vehicles deployed will have PUC certificate.
- Low sulphur diesel will be used for operating DG sets and various other construction equipment(s)
- Diesel Generating (DG) set(s) will have adequate stack height as per regulations
- LPG will be used as domestic fuel in construction camps instead of wood.
- RMC will be used in concrete work to avoid fugitive dust emission
- Regular water sprinkling on haul roads with tankers will be carried out to supress dust emission.
- Ambient air quality monitoring will be carried out on regular basis to check the level of pollutants and effectiveness of proposed mitigation measures

7.6.6 Sanitation and Waste Generation:

The construction camp for the workers may have issues related with safe drinking water, sanitation and solid waste generation. These if not properly managed may adversely effect then water quality of river.

Mitigation Measure:

Workers will be provided with adequate sanitation and waste management facilities in their construction camps. Makeshift toilets shall be provided in the camps and waste from the toilets shall be connected to the existing man holes of the sewer line so that no waste is discharged to the river.

Waste management activities shall also be undertaken and bio-degerdable and non-biodegradable wastes shall be separately collected and taken to the nearby waste collection point ofGuwhatiMunicipal Corporation for their disposal. The guideline on establishing the construction camp will be followed

7.6.7 Drainage Channel:

There is no such parallel drain running along the ghats and thus chances of disturbance to such channels are negligible during the construction work. There are some lateral drains which are getting discharged from other parts of the city into Brahmaputra. These drains will be not be disturbed during the construction. Small drains connected with the houses along the ghats will be connected to interceptor drains and will be taken to other connecting drains to nearby manhole.

7.6.8 Loss of vegetation and tree cutting:

Clearance of vegetation, bushes is involved in the project but tree cutting will be avoided during the designing of the lay out. Additionally, public parks and landscape with green belt shall be created in the project where ever feasible.. This will improve the vegetation of the project area

7.6.9 Noise pollution

During construction, noise level near the project sites is likely to be increased due to plying of vehicles and earth moving equipments. However, the impact will be localised and short term.

Mitigation Measures

- No construction work will be done during night time. DG with acoustic enclosure and satisfying CPCB guideline will be installed. Barricading (Temporary noise barrier) the construction site to minimize the noiselevel to go outsidewill be provided
- No piling and dredging activity at night time.
- Restriction on Honking at the project site
- Hearing test for the workers prior to deployment at site of high noise areas followed by periodic testing every six months will be carried out.
- Job rotations systems for workers, working in high noise level areas
- Periodic monitoring (monthly level) of noise levels to check the level of pollutants and effectiveness of proposed EMP will be done
- Protection devices (earplugs or earmuffs) will be provided to the workers operating near high noise generating machines.
- Construction equipments and machinerieswill be fitted with silencers and maintained properly.
- All equipment willbe fitted with silencers/noise mufflers and will be properly maintained to minimize its operational noise.
- Noise level will be one of the considerations in equipment selection, which will favour lower noise.

7.6.10 Water Environment

The aquatic ecology is likely to be disturbed due to construction and piling activities along the bank and river bed. However, the impact is mostly confined to the construction sites and localised.

Mitigation Measures

Measureswill be taken to prevent run off to get discharged to river. Wastewater and waste will be properly managed so that the water quality of river is least effected

- Attempt will be made to minimize and optimize the dredging requirements by effective assessment and study of the profiles of the river. This can be achieved by taking following measures
- Increase use of bundling which helps in diverting the flow of river towards the channel and reduces the quantity of dredging
- Low draft vessels should be deployed which will reduce the requirement of dredging
- Dredging will not be carried out during very low flow seasons so as to minimize the dispersion of fine sediments
- Usage of silt or air bubble screens/curtains will be explored to minimize the sediment release during dredging operations.
- To minimize the sediment dispersal during disposal of dredge sediments, it will be place as close to the bed possible preferable at a level of 1m above the bed to minimise the dispersal of sediments.
- Provision will be made of emergency response equipment like floating booms to deal with any emergency of oil spills or leakages.
- Regular servicing and maintenance of dredgers will be taken up so as to prevent any leakage of the dredged material. Leakage detection of the sediment transportation pipe will be carried out regularly to prevent any sediment loss and water pollution at leakage location.
- Domestic Wastewater from the toilets will be treated in septic tank and soak pit.

7.6.11 Repairing & Retrofitting of vessels of IWT:

Impact: The reparing and retrofitting of vessels involve replacement of old machineries with latest one. In the process the waste water is likely to be generated from the washings and contaminated with oil and grease. The waste generated from repairing will be asbestos, ferrous and non ferrous scraps, plastics, packings, oil contaminated cotton, paint waste etc. in addition to this, used engine oil and oily sludge are likely to be generated.

Mitigation Measures:

The following mitigation measures are proposed:

- Wastewater will be passed through oil and grease trap and treated in STP.
- The contaminated waste will be seggregated and kept in separate drums/bins under shed.
- The used oil will be collected in leak proof drums and kept under shed.
- The waste will be categorised as recycleable, incinerable and land disposable.
- Used oil and mettalic waste will be sold to authorised recyclers.
- The incinerable waste such as oil contminated cottons, filters, waste oil sludge, paint waste etc will be disposed of in authorised common incinerator.
- Land disposable waste such as wood, fibers etc will be disposed of in authorised common hazardous waste treatment, storage and disposal facilities (TSDF).

7.7 Impact on Biological Environment

7.7.1 Impacts During Design and Construction Phase: Terrestrial Ecology

Small land area is required for the proposed terminal development. As per the site visit records the there is no trees present on identified land. However, the development of the proposed terminals will require clearing of the vegetation (herbs and grasses) from the identified land. No major wildlife is reported or observed during the visit at the proposed sites. Thus, no impact on wildlife is anticipated during construction phase of the project.

For development of the terminal,proposed land may be excavated and filled which may impact the micro-fauna & flora residing within the soil. Also, riparian fauna/flora is also likely to be affected due to project development but since construction phase is temporary and short term thus it is likely for vegetation to recover after removal of disturbance or completion of construction activities. Thus, the impact anticipated due to project design & construction on terrestrial ecology are low-moderate.

Also during the construction of project, the transportation of heavy vehicle carrying the construction materials will move in the project area. It will generate dust and noise during movement. The dust will be settled on the nearby flora of the roads and adjoining area, and covering the leaf and hence reducing the photosynthetic activity. Noise created due to increased traffic will have impact on the nearby fauna, it may have impact on the nocturnal animals/birds also. However, the intensity of the construction is very less the impact is anticipated to be short term and temporary and will be restricted to construction phase only. Anticipated impacts can be minimized by taking proposed mitigation measures.

There is no critical environment resource present in Aphalamukhghat study area. However in GatewayGuwahati Ghat and North Guwahati ghat, Amchag wildlife sanctuary and DeeporBeel Ramsar site arewithin 10 km area of the proposed terminal. The prposed terminal site itself doesnotfall within eco-sensitive zone of Amchag wildlife sanctuary and Deeporbeel wetland. The ESZ of the sanctuary is located more than 9 km from the site. Hence no impacts are anticipated on flora/fauna of Amchag sanctuary as well as Deeporbeel wet land. There are locations where migratory birds visit – close tothe Deepor Beel site and Majuli. However, these sites are located far away from the proposed terminalsite. Mitigation measures proposed to minimize the anticipated impact on the terrestrial ecology due to proposed project are given below.

Mitigation Measures

- Caution sign shall be placed to prohibithunting of animals
- Construction activities shall be restricted to 6:00 Am-10:00 Pm especially noise generating activities.
- Workers should not use any timber or firewood as fuel for any purpose. LPG should be made available to workers in construction camp.
- No hazardous material or waste shall be disposed in the other land or nearby area as it may harm the animals, if consumed accidently
- Speed limit will be regulated to prevent any accidents of animals. Regular maintenance of the dumper shall be done to prevent leakage of oil to prevent pollution of the soil and impact on fauna and flora dependant on soil.
- Regular Water Sprinkling shall be carried out to minimize dust generation.
- Adequate parking space should be provided within the site for construction vehicle and equipment to avoid any harm to flora of that area due to movement of heavy vehicles.

- Construction activities and vehicle washing should not be undertaken at the river or any other water body or close to the water body
- Site should be barricaded to prevent entry/trespassing of the animal in the site
- Hunting, poaching and harming any animal (wild or domestic)/birds by any worker or project related person should be strictly prohibited and monitored. Provision shall be made for strict penalty for hunting/harming any animal/birds
- No animal (wild or domestic or bird) shall be harmed by any construction worker in any condition at site and nearby areas
- Appropriate protocols and procedures must be prepared for sighting of dolphins and other endangered wildlife species (migratory birds, reptiles etc.) within the vicinity of the dredging site. The objective of the protocols and procedures must be aimed at having no or minimal impacts on the respective wildlife species.
- Noise generating activity should not be undertaken during night time to minimize disturbance to animals/birds. Noise levels should be maintained within the prescribed CPCB limits to the extent possible during the day time.

7.7.1.1 Impacts During Design and Construction Phase*:* Aquatic Ecology

As per the secondary data, Brahmaputra River is home to Dolphins, fishes and other aquatic fauna. Baseline study indicates no permanent habitat of dolphin is reported in study area. Thus, impacts anticipated on these eco-sensitive zones during design & construction phase are minimal. However, construction activities like piling is proposed to be carried out in river stretch along the planned terminals site. The construction activities like Dredging, Manoeuvring at the jetty, construction of Fixed / floating Pier or Jetty Structure, Berthing area, Access bridges and Turning Circles to Access Bridges activities have potential to impact aquatic ecology of the area. Anticipated impacts during construction phase on aquatic ecology for the project are given below:

Impact of Piling Activity due to sound Generation on Aquatic ecology:

Pilling activities will be carried out at few locations for holding the floating pontoon and gangway. For the purpose, dredger will be placed in the River which will occupy some physical space in the River. This space was being used by the biotic components of the river. As a behavioural response, instinctively animals at the first encounter avoid approaching the site of unknown object. This is done using echolocation, olfaction or chemo-reception, if the object is not making any sound. If object / machine starts making sound / noise, then all vertebrates through auditory acoustic sense avoid the area which has disturbing range of sound and hampers to the natural acoustic behaviour and physiology of these vertebrate fauna from fishes to dolphins.

Apart from occupying the physical space, piling activity will generate significant noise. Exposure to low levels of sound for a relatively long period, or exposure to higher levels of sound for shorter periods of time, may result in auditory tissue damage in fish, though recovery is generally possible within 24 hrs (Popper et al. 2005). However, the piling activity in the terminal sites will be for a short duration and the biotic conditions of the area will normalize after the activity is completed.

Mitigation Measures:

- The area in which the piling is planned, advisable to carefully determine drop sites before anchor placement to ensure that Dolphin and fish communities that could locally still be present in the area are not unnecessarily damaged.
- Before starting piling allow some time to aquatic fauna to displace from the piling area. Bubble curtains can be provided at the time of piling to displace the aquatic fauna prior start of construction activities

- Fish exclusion devises shall be installed in water column around the pile driving area to prevent fish access
- The piling activities must be carried out in shortest possible timeframe as possible
- All the debris should be disposed away from river course as per debris management plan of the project (**Annexure 7-4**).
- Decisions on method of construction and type of technology and equipment to be used must consider the noise and vibration levels and extent of siltation being generated. Noise and vibration levels must be far below levels that can cause injury to dolphins and other wildlife.
- Noise reducing devices like mufflers, enclosures shall be fitted with the equipment as much as feasible. Noise barriers shall also be installed
- Geo Textile synthetic sheet curtain & turbidity traps shall be placed around piling and construction area to prevent movement of sediments and construction waste

Impact due to release of sediments Piling, dredging and other construction**:**

The riparian area soil is loose and sticky/clayey. Release of these sediments would cause high increase in turbidity of water due to bank protection work and other constriction work close to water area. Such soil has a tendency of sticking over the skin and gills and blocking the pores and is hence harmful. Suspended sediment due to piling operations in the water column blocks available light for photosynthesis, reducing benthic primary productivity and inhibiting the ability of benthic plants to recover from dredging impacts. But the effect of suspended sediments and turbidity in open environment like river are generally short term (<1 week after activity).

Construction activities to be undertaken involves storage of raw material, debris, fuel, paints etc. There are likely chances that, the run-off from the site may get contaminated with these materials and when it will enter the water body may also degrade the water quality of the river.

Mitigation Measures:

- To avoid the construction debris, wash or blown into the water the area shall be surrounded by silt screens, which must be placed in the water before the work starts. Geo-Textile synthetic sheet curtain can act silt screen which should be placed around piling and construction area to prevent movement of sediments and construction waste. The screens should also be placed around storage areas, to prevent waste from blowing away and to prevent sediment run-off into the river.
- In addition to silt screens, storage areas for sand and soil, and all work areas, must be located at least 20 meters away from river. Construction equipment must not be cleaned or washed within 50 meters of the river.
- Piling activities should be carried out rapidly. Piling should not be carried out during breeding and spawning season means during rainy season. It should be carried out in low water season, i.e. pre-monsoon.
- Piling should be stopped for some time, if any dolphin/RET species is sighted in activity area.
- Equipment shall be maintained in good condition to prevent noise, leaks or spills of potentially hazardous materials like hydraulic fluid, diesel, gasoline and other petroleum products
- Excavation activities onshore should not be undertaken during monsoon season to minimize sediment load of run-off

- Workers should be trained to handle the equipment and material at site to minimize the spillage of materials and contamination of water.
- All workers should be made aware of not throwing any waste in the river or any drain.
- No construction debris/ already accumulated solid waste at site or waste generated from labour camp should be thrown in river or any drain
- Sewage generated from labour camp should not be directed into river but should be disposed through septic tank/soak pit.
- Run-off from site should pass through oil/grease traps and sedimentation tank prior discharging into the river.
- All construction and operation equipment shall be maintained in good condition shall be checked for oil & grease leakage.
- Dredged soil should not be disposed in river or its banks especially during breeding spawning seasons of aquatic organisms
- Aquatic ecology monitoring should be carried out prior to start of construction and after completion of construction to assess the impact of construction activities on aquatic life.
- All construction and operation equipment shall be maintained in good condition shall be checked for oil & grease leakage

7.7.2 Impacts on Dolphin:

Based on the outcome of primary survey and secondary information, it has been established that dolphins are spotted at the project sites. As dolphins are present in whole of Bramhaputra river, their movement and surfacing behavior for breathing are reported in specific areas.

Dolphins are reported at the siteswhere fishes are maximum available at the confluence sites and where counter current exists, which make them easier to catch prey. Dolphins prefer to stay where water depth is more with counter current.

Adequate care shall be taken towards ensuring that the debris and other silt and construction materials are not disposed directly to the river and adversely affect the dolphins.

7.8 Environmental Impact and Mitigation Measures-Operation Stage

7.8.1 Environmental Impact:

Meteorology and Climate:

The project involves only development of passangerteminals and introduction of fleet of new vessels. The project components are state of art technology and environmentally friendly. Therefore, the probability of change in macro and micro climate is very less. Tree felling will be minimum in this project. The development will improve the microclimate of project sites.

7.8.2 Land Use Pattern

After completion of the project, the commercial importance of the area will increase. It is expected that more shops will come up in the area. However, these have socio-economic benefit for the people.The project development is likely to induce growth in the area and increase more land requirement for residential and commercial purposes.

7.8.3 Physiography and Drainage:

The proposed development activities for the project involve development of existing terminals with necessary infrastructures and amenities including river bank stability. As such there is no such change in drainage pattern of the area. However, a localized change in flow may be observed immediately after completion of the project construction.

Mitigation Measure:

The chances of increase of river flow speed are localized as edge restoration and embankment protection will be taken up. This will reduce the localized water speed and thereby would minimize the chances of erosion.

7.8.4 Water Environment

It is envisaged that with the development of the project there would be increase in passenger volume along the terminals and hence probability of pollution of river water is expected (mainly solid and liquid waste and sanitation issues). Further during the various religious festivals,disposal of waste materials may pollute the water course. In addition, the discharges from vessel, oil spill and garbage handling are the possible sources of water pollution. Periodical maintenance dredging of channels may also affect the water quality.Maintenance of vessels will also generate wastewater.

Mitigation Measures:

Mitigation measures proposed are as follows:

- Sewage from the public convenience facilities will be treated in septic tank/STP constructed at the terminal.
- Wastewater from vessels will be evacuated through flexible pipes and treated in STP and under no circumstances, it will be allowed to discharge directly to river.
- Treated wastewater will be used for plantation, gardening, toilet flushing etc
- Used oil and waste oil will be collected through spill proof system and collected & stored separately so that it does not get discharged to river.
- Wash water generated from repairing shops shall be treated adequately in STP
- Environmentally sound equipment for dredging will be deployed and proper sediment management practice will be followed
- All waste water and solid waste or maintenance waste will be disposed at the designated vessel maintenance facility only. Till the time such facility is not developed, terminals should have arrangement for reception of the waste and wastewater from vessels so as to prevent its unauthorized disposal in river.
- SOPwill be developed for reception of vessel waste, its storage and treatment and disposalat terminal facilities.
- Further a waste management plan is required to be be followed by vessels. This plan can also indicate the fee to be paid by waste generator. Penalties should be imposed on the vessel operators in case of violation.
- The wastewater from vessels can be sent to STP for treatment and the treated water can be used for landscaping, plantation and dust suppression at terminal sites. Vessels willhave some facilities for treatment of the waste generated on-board like green/bio recycling/chemical toilets. Standards for discharge of wastewater & garbage from vessels as per MARPOL is attached as **Annexure 2-1**.
- Vessel crew/captain should be aware about the waste handling and reception facilities and procedure at terminals and should be in line with above mentioned MARPOL standards.
- Standards will be formulated for vessels for disposalof waste and sewage as per Indian scenario by concerned authorities
- Provision of oil water interceptors with the bilge tank to separate oil prior to discharge of bilge water into river. Bilge water will be discharged as per MARPOL requirements. Bilge water tank should be maintained as per MARPOL requirement. Standards for discharge of oily waste is attached as Annexure 2-1.
- Oil spill control and management plan will be prepared for each terminal facility and for vessel operations in IWT as part of EHS management system of AIWTDS which should be duly communicated to vessel operator. Immediate/quick clean-up of oil/other spills to

prevent damage to aquatic organisms should be undertaken and ship owners should be liable for the same. Facilities should be made to ensure quick response and clean-up operations in case of accidents.

- An oil spill management plan proposed for the IWT by AIWTDS is attached as **Annexure 8-1 to 8-6** and also in Chapter 8.
- Vessels will not be washed or cleaned at terminal/jetty facility and wash waterwill not be dischargedto river. Washing should be undertaken only at the maintenance facility. Standards for discharge of washing water from the vessels carrying noxious chemicals (vessel washing water) as per MARPOL is given in **Annexure 2-1**.
- Incase maintenance facility is not in place then washing can be done at terminal sites also but terminal sites should have proper system for handling the wash water from vessels.
- All wash water should be directed through closed drains to settling tank. Supernatant water willbe tested and if suitable should be sent toSTP for treatment.
- Sludge will be disposed of in municipal waste disposal facility or hazardous waste disposal facility depending on thequality of sludge.

7.8.5 Solid Waste Generation

The projected population in each terminal after the completion of the project is expected to be around 2000/day. The quantum of waste generation could be around 200gm/capita. Hence the total waste generation from three terminals would be around 1.2T/Day

Mitigation Measures:

Adequately sized colour coded dust bins shall be provided at strategic locations for collection of segregated waste. Intermittent storage facility will also be a part of infrastructure development.

A detailed environmental awareness program on waste disposal has been proposed with the involvement of local schools, ferry operators etc. The awareness program can be in the forms of waste cleaning, road play IEC materials etc.

7.8.6 Air Environment

Air emission during operation stage are expected from

- Increased vehicular movement
- Emission from Dredging equipment
- Emission from vessels
- DG

The impact is likely to be localised and confined to asmaller area around the project. Since the area is relatively windy, the pollutants will be dispersed. Emission from Vessels during navigation will not be significant. Major pollutants will be Sulpher dioxide and Nitrogen oxides. The concentrationof these air pollutants in ambient air as per the monitoring data is much below the limit. Contribution from above sources will be negligible increase in concentration.

Mitigation Measures:

Following mitigation measures will be taken:

- Vehicles only with PUC will be allowed
- High efficient combustion engine for vessels and dredging equipmentswill be selected so that the emission will be minimum.
- DG with CPCB emission norm and acoustic enclosures
- Plantation along the terminals for reducing the effect

7.8.7 Noise Pollution

Noise level will not rise against the present level, as better vessels will be deployed. Noise will be contributed from DG, vessels and vehicles. However, the impact on the surrounding will not be significant.

Mitigation Measures:

- DG will be with acoustic enclosures
- Vessels will be designed for acceptable noise
- Plantation around the site for further reduction of impact
- Under Jibondinga scheme, proposed by AIWTDS for the procurement and replacement of vessels, boats will be certified by IRS and will be designed with acceptable noise level

The proposed mitigation measures can substantially reduce the anticipated significant impacts. Some of these measures are preventive which will prevent the damage due to increase in noise levels and some are mitigative which will help in reducing the noise levels.

7.8.8 Economic Development & Employment generation

The development of terminals, deployment of new vessels, repairing facility, dredging of channels will have potential opportunities for employment. There will be direct as well as indirect employment. Due to improve transportation, there will be improvement in demand of commerce and consumer goods. This may also facilitate setting up small industries. All these will increase the employment opportunities in the area

7.8.8.1 Impacts During Operation Phase*:* Terrestrial Ecology

Positive impact on ecology is anticipated during the operation stage of planned interventions. 3 m wide peripheral green belt will be developed and avenue plantation will be carried out at all the proposed intervention sites. Green belt will provide excellent habitat to avifauna, insects, small animals like squirrels, lizards, chameleons etc. Tree survival rate will be monitored and will be maintained to minimum 70%. Proper after care will be done for the planned green belt and this has separate budgetary provision under the EMP. But as the terminals involve movement of vehicles at and around the site, dust level may increase in the area. This dust when settles on the leaves of the trees will hamper the photosynthesis activity.

Mitigation Measures:

- Proper aftercare and monitoring of the green belt & avenue plantation
- Maintaining survival rate of plantation to minimum 70%
- Regular watering and cleaning of the leaves to remove the accumulated dust on the leaves
- All the internal roads and access road shall be made pucca.

7.8.8.2 Impacts During Operation Phase*:* Aquatic Ecology

Impact due to operation of any project is of main concern as it always persists. Installation of pontoon, gangway and other off-shore structure will consume physical space in water reducing the available space for the aquatic organism. Planktonic population at pontoon and gangway and nearby area will reduce or will decrease drastically which will impact the primary productivity of the water body. Planktons is feed for various big fishes, thus reduce in plankton population will affect the aquatic food chain. However, area to be covered by pontoon and gangway is very less as compared to width of the river. Thus, reduction of this much space will not have significant impact. Also, it is possible that aquatic organisms may collide with these newly constructed structures. But as behavioural response, instinctively aquatic animals at the first encounter avoid approaching the site of unknown object. This is done using echolocation, olfaction or chemo-reception, if the object

is not making any sound. Thus, the space occupied by unknown structures will be avoided by aquatic organisms thereby reducing the chances of collisions and injury to aquatic organisms.

Sewage & waste will be generated at terminal and in vessel. If this waste is disposed on the land or in river, then this waste can pollute the soil impacting the terrestrial ecology and can pollute the water impacting aquatic ecology.

