

# Environmental Impact Assessment Report (Final)

GUWAHATI GATEWAY GHAT

ASSAM INLAND WATER TRANSPORT DEVELOPMENT SOCIETY

## 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
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

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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
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, Storage 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) are developed, which serve as multi modal transport hub in the entire North East region.

The cargo movements through NW-2 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 waterway.

The Inland Water Transport departments of both the state and central governments of India are very keen to realize NW-2’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.

Waterways are 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 upgradation of ferry Infrastructure, Fleet Modernization, institutional capacity development etc. Approximate project cost would be 150 million USD for entire investment. AIWTDS proposes to develop & modernize terminal infrastructure initially at one (1) location i.e. Gateway Guwahati Ghat. 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 traffic demand at Guwahati in 2020, 2025, 2030 & 2035 is presented in **Table 1-1**

ID	Name	2020		2025		2030		2035	
		Average	Peak	Average	Peak	Average	Peak	Average	Peak
GGG-North Guwahati, Water Bus Line 2									
1	Gateway Guwahati	215	367	350	596	778	1316	1234	2100
2	North Guwahati	120	215	190	340	285	511	480	861

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

## 1.2 Project Background

Assam has approximately 1980 Kms of navigable waterways, which is 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 as Subansiri, Jia Bharali, Dihing, Burhi Dihing, 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)

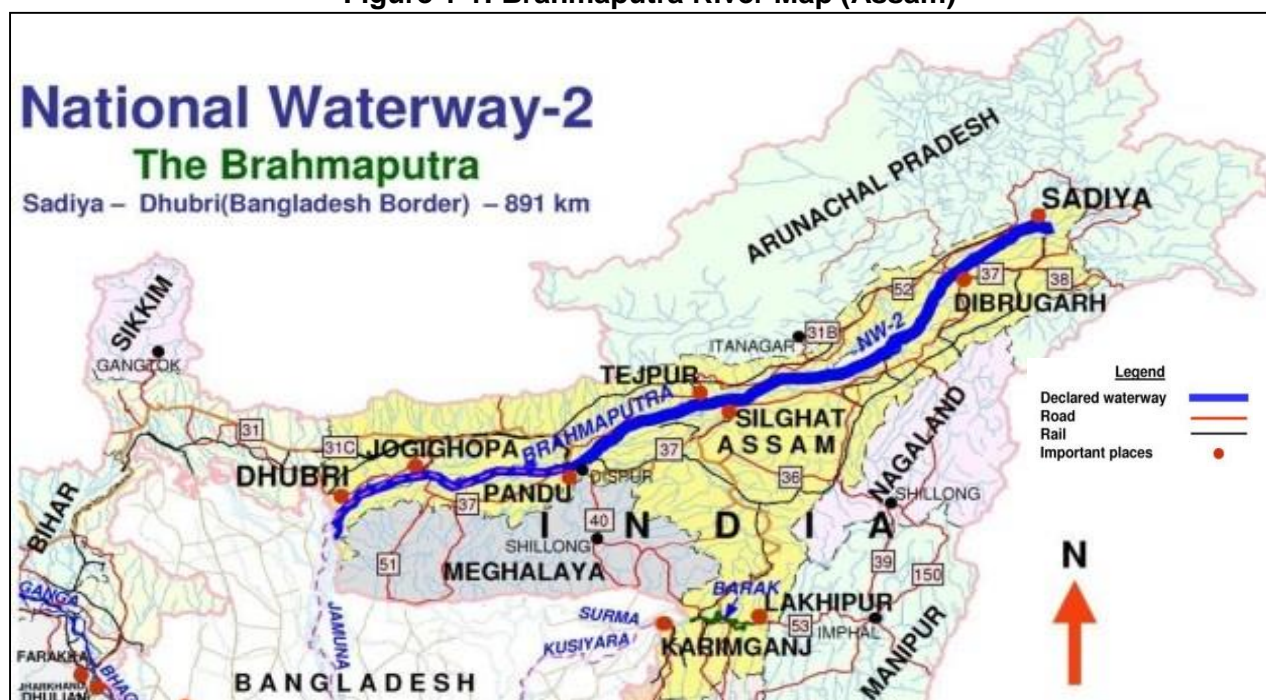


Figure 1-2: National Water Way 2 in Assam State along Brahmaputra River

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 throughout. This is caused by its very low gradients making it very sensitive to rapid geometry (boundary and channel) changes, channel barring 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 10 km 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 2.80 m/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 2.0 m 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 passenger traffic movement from 2014 to 2018 has more than doubled for Guwahati as shown in the **Table 1-2**

**Table 1-2: Annual Passenger traffic from 2014-15 to 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

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 is not 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 currently also require upgradation.