Other activities at the terminal sites may have impact on aquatic ecology are oil/material spillage, dust generation from material transportation, barge movement and maintenance dredging for keeping the berth area navigable. Berthing of the vessel at terminal reduces the circulation of water in the area thereby reducing the air flow in the water and self-assimilative capacity of river in that stretch. If vessel is berthed for longer duration at terminal/jetty sites, then there are increased chances of release of toxins from anti-fouling coating of vessel or leakage of some oil from bilge tank into the river. All these may pollute the river water quality near the terminal sites. There are also chances of accidental oil spillage near the terminal site or in the waterway. Oil spillages are threat to aquatic organisms and can lead to mass mortality also. Oil spills can affect all planktons, benthos and Fishes.The indirect potential impact that may be envisaged from the project on Dolphin are due to vessel movement. The project sites have already number of country boats and ferry for transporting passengers.

Mitigation Measures:

- No wastewater or waste should be disposed in river from terminal site or from vessel into the water. Penalty should be imposed on the vessels reported of disposing waste/wastewater in the river
- Surface run-off from site should be collected separately in dump pond, retained and then clear water should be re-used at site for dust suppression and greenbelt development.
- Instruction should be given to all vessels and all employee and staff that no dolphin or any other endangered species should be harmed due to any reason.
- Instruction should be given to vessel operator that in case any accident with dolphin occurs that should be reported immediately to terminal authority.
- Waiting time of vessel should be reduced at the terminal by providing the adequate loading and unloading equipment and vehicles.
- Vessel should be instructed for not using sharp lights and sounds as they may disturb aquatic organisms
- Ship speed should be controlledto minimize aquatic fauna kill and the design of vessel and acoustic treatment should be done for vessel to minimize the sound exposure of aquatic fauna.
- As part of the project, measures are being taken to enhance the natural condition of the river bank, exchange of nutrients so that natural habitats are restored during the operation stage. The vessels will be designed for protection of aquatic animals by providing necessary attachments in propeller of the vessels.
- Propeller guards should be provided for all the vessels to minimize the propeller inflicted injuries and scars.
- Quick clean-up operations should be carried out in case of accidents. Vessel owner should be responsible for paying the clean-up expenses in case of the accidents and pollution of river water quality
- Time schedule and the quantity of material allowed shall be strictly checked and monitored for each ship. This will prevent overcrowding of the vessels at terminal site and thus no obstruction will be there on movement of the aquatic organisms due to vessel.
- Survival rate of planted tree species should be monitored after every six months.
- Aquatic ecology monitoring should be carried out yearly to assess the impact of terminal activities on aquatic life.

7.9 Climate Change Impacts and Mitigation Measures

Inland water Transport is considered to be more energy efficient and emit less CO_2 per ton-km, compared to other transport modes namely road or rail transport. The average emissions from IWT mode range from 25 gm CO_2/ton-km to 70 gm CO_2/ton-km. Whereas, from road transport by truck, it varies from 60-120 gm CO_2/ton-km and in the case of rail, it varies from 20-80 g CO_2/ton-km.

At 2.5°C warming, melting glaciers and the loss of snow cover over the Himalayas are expected to threaten the stability and reliability of northern India's primarily all glacier-fed rivers, particularly Brahmaputra. As per WB reports downward trend of river flow of the Indus, Ganges, and Brahmaputra rivers alone could significantly impact irrigation, affecting the amount of food that can be produced in their respective river basins thereby adversely impacting livelihoods of millions of people (62 million in the Brahmaputra basin in the year 2005). However, the project will have lesser carbon foot print.

Some of the energy conservation measures envisaged in the project are:

- Use of LED Lights
- Building will be energy efficient with natural light
- Solar energy for selected utilities

Brahmaputra face the consequences of water-level rise, higher river discharges during pre-monsoon, summer & monsoon season starting from the month of April upto the end of September. Water level is at peak during the month of July, August & September. The river get widen with this increase level of water volume. During the winter season water level become considerably low and the breadth of the river also get reduced. Increase in river water volume is due to melting of glaciers during summer and heavy rainfall during monsoon.

Climate change could be a threat for inland navigation. Knowledge on climate change is important to make proper policy and infrastructure planning. Fluctuation in water level hinder the smooth inland water navigation leading to delayed and cancellation of services especially during the high rise in the water level during wet season. The inland water transport also get disturbed frequently with decrease in water level as it involved frequent shifting of terminals/ ghats due to non-availability of minimum draft for the vessels.

Following mitigation measures suggested to mitigate impact due to climate change in the project activities-

1. Daily monitoring of the CWC Gauge data at Pandu Ghat (for North Guwahati & GGG Ghat) & Neamati Ghat (for Aphalamukh Ghat)
2. Regular interaction mechanism with Indian Meteorological Department (IMD) for early forecasting to avoid casualties
3. Working jointly with State Disaster Management Authority, State Disaster Response Force (SDRF) & National Disaster Response Force (NDRF) during emergency situation
4. Awareness programme with staff, passengers and contractors on Climate Change.

7.10 Socio Economic Profile of Project Affected Households

Few persons are directly impacted by the project as they are falling within the close vicinity of the Ghats where construction works are proposed and hence need to be shifted. A Census and Socio-Economic survey was carried out to collect baseline information of these Project Affected Households, to understand their social and economic conditions and the likely impacts. Data collected includes information on religion, social category, social group, land and structures, present usage of structures, education, occupation, sources of income, ownership of fixed assets and consumer items, awareness about the projects, choice with regard to compensation and resettlement and rehabilitation, etc.

The project will affect 13 PAHs comprising of 72PAPs. This include 18% children, 57% males and 43 % females. The maximum number of PAPs is likely to be affected by the project investment in Aphalamukh. Sub-project wise distribution of PAPs is given below-

Table 7-5: Population of PAPs in 3 Ghat Areas

Name of Ghat	Population of PAPs		
	Children	Female	Male
LachitGhat	0	0	0
North Guwahati	4	8	12
Aphalamukh Ghat	9	23	29
Total	13	31	41

As such four categories have been made for the purpose of analysis. It is observed that 23% of the household comprise up to 4 members, 54% families are having 5-6 members, 23% families have 7-10 members and no families have more than 10 persons reported.

Table 7-6: Distribution of PAHs by household size

Household members	Household surveyed	
	No.	%
Up to 4	3	23
5 to 6	7	54
7 to 10	3	23
> 10	0	0
Total	13	100

However, all the project affected households (PAHs) of the project are 'Non-Title Holder's. But socially all the PAHs belongs to vulnerable groups i.e. Schedule Caste.

Mitigation Measures:
All the proejct affected households shall be compensated according to "Entitlement Matrix' as per the Right to Fare Compensation & Transparency for Land Aquisition, Rehabilitation & Resettlement Act, 2013. Details of compensation as per the 'Entitlement Matrix has been discussed in Social Management Framework (SMF).

7.11 Gender Based Violence (GBV)

There are increasing instances of domestic violence, sexual assault/ harassment and even robbery in the state.As per NCRB 2016, Assam has reported the highest crime rate under Section 498A 'Cruelty by Husband or His Relatives' (58.7%).Women also report feeling unsafe in public spaces, further reducing their mobility. As per the study conducted by the Centre for Urban Equity, women in Guwahati listed general harassment by co-passengers, driver or conductor (47 %), eve-teasing (10 %), and stalking (7 %), as major constraints to use of public transportation.

Assam is also a major source and transit point for human trafficking in India. As per the NCRB report of 2015, Assam (1,494 cases) accounted for 21.7 per cent of all cases relating to human trafficking recorded across the country. Of the 3,087 cases under procuration of minor girls (Sec. 366A IPC), Assam accounted for 1,303 cases, with highest crime rate (11.0) in the country(increased by 52.8% as compared to the previous year*).*

The SIA of GG Ghat (Guwahati Division) and a World Bank study on gender-inclusive Assam IWT, revealed that women particularly students (school/college) were susceptible to experiencing sexual

harassment on board the vessel. The studies further revealed that most IWT terminals and vesselshad limited seating; while waiting areas were mostly overcrowded. Few, if any had clean toilets or drinking water facility. Based on the findings, the study provided the following recommendations:

- Potential for sexual harassment of women and girls on IWT can be addressed by limiting overcrowding, providing sufficient seats and well-lit spaces. All terminals should have toilet facilities that are safely accessible to all individuals including the differently-abled. Designated space for nursing mothers to breastfeed and to look after infants at the terminal, should be considered as well.
- The dedicated hotline for public grievances should include specific procedures for GBV including confidential reporting with safe and ethical documenting of GBV cases. AIWTDS should have aMoU with specialised cells/organisations or state-run women helpline for referring victims of harassment to these organisations.
- Display of women helpline nos., dedicated hotline for the project at prominent location of the terminals and ferries including deployment of security personnel at every terminal is needed.
- Initiatives to encourage greater bystander vigilance and sensitivity will also contribute to a safer travel environment. User satisfaction survey will include evaluating how women and girls experience IWT travel in terms of their safety, security and convenience.

7.12 Labour Standard Compliance and Labour Influx Mitigation Framework

Often developmental activities call for supply of labour forces and attract workers from different parts of the country. If not but to check, such trends can become a heavy burden on the resources, infrastructure, capital, social fabric, culture and economy of the affected area.

Due to its geographical placement, Assam is already subjected to severe migrations (interstate and cross border migration) from neighbouring areas. The State after all serves as the most important corridor that connects North Eastern States to the rest of India, and India to its neighbouring countries. Migrations trends prevalent in Assam is already putting severe strain on the existing resources and its limited land area, resulting in social conflicts and ethnic differences. Mass protests held against the recently tabled “Citizenship (Amendment) Bill, 2016” which seeks to legitimize the status of illegal immigrants, is a testimonial of prevalent social conflicts within the community which can easily be exacerbated by the influx of labours.

The State also reports higher instances of poverty and unemployment. Despite the abundant supply of raw materials, the lack of proper infrastructure limits Assam’s potential to a supplier of raw materials than producer of profitable end products. Another challenge salient to Assam is the population displacements due to floods and developmental projects. The Brahmaputra river poses a significant challenge to riparian communities who are often forced to move, due to floods. They are faced with heavy losses of property, land, household, agricultural products, animals and life, often causing severe economic and social distress to the inhabitants. Furthermore, insurgency and social conflicts in the recent past puts heavy strain on the social and economic equilibrium of the State.

Labour Influx Risk Assessment

The influx of workers and followers can lead to adverse social and environmental impacts on local communities, especially if the communities are rural, remote or small. However, the current project for development of IWT involves both rural and urban areas of Assam. While some Ghats are located in typical urban centres like Guwahati and Jorhat, others are located in remote rural settings of Majuli. Furthermore, IWT services offers one of the most important modes of connectivity for multiple sections of population, especially in rural areas.

As per the census 2001, out of the total population in Assam about 0.71 percent were international migrants, particularly from Bangladesh, Bhutan and Nepal. Bangladesh constituted 86.14% of the total immigration to Assam. The district which reported the highest number of immigrants were Cachar (1.63%), followed by Karimganj (1.61%), Bongaigan (1.40%), Nagaon (1.13%) and Goalpara (0.95%). The district which had the lowest number of immigrants were Sibsagar (0.11%), followed by Jorhat (0.14%), Golaghat (0.18%) and Dibrugarh (0.33%).

Along with the international migration the migrants from the other states of India also contributes to the population growth in Assam. Out of the total migrants, the interstate migrant into Assam contributes about 2.39 per cent and 1.93 per cent during 1991 and 2001. In both years, Bihar contributed to the highest volume of interstate migrants as about 36.31 per cent and 33.50 per cent respectively, followed by West Bengal (17.62 per cent and 19.19 per cent) and Uttar Pradesh (10.17 per cent and 9.72 per cent). According to the 2011 Census, net interstate migration rate for Assam during 1991-2011 is estimated at -2.02%. The share of interstate migration has increased from -0.69% to -2.02% from 1991 to 2011. Influx of migrants from the different districts of India can be attributed to the existence of labour market and employment prospects in the destination area.

Based on this assessment, potential adverse impacts of labour influx have been enumerated below:-

- Labour influx may influence the demographic composition of the existing mass of population in riparian areas, where there already seems to be a decline of man-land ratio, shortage of food, settlement pattern, and ethnic differences.
- Increased demand and competition for local social and health services, as well as for goods and services, which can lead to price hikes and crowding out of local consumers.SIA of three priority sites indicated low capacity of the community to manage and absorb the incoming labour force. This is particularly relevant for Assam, as it already deals with such risk from cross border and interstate migration.
- Bearing in mind the present socio-political environment, temporary labour influx due to the project may amplify social conflicts between the local community and the construction migrant workers.
- Project may result in increased rates of illicit behaviour and crime against women, which is a real threat for Assam where gender-based violence is rampant.
- SIA of three priority sites revealed that the project will directly impact the livelihood of affected families who earn their living through petty businesses and agricultural activities (marginal/small) in the project area. It is therefore imperative to ensure that the PAPs can reconstruct their livelihood. The temporary labour influx may increase competition for jobs and have an impact on wage distribution.

While most of these potential impacts are identified in the Environmental and Social Impact Assessment (ESIA) carried out for the sub-projects, they may become fully known only after a project contractor is appointed to take decisive actions on sourcing the required labour force. It is vital to develop a dynamic plan for addressing risks associated with labour influx before the stipulated work starts. It is also important to update such plans as necessary to reflect project improvements and developments that result from the course of project implementation. Overall, adequate monitoring and adaptive management of the potential impacts from labour influx are crucial for properly addressing and mitigating the risks involved.

Recommended Mitigating Measures

- The most effective mitigation measure against labour influx is to reduce it. Unskilled workers are available in plenty, and many of them are migrating in search of employment, can be retained locally. The contractor is responsible for recruitment of labourers for construction work. Specifications on employment of local workforce including women should be reflected in the civil works bidding documents and subsequent contracts to ensure that the contractors fulfil these commitments. Locals including women may be screened further for skills, and adequate

orientations can be provided to recruit for the work. AIWTDS can prepare a roster of interested workers and their skills. The lists can be provided to contractors at the pre-bid meetings for recruitment consideration.

- The project contractor needs to prepare a site-specific Labour Influx Management Plan and/or a Workers' Camp Management Plan. This plan will include specific measures that will be undertaken to minimize the impact on the local community, including elements such as worker codes of conduct, grievance redressal, skills development, training programs and awareness generation on HIV/AIDS and gender-based violence (GBV)for the workers and host community. A Workers' Camp Management Plan will also address specific aspects of the establishment and operation of the workers' camps in compliance with relevant labour laws. The plan should include appropriate screening and monitoring mechanisms for addressing non-compliance.
- Adequate measures will be taken to ensure safety and security of women within the community and at the construction site. A security personnel will be deployed at the construction sites, and emergency nos. including contact details of local law enforcement officers, project's helpline no., existing state-run women helpline nos. will be prominently displayed at the site. The contractors will ensure that an Internal Complaints Committee (ICC) for each establishment is set-up to meet their corporate requirement and legal mandate under the Sexual Harassment at the Workplace Act, 2013.
- 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 the requisite staff, free 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 and critical cases.
- Awareness camps on HIV/AIDS for both, construction workers and neighbouring villages must be organised at regular intervals by NGOs empanelled with NACO.
- It is expected that among the women workers there will be mothers with infants and small children. The provision of a day care crèche as per the Building and Other Construction Workers (regulation of employment and conditions of service) act, 1996 is the contractor's responsibility. The crèche should be provided with trained women to look after the children.
- In case work schedule extents up till night, it should be ensured that women workers are exempted night shifts.

7.13 Community Health & Safety

The objective of community health, safety program is a step towards improvement in safety, health and environment at workplace during the execution stage of the project. The objectives are to achieve:- a) Continuous reduction in the incidence of work related injuries, fatalities, diseases, disasters and loss of national assets. b) Improved coverage of work related injuries, fatalities and diseases and provide for a more comprehensive data base for facilitating better performance and monitoring. c) Continuous enhancement of community awareness regarding safety, health and environment at workplace related areas. d) Continually increasing community expectation of workplace health and safety standards. These objectives can be achieved by-

- effectively enforcing all applicable national laws and regulations concerning safety, health and environment at workplaces in all economic activities through an adequate and effective labour inspection system;
- Ensuring that employers, employees and others have separate but complementary responsibilities and rights with respect to achieving safe and healthy working conditions;
- Amending expeditiously existing laws relating to safety, health and environment and bring them in line with the relevant international instruments;
- Monitoring the adoption of national standards through regulatory authorities;
- Facilitating the sharing of best practices and experiences between national and international regulatory authorities;

Chapter 8 : Additional Studies

8.1 Flood Assessment

A flood is a relatively higher stage of a river that overtakes the natural channel, provided for its flow. In India, a river is said to be in flood, when its water level crosses the danger level (DL). DL for a particular river stretch is fixed by CWC. Major floods are those where water level is 1 m or above DL and if it is more than 5 meters, it is catastrophic. The massive earthquake in 1950 changed the course of mighty Bramhaputra. The riverbed rose with silt deposits. Due to heavy deposition, the river frequently changes its course with the main channel flowing into multiple channels.

8.1.1 Water Level Studies

Bramhaputra is a trans-Himalayan river. It is one of the three major rivers of Indian subcontinent. Surface river level variations in the Brahmaputra River are generally driven by the seasonal periods. Central Water Commission's "Flood Forecast Monitoring (FFM) Directorate monitor the water level of river Bramhaputra. The same is presented in **Table 8-1**.

Table 8-1:Water level variations Guwahati (D.C. Court)

	Unit	Figure [m]	Source of information
Lowest Water level	[LWL]	41.40	Recorded level of 2002 at Pandu
Warning level	[WL]	48.68	Central Water Commission's "Flood Forecast Monitoring (FFM) Directorate" (List based exploration)
Danger level	[DL]	49.86	Central Water Commission's "Flood Forecast Monitoring (FFM) Directorate" (List based exploration)
Highest flood level	[HFL]	51.46	Central Water Commission's "Flood Forecast Monitoring (FFM) Directorate" (List based exploration)

8.1.2 Water Flow Rate

Maximum and minimum velocities observed along the various stretches of navigation is essential for the designing of the inland vessels used for ferry service across River Brahmaputra. As per Watere Resource Department, Govt. of Assam, the water velocity recorded as follow:

- Up-stream= 4.0 m/s
- Downstream = 2.5 m/s to 3.5 m/s
- Flood season = +/- 0.5 m/s

Also information was obtained by operational staff of the respective ferry routes during Consultants site reconnaissance surveys at various locations.

Guwahati

Service Guwahati – North Guwahati (date of interview, 25.04.2018):[1]

- Regular: ~1.0 m/s

- Flood season: ~2.5 m/s

Dibrugarh
Service Neamati – Aphalamukh (date of interview, 10.07.2018):

- Regular: ~0.5 m/s

- Flood season: ~3.0 – 4.0 m/s

8.1.3 Flood Control Measures

Flooding in river Brahmaputra is observed almost every year. Water Resource Dept, Govt. of Assam is the nodal agency for advance warning of flood and have been taking long-term action to prevent flood. Flood erosion control with water resource development is required to be integrated.

Flood-mapping based on historical records is an important tool for analysis and interpretation of the hazards. Proper management of flood should rely more on long term integrated plans. Flood prone areas have been identified by CWC based on hydrological & geomorphological data.

Government has taken measures like construction of ring bunds, embankments, anti-erosion and river diversification works.

The important measures necessary to be taken for flood control in Assam are given below-

- Controlling the major rivers by constructing small dam and reservoirs without hampering the existing environmental condition.
- Checking bank erosion.
- Stopping deforestation and taking up forestation in the catchment areas. This will stop soil erosion and siltation of the river beds at the plains.
- Protective embankment at settlements both urban and rural.
- Construction of drainage channel, culvert and sluice gate whenever necessary.
- Construction of raised platform near the settlements of the flood prone areas as shelter during high flood.

Flood control is in operation in Majuli considering the sensitive location. Flood control measures in Majuli, are very specific, as before 1950 the erosion problem was not significant. From 1953 -2003 the Flood Control Department of Assam has so far constructed 105.2 km. of embankments on the bank of the Brahmaputra, Kherkotia and Subansiri Rivers.

Embankment constructed is shown in the map in **Figure 8-1**.

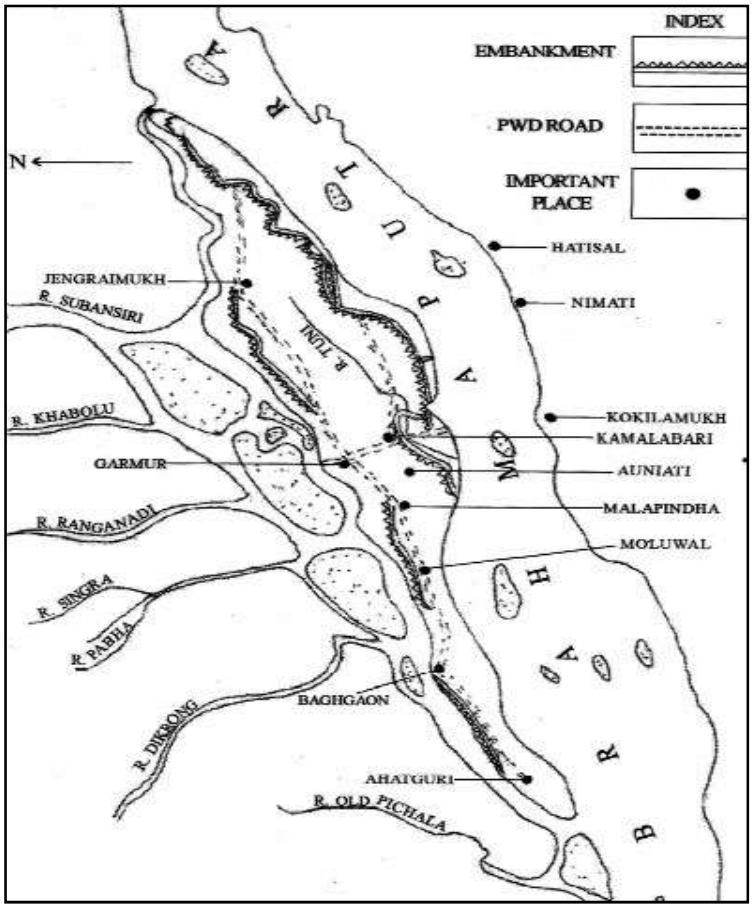


Figure 8-1: Embankment System of Majuli

The Brahmaputra Board had prepared a master plan for the development of Majuli Island which included measures for flood control, erosion control and drainage improvement. Following measures are studied for flood control in Majuli Island.

- Construction of Flood Control Dykes and Embankment

- Construction of Stone Spurs

- RCC Porcupines

8.1.4 River Bank Profiles – Guwahati Corridor

Time history bathymetric chart is the best representation to understand the morphological changes including bank stability and to determine the berthing line with assured required draft. In absence of such data base, an attempt has been made to assess the changes of the River bank profile using the satellite image of the various period.

8.1.4.1 Guwahati Gateway Ghat (GGG)

Satellite images(GGG) of 2003, 2010 and 2018, presented in **Figure 8-2**to**8-4**respectively, indicate changes on the embankments cope line. The yellow line indicates the embankments cope line of 2018, which is then superimposed with maps of 2010 and 2003. It becomes evident that no substantial changes on the embankments cope line around ISDP 1 (~500m east of GGG Ghat) are observed within a period of 15 years.

Figure 8-2: River bank at GGG Ghat on 13th May 2018

Figure 8-3: River bank at GGG Ghat on 25th November 2010

Figure 8-4: River bank at GGG Ghat on 10th March 2003

8.1.4.2 North Guwahati

Satellite image (NG) of 2003, 2010 and 2018 are presented in **Figure 8-5, 8-6** and**8-7** respectively indicating changes of the embankments cope line. The yellow line indicates the embankments cope line of 2018, which is superimposed with the map of 2010 and 2003. It becomes evident that no substantial changes on the embankments cope line at MajgaonGhat are observed within a period of 15 years.

Figure 8-5: River bank at North Guwahati Ghat on 13th May 2018

Figure 8-6: River bank at North Guwahati Ghat on 25th November 2010

Figure 8-7: River bank at North Guwahati Ghat on (10th March 2003)

8.1.5 River Bank Profiles – Dibrugarh Corridor

8.1.5.1 Aphalamukh

Satellite image of 2009, 2012, 2014 and 2016 are presented in **Figures 8-8, 8-9, 8-10**and**8-11** respectively. The imageries are compared to find out whether major changes in river bank has taken place over the years. The yellow line indicates the embankments cope line. Map of 2018, is then superimposed on maps of 2014 and 2009. It is observed that, between 2009 and 2014, substantial changes on position of river have occurred. Comparing images of October 2012 and February 2014 vary between 100 - 190m westwards.

The vulnerability of the stretch for adequate and sustainable embankment protection measures may be worked out. There is necessity for major investment in initial embankment stabilisation or embankment protection works, may dependent on the conceptual design approach of the Ghat

Figure 8-8: River bank at Aphalamukh on 13th April 2016

Figure 8-9: River bank at Aphalamukh on 20th February 2014

Figure 8-10: River bank at Aphalamukh on 17th October 2012

Figure 8-11: River bank at Aphalamukh on 01st November 2009

8.1.6 Erosion Control Measures

8.1.6.1 Embankment Protection Measures

Embankment protective measures are as follows:

An overview of different embankment protective materials is given in **Table 8-2**.

Table 8-2: Embankment Protection Materials

S. No.	Structure Type	Loading Class				Bank Slope			Main Applicability
		1	2	3	4	<1:2 V:H	>1:2 V:H	Near Vertical	
		+ =Recommended-=Not Recommended							
1.Rip-rap									
1.1	Rip-rap	+	+	+	-	+	-	-	• Bank and bed protection • Installation above and below water level
1.2	Stone Pitching	+	+	+	-	+	+	-	• Short bank reaches • Repair of existing revetments
1.3	Cement ground stone	+	+	+	+	+	+	-	• Areas of attack by strong currents
1.4	Bitumen grouted stone	+	+	+	+	+	+	-	• Areas of attacks by strong currents • Installation above water level
2.Gabions									
2.1	Mattresses (brick or stone fill)	+	+	+	+	+	-	-	• Bank protection of large areas • Installation above water level
2.2	Box Gabions (stone/rock fill)	+	+	+	+	+	+	+	• Retaining wall for bank protection • Installation above water level
2.3	Gabions Sacks (stone / rock fill)	+	+	+	+	+	-	-	• Toe protection • Installation above and below water level
3.Concrete (pre-cast units)									
3.1	CC-slabs	+	+	-	-	+	+	-	• Slope protection • Installation above water level
3.2	CC-Interlocking slabs	+	+	-	-	+	+	-	• Slope protection • Installation above water level
3.3	Hand pitched CC-blocks	+	+	+	+	+	+	+	• Slope protection • Installation above and below water level
3.4	Dumped CC-blocks	+	+	+	+	+	+	-	• Bed and bank protection in case of strong current and wave attack • Installation above and below water level
4.Articulating Mattresses									
4.1	Gabions mattresses, (with stone fill)	+	+	+	-	+	+	-	• Launching apron • Slope protection • Construction above water level (limited water depth)
4.2	CC-blocks attached to geotextile filter mat, steel wire linked	+	+	+	-	+	+	-	• Launching apron • Slope protection • Construction above water level • (cast in place)
4.3	Tubular	+	+	-	-	+	+	-	• Launching apron

S. No.	Structure Type	Loading Class				Bank Slope			Main Applicability
		1	2	3	4	<1:2 V:H	>1:2 V:H	Near Vertical	
		+ =Recommended-=Not Recommended							
	geotextile fabric mattress; sand Filled or bitumen-sand filled								• Slope protection • installation above water level
4.4	Collapsible sand filled geotextile mattress	+	+	-	-	+	+	-	• Launching apron • Slope protection • Installation above water level
4.5	Collapsible concrete filled geotextile mattress	+	+	+	-	+	+	-	• Launching apron • Slope protection • installation above water level
5.Sand containers									
5.1	Geotextile-Sand bags (up to 250kg)	+	-	-	-	+	+	+	• falling apron and toe protection
5.2	Geotextile – Sand	+	+	+	-	+	+	+	• Installation above and below water level
6.Bio-Engineering									
6.1	Durba grass sods	+	-	-	+	-	-	-	• Upper reaches of banks above mean water level • Preferably on land-side • On river - side prone to wave erosion • Installation above water level
6.2	Vetiver plantation	+	+	-	-	+	-	-	• Toe protection of upper reaches of banks • Installation above water level

It is recommended that repairing of embankments in the island should be reconstructed immediately using latest technology.

8.1.7 Recommendations

It is observed that since 2014 general stability of the river banks in the selected corridors seem adequate for establishment of permanent ferry locations. Observations of certain erosion are only observed at Neamati and Appalamukh in Slichar corridor between 2009 and 2014. Necessity for major investment in initial embankment stabilisation or embankment protection works, may, dependent on the conceptual design of the Ghat.

Concepts for bank protection measures are covered under Section 9.2.4. General large scale bank stabilisation measures for purposes of generally safeguarding major cities and villages along the river may though certainly be advantages, but is not part of Consultants scope of work and can only be achieved through long term morphological studies covering several kilometres up and downstream of the river(s).

8.2 Risk Assessment

8.2.1 Hazard Identification

Identification of hazards in the proposed terminals is of primary significance in the analysis, quantification and effective control of accidents. Hazard is the characteristic of system/ process that pose potential for an accident. Hence, all the components of a system need to be thoroughly

examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident. The following two methods for hazard identification have been employed in the proposed Ferry Ghat study:

- Identification of major hazardous units based on Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 of Government of India (GOI Rules, 1989); and
- Identification of hazardous units and segments based on relative ranking technique, viz. Fire-Explosion and Toxicity Index (FE&TI).

8.2.2 Classification of Major Hazardous Units

Hazardous substances may be classified into three main classes, namely flammable substances, unstable substances and toxic substances. The ratings for a large number of chemicals based on flammability, reactivity and toxicity have been given in NFPA Codes 49 and 345 M. Following hazard potentials are identified.

- Damage of Fuel tanks and oil leaks into the river.
- Fire hazard from Fuel Storage
- Emergency during ship manoeuvring
- Vessel or boat collision

Spills from these accidental situations is the major sources of water pollution. Vessel spills occur during loading or unloading in Jetty, due to handling errors or equipment problems. Such spills are typically relatively small in volume.

Much less common, but potentially more dangerous, are goods spills which occur when a boat runs aground or breaks up in bad weather. Such disasters typically occur when boats are moving into or out of terminals or in other restricted area. Boats can handle storms or high winds with little risk of accident, because if they are blown, they are unlikely to run into anything.

8.2.3 Damage Criteria

The consequences of release of such substances and the damage to the surrounding area can be estimated by means of modelling or physical observation. These physical effects are explained in terms of injuries and damages to the exposed population and structures. The degree of damage depends on.

- Nature of hazardous substances (gas, liquid or vapour);
- Pathway of release (boat, vessel etc);
- Dispersion of released gas or vapour in atmosphere or liquid in river water.

Major hazards of vessel collision relate to accidental release of petroleum products may potentially resulting in injury to people and damage to property.

8.2.4 Damage due to Fire

A flammable liquid will burn with a large turbulent diffusion flame. This may cause radiation and degree of damage depends on quantity of petroleum products and their chemical characteristics.

8.2.5 Collisions of Vessels / Crafts / Ships

Offshore traffic may be divided into two groups:

- Merchant vessels, fishing vessels, naval vessels and also offshore related traffic not relating terminal use
- Offshore related traffic for supplying, e.g. supply vessels, oil tankers, work vessels.

Inland waterway traffic is an ever-increasing phenomena. Consequently, new channels are being built and new solutions are being found in order to enlarge inland waterways. If they possess the River Information System - RIS, Vessel Tracing System - VTS, Electronic Charts Display Information System - ECDIS, Automatic Information System - AIS etc., the probability of vessel collision can be prevented.

. The incidents of accidents in Assam IWT ferry can be attributed to the following reasons;

1. Insufficient PPP Equipment
2. Extremely High Siltation Rate
3. Deficient Hydrographic Surveys
4. Scarce Navigational Aids
5. Insufficient Manpower / Skilled Workers
6. Insufficient capsize / vessel crafts
7. Old / outdated vessels / crafts
8. Intense Traffic Density

Mitigation

- A direct investigation of accidents through an interactive system may serve the purpose of both developing an authentic and reliable accident database
- Regular hydrographic survey on the waterway should be carried out and the navigation aid should be provided appropriately.
- Early warning of extreme weather condition.

8.2.6 Oil Spill Prevention

Operational oil spill is envisaged during the fuelling of vessel, operation and maintenance.

Due to mechanical failure or human negligence

Mitigation:

- Refuel of vessels and boats with proper care to avoid any spills.
- Make available spill kits and other absorbent material at refuelling points of the vessels.
- Compact fuelling is proposed in the project.
- Develop and implement spill contingency plans for leakages. Ensure that emergency response equipment, e.g. floating booms, Foam Dispersant are serviceable and available to deal with any oil spills or leakages

8.3 Occupational Health and Safety

Safety of personnel working in the inland water ways is a major concern. Safety standards are applied during all phase of project activities. The personnel should be periodically undergoing medical check to identify anybody suffering from occupational health hazard.

Table 8-3 summarise various anticipated occupational hazards and relevant measures.

Table 8-3: Anticipated hazards for the project based on the project scope of work and site conditions

Hazard	Control Measures
Cold Stress	Warm clothes, water proof outer layer, regular breaks as necessary.
Water Drowning	Personal Floatation Device (PFDs) will be worn at all times when in water
Vehicular Traffic	One person will be on watch for approaching vessels
Slips / Falls	Proper footwear must be worn when on board

Hazard	Control Measures
Sun Exposure	Shaded glasses to be worn during sunny conditions.
Inclement Weather	Field activities will cease in the event of approaching storms or high winds
Heavy Machinery Area	Obey no-go-areas where machinery is operating
Physical/Back Injury	First aid followed by proper medical assistance
High Crime Area	Lock all boats and equipment at the end of every day.
Flammable Materials	No smoking will be allowed during work activities. All flammable substances will be stored in appropriate fire-proof containers.
Chemical	PPE worn when handling hazardous substances
Biohazard	PPE worn if working in a hazardous area

Personal Protective Equipment (PPE) is a crucial part of worker safety and can include face shields, safety glasses, hard hats, and safety shoes. Additional PPE may also include high visibility tests, high-visibility fleeces, and raincoats and trousers. This type of equipment has become standard for the dredging industry and has accounted for a significant reduction in accidents and incidents that could endanger a worker. In each case the type of PPE to be used is determined through a risk assessment.

Specific occupational health and safety issues relevant to Jetty operations primarily include the following:

- Physical hazards
- Chemical hazards
- Confined spaces.

8.4 Emergency Response and Preparedness Plan and Contingency ResponsePlan

Many emergencies can occur on any construction site and need to be effectively handled. During construction on river bank, emergencies such as flood, heavy rains and collapse of structure in the river, fall in the deep and flowing water are likely to occur. On site and off-site emergency management plan need to be developed to effectively handle them.

Thus, every contractor shall have an approved on-site emergency plan. The contractor should submit a copy of this plan to PIU and Supervision consultant before the start of the work. Contractor shall develop the onsite emergency plan considering the potential environmental, occupational health and safety emergency situation at site and activities involved. This plan shall include a list of these potential emergency situations & response plan. Contractor shall get the plan approved from the inland water authorities.

Risks and hazards are associated with every construction site as it involves usage of heavy machinery and equipment. An emergency is a situation that poses an immediate risk to health, life, property, or environment.

Most emergencies require urgent intervention to prevent worsening of the situation. To handle emergency situations efficiently and to mitigate the damage of potential events, Emergency Preparedness and Response Plan is prepared.

8.4.1 Objectives

The objectives of Emergency Management Plan shall be to;

a. Provide an Emergency Management organization structure which will enable project proponent to respond rapidly and efficiently to any emergency in order to prevent injury to personnel, damage to property or the environment as well as minimizing or eliminating the impact to neighbouring communities

b. Ensure all appropriate and relevant resources are identified in advance and made available as quickly as possible during an emergency.

8.4.2 Types of Potential Emergencies

For any development activities, potential emergencies can be categorised in to three types as listed below;

1. Spillage of oil while handling at terminal
2. Grounding & sinking of vessels
3. Collision of vessels with another vessel
4. Collision of vessel with country boat carrying passengers / vehicles if any during emergency landing
5. Collision of vessel with ferry boat carrying passengers
6. Collision of vessel with small country crafts
7. Hitting of vessel with river bank / rocks in the river bed
8. Hitting of vessels on shore structure/cross structures like bridges
9. Fire hazard
10. Spillage of oil in waterway due to mishandling of oil tanks while loading & unloading, accident/collision of vessels, damage of tank during grounding of vessels, leakage of fuel tank/bilge tank.
11. Terrorist attack
12. Natural Calamities (Earth Quack, Cyclone, Outbreak of Disease, and Excessive Rains etc.) Extraneous (Riots/Civil Disorder/ Mob Attack, Terrorism, Sabotage, and Bomb Threat etc.)
13. Man Made (Heavy Leak, Fire, Explosion, and Design Deficiency etc.)
14. PMU/Contractors shall identify all potential emergencies which are relevant to the nature of the project. It shall be shall be ensured that Emergency Management Plan deals with all possible emergencies scenarios. Indicative scenarios for both construction and operation phase of the project are listed down below;

A. Construction Phase

Primarily the potential emergencies during the construction phase (Water and Land) could result from any of the following:

a. Collapse of structure due to design fault, soils conditions, poor quality of construction material etc.
b. Overturning of a crane during lifting / transportation of the materials
c. Overturning of motorized boat / normal boat used for transportation of workers in off shore construction
d. Leakage of Oil (HSD) in oil storage area leading to fire
e. Gas leakage from Cylinders used for the purpose of gas cutting and welding (Dissolved Acetylene, LPG etc.) leading to explosion
f. Bursting of cables due to cable breakage / over loading leading to fire
g. Mass leakage of oils leading to land contamination
h. Collapse of complete scaffolding leading to multiple fatalities

B. Operation Phase

During operation phase where lot of ships and vessel movements are expected near the loading and unloading platforms, following types of scenarios are envisaged;

B.1 Off-Shore Emergencies

a. Major incident on board a vessel such as fire, flooding
b. Collision between vessels or between a vessel and a fixed object
c. Grounding and drowning of a Vessel
d. Major Oil Spillage from a Vessel or Jetty
e. Major Oil spill at river or Oil entering the bay from a source upriver
f. A major incident involving small craft within the terminal jurisdiction.
g. A security incident, involving a ship, which has the potential to escalate into an emergency situation.

B.2 On-Shore Emergencies

a. Major fire within the general bay area
b. Major oil spill
c. Major spill of hazardous material
d. A vehicle accident involving hazardous material
e. Chemical incidents (e.g. toxic cloud).
f. Major incident in an oil, gas or hazardous material storage facility.

8.4.3 Oil Spill Management

Oil spill Management plan covers the planning for handling of the potential off-shore and onshore oil spillage accidents during operation phase of IWT & Terminal. Disaster which may arise due to oil spillage is not anticipated to be of high risk. As they are in smaller magnitude

8.4.3.1 Type of Oil which can be spilled & Characteristics

Edible oil & POL will be handled at terminal and potential for spillage. Characteristics of the oils are given in**Table 8-4**.

Table 8-4: Characteristics of Oil

Sl. No.	Parameter	Edible oil	POL	Residual Oil
1.	Density at 15°C ,g/ml	-	0.8558	30 Max.960
2.	Specific gravity @60°C	0.87-0.94	0.8562	-
3.	Pour Point °C	-	33	6Max
4.	Kinematic Viscosity (cst) at40 °C	-	7.65	30.0
5.	Water content %vol.	-	2.0	0.5
6.	Total sediments % m/m.	-	0.05(basic sediment % vol)	0.1
7.	Ash % m/m	-	-	0.1
8.	Carbon residue on 10% V/V Distillation bottoms carbon residue	-	-	10 Max
9.	Cetane index	-	-	-
10.	Sulphur content	-	0.5%	3.5%
11.	Flash point	-	52-96°C	60.0Min
12.	Vanadium mg/kg	-	-	150 Max
13.	API gravity at 60°F	-	33.76	

8.4.3.2 Probable fate of spilled oil

When oil leaks, it reaches the surface of the waterway. When oil is spilled, its light fractions evaporate instantaneously and, it spreads with no water surface. Fate of the spilled oil in river, depend upon river/ weather conditions:

The un-evaporated oil would form water-oil emulsion which is fairly stable due to high wax content and asphaltenes.

Emulsion is a colloid of two liquids which are not miscible with each other. This phenomenon is also called dispersion. The action of flowing water will break down the insoluble globules of oil into tiny droplets less than 50 microns thus forming the emulsion in water. The oils with low viscosity like petrol and kerosene will more easily disperse into the water than heavy fuel oils. When the oil

gets emulsified, it is not possible to skim.

If the water current of the river is high especially in rainy season, the chances that most of the spilled oil will get emulsified due to turbulence.

This method of dispersion is a proven method for oil spill management. Hence dispersants are added to disperse oil in to the water. The dispersants do lower the surface tension and enhance the process of dispersion.

8.4.4 Response Strategy

To mitigate any possible oil spill/incident/accident during the voyage, the following actions are suggested.

8.4.4.1 Coordination & Control of Emergency

1. A coordination cum monitoring committee will be formed at AIWTDS Regional office for round the clock monitoring of voyage of the vessel
2. Important telephone no/contact detail of AIWTDS emergency handling team, district administration officials, police, hospitals, fire stations etc. shall be maintaining.
3. Sensitize AIWTDS/State Govt. agencies for any salvage/rescue operation. Also, sensitize the users of the waterway mostly the general public, fisher men & passenger ferry operators & crew about risk & its response strategy
4. Rescue stations shall be equipped with high speed launches/boat fitted with additional lifesaving gears, fire-fighting equipment & first aid facilities
5. AIWTDS shall make available the water ambulance & road ambulance at each of its terminal site available 24X 7 to take injured to nearby hospitals. AIWTDS should have tie ups with nearby hospitals to take up emergency case on priority & mutual aid programme.

8.4.4.2 Emergency Prevention Aids

Maintaining adequate navigational aids for easy passage of vessels near critical locations and preventing accidents. Meaning of the signals and cautionary marks should be communicated to the sailors/vessel crews by displaying this management plan on the website. Details of various navigational aids and marks to be provided by AIWTDS for prevention of accidents which may result to oil spills are given below. All signage will be as per the guidance given in **Annexure I, II, III** of IWAI Act, 1985.

a. Navigational Aids

i. LED Lights (Green & Red) fitted on MS Post LED lights fitted on bamboo towers Red/Green flags on MS Posts and bamboo towers

ii. Day Marks/Cautions Marks at critical locations

iii. Bend marks in the entire channel for better maneuvering of the vessel

iv. Chainage marks for assistance of the Master and Pilots on board the vessel

v. Pilots who are acquainted with the river/channels for the different beats

b. Transiting Marks

i. Provision & maintenance of 2 NM LED lights fitted on the MS posts/bamboo towers at different locations along the stretch for safe vessel transiting

ii. Above posts will be fitted with red/green flags for better visibility

iii. The masters shall keep the vessel on left to the red lighted beacons/right to the green lighted beacons while sailing downstream

iv. For any additional requirement of lighted marking, the vessel Masters should contact the concerned nodal officers

v. The nodal officers would relocate/provide additional marks as per requirement

c. Signage for bends and snags

i. Signage boards with bend signs in reflective paint fitted on bamboo towers will be provided to identify bends in advance

ii. Vessel masters will keep the vessel left to the red signage and right to Green signage while sailing downstream

iii. Vessel master should inform beat in charge / nodal officer in case of any change in the nature of bends

d. Provision of buoys at critical locations

i. Buoys should be provided at all critical locations

ii. Vessel operators have to be cautious while negotiating through critical zones

iii. Vessel operators may ask for assistance of tug in such locations in advance

iv. Tug should be provided to vessel operators within 2 days of making such request

e. Marking on navigable span of bridge (wherever applicable)

i. Red marks should be put on right piers and green on left piers of the navigable span of the bridges with the reflective paint

ii. Vessel operator should keep the vessel in between the navigable span of the bridges at controlled speed

iii. Vessel master should keep the search light on for identifying the navigation span at least 1 km ahead of the structure or navigation radar can be used for night time navigation

f. Chainage & information boards

i. To identify the location during voyage, chainage marks should be provided all along the stretch

ii. Details of contact persons should be provided at prominent locations. The contact no of AIWTDS emergency team, police station, fire station, hospital, water ambulance and medical facilities will be displayed at each such prominent location.

g. Pilotage

i. AIWTDS should provide its pilots for specified reaches in the waterway on request of fixed fee amount. Pilotage can be provided at advance request of 3 days minimum

ii. Pilots of AIWTDS shall be available only for guidance; however pilot of the vessel will be responsible for safe navigation in channel

8.4.4.3 Oil Spill Management Facilities

Facilities to be included in oil spill contingency plan are listed below:

a. Oil spill dispersant with spray arm/applicators (conventional hydrocarbon base, water dilutable concentrate & concentrate)
b. Boom for containment of oil
c. Skimmer for pumping the contained oil (20 TPH)
d. Flex vessel/floating storage for collection of spilled oil
e. Disposal facility at shore

f. Vessel for laying the booms

g. Oil recover boats

h. Sorbent pads and sorbent boom packs

i. Shore cleanup equipment-mini vacuum pumps/OSD applicators/fast tanks

j. Work boats

k. Tugs

The response time to emergency should be decided

8.4.5 Nodal Officers and Disaster Management Units of AIWTDS

AIWTDS shall set up a disaster management unit, with designated Nodal Officer. The unit should be alerted during time of accidents, disasters, oil spills and other emergencies. The unit should have reprentation from the following

- Terminal Operator
- Terminal manager
- E&S Cell of AIWTDS
- GRM Officer, AIWTDS
- DySPD, AIWTDS
- ASPD, AIWTDS, Guwahati

Terminal managers would coordinate for timely deployment of multipurpose tugs, oil spill management systems & equipment, fast launches/ports for possible assistance, provide all kind of medical support and services to take the person to the nearest hospital and visit the incident site for timely coordination. Following are the district disaster management authority (DDMA) management team. **Table 8-5**to**8-6** are DDMA of Dibrugarh and Kamrup (Metro) respectively.