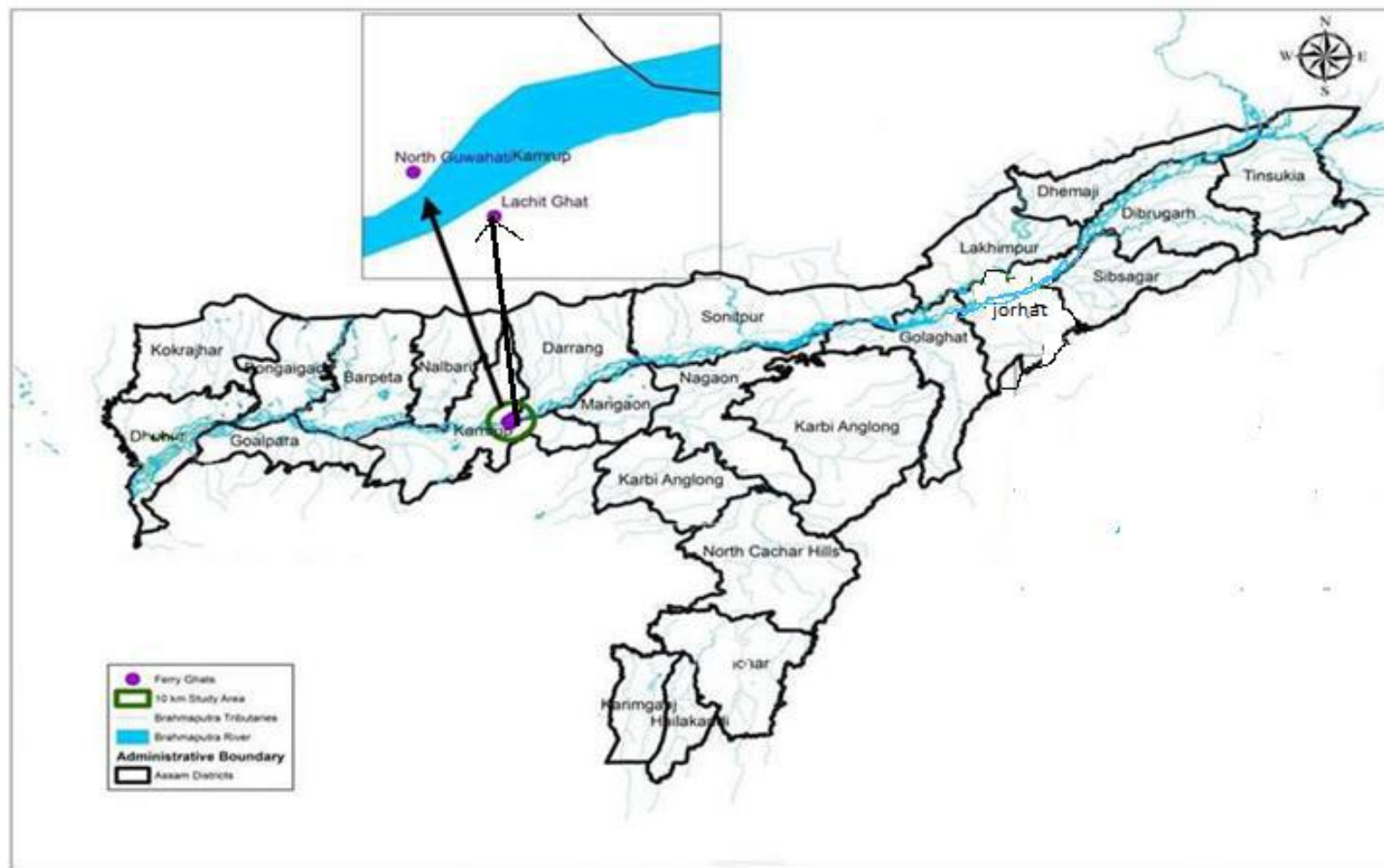
The Environmental Impact Assessment (EIA) studies for the AIWT Project are carried out in accordance with applicable World Bank, National, and Assam state Government requirements on environmental, health and safety management. This report outlines the requirement for the proposed developments, a description 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 one (1) Terminal	Gateway Guwahati Ghat
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. 7 nos of vessels
4.	Upgradation/construction of new Crew Training Centre	Infrastructure Development
5.	Implementation of 'Jibondinga' scheme	New and / or upgradation of private boats

The location of GGG in Bramhaputra River are shown in the map in **Figure-1-3**.



Figure 1-3: Location Map of GGG Terminal Ghat 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.

#### 1. 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

#### 2. 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 their business plans 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).

## **2. 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 public vessels for the provision of alternative (non-transport) critical public services (e.g. mobile clinics, schools, libraries, etc.)(US\$15 million).