Table 8-5: District Disaster Management Authority (DDMA), Dibrugarh

Sl. No	Designation	
1.	The Deputy Commissioner	Chairperson
2.	Chairperson, Zilla Parishad	Co-Chairperson
3.	Chief Executive Officer of the District Authority	Member secretary
4.	Superintendent of Police	Member
5.	Chief Medical Officer	Member
6.	Executive Engineer,	PWD Member
7.	Executive Engineer, Water Resource	Member

Table 8-6: District Disaster Management Authority (DDMA), Kamrup (Metro)

Sl. No	Designation	
1.	Deputy Commissioner, Kamrup	Chair person
2.	Mayor, Guwahati Municipal Corporation	Co- Chairperson
4.	Supttd. of Police	Member
5.	Jt, Director of Health Services/Chief Medical Officer	Member
6.	Executive Engineer PWD (B)	Member
7.	Executive Engineer PWD PWD (R)	Member
8.	Executive Engineer WR	Member

8.4.6 Clean-up Guidelines for oil spills

The various guidelines for oils and waste storage and disposal methods with contact details of clean-up for shoreline contamination authorized waste recyclers and suppliers / service agencies for oil response are given at **Annexure 8-1, 8-2** and**8-3** respectively.

8.4.7 The Important Government and Resource and Response Agencies

Pollution control board of Assam has pre-designated OSC/lead agency when oil affects the shoreline in Assam which will be contacted in case of an emergency..

8.5 Action Sequence Strategy

8.5.1 Emergency facilities to be Available On-board at Jetty

Project Proponent shall ensure that following facilities should be provided at the facility to tackle any emergency at any time (On Board);

- Fire protection, fire fighting facilities and trained personnel
- Emergency lighting and standby power
- Emergency Equipment and Rescue Equipment
- Breathing apparatus with compressed air cylinder
- Fire proximity suit
- ResuscitatorWater Gel Blanket
- Low temperature suit
- First Aid Kit
- Stretchers
- Torches
- Ladders
- Safety Equipment
    - Respirators
    - Gum Boots
    - Safety Helmets
    - Asbestos Rubber Hand Gloves
    - Goggles and Face Shield
    - Toxic gas measuring instruments
    - Explosive Meter
    - Oxygen measuring instruments
- Toxic gas measuring instrument
- Wind Direction Indicator
- Communication facilities,
- Transport facilities,
- Occupational Health Facilities
- List of Emergency Drugs and Appliances, etc.

- Communication system and list of contact no of All emergency personnel (AIWTDS, police, Hospital, District Authority, Fire-fighting, External spill management agencies)
- List of the locations of critical bends, areas of ferry operations, heavy fishing activity, low LAD and festive seasons in Brahmaputra
- Adequate lighting, horn, search lights (navigation radar if possible)
- Lifesaving equipment as per schedule I of IWAI Act, 1985 (boats, life rafts, life jackets, life buoys). These should be handled as per Annexure II of IWAI Act, 1985

8.5.2 Action Sequence / Flow of Information of Emergency

Whenever there is an emergency following steps shall be followed:

1. Identification / Notification of emergency
2. Activation of spill management response strategy for clean-up
3. Positioning and activation and communication of clean-up committee
4. Cleanup completion intimation
5. Documentation

The oil spill internal reporting format and format for spill report to India Coast Guard Organization are given at **Annexure 8-5** and **Annexure 8-6**.

Information flow of emergency /disaster/accident/oil spill will flow as per the given diagram in **Figure 8.13**.Project Proponent shall have and maintain an alarm system. Alarm system should use a distinctive signal for each purpose and comply with following requirements;

8.5.2.1 Assembly points

Project Proponent shall pre-determine and designate safe places far away from the risk prone areas of the facility where in case of emergency personnel evacuated from the affected areas shall assemble. Depending upon the location of the emergency and wind direction, the assembly points shall be selected. All assembly points should be clearly marked with directional display board along the route.

Following requirements shall be considered for the effective assembly and head count process;

- Establish a Head-Count system for employees at the Assembly Area
- A list of the names and last-known locations of missing employees should be made available on the assembly point as soon as possible after arriving at the assembly area
- Evacuation coordinator should take charge of assembly point and take roll call of the employees
- There should be an established method for the accounting of non-employees (contractors, supplier, visitors, vendors etc.
- Establish procedures for further evacuation in case the incident expands. This may consist of sending employees home by normal means or providing them with transportation to an off-site location.
- Identify Safe shelter space within facility or nearby safe area
- Establish procedures for sending evacuees to shelter
- Develop a list of necessary emergency supplies such as water, food, and medical supplies.
- Coordinate plans with local authorities.

8.5.2.2 Actuation of Emergency Management Plan and Declaration

In case incident goes beyond control, Emergency Management Plan shall be actuated by Chief Incident Controller at the appropriate stage as considered necessary. Other key persons shall also start performing their defined role as per the emergency organization chart and inform to various emergency controllers for guidance and control the situation. When emergency becomes catastrophic and evacuation beyond the plant premises is considered necessary by the Chief Incident Controller, the situation will be handed over to district authorities for implementing the off-site emergency plan. For on-site emergency plan, the relevant authorities shall enforce directions and procedures in respect of preparation of off-site emergency plan in consultation with other Government Agencies.

8.5.2.3 Post Emergency Actions

PMU/ Contractor shall appoint an investigation team to investigate the incident, find the direct and root causes and suggest corrective and preventive actions to prevent the re-occouranes of the same incident. They shall be responsible to keep all relevant evidence records of incident.

8.5.2.4 Incident Investigation

Project Proponent shall ensure that all incidents including “near-miss” should be recorded and analysed to prevent their recurrence in future. The system of accident investigation, reporting and documentation to be established and monitored. A system of communicating back the incident findings to employees and contract workers shall be ensured

8.5.3 Communication Facilities

Communication facilities for transmitting information related to emergency are given below

1. Incident control room at each terminal site
2. Wireless services should be available at incident control room to coordinate with emergency control units
3. Adequate communication system on-board

8.5.4 Communication System

Project Proponent shall ensure that after the assessment of risks and their possible environmental impacts, emergency, communication systems should be established. For advance communication on emergency preparedness, sites shall ensure that relevant information reaches to all employees, contractors, general public and local authorities. Through effective communication systems, emergency information should reach to;

a. Affected area of the facility
b. To key personnel outside normal working hours
c. To the outside emergency services and authorities and
d. To neighbouring factories and public in vicinity.

The communication system shall initiate with raising the alarm, declaring the major emergency and then follow the procedure to make it known to others. Components of communication system are explained below in brief;

8.5.4.1 Raising the First Level Emergency Alarm (FLEA)

Any person noticing an Emergency should raise First Level Emergency Alarm (FLEA). All persons working at the facility shall be trained to operate such emergency alarms. There should be an adequate number of points from which the alarm can be raised either directly, by activating an audible warning or individual signal or message to a preliminary manned location. This has the

advantage of permitting the earliest possible action to be taken to control the situation, which in turn, may avoid the development of a major emergency. All such points shall be distinctively marked and known to all employees.

8.5.4.2 Declaring the Major Emergency

Declaration of the major emergency shall be done by Incident Controller and his appointed deputy as early as possible and without wasting the time. (Note: The declaration of major emergency puts many agencies on action and the running system may be disturbed which may be very costly at times or the consequences may be serious. Emergencies should be declared by skilled, knowledgeable person who is able to envisage emergencies scenarios).

8.5.4.3 Telephone Message

Telephone operator (or communication officer) shall play an important role while receiving the emergency message on phone. He should be precise, sharp, attentive, and quick in receiving and noting the message and then for immediate subsequent action of further communication.

8.5.5 Communication of Emergency

Project Proponent shall ensure establishment of effective system to communicate emergency. As minimum following routes of communications shall be followed;

a. At the facility i.e. to the workers including key personnel and essential workers, on duty and inside during normal working hours

b. To the key personnel and essential employees not on duty and outside during normal working hours

c. To the outside emergency services and the government authorities and d. To the neighbouring firms and the general public in the vicinity

8.5.5.1 Communication to the Employees

Emergency prevention and control related information (as per the statutory requirements) shall be made available (in the form of a safety manual or a separate safety booklet) to the employees so that they can prepare themselves to take prompt actions in case of emergency. As minimum following information should be communicated to the employees.

a. Statutory Requirements

b. Hazard Information

8.5.5.2 Communication to the outside emergency services and the authorities

Once the declaration of major emergency is made, sites shall ensure that is immediately communicated to the Government authorities such as local Authorities, Collectorate, Police and District Emergency Authority.

The statutory information to above authorities shall be supplied beforehand so that they can be will prepared to operate their off-site emergency control (contingent) plan. As per their advice or consultation your on-site plan should be modified and modified and updated also.

8.5.5.3 Communication to neighbouring firms and the general public

Project Proponent shall notify about the major emergencies to nearby Industries and general public. This can serve a dual purpose in that it will enable them to take prompt action to protect their own employees and to take whatever measure may be possible to prevent further escalation of the emergency due to effects on their own installations. At the same time, they may be able to provide assistance as a part of a prearranged mutual aid plan. The statutory information to the general public shall be supplied to them for their emergency preparedness. Such information is mentioned as under:

- The common names of the hazardous substance used which could give a rise to an accident likely to affect them, with an indication of their principal harmful characteristics.
- Brief description of the measures to be taken to minimize the risk of such an accident in compliance with its legal obligations under relevant safety statues.
- Salient feature of the approved disaster control measures adopted in the factory.
- Details of the factory's emergency warning system for the General public.
- General advice on the action, members of the public should take on hearing the warning.
- Brief description of arrangements at the facility including liaison with the emergency services to deal with foreseeable accidents of such nature and to minimize their effects.
- Details of where further information can be obtained.

8.5.6 TEST and Mock Drills

To evaluate the thoroughness & effectiveness of Emergency Preparedness and Response Plan, Mock Drills shall be conducted on all sites at appropriate frequencies (onsite as well as offsite). These mock drills shall cover various levels of emergencies and variety of realistic emergency scenarios. The results of emergency drill exercises shall be communicated to appropriate personnel, including employees from the affected area. A follow-up system shall be established at the facility to help ensure prompt and effective resolution of all emergency drill exercises. Resolution of drill recommendations shall be documented and maintained along with the drill or critique report.

The emergency mock drills shall be carried out on the objective of –

- To evaluate the awareness of Emergency Handling team members with respect to their responsibilities during Emergency as per on site emergency management plan
- To evaluate the actions for effective mitigation of the emergency through team work.
- To check efficacy, availability & healthiness of Warning system, Fire Protection & Prevention System & Medical facilities.

8.5.7 Mutual Aid

Project Proponent shall ensure that to supplement a site's emergency control plan, services of member agencies shall be requested when the emergency threatens to exceed the capability of otherwise available resources. Formation of "Mutual Aid Scheme (MAS)" is beneficial for each member in case of major fire hazards, explosion or other accidents involving threat to life and damage to plant property to a very large extent.

8.5.8 Emergency Organisation & Responsibilities

Project Proponent shall ensure that key personnel to combat emergency are nominated with specific responsibilities according to set procedures and make best use of the resources available. Emergency Organisation shall meet the following objective;

- To promptly control problems as they develop at the scene
- To prevent or limit the impact on other areas and outside the project boundary
- To provide emergency personnel, selecting them for duties compatible with their normal work functions wherever feasible. The duties and functions assigned to various people shall include making full use of existing organizations and service groups such as fire, safety, occupational health, medical, transportation, personnel, maintenance, and security.
- Project Proponent willarrange an alternate arrangement for each function.

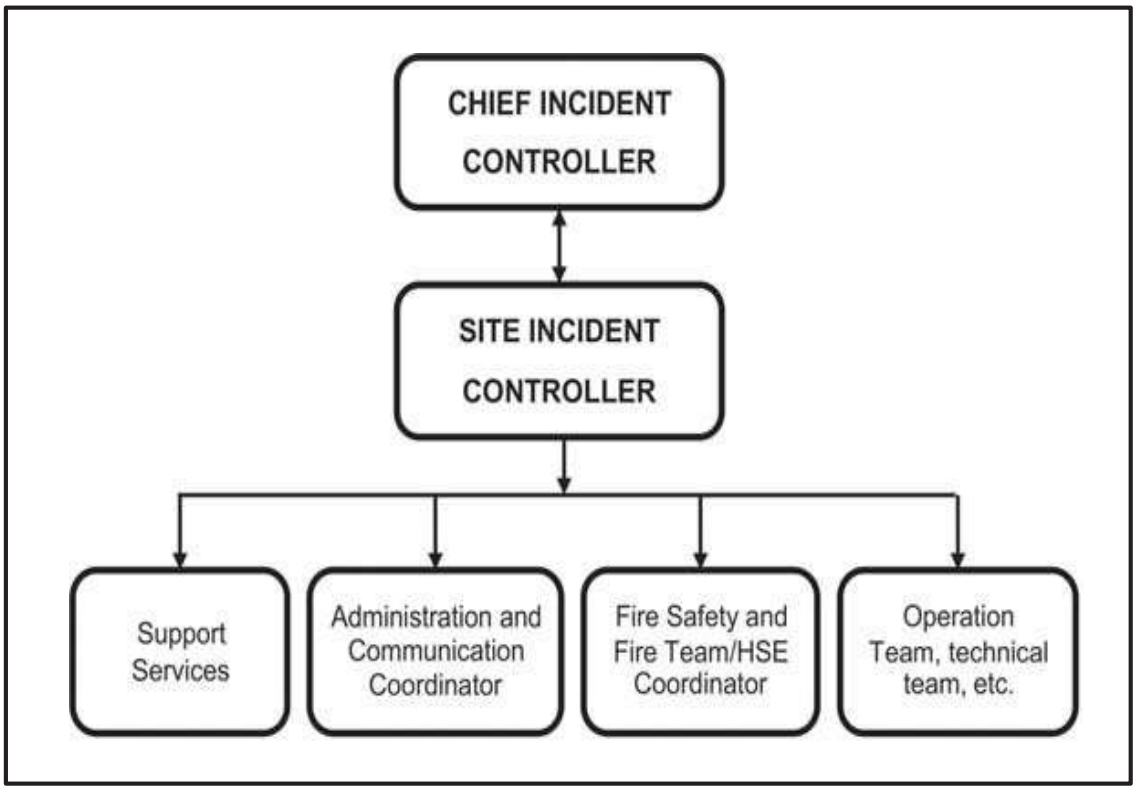


Figure 8-12: Typical facility level IMT (Incident Management team) for control of an oil spill

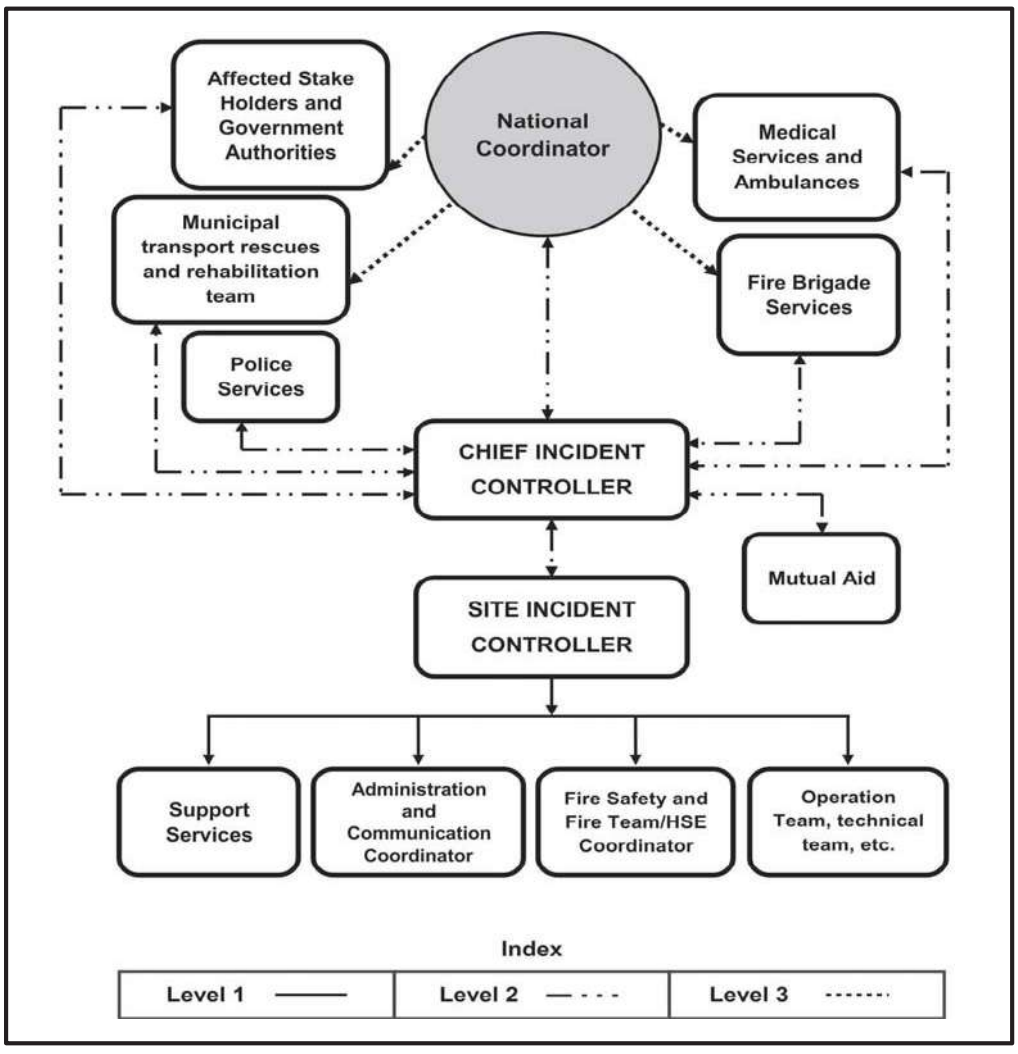


Figure 8-13: Basic oil spill emergency organogram

8.5.8.1 Roles & responsibility of Vessel Owners/Masters for Prevention and Management of Emergency on Site

Roles and responsibility of owners and masters of the vessels are as prescribed in IWAI Act, 1986 for management of emergencies and ensuring safety and prevention of accidents and are listed below;

1. The master of vessel shall be responsible for ensuring that the vessel is river worthy. He should follow the regulations relating to the safety measures for navigation in particular: take all precautions required to exercise vigilance and to avoid damage to the vessel, installations in the national waterway and avoid causing obstructions to shipping and navigation

a. to avoid imminent danger, take all steps required by the situation (according to the general practice of seamanship) even if this entails departing from these regulations;

b. be responsible for compliance with the rules or regulations applicable to his vessel and his crew and to the vessels in tow, while his vessel is engaged in towing of other vessels;

c. ensure possession of a valid certificates of registration and survey of the vessel and valid certificate or licence by the crew, ships article or the crew list, ships log and engine log

d. ensure that at no time the vessel is over loaded or carried more than the number of passengers it is certified to carry;

e. ensure that dangerous goods or explosive materials are carried on board as authorized by Competent Authority and procedures and safety precautions as per the Explosives Rules, 1983 as amended are taken for carrying of such goods or material onboard;

f. on sighting a vessel or raft which has suffered an accident endangering persons or the vessel or threatening to obstruct the channel, give immediate assistance to such vessels without endangering safety of his own vessel;

g. in case of any marine casualty, give warning to the approaching vessels to enable them to take necessary action in good time and steer clear of the channel when in danger of sinking or goes out of control;

h. ensure that lifesaving appliances as specified in Annexure-IV of IWAI Act, 1985 are carried onboard, in good condition and in a position available for immediate use;

i. ensure that no time the vessel discharge in the waterway except at places designated by the Competent Officer, raw sewage, oily substances garbage etc.

2. The master of a passenger vessel shall display the disposition and use of life saving appliances carried onboard and demonstrate the use of life jackets before commencement of journey;

3. The master shall ensure that all the navigational aids, fire-fighting and flooding control appliances are on board in proper working condition and in a position available for immediate use and cause regular conduct of exercises to his crew for the efficient use of such appliances;

4. The master shall make immediate report to the nearest competent officer on

a. sighting of any other vessel in distress;

b. grounding or sinking of the vessel;

c. outbreak of fire or flooding in his vessel;

d. damage caused to any waterway installations or permanent structures;

e. observing uncharted obstruction or failure of navigational aid is noticed;

f. falling over board of any object which may become an obstruction or danger to navigation

g. spillage of oil into National Waterway

h. piracy or theft onboard.

5. Master or persons in charge of a vessel shall give the competent officer or any person authorized by him all necessary facilities for verifying compliance with these regulations

6. Only qualified personnel with a valid certificate of competency certificate of service or licence are employed on board the vessel as master / serang, engineer or driver and the crew

7. ensure that the crew provided is sufficiently huge and skilled to ensure the safety on those onboard and safe navigation

8. provide insurance for his vessel against third party risks

8.5.8.2 Roles & responsibility of AIWTDS for Prevention and Management of Emergency

Assistance to be provided by AIWTDS during emergencies include the following

1. Assistance during breakdown: On receiving information from vessel master, necessary assistance will be provided by AIWTDS to vessel for rescue by providing tug boats. Vessel master should coordinate with other agencies as well as required
2. Assistance during emergency as specified above in section

Chief Incident Controller (CIC):

The Chief Incident Controller (CIC) shall have overall responsibility to protect personnel, site facilities, and the public before, during, and after an emergency. The CIC shall be present at the main emergency control centre for counsel and overall guidance. Responsibilities of the Chief Incident Controller shall include the following: -

a. Preparation, Review, and Update Emergency Preparedness and Response Plan
b. Direct operational control over areas in the facility other than those affected
c. Assess the situation and decide to evacuate from the assembly points to safe location
d. Ensure that a log of the emergency is maintained in ECC
e. Liaise with Police, Local Government, Pollution Board, and other agencies and appraise on possible affects to areas outside the facility premises
f. Advise incident controller to close out the incident when the situation is under control
g. Control rehabilitation of the affected persons after the emergency

Site Incident Controller (SIC):

The Site Incident Controller shall be identified by the Chief Incident Controller and will report directly to him. Responsibilities of the Chief Incident Controller shall include the following:

a. Take charge of the incident site
b. Assess the situation and alert panel / field operators
c. Inform Chief Incident Controller (CIC)
d. Assess the level of emergency and instruct to actuate emergency siren
e. Evacuate personnel to the assembly point and then to safe location
f. Initiate action for isolation of source
g. Direct all operations within the affected areas
h. Advice firefighting & rescue personnel

i. Preserve all evidences to facilitate any enquiry

j. Assess damage & environmental / toxicity level before ALL CLEAR signal by CIC

Administration and Communication Coordinator:

Responsibilities of the administration and communication controller shall include the following:

a. Liaise with the statutory authorities.

b. Provide necessary support for the administration, welfare, transportation for control of emergency situation as requested by the CIC /SIC

c. Mobilize all the available company vehicles along with the drivers for emergency use.

d. Coordinate with neighbouring agencies for mutual aid support

e. Arrange for transport of victims to hospitals/ dispensaries on advice of medical services coordinator

Fire Safety Coordinator:

Responsibilities of the Fire and Safety Coordinator shall include the following:

a. Take charge of all fire fighting /Rescue operations

b. Guide fire fighting crew and provide logistics support for effectively combating the fire

c. Organize relieving groups for fire fighting

d. Call mutual aid member/external help in fire fighting.

e. Mobilize additional fire fighting equipment /Consumable/PPEs in consultation with coordinator- Commercial

f. Assist in assuming the risk and upgrade / downgrade the level of emergency

Medical Team Coordinator:

a. In case external medical assistance required, inform the nearest hospital for alertness and further assistance if required

b. Initiation of the medical response plan and its monitoring

c. Arrange for examination of the victim and his further treatment

d. Ensure the availability of ambulance all the time at the facility

e. Ensuring availability of water ambulance at terminal facility

Technical Services Coordinator:

a. Provide all technical inputs to ECC

b. Arrange for retrieval of necessary drawings and related documents if required.

c. Coordinate with outside technical consultants and experts and seek help if required.

d. Assist CIC with necessary information, support and resources.

e. Communicate with pollution control authorities to provide / receive (if required) necessary information.

Security Coordinator:

a. Take charge of all security functions like mobilization of security personnel, traffic control/ barricading, evacuation of personnel, threat analysis etc.

b. Assign evacuation coordinator & assembly point coordinator.

c. Mobilize additional / off duty security force for help, if necessary.

d. Liaise with local authorities in consultation with CIC for external help (as necessary) for evacuation of the neighbouring areas. If necessary, arrange for announcement through the mobile PA system for alerting the population in the surrounding areas

e. Depute security staff for managing gates and incident site.

f. Arrange and carry out head controls at assembly point and report to CIC.

Operation Team:

a. The O & M (Operations and maintenance) personnel of the project facility being first line respondent at site shall attempt to control the emergency at the initial stage.

b. Immediately inform about the emergency situation to the ECC

c. Review all operations carefully to ensure that systems in jeopardy are shut down.

d. Ensure critical operations are brought down to safer mode. It shall be done by the skilled and experience staff.

e. Evacuation of all non-responding staff from the areas in distress in crosswind direction

f. Personnel responsible for rescuing victims shall don full protective equipment

Flow of Information:

a. Control Centre shall receive the information from field either in person or from the various systems available at the facility.

b. On receipt of information, the control room shift In-charge shall actuate the EMP and notify the emergency to site incident controller.

c. Control Room shift in-charge will act as site incident controller till arrival of designated person.

8.5.9 Emergency Control Centre

Emergency Control Centre shall be the focal point in case of an emergency from where the operations to handle the emergency are directed and coordinated. Project Proponent shall ensure that the centre is equipped with adequate resources to receive and transmit information and directions from the Chief Emergency Coordinator. It should be ensured that once the hazard is declared, communications systems immediately get activated. An emergency control centre should therefore contain a well-designed communication system and required information such as:

- At least two external telephones (one incoming and the other one out going fitted with simultaneous/ selective broadcasting systems) with a PABX
- Wireless / Radio equipment (VHF/ walkie talkie/ pager/mobile)
- Inundation/vulnerability maps indicating risk zones, assembly points,
- Alternate evacuation routes, safe areas, rehabilitation centres, etc.
- Telephone directory of emergency response system
- List of all emergency equipment and personnel for evacuation, personnel protection, medical aid, etc., under the plan as well as with Govt. agencies in the district
- List of ambulances, base medical facilities, hospitals, rehabilitation centres, etc.
- Plan of the facility showing-
    - Storage area of hazardous materials

- Storage of safety equipment
- Fire fighting system
- Facility Entrance, roadway and emergency exists
- Assembly points
- Truck parking area
- Surrounding location

- Reference Books/ Chemical Dossiers
- Copies of Disaster Management Plan

8.5.10 Training and Awareness

Project Proponent shall have a process in place for the training of employees, contractors & shareholders or any other affected individual or group in the subject area. This training should cover:

- Types of emergencies that may occur
- Potential threats, hazards, and protective actions
- Components of emergency preparedness and response plan
- Individual roles and responsibilities
- Relevant standards and Codes
- Notification, Warning, and Communications procedures
- Evacuation, Shelter, and Head Count procedures
- Location and use of common emergency equipment
- Mock Drill procedure and accounting for personnel
- Techniques of accident investigations

8.5.11 Other Reference Documents

This Plan should be used in conjunction with the following documents;

- Emergency Response Plan (ERP).
- Regional Contingency Plan (Eastern coast guard).
- National Oil Spill Disaster Contingency Plan (NOSDCP).

8.5.12 Reference Framework

Some useful codes and standards that may assist in designing an Emergency Management Plan.

Reference	***Brief Description***
SOLAS, 1974	International Convention for the Safety of Life at Sea (SOLAS), 1974 a. Chapter II-2 – Fire protection, fire detection and fire extinction b. Chapter III – Life-saving appliances and arrangements c. Chapter IV – Radio-communications d. Chapter VII – Carriage of dangerous goods
International Finance Corporation (IFC)	a. Environmental, Health, and Safety Guidelines for Ports, Harbours, and Terminals
Applicable Legislation (Note* Certain requirements from these legislations may be adapted as best practices while developing EMP of the Inland Water Ways Project)	a. Manufacture, Storage and Import of Hazardous Chemicals Rule's (MSIHC Rules, 1989) http://envfor.nic.in

8.6 Cumulative Impact Assessment

The impacts were identified and verified with consultations among stakeholders like other Government Departments responsible for non-AIWTP activities, local pressure groups, and others. Additional mitigation measures identified are being now refined through feedback from other authorities with whom coordination is being undertaken through the Project Guidance Council, and informal meetings. Monitoring mechanism is being finalized based on the feedback from such meetings.

A separate stand-alone document for Cumulative Impact Assessment has been prepared for the phase-I activities of Assam Inland Water Transport Project.

Chapter 9 : Environmental Management Plan and Environmental Monitoring Programme

9.1 Introduction

The Environment Management Plan (EMP) is required to ensure sustainable development of the proposed Inland Water Transport Improvement Project on river Brahmaputra both during the construction as well as operational phases. The EMP is site and time specific. In order to effectively implement EMP, an institutional framework has been developed and roles and responsibilities of various relevant agencies have been worked out. Capacity development program are also identified and part of the EMP.

In general, Assam Inland Water Transport Development Society (AIWTDS), (with assistance from Contractor and Independent Engineer/Supervision Consultant) is the responsible entity for ensuring that the mitigation measures as suggested in the EMP are carried out. Mitigation measures for Environment and Social impacts are listed in Table 10-1. The list provides reference implementing organisation and responsible entity.

9.1.1 Specific activities by Assam Inland Water Transport Development Society (AIWTDS)

The role of Assam Inland Water Transport Development Society (AIWTDS), Government of Assam, in the implementation of EMP involves ensuring the following activities:

- EIA clearance from MOEF&CC, wherever required, and World Bank;
- Disclosure of EIA document in public domain and also in the info shop of World Bank
- Permission from line department for laying of drainage line, construction of Sulabh toilets and connection to city sewer line
- Permission for tree felling (if any)
- Monitoring and Reporting on implementation of EMP measures and corrective actions as agreed with relevant authorities

9.1.2 Specific activities by Contractor

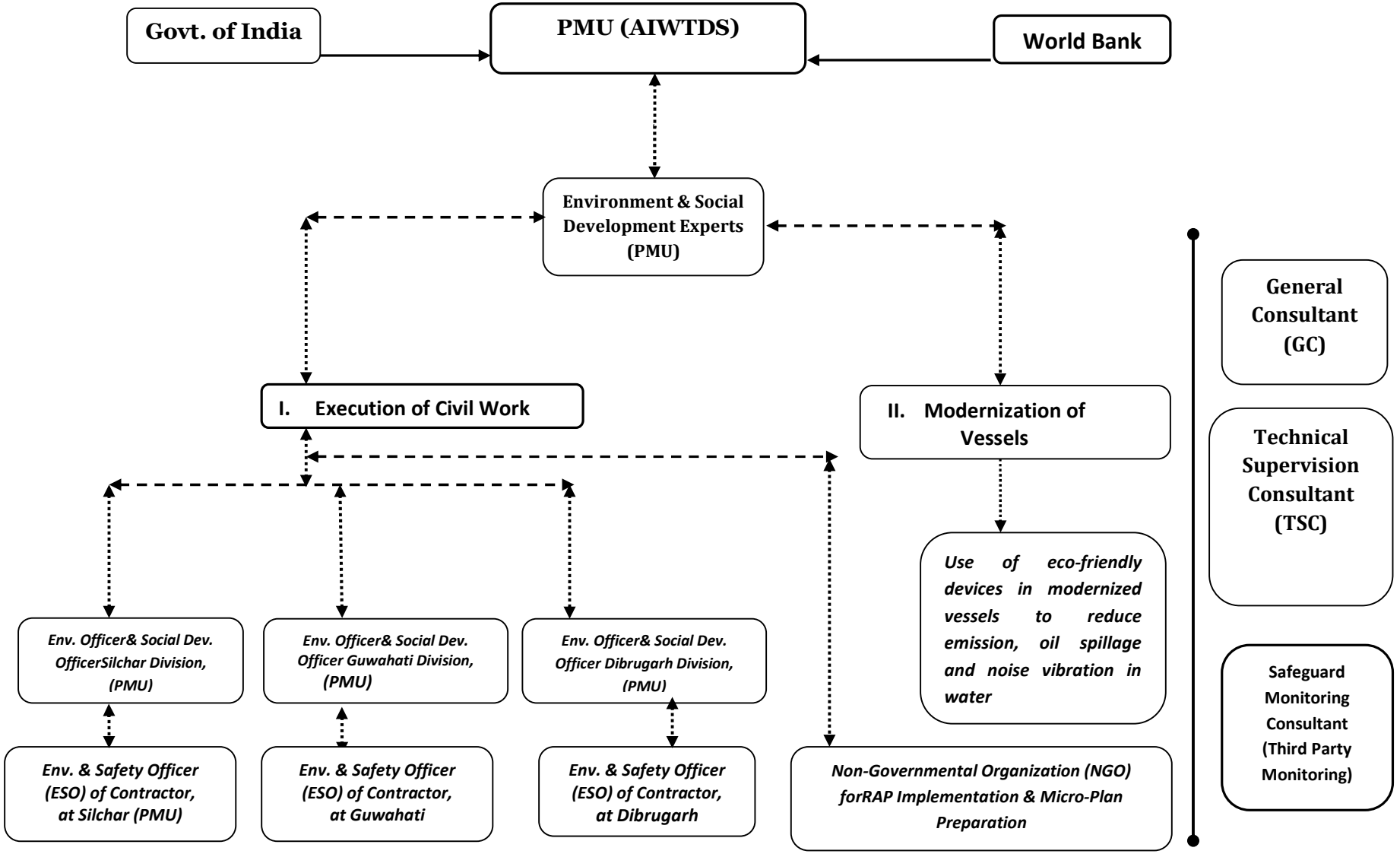
The activities to be performed by the contractor to implement the EMP shall comprise the following:

- Obtain consent to establish from State Pollution Control Board, Assam under Air and Water Acts
- Felling of trees (if at all required) with the prior permission of Forest Department;
- Finalizing the selection of material sources (quarry and borrow material, etc.) and shall follow necessary guidelines as given in **Annexure 9.1**.
- Selection, design and layout of construction areas, labour camps etc. (Refer **Annexure 9.2**)
- Undertake project activities under the contract with AIWTDS in line with relevant portions of theEMP

9.2 Implementation of EMP

The Environmental Officer of the contractor should be available for the entire duration of the project and shall be primarily responsible for compliance of EMP. The Environmental Specialist from the Independent Engineer/ Supervision Consultant shall monitor the compliance of the EMP and all the design drawings of various civil structures shall be implemented after his approval. The proposed organogram for the implementation and monitoring of EMP is presented in **Figure 9-1**.

Figure 9-1: Organization Structure for Implementation of EMP



9.3 Components of EMP

The key components of the EMP are summarized below and explained in detail in the following subsections:

- Mitigation Measures
- Monitoring Measures
- Institutional Arrangement
- Reporting Requirements
- EMP Budget

The Environmental Management Plan for proposed Terminal Project for both constructionand operational phase is given in**Table 9-1** and **9-2** respectively.

Table 9-1: Environment Management Plan for proposed Terminal Project (Construction Phase)

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
1. Site Preparation: Levelling of Terminal Site, Base cap, Construction Camp & Labour camp							
1.1 C & G and levelling of site	• Loss of vegetation. • Loss of top soil. Loss of natural resource (Earth/soil)	• Tree cutting, if any would be carried out only after obtaining NOC from Forest Department • Top soil (15 cm) would be stripped and kept separately in stockpiles for use in landscaping. • Excavated materials would be preferably used for site filling/low lying area filling and the surplus material would be disposed as per norms. • Green belt/landscaping would be developed at the site and as per the Green Belt management Plan. • Survival rate of tree would be regularly monitored. It should be minimum of 70%. • Sedimentation tanks shall be provided for storm water drain to arrest the sediments and these sediments shall be removed and stored with remaining excavated soil. • Shore protection works like stone pitching along the	Solid Waste Management Rules, 2016, Hazardous & Other Waste (Management and Transboundary) Rules, 2016 C & D waste Rules, 2016. The Water (Prevention & Control of Pollution) Act, 1974 and amendments thereof.	Construction site Labour and construction Camp Locations	During design and Construction Stage	Contractor	TSC & PMU

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		bank shall be undertaken.					
1.2 Setting of Labour & Construction Camps:	Contamination of land and water resources from waste generation.	• Construction camp location would be as per proposed Construction & Labour Camp Management Plan. • Labour camps would be located close to the construction sites to the extent possible. • Top soil (15 cm) would be stripped and kept separately in stockpiles for use in landscaping. • Excavated materials would be preferably used for site filling/low lying area filling and the surplus material would be disposed as per norms.	Solid Waste Management Rules, 2016, Hazardous & Other Waste (Management and Transboundary) Rules, 2016 C & D waste Rules, 2016. The Water (Prevention & Control of Pollution) Act, 1974 and amendments thereof.	Labour and construction Camp Locations	Construction Stage	Contractor	TSC & PMU
1.3 Sanitation, Health & Safety:	Unhygienic and unsafe living and working condition.	• Hygiene in the camps would be maintained by providing good sanitation and cleaning facilities. • Camp would be well ventilated with adequate provision for illumination,					

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		kitchen and safe drinking water. Proper drainage to be maintained around the sites to avoid water logging. • Proper sanitation with toilet and bathing facilities would be provided at the sites and labour camps. Wastewater generated from these facilities would be disposed through septic tanks and soak pit • Preventive medical care to be provided to workers • Segregated solid waste would be disposed of at municipal solid waste disposal location. If municipal solid waste site not available then waste should be land fill following local regulations. • LPG will be used for cooking in construction camps • Provision would be made for day crèche for children • First aid facilities, with room, personnel and ambulance would be available at the site. Also, tie-up with local hospitals would be done to handle					

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		emergency case, if any • Rest area would be provided at the site where workers can rest after lunch and should not lie on site anywhere • Working hours of labourers would not exceed than standard norms as per Factory Act • Wastewater from construction site would not be allowed to be accumulated as it may lead to breeding of mosquitoes. Septic tanks/soak pits would be provided for its disposal • Temporary storm water drainage system would also be provided at camp site so that no water logging takes place					
1.4 Waste Management	Generation of solid, liquid and hazardous waste	• Arrangement should be made for segregation of waste into recyclable and non-recyclable waste • Non-recyclable waste generated should be disposed regularly through authorized agency. Recyclable waste should be sold to authorized vendors.					

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		• Construction waste generated should be segregated at site into recyclable, reusable & rejected fraction. Recyclable should be sold to authorized vendor, reusable waste should be stored at site for usage and rejected fraction should be disposed at designated sites of the municipal authority • If no debris or waste disposal site exists in the area then a site would be identified with approval of AIWTDS and would be used & manage for the same as per the Debris Management Plan. • Any waste oil generated from construction machinery, should be stored on concrete platform and disposed off to authorized recyclers.					
2. Climate							
2.1 Climate Change	Project is unlikely to cause negative effect on climate. However, project	• Daily monitoring of the CWC Gauge data at Pandu Ghat (for North Guwahati & GGG Ghat) & Neamati	Kyoto Protocol, Forest Conservation Act & National	Construction site	During Design and construction stage.	Contractor	TSC & PMU

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
	can contribute positively for climate	Ghat (for Aphalamukh Ghat) • Regular interaction mechanism with Indian Meteorological Department (IMD) for early forecasting to avoid casualties • Working jointly with State Disaster Management Authority, State Disaster Response Force (SDRF) & National Disaster Response Force (NDRF) during emergency situation • Awareness programme with staff, passengers and contractors on Climate Change. • Project would be designed in a way to minimize the tree cutting. As far as possible trees along the terminal boundary will be retained as part of greenbelt. • If any tree cutting will be required at any terminal it shall be carried out only after obtaining NOC from Forest Department. • Shifting to alternative energy options like solar energy • Adoption of best practices	Forest Policy				

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		to cut down resources and energy requirement					
3. Air Quality							
3.1 Air Pollution	Dust Generation due to construction activities and material handling. Emission from machinery, DG and vehicular movement.	• No crushers or Batching plants will be located at the sites. Ready mix concrete will be used. These considerably reduce the emission. • Low sulphur diesel would be used for operating DG sets and construction equipment. • Periodic monitoring of air quality for PM_{10}, $PM_{2.5}$, SOx, NO_x, and CO shall be carried out quarterly at construction site • Regular water sprinkling/fogging to suppress the dust generatedat site, approach road & haulage roads. • Proper servicing and maintenance of earth moving vehicles and other machinery to minimize the emission generation • Vehicles transporting the loose and fine materials like sand and aggregates shall be covered. • Masks and other PPE shall be provided to workers in	Environmental Protection Act, 1986 and amendments thereof; The Air (Prevention and Control of Pollution) Act, 1981 and amendments thereof	Construction sites, Loading areas, storage areas,	During the Construction phase	Contractor	TSC & PMU

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		high dust generation area • Loading and unloading of construction materials shall be made at designated locations with provisions of water sprinkling. • Construction vehicle, machinery & equipment shall be regularly serviced and maintained and would have valid PUC certificate • Monitoring of air quality shall be carried out on quarterly basis to check the level of pollutants and effectiveness of mitigative measures •					
4. Noise							
4.1 Noise Pollution	• Noise generation from construction activity. • Noise generation from operation of vehicle, equipment and machinery.	• Protection devices (earplugs or ear muffles) shall be provided to the workers operating near high noise generating machines. • Barricading (Temporary noise barrier) around the construction site to minimize the noise level • Restriction of high noise generating activity between 10:00 PM to 6 AM. • Restriction on Honking at the project site	Noise Pollution (Regulation and Control) Rules, 2000 and amendments thereof	Terminal site and access roads.	During the Construction stage	Contractor	TSC & PMU

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		• Job rotations systems for workers, working in high noise level areas • Periodic monitoring of noise levels to check the level of pollutants and effectiveness of proposed EMP					
5. Water Quality							
5.1 Water pollution	Surface water pollution and Depletion of Groundwater due to abstraction for construction purpose.Siltation due to construction of terminal and contamination due to disposal of domestic waste	• Preference would be given to use river water for construction with permission from concerned authorities • In case of use of ground water, permission will be obtained from CGWA/CGWB • Water monitoring to be carried out as per monitoring plan. • Natural Drainage pattern of area shall be maintained by making a proper drainage network in project site. • Washing of vehicle and equipment shall not be carried out in river or nearby place. Washing area would be in a designated area with oil & grease trap. • Storage of debris and raw materials would be in	Water Act, 1974	Terminal site	During Construction stage	Contractor	TSC & PMU

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		designated area clearly demarcated. • Site would be regularly cleaned • Septic tank/soak pit shall be provided for the toilets at both construction site as well as workers camp. Adequate toilets & bathrooms shall be provided to prevent open defecation. Use of mobile toilets with anaerobic digestion facility would be explored. No domestic wastewater shall be allowed to be discharged to river. • Wastewater, generated from the washing/cleaning area after passing through oil & grease trap shall be re-used for water sprinkling. • Fuel shall be stored in leak proof containers and containers shall be placed on paved surface under shed. • The piling work in river shall be undertaken during low flow period. • Turbidity traps/curtains/ Geo-Textile synthetic sheet					

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		curtain would be placed around piling and construction area to prevent movement of sediments and construction waste. • Sedimentation tanks shall be provided for treating run-off from site before discharging into the river. • Proper collection, management and disposal of construction and municipal waste from site shall be made to prevent mixing of the waste in run-off and entering the water bodies • Monitoring of surface water quality shall be carried out on quarterly basis to check the level of pollutants and effectiveness of proposed EMP					
6. Accident, Incident and Safety Risks							
6.1 Health & Safety	Accident and Incident risk from construction activities and safety of workers Impact on Social life.	• Local labour would preferably be employed for construction. • Site would be barricaded and would have security guards. • Resister would be maintained for entry to the construction sites. No	BOCWA & BOCWR Central Motor Vehicle Act 1988 EP Act 1986	Terminal Site and the material source areas and haulage roads Construction sites	During Construction stage	Contractor	TSC & PMU

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		unauthorized person would be allowed to enter the site. • A board in local language at entrance of site would display name of project, area and hazards associated for public awareness • Adequate illumination would be provided at site during evening and night time till the work is being carried out • Rest area for workers would be provided. • Personal protective equipment like helmet, gum boots, safety shoes, safety jackets, ear plugs, gloves etc to be provided to workers. Fines would be levied if they are found not using PPE • Noise level in the work zone would be maintained and followed as per OSHAS norms • Contractors would adopt and maintain safe working practices. SOPs would be prepared and followed for all activities under supervision of site engineer • Training would be given to	Noise Rules 2002				

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		workers to handle the heavy equipment so as to prevent accidents • Complete medical check-up would be done for workers prior to joining and after six months of joining • Emergency telephone nos.of hospitals, ambulance and doctors would be displayed in first aid room. • Working hours of labour should not exceed norms as per state factory law • Speed limit of vehicles would be restricted at site to prevent any accidents and fines would be imposed for violation. All construction vehicles would follow the designated routes & timings. • Arrangement of fire-fighting would be made at site and workers would be trained on their use. • Maintenance and repair of any local village road used for the project activities should be carried out both before and end of construction by contractor.					
7. Protection of Flora and Fauna							

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
7.1 Loss of Biodiversity	• Loss of terrestrial flora & fauna. • Loss of Aquatic Fauna including Dolphins and macrophytes	• Caution sign shall be placed to prevent hunting of animals • Construction activities shall be restricted to 6:00 Am-10:00 Pm especially noise generating activities. • No hazardous material or waste shall be disposed in the land or nearby area as it may harm the animals, if consumed accidently • Site should be barricaded to prevent entry of the animal in the site • Illumination at the night time should be reduced (if no activity is going on) as it may disturb the nocturnal animals • Workers should not use any timber or firewood as fuel for any purpose • The river area in which the piling is planned, advisable to carefully determine drop sites before anchor placement	Wild Life (Protection) Act, 1972, Bio-diversity Conservation Act, 2002	Terminal site/construction camps Around Piling/dredging Area	During design and construction stage	Contractor	TSC & PMU

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		to ensure that Dolphin and fish communities that could locally still be present in the area are not unnecessarily damaged. • Before starting piling allow some time to aquatic fauna to displace from the piling area. • Bubble curtains can be provided at the time of pilling to displace the aquatic fauna prior start of construction activities • The piling activities must be carried out in shortest possible timeframe. • All the debris should be disposed away from river course. • Noise reducing devices like mufflers, enclosures shall be fitted with the equipment as much as feasible. • Fish exclusion devices shall be installed in water column around the pile driving area to prevent					

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		fish access • Geo Textile synthetic sheet curtain &turbidity traps shall be placed around piling and construction area to prevent movement of sediments and construction waste • Piling/dredging should be stopped for some time, if any dolphin/turtle/RET species is sighted in activity area • Aquatic ecology monitoring should be carried out prior to start of construction and after completion of construction to assess the impact of construction activities on aquatic life.					
Dredging	Generation of suspended sediments causing an increase in turbidity, destruction of benthic environment and change in river	To prepare Dredging plan including timeframe To stop dredging during breeding & spawning season (June to August) To use turtle & Dolphin deflectors at		Terminal site/construction camps Around Piling/dredging Area	During design and construction stage	Contractor	TSC & PMU

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
	morphology & spillage during transportation	sensitive location • Contractors need to submit SOPs and action time chart with risk management plan prior to any dredging work. Dredging sub-contractor should follow the defined safety procedures to avoid accidents and spills, and AIWTDS will ensure that other vessel users are provided with adequate information and instruction to avoid conflict with the dredgers.					
Cultural & Heritage Resources	• Temporary diversion of access towards cultural resources, temples; • Safety issues to devotees during the construction stage various construction activities. etc. • Chances of	• Adequate diversion signs shall be displayed in the access route for the devotees towards these cultural heritage and temples. • Warning signs shall be given if there is any large excavation work done or scaffoloing put thereof		Near the Heritage Site	During design and construction stage	Contractor	TSC & PMU

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
	vibration impact to these cultural resources during the construction work;						
Labour Influx	• Influence in the demographic composition • Increased demand and competition for local social and health services • Social conflicts between the local community and the construction migrant workers. • Increased rates of illicit behaviour and crime against women, which is a real threat for Assam where gender-based violence is rampant • Increase competition for	• Specifications on employment of local workforce including women should be reflected in the civil works bidding documents and subsequent contracts to ensure that the contractors fulfil these commitments. Locals including women may be screened further for skills, and adequate orientations can be provided to recruit for the work. AIWTDS can prepare a roster of interested workers and their skills • The project contractor needs to prepare a site-specific Labour Influx Management Plan and/or a Workers' Camp Management Plan. • Security personnel will be deployed at the construction sites, and emergency nos.		Construction Area	During design and construction stage	Contractor	TSC & PMU

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
	jobs and have an impact on wage distribution	including contact details of local law enforcement officers, project's helpline no., existing state-run women helpline nos. will be prominently displayed at the site. The contractors will ensure that an Internal Complaints Committee (ICC) for each establishment is set-up to meet their corporate requirement and legal mandate under the Sexual Harassment at the Workplace Act, 2013. 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 the requisite staff, free medicines and minimum medical facilities to tackle first-aid requirements or minor accidental cases, linkage with nearest higher order hospital to refer					

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		patients of major illnesses and critical cases. • Awareness camps on HIV/AIDS for both, construction workers and neighbouring villages must be organised at regular intervals by NGOs empanelled with NACO. • It is expected that among the women workers there will be mothers with infants and small children. The provision of a day care crèche as per the Building and Other Construction Workers (regulation of employment and conditions of service) act, 1996 is the contractor's responsibility. The crèche should be provided with trained women to look after the children. • In case work schedule extents up till night, it should be ensured that women workers are exempted night shifts.					

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
8. Repairing & Retrofitting of vessels of IWT:							
Repairing & Retrofitting of vessels of IWT	The reparing and retrofitting of vessels involve replacement of old machineries with latest one. In the process the waste water is likely to be generated from the washings and contaminated with oil and grease. The waste generated from repairing will be asbestos, ferrous and non ferrous scraps, plastics, packings, oil contaminated cotton, paint waste etc. in addition to this, used engine oil and oily sludge are likely to be generated.	• Wastewater will be passed through oil and grease trap and treated in STP. • The contaminated waste will be seggregated and kept in separate drums/bins under shed. • The used oil will be collected in leak proof drums and kept under shed. • The waste will be categorised as recycleable, incinerable and land disposable. • Used oil and mettalic waste will be sold to authorised recyclers. • The incinerable waste such as oil contminated cottons, filters, waste oil sludge, paint waste etc will be disposed of in authorised common incinerator. • Land disposable waste such as wood, fibers etc will be disposed of in authorised common hazardous waste	Hazardous & Other Waste (Management and Transboundary) Rules, 2016 The Water (Prevention & Control of Pollution) Act, 1974 and amendments thereof.	Pandu	Design & Construction Phase	Contractor	TSC & PMU

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		treatment, storage and disposal facilities (TSDF).					

Table 9-2: Environment Management Plan for proposed Terminal Project (Operation Phase)

Component	Environmental Attribute and potential impacts	Remedial Measures	Relevant laws/ Contracts	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
1.0 Climate							
Climate Change	Project is unlikely to cause negative effect on climate. However, project can contribute positively for climate	• Greenbelt shall be developed all along the terminal premises. • Energy efficient measures in the terminal buildings will be implemented • Solar power will be used in potential area	Kyoto Protocol, Forest Conservation Rules & National Forest Policy	Terminal site	Operation and maintenance	IWT	IWT
2.0 Air Quality							
Air Pollution	Emission from machinery, ferry, DG and vehicular movement.	• Only Passenger ferry will be handled in the terminal hence no dust pollution anticipated. • Green belt shall be developed and maintained as per lay out • Local Species selected for development of green belt. • Water sprinkling would be provided in dust generating areas • DG exhaust will be minimised by regular	Environmental Protection Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981	Terminals	Operation and maintenance	IWT	IWT

Component	Environmental Attribute and potential impacts	Remedial Measures	Relevant laws/ Contracts	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		maintenance in AMC • Monitoring of air quality shall be carried out on quarterly basis to check the level of pollutants and effectiveness of EMP • Ferries, deployed, will have efficient fuel combustion system with minimum emission					
3.0 Soil Erosion							
Soil Erosion and management.	• Soil erosion of embankment during heavy rainfall.	• Periodic checking of the slope stabilization measures (stone pitching or otherwise) would be carried to assess the damage if any. Necessary measures for repair shall be followed wherever there are failures	Project requirement	Along river bank and Embankment	Regular surveillance during operation	IWT	IWT
4.0 Wastewater Management							
Water pollution	• Surface water pollution. • Siltation and erosion and contamination due to disposal of domestic waste	• STP (10KLD) would be provided to treat the sewage generated. Treated water would be used for horticulture and plantation purpose at the site • Storm water drainage system would be provided at the site. • Rain water harvesting facility would be developed and maintained • Oil interceptors shall be	Project requirement	Terminal and vessels	Operational Phase	IWT	IWT

Component	Environmental Attribute and potential impacts	Remedial Measures	Relevant laws/ Contracts	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		provided with the storm water drains in the parking lots & loading &unloading areas • Fuel shall be stored in leak proof containers and containers shall be placed on paved surfaces so that no spill occurs • Fuelling of vessels will be leak proof system • Quarterly Monitoring of surface water quality shall be carried out to check the level of pollutants and effectiveness of EMP					
5.0 Noise Control							
Noise Pollution	• Noise generation from operation of vehicle, equipment and machinery.	• Timely maintenance and servicing of transportation vehicles and the machinery/pumps/vessels to be used during operation phase to reduce the noise generation. • Honking shall be prohibited at the project site • Hearing test for the workers shall be undertaken before employing them and thereafter shall be done after every six months • DG sets shall be provided with acoustic enclosure	Noise Pollution (Regulation and Control) Rules, 2000	Access Road & Terminal Site	Operational phase	IWT	IWT

Component	Environmental Attribute and potential impacts	Remedial Measures	Relevant laws/ Contracts	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		• Monitoring of Noise levels shall be carried out on quarterly basis to check the level of pollutants and effectiveness of proposed EMP					
6.0 Accidental Risk							
Accident and Incident.	Accident risks associated with traffic movement.	• Traffic control measures, including speed limits should be enforced strictly.	Project requirement	Access Road	Operational phase	IWT	IWT
	Accidents due to Movement of Vessels and other hazards associated with site	• Further encroachment of squatters within the ROW of approach road will be prevented. • Monitor/ensure that all safety provisions included in design and construction phase are properly maintained • Adequate illumination should be provided at the site during evening	Project requirement	Throughout the Project route	Operational phase	IWT	IWT
7.0 Vessel Repairing							
Water pollution and waste management	Generation of wastewater and hazardous waste	• Wastewater generated from washings is normally contaminated with oil. Therefore, wastewater will be passed through oil water separator and treated in STP.	HW Rules, 2016. EP Act, 1986	Vessel Maintenance Unit	Operational phase	IWT	IWT

Component	Environmental Attribute and potential impacts	Remedial Measures	Relevant laws/ Contracts	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		• Bilge and other water will be treated as above • Wastewater evacuation system would be leak proof and no untreated wastewater would be allowed to discharge to river • Treated wastewater will be used for plantation, lawn and garden to the maximum extent possible • Used and waste oil will be collected separately by adopting leak proof arrangements • Used oil will be stored under shed and will be auctioned to authorised recycler. • Hazardous waste will be stored separately under shed and disposed in Common TSDF • Non-hazardous scraps, plastics will be collected separately and sold as scrap • Domestic waste will be segregated and hand over to facility of local body					
8.0 Flora & Fauna							

Component	Environmental Attribute and potential impacts	Remedial Measures	Relevant laws/ Contracts	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
Biodiversity loss	Loss of Aquatic Fauna including Dolphins and other macrophytes	• Propeller shall have net system to avoid any accident with dolphins and other aquatic animals. • No wastewater or waste shall be disposed in river from terminal site or from vessel into the water. Penalty shall be imposed on the vessels reported disposing waste/wastewater in the river • Run-off from stockpile area, storage yards, parking areas & roads shall not be disposed directly in to river. • Instruction should be given to all vessels and all employee and staff that no dolphin or any other endangered species shall be harmed due to any reason • Instruction shall be given to vessel operator that in case any accident with dolphin occurs that should be reported immediately to terminal authority	Forest Conservation Act 1980, Wild Life Protection Act, 1972	Project tree plantation sites. Terminal site and surrounding area	Operational phase	IWT	IWT

Component	Environmental Attribute and potential impacts	Remedial Measures	Relevant laws/ Contracts	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		• Waiting time of vessels shall be reduced at the terminal/lock sites by providing the adequate loading and unloading equipment and vehicles. • Vessels shall be instructed for not using sharp lights and sounds all the time as they may disturb aquatic organisms.					
9.0 Repairing & Retrofitting of vessels of IWT:							
Repairing & Retrofitting of vessels of IWT	The reparing and retrofitting of vessels involve replacement of old machineries with latest one. In the process the waste water is likely to be generated from the washings and contaminated with oil and grease. The waste generated from repairing will be asbestos, ferrous and non ferrous scraps, plastics, packings, oil contaminated cotton, paint waste etc. in addition to this, used	• Wastewater will be passed through oil and grease trap and treated in STP. • The contaminated waste will be seggregated and kept in separate drums/bins under shed. • The used oil will be collected in leak proof drums and kept under shed. • The waste will be categorised as recycleable, incinerable and land disposable. • Used oil and mettalic waste will be sold to authorised	Hazardous & Other Waste (Management and Transboundary) Rules, 2016 The Water (Prevention & Control of Pollution) Act, 1974 and amendments thereof.	Pandu Repairing & Retrofitting of vessels of IWT	Design & Construction Phase	Contractor	TSC & PMU

Component	Environmental Attribute and potential impacts	Remedial Measures	Relevant laws/ Contracts	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
	engine oil and oily sludge are likely to be generated.	recyclers. • The incinerable waste such as oil contminated cottons, filters, waste oil sludge, paint waste etc will be disposed of in authorised common incinerator. • Land disposable waste such as wood, fibers etc will be disposed of in authorised common hazardous waste treatment, storage and disposal facilities (TSDF).					

9.4 EMP Monitoring Programme

EMP Monitoring Programme is very importantand refers to systematic review of implementation of Environment Management Plan during Construction and Operation Phase of the project. One of the objectives is to evaluate environmental performance and ensure effectiveness of mitigation measures. Another important objective of EMP monitoring is to verify the impact of the project on the predicted environmental components. To ensure the effective implementation of EMP, it is proposed to undertake environmental monitoring both during construction and operation period.

A three-tier monitoring program has been proposed. They are:

- Compliance monitoring,
- Effects monitoring, and
- External monitoring.

The main purpose of this monitoring program is to ensure that the various tasks detailed in the EMP are implemented in an effective manner, and also to evaluate program impacts on the key environment and social parameters.

9.4.1 Effects Monitoring

Effects monitoring is a very important aspect of environmental management to safeguard the environment. The monitoring will comprise surveillance to check whether the contractor is meeting the provisions of the contract during construction (assuming 3 years) and operation of the project (assuming 3 years which will get repeated as per the SPCB consent) including the responsible agencies for implementation and supervision. This exercise will ensure that the receptor environment is not adversely affected.

9.4.2 Third Party Monitoring

The AIWTDS will engage an independent consulting firm to conduct external and independent monitoring of the EMP implementation. The main purpose of the external monitoring will be toensure that all the key entities including E&SConstruction Supervisor, and contractors are effectively and adequately fulfilling their designated role for EMP implementation and that all the EMP requirements are being implemented in a timely and effective manner. This monitoring should be on-going throughout the project life-cycle and must be implemented to ensure that environmental impacts are within the predicted levels and that specified environmental performance targets are being achieved.

The objective of appointing an independent consultant is to review and monitor the performance on the basis of detailed on-site review, examination of EIA document and interaction with the PIU, and other stakeholders. The scope of services of the Third party monitoring (TPM) is described below in **Table 9-3**.Review visits at a frequency higher than that mentioned below, shall only be undertaken at the express request from the PIU.

Table 9-3: Nature, Method and Timing of Review

Sl. No	Nature of review	Timing	Method of review
1.	Review of project design document	• On completion of design ofproject	• Design documents and drawings
2.	Review of bid documentation and bid process	• Review of documentation • During bidding process initiation	• Proof of advertisement, letters, and correspondence Bid Documents, contract agreements
3.	Review of site preparation and clearances	• Prior to start of construction	• Inter departmental correspondences Official records
4.	Review of Project Management Systems	• After deployment of Project Management Systems	• As per official records Observations Discussions with PIU
5.	Report on Physical progress of EMP implementation	• After handing over the site tocontractor/ during Construction period	• Reports and documents submitted by PIU • Review of milestones as per Contract agreement Discussions with PIU
6.	Compliance to the statutory requirements	• Pre-Construction, during Construction and Post-Construction	• As per the MoEFCC guidelines • EMP document for the project. • Compliance with relevant legislation / rules
7.	Safety and Health	• Construction and Post-Construction stage	• As per relevant standards/ good practices / contracts
8.	Progress of Resettlement and Rehabilitation	• During Pre-Construction and Construction stage if the Land acquisition process is not completed.	• As per R&R Action Plan submitted along with PR/Land acquisition proposal submitted, Records of Competent Authority • No. of court cases against land acquisition for the project

9.5 Institutional setup for Effective EMP Implementation and its Monitoring

The Project implementation will be led by the Project Implementation Unit (PIU) that will be established within AIWTDS. The PIU will be responsible for procurement of consultants for carrying out the various studies related to EMP. The PIU will be headed by the Project Director (PD).

The PIU consists of an Environment and Social (E&S) Cell with environmental & social expert. This E&S Cell will assist the PMU on issues related to environmental and social management and oversee the Construction Supervision Consultant (CSC) and contractors and will compile quarterly monitoring reports on EMP compliance, to be sent to the Project Director and also shared with the World Bank, throughout the construction period.

The E&S Cell will also provide trainings to the AIWTDS field personnel, responsible for monitoring of environmental compliance during both construction and O&M phases of the project.

The overall responsibility of environmental performance including EMP implementation of the Project will rest with the PIU. Aside from their in-house environmental and social specialists, the PIU will engage construction supervision consultants (CSC) to supervise the contractors including on their execution of construction-related environmental and social management requirements and measures. The CSC will ensure adherence to the design parameters including quality requirements, as well as all EMP measures.

The CSC will supervise and monitor the contractors for effective EMP implementation. The contractors in turn will also have HSE supervisors who will ensure EMP implementation during construction activities and will be tasked to develop necessary detailed plans as per this EMP, and oversee their implementation.

9.6 Environmental Codes of Practices

The environmental codes of practice (ECoPs) are generic, non-site-specific guidelines. The ECoPs consist of environmental management guidelines and practices to be followed by the contractors for management of all environmental issues. The contractor will be required to follow them by preparing site-specific management plans. The ECoPs are listed below and attached in **Annexure 7-1**.

- ECoP 1: Waste Management
- ECoP 2: Fuels and Hazardous Substances Management
- ECoP 3: Water Resources Management
- ECoP 4: Drainage Management
- ECoP 5: Soil Quality Management
- ECoP 6: Erosion and Sediment Control
- ECoP 7: Top Soil Management
- ECoP 8: Topography and Landscaping
- ECoP 9: Borrow Areas Management
- ECoP 10: Air Quality Management
- ECoP 11: Noise and Vibration Management
- ECoP 12: Protection of Flora
- ECoP 13: Protection of Fauna
- ECoP 14: Protection of Fisheries
- ECoP 15: Road Transport and Road Traffic Management
- ECoP 16: River Transport management
- ECoP 17: Construction Camp Management
- ECoP 18: Cultural and Religious Issues
- ECoP 19: Workers Health and Safety
- EcoP 20: Dredging Management

9.7 Performance Indicators for EMP Implementation and Monitoring

For evaluating the performance of the environmental management and monitoring plan, performance indicators are identified to evaluate the efficiency. The indicators are defined both for construction and operation phase. Construction Supervisor will be responsible for compiling the information on these indicators and report to AIWTDS. To measure the overall environmental performance of the project, a list of performance indicators is given below. Number of inspections carried out by Construction Supervisor per month

- Number of non-compliances observed by Construction Supervisor
- Availability of environmental specialists
- Availability of environmental specialists.

- Availability of environmental specialists with contractors.
- Timely reporting of documents (as defined in EMP and monitoring plan)
- Number of trainings imparted to stakeholders/other capacity building initiatives
- Number of grievances received.
- Number of grievances resolved.
- Number of construction related accidents
- Air and water quality data.

9.8 Implementation Schedule

EMP Implementation Schedule (Monthly Track Chart for Monitoring of Contractor's Activities) is presented in **Annexure 9-3**. TPM report will be released on the basis of monthly contractors monitoring report. The format is provided in **Annexure 9-4**.

9.8.1 Implementation Environmental Management Plan during Construction Phase

EMP implementation by contractor can be achieved by following ways:

- Incorporation of contractor's EMP in bid document and should have full-fledged environment health and safety management cell (E&S Cell) to ensure the implementation of the EMP and the SHE policy
- The contractor E&S cell should have necessary experience in the field of Environment
  Health and Safety.
- Contractor should stipulate to the ECoPs designed for the project
- The contractor E&S cell should function in close coordination with PMU of AIWTDS and PMC to the project.
- The contractor E&S cell should submit the EMP compliance and applicable regulatory and AIWTDS E&S systems compliance on monthly basis.
- Mandatory Deputation of environmental and social expert (by contractor) at site Linking payments of the contractor to environmental performance Assigning penalties in case the environmental safeguard measures are not taken up adequately
- Appointing CSC to monitor the performance of contractor and compliance of the EMP by contractor. CSC is responsible to communicate the status of compliance/non-compliance to project proponent and suggest the measures to be taken to contractor to meet the gaps/non-compliances.
- CSC can be appointed by AIWTDS through tendering process again and the company's having experience of managing similar kind of projects should only be appointed for the work.

Table 9-4: Responsibility separation between TSC, SMC and AIWTDS

Organizations	Responsibilities
PIU	• Ensure that all project activities are well-managed and coordinated. • Recruitment of consultants for EIA and engineering designs; • Procurement of works and goods. • Payment of compensation to the project affected • Recruitment and supervision of external monitor and independent

Organizations	Responsibilities
	Panel of Experts
Environmental Expert & Social Development Expert within PIU	• Responsible for screening and determining scope of EA work required for Component B activities and studies, assisting PD with developing TORs and hiring of consultants to carry out any required environmental assessment work for Components B, reviewing consultant deliverables related to environmental assessment, reviewing bid documents for inclusion of EMP measures, supervising construction activities, producing periodic monitoring reports, • Ensuring inclusion of EMP in bidding documents • Closely coordinate with other concerned agencies, local governments and communities to support implementation of EMP • Preparation of progress reports on implementation of EMP. • Ensure effective implementation of EMP components not directly tasked to the contractor including components dealing with indirect, induced and cumulative effects, as well as operations and maintenance stage plans and measures. • Commissioning and oversight/review of consultant reports for EIAs/EMPs to be developed for the subcomponents of the Project
EIA Consultants	• Carrying out EIA studies in compliance with the MoEF&CC and World Bank guidelines following the EMF • Preparing EMP for inclusion in the bid documents
Design Consultant	• Prepare Detailed Project Report (DPR), Front End Engineering Design (FEED) and tender document • (as per World Bank guidelines) for development works amounting to approx. US $100 million, selected basedon assessment of output provided by ISDP Consultant. • □ Task 1 - Detailed Design, Engineering & Preparation of DPR • □ Task 2 - Preparation of Bid Document • □ Task 3 - Draft TOR for Supervision of Works • Modularization of design elements for passenger (and cargo) ferry terminals & development of customizable design models for future interventions • For the sake of clarity, the above scope will involve carrying out the following basic tasks / activities: • a) Collect the relevant data, review and assess the earlier reports provided by the ISDP Consultant in detail for the declared feasible sites/banks, proposed terminal size and associated costs. • b) Based on the finalized sites as per ISDP Consultant / Client, carry out site surveys and investigations to • assess the underlying soil conditions, river bed levels and topographic levels for the adjacent land. • c) Planning and Design of fixed / floating infrastructure for terminal development to cater primarily for passengers (including those with cargo facilities). • d) Carry out Front End Engineering and Design for the terminal works (water and landside) along with cost estimate and construction schedule of the works. • e) Preparation of Detailed Project Report based on activities listed from (a) to (d) above along with FIRR and EIRR. • f) Preparation of Tender Documents for each of the sites. • 1.4 Project Organization and Deployment Details • The services required for the project will be performed by an integrated and multi-disciplinary team of key experts and support team mentioned in the section below.

Organizations	Responsibilities
TSC	• Supervise and monitor Environmental and Social safeguard components as per the management Frameworks, during implementation phase • Supervising contractors for EMP implementation • Prepare monthly reports and submit to PMU • GC will have dedicated environmental and social staff • Supervise civil works, ensuring compliance with all design parameters including quality requirements • Supervising contractors for EMP implementation • Prepare monthly reports and submit to PIU
Contractor	• Responsible for implementation of mitigation and monitoring measures proposed in the EMP • Each contractor will recruit an Environmental, Health, and Safety Manager, who will be responsible for implementing the contractors' environmental, health and safety responsibilities, and liaising with government agencies. S/he will have adequate number of staff to support him/her for these tasks.
Safeguard Monitoring Consultant(3rd party)	• Independent monitoring of implementation of EMP • External Monitoring and evaluation

Table 9-5: Proposed Roles & Responsibility on Environmental Management of Key Expert as per Organogram

SL.No	Expert Position	Roles & Responsibilities
1	Environmental Specialist	• Environmental Specialist will be overall responsible to provides direction, instructions and guidance to other experts under the E&S Cell working on this project • Responsibility to execute & implement EMF, EIA &EMP through design DPR Consultant, contractors etc. • Assist the Environmental Specialist of the Design Consultants and Contractor in preparation of the training materials and in conducting training; • To obtain mandatory statutory clearances. related to project • Consult with and advise individuals such as administrators, social workers, and legislators regarding social issues and policies, as well as the implications of research findings • Carry out site inspections, check and undertake periodic environmental monitoring and initiate necessary follow-up actions; • Document the good practices in the project on incorporation and integration of environmental issues into engineering design; • Facilitate and coordinate with the Safeguard monitoring consultant (3rd Party). • Assist in the preparation of periodic reports for dissemination to the PIU, and World Bank. • Any other tasks specified by the SPD
2	River Specialist/ Hydrologist	• Carry out site inspections, check and undertake periodic environmental monitoring and initiate necessary follow-up actions • Measure the properties of bodies of water, such as volume and stream flow at regular interval • Collect water and soil samples to test for certain properties,

		such as the pH or pollution levels, sediment load etc. • Analyse data on the environmental impacts of pollution, erosion, drought, and other problems • Research ways to minimize the negative impacts of erosion, sedimentation, or pollution on the environment • Looking after the hydrology properties in the project at different stages and report the findings and recommendation to Environmental Specialist. • Review, evaluate, and analyse work environments and design programs and procedures to control erosion • Any other tasks specified by the SPD and Senior Environmental Specialist
3	Marine Expert/IWT Specialist:	• Responsible for all Marine Design related works. • Responsiblefor policy / guidelines of Central / State Govt. Related toIWT matter. • Responsible for supervising /marine works related to IWT Projects. • Technical and contractual aspects of the projects. • Supervise project clearances for the project.

9.8.2 Integrated Grievance Redress Mechanism

AIWTDS has established a Grievance Redress Mechanism (GRM) which will be implemented by Project Implementation Unit (PIU) under leadership of Advisor (Administration) as GRM Officer. A formal grievance redress process will be outlined in the project's operational manual and a protocol will be set up.The griviencesubmission mechanism should be online or though toll-free communication system. It is envisaged that the PIU will have a dedicated person who can oversee the grievances and appropriately redress it.

This GRM shall serve as part of AIWTDS Environmental and Social Management system. The GRM is based on four guiding principles of the company which include:

- Transparency
- Fairness
- Respect
- Accountability

9.8.3 Capacity Building / Training and environmental awareness

Capacity building for effective implementation EMP is highly essential. Capacity building on environmental and social safeguard is required for all levels stakeholders, including AIWTDS, E&S Cell of AIWTDS, supervisor, and contractors. The PMU is staffed with senior experts in technical and engineering fields, procurement, environmental and social development, business development strategy, legal, communications, and finance. PIU i.e. AIWTDS under state IWT will be project development team having Transport Specialist, Advisor, Financial Specialist, Assistant Procurement Engineer, Environmental Specialist and Social Specialist. Four project preparation consultants have been appointed to help the PIU i.e. Design Consultants (ISDP), an ESIA Consultant, ISBP Consultants i.e. business development studies and Design DPR Consultants.

At the construction site, supervisor will take the lead in capacity building plan.The contractors will also be responsible to conduct trainings for their own staff and workers. Table 9-6 provides a summary of various aspects of the environmental and social trainings to be conducted at the construction site. During the O&M phase of the project, these

trainings will continue to be conducted by AIWTDS staff for all relevant O&M personnel and community.

It is vital that all personnel are adequately trained to efficiently perform their designated tasks. In addition to training, general environmental awareness must be fostered among the project's workforce and general public to encourage the environmentally sound practices. The onus is on the different parties involved in the various stages of the life-cycle of the project to be environmentally conscious. Environmental awareness could be fostered in the following manner:

- Induction course for all workers on site, before commencing work on site.
- Refresher courses as and when required.
- Daily toolbox talks at the start of each day with all workers, where they might be alerted to environmental concerns associated with their tasks for that day or the area/habitat in which they are working.

Table 9-6: Environmental and Social Trainings

Contents	Participants	Responsibility	Schedule
General environmental awareness; Environmental and social sensitivity of the project influence area; Key findings of the EIA; Mitigation measures; EMP; Social and cultural values of the area.	Selected staff of AIWTDS, supervisor, and contractors/ stakeholders	Supervisor	Prior to the start of the project activities. (To be repeated as needed.)
General environmental and awareness; Environmental and social sensitivity of the project influence area; Mitigation measures; Community issues; Awareness of transmissible diseases; Social and cultural values.	PIU; supervisor; selected contractors' crew/General public	Supervisor	Prior to the start of thefield activities. (To be repeated as needed.)
EMP; Waste disposal;	Construction crew	Contractors	Prior to the start of theconstruction activities. (To be repeated as needed.)
Road/waterway safety; Defensive driving/sailing; Waste disposal; Cultural values and social sensitivity.	Drivers; boat/launch crew	Contractors	Before and during thefield operations. (To be repeated as needed.)
Camp operation; Waste disposal; Natural resource conservation; Housekeeping.	Camp staff	Contractors	Before and during thefield operations. (To be repeated as needed.)
Restoration requirements; Waste disposal.	Restoration teams	Contractors	Before the start of the restoration activities.
Conservation of important flora / fauna Dolphin; Cultural resources;	PIU; supervisor; selected contractors' crew	Contractors, Supervisor and E&S cell	Before the start of the restoration activities.

9.8.4 Documentation and Record Keeping

A document handling system must be established to ensure updating of EMP documents, and availability of documents for the effective functioning of the EMP. Responsibilities must

be assigned to relevant personnel for ensuring that the EMP documentation system is maintained and produced as when required.

Environmental Monitoring Reports: The environmental monitoring reports will include environmental mitigation measures undertaken and periodical environmental. The environmental monitoring reports will be submitted quarterly during the construction period and annually for three years after completion of construction.

Project Completion Environmental Monitoring Report: One year after completion of construction, the E&S Cell will submit a Project Completion Environmental Monitoring Report which will summarize the overall environmental impacts from the project. AIWTDS will engage External Monitors during construction period to measure the effectiveness and outcome/impact of EMP, as stated earlier. The External monitors will submit quarterly reports on impact evaluation.

The report shouldinclude description of :

- Implementation activity specifications (including Method Statements and ECoPs modified to reflect actual site conditions);
- Site instructions;
- Emergency preparedness and response procedures;
- Incident reports;
- Training records;
- Site inspection reports;
- Monitoring reports;
- Auditing reports; and
- Complaints received.

9.8.5 Reporting Procedures

Reporting procedures for conveying information from the monitoring activities must be developed. reporting procedures as below:

- .Inspections;
- Accidents and emergencies;
- Measuring performance indicators and interpreting and acting on the indicators;
- Records of monitoring activities to test the effectiveness of mitigation measures and impact controls, as well as for compliance auditing purposes; and
- Training programmes and evidence of appropriate levels/amount of skills/capacities created.

Reporting Requirement during Pre-Construction & Construction Phase

Report submissions by contractor to PMU are given below:

- Monthly Environment Report- Detail compliance status of EMP and EMoP along with the status of regulatory/applicable permits & NoCs.
- Monthly Accidental Reporting and Investigation Report

Reporting Requirement during Operation Phase

AIWTDS should maintain the following records/reports

- Six monthly compliance report of EMP
- Audit Report for compensatory plantation, where undertaken
- Energy audit reports of the terminal buildings
- Accident and Investigation Report
- Report containing details of dredging and LAD maintained in different stretches

9.8.6 Stakeholder Engagement

It is expected that the stakeholders would have had opportunity to comment on the content of the EIA report.

9.9 Environment Monitoring Programme

EnvironmentalMonitoringProgramme is to ensure that the intended environmental protection goals are achieved and result in desired benefits of the project. The same will be included in tender / bid document. The broad objectives of the environment monitoring program are:

- To monitor impacts on the surrounding environment and the effectiveness of mitigation measures during the construction and operation phase.
- To ensure that the environmental control systems, installed are effective.
- Comply to the provisions of relevant environmental regulations.
- Air quality monitoring with respect to PM_{10}, $PM_{2.5}$, NOx, SO_2 and CO at selected locations to asses the impact.
- Water quality with reference to DO, BOD, COD, suspended solids, turbidity, alkalinity, oil and grease at selected water bodies to ensure maintenance of BDU criteria.
- Noise level at Ghat/commercial zone, Sensitive zones, Approaching roads
- Survival rates of trees plantation.

The environmental monitoring plan alongwith frequency is summarised in **Table 9-7**.

Table 9-7: Environmental Monitoring Plan for single terminal during Construction & Operation Phase

Environmental component	Parameters to be monitored	Location	Frequency	Responsible Agency	
				Implemented by	Supervised by
Construction Stage					
Ambient Air Quality	PM10, PM2.5, SOx, NOx, CO	Terminal Site	1 sample/ location/ Quarter (i.e.,4 Samples/Year)	Contractor	Construction supervisor
		Along the Stretch	1 sample/ location/ Quarter (i.e.,4 Samples/Year)		
Noise	Leq dB (A) (Day and Night) Average and Peak values	Terminal sites	2 Samples/ location/season (I.e., 6 Samples/Year)	Contractor	Construction supervisor
		Under water noise	3 Samples/ Location/Quarter		

Environmental component	Parameters to be monitored	Location	Frequency	Responsible Agency	
				Implemented by	Supervised by
		monitoring	(i.e.,12 Samples/Year)		
Water Quality (Drinking water)	pH, temperature, DO, BOD, COD, Oil & Grease, Total Suspended Solid, turbidity, Total Hardness, Chlorine, Iron, As, Total Coliform	Labour camp / Base camp	3 sample/location/ quarterly	Contractor trough a nationally recognized laboratory Contractor trough a nationally recognized laboratory	Construction supervisor External Monitor Construction supervisor
Water Quality (Surface Water)	pH, temperature, DO, BOD, COD, Oil & Grease, Total Suspended Solid, turbidity, Total Hardness, Chlorine, Iron, As, Total Coliform	At terminal site	3 Samples/ Location/Year (i.e., Sample to be collected for three seasons (Pre-monsoon, monsoon & post monsoon or winter) at each location).	AIWTDS through a NABL Accredited laboratory	AIWTDS
Water Quality (Ground Water)		At terminal site	3 Samples/ Location/Year (i.e., Sample to be collected for three seasons (Pre-monsoon, monsoon & post monsoon or winter) at each location).		
Soil Quality	Pb, Cd, Cr, Cu, Zn, Mn, As, Se, Hg, PCBs, POPs, and hydrocarbons	At terminal site	3 Samples/ Location/Year (i.e., Sample to be collected for three seasons (Pre-monsoon, monsoon & post monsoon or winter) at each location).	Contractor	Construction supervisor
Ecology & Biodiversity	The practices mentioned in ecology management plan are to be followed.	At terminal site	Once in Six months.	Construction supervisor	AIWTDS
River Bed Sediments	PCBs, POPs, Hydrocarbons, Heavy Metals (Lead Arsenic, Cadmium Mercury)	At terminal site	4 Samples/ Location/Year (i.e., Sample to be collected for three seasons (Pre-monsoon, monsoon & post monsoon or winter) at each location).	Contractor	AIWTDS
Dredged Material Management		At terminal Site	Daily	Contractor	AIWTDS
Waste Mangement		At all locations	Daily	Contractor	AIWTDS
Grievances	Maintaing Registrar	At all locations	Daily	AIWTDS	

Environmental component	Parameters to be monitored	Location	Frequency	Responsible Agency
Operation Stage				
Ambient Air Quality	PM_{10}, $PM_{2.5}$, SO_x, NO_x, CO	Terminal Site	1 sample/location/Quarter (i.e.,4 Samples/Year)	AIWTDS
		Along Stretch	1sample/location/Quarter (i.e.,4 Samples/Year)	
Noise	Leq dB (A) (Day and Night) Average and Peak values	At monitoring locations	2 Samples/location/season (I.e., 6 Samples/Year)	AIWTDS
		Underwater noise monitoring	3 Samples/Location/Quarter (i.e.,12 Samples/Year)	
Water Quality (Surface Water)	pH, temperature, DO, BOD, COD, Oil & Grease, Total Suspended Solid, turbidity, Total Hardness, Chlorine, Iron, As, Total Coliform	At terminal site	3 Samples/Location/Year (i.e., Sample to be collected for three seasons (Pre-monsoon, monsoon & post monsoon or winter) at each location).	AIWTDS
Water Quality (Ground Water)		At terminal site	3 Samples/Location/Year (i.e., Sample to be collected for three seasons (Pre-monsoon, monsoon & post monsoon or winter) at each location).	
Soil Quality	Pb, Cd, Cr, Cu, Zn, Mn, As, Se, Hg, PCBs, POPs, and hydrocarbons	At terminal and landing site	4 Samples/Location/Year (i.e., Sample to be collected for three seasons (Pre-monsoon, monsoon & post monsoon or winter) at each location).	AIWTDS
Ecology & Biodiversity	The practices mentioned in ecology management plan are to be followed.	At terminal site	Once in six months.	AIWTDS
River Bed Sediments	PCBs, POPs, Hydrocarbons, Heavy Metals (Lead Arsenic, Cadmium Mercury)	At terminal site	4 Samples/Location/Year (i.e., Sample to be collected for three seasons (Pre-monsoon, monsoon & post monsoon or winter) at each location).	AIWTDS
Dredged Material Management		At terminal Site	Daily	AIWTDS
Waste Mangement		At all locations	Daily	AIWTDS
Grievances	Maintaing Registrar	At all locations	Daily	AIWTDS

Note: All the Samples to be collected as per standard norms. Parameters and components may varies as per requirement.

9.10 Environment Monitoring Plan EMP Budget

Tentative Environment budget has been prepared for design, construction and operation phase of the project. The Environmental budget includes the cost of environmental structures like septic tank & soak pit, Air Pollution Control System at terminals, monitoring, enhancement measures, training and awareness and technical support for establishment, enhancement measures and environmental guidelines. As per the intial assessment and site visit data and consultation during site it was found that there is no permanent habitat of Dolphin is reported near the proposed terminal ghat, hence budegtery allocation for dolphin conservation not considered. Environmental budget is estimated as ₹ 92.6 lacs for all the three ghats.The summary of environmental budget is given below. The detailed break-up of costs is given at **Table 9-8**.

Table 9-8: EMP Cost Estimates North Guwahati Terminal

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
CONSTRUCTION STAGE					
Technical Support	Technical support for preparation of guidelines, conservation action plan for turtle and dolphin areas and performance indicators	1	Lump sum	65000	65000
Drainage congestion & disposal of accumulated water	Provision of adequate surveillance	To be covered in project design and engineering cost			
Covered in project design and engineering cost	Embankment and River Bank Protection Measures	To be covered in project design and engineering cost			
Measures to reduce dredging requirement	Bandalling, Catchment treatment	To be covered in project design and engineering cost			
Land	Compensation against land	As required for specific site and is included separately under SIA/RAP reports.			
Soil	Soil contamination protection(Septic tanks, grease traps etc.) and rehabilitation of borrow areas/debris disposal site/plant site & labour camps	To be covered in project design and engineering cost			
Noise	Canopy for DG sets PPEs like ear plug	To be covered in project design and engineering cost			
	Timely maintenance of the machinery, equipment and vehicles Barricading the site				

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
Water	Provision of storm water and wastewater management system	To be covered in project design and engineering cost			
	Construction of soak pits at construction sites & labour camps	To be covered in project design and engineering cost			
	Provision of clean drinking & domestic water facility at labour camps and construction site	To be covered in project design and engineering cost			
	STP construction, Zero Discharge management (collection of storm water and its distillation and use, and rain water harvesting	Including in project design and engineering costs			
Air Quality – Dust Management during construction	Water Sprayer / Watering for Dust suppression	To be covered in project design and engineering cost			
	Green belt development, dust control system, mechanized material handling systems for material loading and unloading at terminal and vessel.	To be covered in project design and engineering cost			
Safety	Appointment of Safety Officers	To be covered in project design and engineering cost			
	Safety signage, fire-fighting measures& water ambulance etc.	To be covered in project design and engineering cost			
	Provision of trainings and PPE to workers	To be covered in the responsibility of the Contractor			
Health	Health check-up camps for construction workers	To be covered in the responsibility of the Contractor			

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
Reparing and Retrofitting of vessels of IWT, Assam	Improvement of old vessels of IWT with modern gadgets	To be covered in project design and engineering cost			
Enhancement Measures	Institutional Support for ecology awareness through reputed institutions	No		Lump sum	25000
	Bath shelter for women along the stretch for maintaining privacy from vessel movement	No			
	Support for cleanliness at Ghats and improvement of Ghats	To be covered in the responsibility of the Contractor		Lump sum	0
Environmental Monitoring in the construction phase	Terrestrial and Aquatic Fauna (Including Dolphin Conservation Management Plan)	50,000 per season. Once in six month for 3 years			300000
	Ambient Air Quality	Monitoring at along the stretch	Total sample per location for 3years is 12, Considering 15,000/sample, cost for12 samples will be 12X15000	15,000/ sample	180000
		Monitoring at construction sites	Total sample per location for 3years is 12, Considering 15,000/sample, cost for12 samples will be 12X15000	15,000/ sample	180000
	Surface Water Quality	Surface water resources	As per the standard norms, sample may be collected for three season (Pre-monsoon, monsoon & post monsoon or winter) at each location for three years. Hence, 3samples each location in one year & 9 samples each	12,000/ sample	108000

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
			location for 3years. Then costing @12000/sample will be 12000*9 i.e 108000		
Environmental Monitoring in the construction phase	Surface Water Quality	Ground water bodies	As per the standard norms, sample may be collected for three season (Pre-monsoon, monsoon & post monsoon or winter) at each location for three years. Hence, 9 samples each location for 3years. Then costing @12000/samples will be 12000*9 i.e 108000	12,000/ sample	108000
	Drinking Water Quality	There will be strict instruction to all the contractors to supply filtered driking water to the labours. Hence, it is not required to anyalysis drinking water quality since the project activities have no direct impact on drinking water in the nearby area.			0
	Noise & Vibration	At monitoring locations identified in the Environmental management plan 1 site for 3 years	24 hourly/season for pre and post monsoon at 3 locations per site for 3 years for 1 ghat. Number of sample per year per location is 2. Total number of samples is 18	4,000/ sample	72000
		Underwater noise Monitoring	Per month for 3years i.e. 36 samples during construction stage	4,000/ sample	144000
	Soil Quality, Erosion & Siltation and River Bed	At terminal and landing construction site for 3 years	As per the standard norms, sample to be collected for three season (Pre-monsoon, monsoon & post monsoon or winter) at each location for three years. Hence 9	8,000/ sample	72000

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
			samples each location for 3years. Then, 9X8000will be total cost per terminal.		
	River Bed Sediment	At dredging sites	2 times per year for three years	8,000/ sample	48000
SUB TOTAL (CONSTRUCTION STAGE)					**1302000**
OPERATION STAGE					
	Erosion Control and landscaping	Visual Check	To be part of Regular maintenance and operation costs		
Water	Waste Water Management (compact STP cost in NBC) based on number of people/hour	STP Operation, rainwater harvesting management and maintenance	To be part of Regular maintenance and operation cost		0
	Storm Water Management System	Maintenance of Storm water drains	To be part of Regular maintenance and costs		
	Provision of drinking water facilities	There will be strict instruction to all the contractors to supply filtered drinking water to the labours. Hence, it is not required to analysis drinking water quality since the project activities have no direct impact on drinking water in the nearby area.			0
	Waste Management System	Collection, segregation and disposal of municipal waste, hazardous waste (used oil) and dredged soil	To be part of Regular maintenance and operation cost		

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
	Environmental Monitoring in the operation phase	Terrestrial and Aquatic Fauna including surveillance audit & Dolphiin Conservation Management Plan	During operation stage, surveillance audit of Aquatic ecology to be conducted on quarterly basis for 3years @ Rs. 25000/-		300000
		Ambient Air Quality	4 samples/location/year @15000/samples for 1 location will be 4X1X15000 i.e. 60000 For 3years it will be 180000	15,000/ sample	180000
		Surface Water Quality	3 samples per location for one year (at pre-monsoon, monsoon & post-monsoon) @12000/- will be 3X1X3X12000 i.e. 1,08,000/- . For three years, it will be 3,24,000/-	12,000/ sample	324000
Environmental Monitoring during Operation Stage		Ground water	3 samples per location for one year (at pre-monsoon, monsoon & post-monsoon) at 1 location @12,000/sample will be Rs36000 . For three years it will be 108000	12,000/ sample	108000
		Noise & Vibration	24 hourly/season for3 season per year at 3 locations per site for 1 year for 1 ghat i.e. 3X3X3X4000	4,000/ sample	1,08,000
		Soil Quality, River Bed	4 samples/location/year @8000/samples for 1	8,000/ sample	96000

COMPONENT	ITEM	UNIT		QUANTITY	RATE	Amount (in INR)
		Sediments, Soil Erosion & Siltation, Integrity of embankments	location will be 4X1X8000 i.e. 32000. For 3years it will be 96000			
Electricity	Solar Panels	Cost of solar panels for priority ghats	Provision of installing solar panels to be covered in design & engineering cost			0
SUB TOTAL (OPERATION PHASE)						**1116000**
ESTABLISHMENT, TRAINING & MANAGEMENT SYSTEM						
Training	General environmental awareness; environmental and social sensitivity of the project influence area; Key findings of the EIA; Mitigation measures; EMP; Social and cultural values of the area.	Selected staff of AIWTDS, supervisor, and contractors		Training for Selected staff of AIWTDS, supervisor, and contractors, Vessel Operators	Lump sum	15000
	Training for Ghat management via traing for Ghat/section officers/ vessel operators/masters/ khalasi etc.	Ghat officers, Ghat Maintenance workers			Lump sum	50000
	General environmental and awareness;Environmental and social sensitivity of the project influence area;Mitigation measures;Community issues;Awareness of transmissible diseases;Social and cultural values.	PIU; supervisor; selected contractors' crew			Lump sum	5000
	EMP;Waste disposal, Cultural values and social sensitivity.	Construction crew		Contractors		10000
	Road/waterway safety;Defensive	Drivers;boat/launch crew,		Contractors		10000

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
	driving/sailing;Waste disposal;				
	Camp operation; Waste disposal;Natural resource conservation;Housekeeping.	Camp staff	Contractors		10000
	Restoration requirements; Waste disposal.	Restoration teams	Contractors		10000
	Construction Implementation requirements;handling situations for important flora / fauna especially Dolphin;Physical Cultural resources;	PIU;supervisor; selected contractors' crew	Contractors, Supervisor and E&S cell		10000
	Management Systems	Health and safety equipment on board and in terminals	1	Lump sum	25000
		Management Information and tracking system	1	Lump sum	350000
SUBTOTAL (ESTABLISHMENT & TRAINING and MANAGEMENT SYSTEM)					**495000**
SUB TOTAL (Construction, and Operation and mobilization)					**2913000**
CONTINGENCIES @ 5 % on total Environmental Costs					**145650**
GRAND TOTAL for one ghat (in Rs)					**3058650**

Table 9-9: EMP Cost Estimate for Gateway Guwahati Ghat

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
CONSTRUCTION STAGE					
Technical Support	Technical support for preparation of guidelines, conservation action plan for turtle and dolphin areas and performance indicators	1	Lump sum	65000	65000
Drainage congestion & disposal of accumulated water	Provision of adequate surveillance	To be covered in project design and engineering cost			
Covered in project design and engineering cost	Embankment and River Bank Protection Measures	To be covered in project design and engineering cost			
Measures to reduce dredging requirement	Bandalling, Catchment treatment	To be covered in project design and engineering cost			
Land	Compensation against land	As required for specific site and is included separately under SIA/RAP reports.			
Soil	Soil contamination protection(Septic tanks, grease traps etc.) and rehabilitation of borrow areas/debris disposal site/plant site & labour camps	To be covered in project design and engineering cost			
Noise	Canopy for DG sets PPEs like ear plug	To be covered in project design and engineering cost			
	Timely maintenance of the machinery, equipment and vehicles Barricading the site				
Water	Provision of storm water and wastewater management system	To be covered in project design and engineering cost			
	Construction of soak pits at construction sites & labour camps	To be covered in project design and engineering cost			
	Provision of clean drinking & domestic water facility at labour camps and construction site	To be covered in project design and engineering cost			

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
	STP construction, Zero Discharge management (collection of storm water and its distillation and use, and rain water harvesting	Including in project design and engineering costs			
Air Quality – Dust Management during construction	Water Sprayer / Watering for Dust suppression	To be covered in project design and engineering cost			
	Green belt development, dust control system, mechanized material handling systems for material loading and unloading at terminal and vessel.	To be covered in project design and engineering cost			
Safety	Appointment of Safety Officers	To be covered in project design and engineering cost			
	Safety signage, fire-fighting measures& water ambulance etc.	To be covered in project design and engineering cost			
	Provision of trainings and PPE to workers	To be covered in the responsibility of the Contractor			
Health	Health check-up camps for construction workers	To be covered in the responsibility of the Contractor			
Enhancement Measures	Institutional Support for ecology awareness through reputed institutions	No		Lump sum	25000
	Bath shelter for women along the stretch for maintaining privacy from vessel movement	No			
	Support for cleanliness at Ghats and improvement of Ghats	To be covered in the responsibility of the Contractor		Lump sum	0
Environmental Monitoring in the construction phase	Terrestrial and Aquatic Fauna including Dolphin Conservation Management Plan	50,000 per season. Once in six month for 3 years			300000
	Ambient Air Quality	Monitoring at along the stretch	Total sample per location for 3years is 12, Considering 15,000/sample, cost for12 samples will be 12X15000	15,000/ sample	180000

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
		Monitoring at construction sites	Total sample per location for 3years is 12, Considering 15,000/sample, cost for12 samples will be 12X15000	15,000/ sample	180000
	Surface Water Quality	Surface water resources	As per the standard norms, sample may be collected for three season (Pre-monsoon, monsoon & post monsoon or winter) at each location for three years. Hence, 3samples each location in one year & 9 samples each location for 3years. Then costing @12000/sample will be 12000*9 i.e 108000	12,000/ sample	108000
Environmental Monitoring in the construction phase	Surface Water Quality	Ground water bodies	As per the standard norms, sample may be collected for three season (Pre-monsoon, monsoon & post monsoon or winter) at each location for three years. Hence, 9 samples each	12,000/ sample	108000

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
			location for 3years. Then costing @12000/samples will be 12000*9 i.e 108000		
	Drinking Water Quality	There will be strict instruction to all the contractors to supply filtered driking water to the labours. Hence, it is not required to anyalysis drinking water quality since the project activities have no direct impact on drinking water in the nearby area.			0
	Noise & Vibration	At monitoring locations identified in the Environmental management plan 1 site for 3 years	24 hourly/season for pre and post monsoon at 3 locations per site for 3 years for 1 ghat. Number of sample per year per location is 2. Total number of samples is 18	4,000/ sample	72000
		Underwater noise Monitoring	Per month for 3years i.e. 36 samples during construction stage	4,000/ sample	144000
	Soil Quality, Erosion & Siltation and River Bed	At terminal and landing construction site for 3 years	As per the standard norms, sample to be collected for three season (Pre-monsoon, monsoon & post monsoon or winter) at each location for three years. Hence 9 samples each location for 3years.	8,000/ sample	72000

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
			Then, 9X8000will be total cost per terminal.		
	River Bed Sediment	At dredging sites	2 times per year for three years	8,000/ sample	48000
SUB TOTAL (CONSTRUCTION STAGE)					**1302000**
OPERATION STAGE					
	Erosion Control and landscaping	Visual Check	To be part of Regular maintenance and operation costs		
Water	Waste Water Management (compact STP cost in NBC) based on number of people/hour	STP Operation, rainwater harvesting management and maintenance	To be part of Regular maintenance and operation cost		0
	Storm Water Management System	Maintenance of Storm water drains	To be part of Regular maintenance and costs		
	Provision of drinking water facilities	There will be strict instruction to all the contractors to supply filtered drinking water to the labours. Hence, it is not required to analysis drinking water quality since the project activities have no direct impact on drinking water in the nearby area.			0
	Waste Management System	Collection, segregation and disposal of municipal waste, hazardous waste (used oil) and dredged soil	To be part of Regular maintenance and operation cost		

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
	Environmental Monitoring in the operation phase	Terrestrial and Aquatic Fauna including surveillance audit and Dolphin Consevation Management Plan	During operation stage, surveillance audit of Aquatic ecology to be conducted on quarterly basis for 3years @ Rs. 25000/-		300000
		Ambient Air Quality	4 samples/location/year @15000/samples for 1 location will be 4X1X15000 i.e. 60000 For 3years it will be 180000	15,000/ sample	180000
		Surface Water Quality	3 samples per location for one year (at pre-monsoon, monsoon & post-monsoon) @12000/- will be 3X1X3X12000 i.e. 1,08,000/-. For three years, it will be 3,24,000/-	12,000/ sample	324000
Environmental Monitoring during Operation Stage		Ground water	3 samples per location for one year (at pre-monsoon, monsoon & post-monsoon) at 1 location @12,000/sample will be Rs36000 . For three years it will be 108000	12,000/ sample	108000

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
		Noise & Vibration	24 hourly/season for3 season per year at 3 locations per site for 1 year for 1 ghat i.e. 3X3X3X4000	4,000/ sample	1,08,000
		Soil Quality, River Bed Sediments, Soil Erosion & Siltation, Integrity of embankments	4 samples/location/year @8000/samples for 1 location will be 4X1X8000 i.e. 32000. For 3years it will be 96000	8,000/ sample	96000
Electricity	Solar Panels	Cost of solar panels for priority ghats	Provision of installing solar panels to be covered in design & engineering cost		0
SUB TOTAL (OPERATION PHASE)					**1116000**
ESTABLISHMENT, TRAINING & MANAGEMENT SYSTEM					
Training	General environmental awareness; environmental and social sensitivity of the project influence area; Key findings of the EIA; Mitigation measures; EMP; Social and cultural values of the area.	Selected staff of AIWTDS, supervisor, and contractors	Training for Selected staff of AIWTDS, supervisor, and contractors, Vessel Operators	Lump sum	15000
	Training for Ghat management via traing for Ghat/section officers/ vessel operators/masters/ khalasi etc.	Ghat officers, Ghat Maintenance workers		Lump sum	50000
	General environmental and awareness; Environmental and social sensitivity of the project influence area; Mitigation measures;Community issues;Awareness of transmissible diseases;Social and cultural values.	PIU; supervisor; selected contractors' crew		Lump sum	5000
	EMP;Waste disposal, Cultural values and	Construction crew	Contractors		10000

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
	social sensitivity.				
	Road/waterway safety;Defensive driving/sailing;Waste disposal;	Drivers;boat/launch crew,	Contractors		10000
	Camp operation; Waste disposal;Natural resource conservation;Housekeeping.	Camp staff	Contractors		10000
	Restoration requirements; Waste disposal.	Restoration teams	Contractors		10000
	Construction Implementation requirements;handling situations for important flora / fauna especially Dolphin;Physical Cultural resources;	PIU;supervisor; selected contractors' crew	Contractors, Supervisor and E&S cell		10000
	Management Systems	Health and safety equipment on board and in terminals	1	Lump sum	25000
		Management Information and tracking system	1	Lump sum	350000
SUBTOTAL (ESTABLISHMENT & TRAINING and MANAGEMENT SYSTEM)					**495000**
SUB TOTAL (Construction, and Operation and mobilization)					**2913000**
CONTINGENCIES @ 5 % on total Environmental Costs					**1456000**
GRAND TOTAL for one ghat (in Rs)					**3058650**

Table 9-10: EMP Cost Estimate for Aphalamukh Ghat

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
CONSTRUCTION STAGE					
Technical Support	Technical support for preparation of guidelines, conservation action plan for turtle and dolphin areas and performance indicators	1	Lump sum	65000	65000
Greenbelt development	Plantation along the access road to the terminal	No. of trees	50trees	50000 per terminal	50000
	provisional Monitoring and aftercare	No. of trees	50trees	10000 (once in a year for 1 terminal for 3yrs i.e., 10000x3)	30000
Drainage congestion & disposal of accumulated water	Provision of adequate surveillance	To be covered in project design and engineering cost			
Covered in project design and engineering cost	Embankment and River Bank Protection Measures	To be covered in project design and engineering cost			
Measures to reduce dredging requirement	Bandalling, Catchment treatment	To be covered in project design and engineering cost			
Land	Compensation against land	As required for specific site and is included separately under SIA/RAP reports.			
Soil	Soil contamination protection(Septic tanks, grease traps etc.) and rehabilitation of borrow areas/debris disposal site/plant site & labour camps	To be covered in project design and engineering cost			
Noise	Canopy for DG sets PPEs like ear plug	To be covered in project design and engineering cost			

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
	Timely maintenance of the machinery, equipment and vehicles Barricading the site				
Water	Provision of storm water and wastewater management system	To be covered in project design and engineering cost			
	Construction of soak pits at construction sites & labour camps	To be covered in project design and engineering cost			
	Provision of clean drinking & domestic water facility at labour camps and construction site	To be covered in project design and engineering cost			
	STP construction, Zero Discharge management (collection of storm water and its distillation and use, and rain water harvesting	Including in project design and engineering costs			
Air Quality – Dust Management during construction	Water Sprayer / Watering for Dust suppression	To be covered in project design and engineering cost			
	Green belt development, dust control system, mechanized material handling systems for material loading and unloading at terminal and vessel.	To be covered in project design and engineering cost			
Safety	Appointment of Safety Officers	To be covered in project design and engineering cost			
	Safety signage, fire-fighting measures& water ambulance etc.	To be covered in project design and engineering cost			

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
	Provision of trainings and PPE to workers	To be covered in the responsibility of the Contractor			
Health	Health check-up camps for construction workers	To be covered in the responsibility of the Contractor			
Enhancement Measures	Institutional Support for ecology awareness through reputed institutions	No		Lump sum	25000
	Bath shelter for women along the stretch for maintaining privacy from vessel movement	No			
	Support for cleanliness at Ghats and improvement of Ghats	To be covered in the responsibility of the Contractor		Lump sum	0
Environmental Monitoring in the construction phase	Terrestrial and Aquatic Fauna including Dolphin Consevation Management Plan	50,000 per season. Once in six month for 3 years			300000
	Ambient Air Quality	Monitoring at along the stretch	Total sample per location for 3years is 12, Considering 15,000/sample, cost for12 samples will be 12X15000	15,000/ sample	180000
		Monitoring at construction sites	Total sample per location for 3years is 12, Considering 15,000/sample, cost for12 samples will be 12X15000	15,000/ sample	180000

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
	Surface Water Quality	Surface water resources	As per the standard norms, sample may be collected for three season (Pre-monsoon, monsoon & post monsoon or winter) at each location for three years. Hence, 3samples each location in one year & 9 samples each location for 3years. Then costing @12000/sample will be 12000*9 i.e 108000	12,000/ sample	108000
Environmental Monitoring in the construction phase	Surface Water Quality	Ground water bodies	As per the standard norms, sample may be collected for three season (Pre-monsoon, monsoon & post monsoon or winter) at each location for three years. Hence, 9 samples each location for 3years. Then costing @12000/samples will be 12000*9 i.e 108000	12,000/ sample	108000
	Drinking Water Quality	There will be strict instruction to all the contractors to supply filtered driking water to the labours. Hence, it is not required to anyalysis drinking water quality since the project activities have no direct impact on drinking water in the nearby area.			0
	Noise & Vibration	At monitoring locations identified in the Environmental management plan 1 site for 3 years	24 hourly/season for pre and post monsoon at 3 locations per site for 3 years for 1 ghat. Number of sample per year per location is 2. Total	4,000/ sample	72000

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
			number of samples is 18		
		Underwater noise Monitoring	Per month for 3years i.e. 36 samples during construction stage	4,000/ sample	144000
	Soil Quality, Erosion & Siltation and River Bed	At terminal and landing construction site for 3 years	As per the standard norms, sample to be collected for three season (Pre-monsoon, monsoon & post monsoon or winter) at each location for three years. Hence 9 samples each location for 3years. Then, 9X8000will be total cost per terminal.	8,000/ sample	72000
	River Bed Sediment	At dredging sites	2 times per year for three years	8,000/ sample	48000
SUB TOTAL (CONSTRUCTION STAGE)					**1382000**
OPERATION STAGE					
	Erosion Control and landscaping	Visual Check	To be part of Regular maintenance and operation costs		
Water	Waste Water Management (compact STP cost in NBC) based on number of people/hour	STP Operation, rainwater harvesting management and maintenance	To be part of Regular maintenance and operation cost		0
	Storm Water Management System	Maintenance of Storm water drains	To be part of Regular maintenance and costs		
	Provision of drinking water facilities	There will be strict instruction to all the contractors to supply filtered drinking water to the labours. Hence, it is not required to analysis drinking water quality since the project activities have no direct impact on drinking water in the nearby area.			0

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
	Waste Management System	Collection, segregation and disposal of municipal waste, hazardous waste (used oil) and dredged soil	To be part of Regular maintenance and operation cost		
	Environmental Monitoring in the operation phase	Terrestrial and Aquatic Fauna including surveillance audit & Dolphin Conservation Management Plan	During operation stage, surveillance audit of Aquatic ecology to be conducted on quarterly basis for 3years @ Rs. 25000/-		300000
		Ambient Air Quality	4 samples/location/year @15000/samples for 1 location will be 4X1X15000 i.e. 60000 For 3years it will be 180000	15,000/ sample	180000
		Surface Water Quality	3 samples per location for one year (at pre-monsoon, monsoon & post-monsoon) @12000/- will be 3X1X3X12000 i.e. 1,08,000/-. For three years, it will be 3,24,000/-	12,000/ sample	324000
Environmental Monitoring during Operation Stage		Ground water	3 samples per location for one year (at pre-monsoon, monsoon & post-monsoon) at 1 location @12,000/sample will be Rs36000 . For three years it will be 108000	12,000/ sample	108000
		Noise & Vibration	24 hourly/season for3 season per year at 3 locations per site for 1 year for 1 ghat i.e.	4,000/ sample	1,08,000

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
			3X3X3X4000		
		Soil Quality, River Bed Sediments, Soil Erosion & Siltation, Integrity of embankments	4 samples/location/year @8000/samples for 1 location will be 4X1X8000 i.e. 32000. For 3years it will be 96000	8,000/ sample	96000
Electricity	Solar Panels	Cost of solar panels for priority ghats	Provision of installing solar panels to be covered in design & engineering cost		0
SUB TOTAL (OPERATION PHASE)					**1116000**
ESTABLISHMENT, TRAINING & MANAGEMENT SYSTEM					
Training	General environmental awareness; environmental and social sensitivity of the project influence area; Key findings of the EIA; Mitigation measures; EMP; Social and cultural values of the area.	Selected staff of AIWTDS, supervisor, and contractors	Training for Selected staff of AIWTDS, supervisor, and contractors, Vessel Operators	Lump sum	15000
	Training for Ghat management via traing for Ghat/section officers/ vessel operators/masters/ khalasi etc.	Ghat officers, Ghat Maintenance workers		Lump sum	50000

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
	General environmental and awareness; Environmental and social sensitivity of the project influence area; Mitigation measures; Community issues; Awareness of transmissible diseases; Social and cultural values.	PIU; supervisor; selected contractors' crew		Lump sum	10000
	EMP; Waste disposal, Cultural values and social sensitivity.	Construction crew	Contractors		10000
	Road/waterway safety; Defensive driving/sailing; Waste disposal;	Drivers;boat/launch crew,	Contractors		10000
	Camp operation; Waste disposal; Natural resource conservation; Housekeeping.	Camp staff	Contractors		10000
	Restoration requirements; Waste disposal.	Restoration teams	Contractors		10000
	Construction Implementation requirements; handling situations for important flora / fauna especially Dolphin; Physical Cultural resources;	PIU;supervisor; selected contractors' crew	Contractors, Supervisor and E&S cell		10000
	Management Systems	Health and safety equipment on board and in terminals	1	Lump sum	25000
		Management Information and tracking system	1	Lump sum	350000
SUBTOTAL (ESTABLISHMENT & TRAINING and MANAGEMENT SYSTEM)					**495000**

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
SUB TOTAL (Construction, and Operation and mobilization)					2993000
CONTINGENCIES @ 5 % on total Environmental Costs					149650
GRAND TOTAL for one ghat (in Rs)					3142650

Chapter 10 : Summary and Conclusion

10.1 Summary &Conclusions

Environmental impact assessment is carried out pertaining to the up-gradation proposals of Ghats and ferry services. In first phase three ghats (Gateway Guwahati Ghat, North Guawahati Ghat and Aphalamukh Ghat). In addition 19 nos. of vessels of IWT, Assam will be repaired and retrofitted. The investigation programme is taken into account both national and international legal requirements (as per WB) and applicable practice of River Jetty projects. It is also based on the preliminary investigations and on the responses from the stakeholders. Baseline environmental status including ecology have been carried out. Various environmental components relating to the project site and activities have been identified and their probable environmental consequences have been considered. Various metigative measures for minimising the environmental impact have been worked out.

The results of the environmental investigation are presented in the EIA report. Public consultation will be carried out at district level. The final EIA report incorporating the Public consultation out comings will then be submitted for the approval from AIWTDS and WB. The EIA report is prepared to assess the optimised alternatives for strategic planning, design along with report on best practices and environmental codes of practices.

The positive environmental impacts of the Project are development of all weather navigation routes for transportation of passengers and generation of employment opportunities during construction, operation and maintenance stages. The project will induce economic growth in the region. The negative environmental impacts are not significant. However, the positive impact of the project will improve the sanitary condition, proper waste management and over all asthetics of the area.

EMP has been formulated to mitigate the negative impacts during various phases (pre-dredging/construction, during dredging/ construction and Post dredging/O&M).The main monitoring parameters include monitoring of dredging and dredge material disposal, biological monitoring and enhancement, environmental quality monitoring (air, noise, surface water, river bed sediment), health and safety, etc. Most of the potential impacts are short-term that can be addressed by adopting mitigation measures and relevant ECoPs. To keep the project influence area environmentally friendly, AIWTDS should ensure that the Contractor prepare site specific EMPs including Emergency response plan, Oil Spill Contingency Plan and Workers Health and Safety plan and Environmental Pollution Abatement and Mitigation Measures Plan. Regular and effective monitoring of environmental quality parameters as indicated in this EIA report.

Chapter 11 : References

Type of Data	Report/source Name	Source
Air Quality Baseline Secondary data:	• https://pcbassam.org/aaq1.php; • http://www.pcbassam.org/publications/State%20of%20Env%20of%20Assam.pdf; • AQI Bulletin (Manual Stations) –July 2018-CPCB; • Air Emissions from Marine Vessels by Maine Department of Environmental Protection Bureau of Air Quality January 15, 2005; • Ambient Air Quality Data for The Year 2017 (Under National Ambient Air Quality Monitoring Programme);	The International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978-MARPOL-73 / 78.
Noise Quality baseline secondary data:	• https://pdfs.semanticscholar.org/aac0/ae6a81ba003f9750ff7a407c5064288e0bce.pdf; • http://ocr.org/ocr/pdfs/policy/2014_Shipping_Noise_Guidelines_IMO.pdf; • High frequency components of ship noise in shallow water with a discussion of implications for harbour porpoises (Phocoenaphocoena) by Line Hermannsen and Kristian Beedholm, Jakob Tougaard and Peter T. Madsen; • http://ocr.org/ocr/pdfs/marine_protection/Ross_Prediction_Mech_of_Underwater_Noise_Excerpt.pdf.	MoEFCC / CPCB
Carbon Footprint identification	• http://greencleanguide.com/how-to-calculate-ghg-emission-for-electricity-consumption-from-the-grid/	http://greencleanguide
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Trees on the Ghats	• Tree species diversity in tropical forests of Barak valley in Assam, India by Nepolion Borah1, Debajit Rabha and Florida Devi Athokpam (Tropical Plant Research)	(Tropical Plant Research)
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Details of Fisheries	• Fish fauna of the Brahmaputra River, Bangladesh: richness, threats and conservation needs by Shams Muhammad Galib • Preliminary study of fish fauna found in Brahmaputra river and its tributaries in Assam byMrinmoy Das • Loss of Fish Diversity of Assam (India): A Threat to Ichthyo fauna by Haren Ram Chiary, Neetu Singh, HridayaShanker Singh • River Fisheries of the Gangetic Basin,India	• The Journal of Biodiversity. Photon 115 (2015) 419-422 Review. ISJN: 8359-6193) • Nachiket Kelkar☹ A Primer(Vol 13 | Issue 3-5 | April-June 2014) • (Lake 2010: Wetlands, Biodiversity and Climate Change) Journal of Fisheries Volume 3 Issue 3 Pages: 285-292 December 2015)
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Turtles citing locations	Tortoises and Turtles of Northeast India, Saving them from Extinction by M Firoz Ahmed and Abhijit Das	
AAQ Standards BDU Criteria Standards Noise Standards	CPCB Gazette notification dated 18.11.2009 on AAQ, Noise Notification, and BDU criteria	CPCB &MOEF&CC
Water Quality	Water Quality Assessment River Brahmaputra 2013	CPCB and APCB
Endangered Species	Endangered Species	MOEF & CC Brochure, 2009
Met Data	Climatological Normal 1961-1990 - Indian	Meteorological department
Seismic data	Seismicity and seismic map and Cyclone Hazard Prone Map	First order seismic micro zonation IMD
Wetland information	Jharkhand Wetland Atlas, Prepared by Space Applications Centre (ISRO), Ahmadabad and Institute of Environmental Studies & Wetland Management (IESWM), Kolkata)	MOEF & CC
Wetland information	Information on Wetlands MOEF & CC	
Geology, Ground water related information	Ground Water Boucher of Project Districts Central Ground Water Board	CGWB

Type of Data	Report/source Name	Source
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	Red data book on Indian Animal Zoological Survey of India	
RET species	Gland, Switzerland: International Union for Conservation of Nature. IUCN (International Union for Conservation of Nature) 1980. World Conservation Strategy: Regional strategies for international river basins and seas.	IUCN (International Union for Conservation of Nature) 1980
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Flora	Phenology and Biodiversity of Riparian Plant Species of Brahmaputra River Bank at Bharwari (Kaushambi), U.P., India.	Indian J.Sci. Res. 4(1) Srivastava, P. And M.P. Singh, M.P. (2013)
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IFC, World Bank Group	General Environment Health & Safety Guidelines Environment Health and Safety Guidelines for Ports, Harbours and terminals	
NMCG & WWF	Recommendations of the Workshop on Operationalization of Dolphin Action Plan 2010 – 2020	
IFC & EBRD	Workers" accommodation: processes and standards A guidance note by IFC and the EBRD	
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Type of Data	Report/source Name	Source
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