## **3. 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.

## **4. 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 Guwahati Gateway Ghat is given in **Table 1-7**

**Table 1-7: Geo-Coordinates of the proposed Guwahati Gateway Ghat**

Ghats	South Bank	
	Latitude	Longitude
AIWTDS Division, Guwahati District, Guwahati Gateway Ghat	26.17993	91.734282

## 1.5 Objective of EIA study

The activities 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

EIA for the project was undertaken by Arkitechno Consultants Indis Pvt. Limited. The EIA consultants prepared an EIA outline, proposed approach to the EIA, conducted the screening and scoping studies including stakeholders' consultation at the initial stages, baseline evaluation and impact assessment. The EIA report was subsequently reviewed by Technical specialists at the World Bank and project team and thereby recommendations were made which were incorporated and also a need for special studies in relation to the development of proposed project on the endangered Gangetic dolphins was felt. The EIA consultants has commissioned this study which was reported separately and the summary of the findings is incorporated in the EIA report. The draft EIA report initially for three (3) Terminals was submitted to the project in December, 2019 and further revised by AIWTDS in July, 2021 for considering the proposed development activities in only one (1) out of the three terminals i.e. the Gateway Guwahati Ghat.

Rationale for this revision mainly lies on two important decisions taken in the Governing Body meeting of the AIWTDS where the Chairman suggested to examine possibility of construction of floating modular terminals at Aphalamukh and North Guwahati and at the same time proposed to construct the South Guwahati (Guwahati Gateway Terminal) with World Class features. The upcoming 2-lane bridge from Jorhat to Majuli lead to the holding back of the Aphalamukh Terminal in the present design and including the same in the list of smaller terminals.

The revised EIA report now tries to understand and analyse the environmental and social aspects in relation to the construction of the GGG terminal and riverine infrastructure as close as possible to the proposed design of the Terminal. Rest of the identified ghats will be studied for EIA separately at a later stage.

## 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, EHS Guidelines for Ports, Harbours, and Terminals, 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
- 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 for the EIA study. 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 Gol, 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. 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 that will be complied 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. EIA study also provides the scope to incorporate measures at later stage of the project when the design gets finalized.

## **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 and MoEF&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, the following 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 and EMF stage consultations for Guwahati Gateway Ghat was conducted and presented in Chapter 5 along with the details of the public consultation held on 15<sup>th</sup> July, 2021 at the AIWTDS office with the presence of key stakeholders as well virtual participation by representatives of local/national level NGOs, members of Sukreswar devalaya committee, Marwari Yuva Manch and government line departments.

### Structure of EIA Report

**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 as well as capacity building needs for the implementation. The chapter also specifies environmental monitoring programme.

**Chapter 10: Summary and Conclusion:** This chapter provides 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 Pollution) Act, 1981, 1987	To prevent and control Air pollution	Applicable Emission is expected during construction,	Consent to Establish (CTE) before construction &Consent to	SPCB	Contractor, should obtain CTE for setting up each facility, batching plant, hot-mix plant,



Name	Key Objective	Applicability	Type of permit and stage of applicability	Administrative Authority and indicative time frame for grant of permission	Responsibility
The Air (Prevention & Control of Pollution) Assam Rule, 1991, framed under Air (Prevention & Control of Pollution) Act, 1981		operation of DG, vessels etc.	Operate (CTO) after commissioning		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 <sup>2</sup>	MoEF&CC& SEIAA / SEAC	AIWTDS/ Contractor for obtaining environmental clearances as applicable.
EIA Notification 14 <sup>th</sup> 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 as a project requiring environmental clearance. The applicability of this legislation should be reassessed periodically from the concerned authority during IWT project development and implementation stages to	Construction stage for EC for borrowing earth not applicable as no new road will be constructed in the current design of GGG		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
		<p>ensure conformity with changes in the regulations if any.</p> <p>Borrowing of earth for road construction (if any) will require prior environment clearance under mining category.</p>			
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 Rules. Safety audit and other requirements should have to be	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
			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 for disposal of used lead acid battery if likely to be used in any equipment during construction and operation stage	No specific registration required.	SPCB	Contractor and AIWTDS. Compliance to the rules should be ensured. Proper collection, buy-back system with Battery Manufacturer.

Name	Key Objective	Applicability	Type of permit and stage of applicability	Administrative Authority and indicative time frame for grant of permission	Responsibility
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
<b>Forest Conservation and Wildlife Protection Legislation</b>					
The Forest (Conservation) Act, 1980 and amendments The Forest (conservation) Rules 1981 and amendments till date	To protect forest by restricting conversion of forest areas 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
<b>Safety and Other Related Legislations</b>					
Chemical Accidents (Emergency Planning, Preparedness	Chemical Accident Response	Applicable. The project will involve handling of hazardous	Permits issued under this act	Central, State & District Crisis Group	AIWTDS & Contractor

Name	Key Objective	Applicability	Type of permit and stage of applicability	Administrative Authority and indicative time frame for grant of permission	Responsibility
s and Response) Rules, 1996		chemical during both construction and operation above the regulatory quantity.		Chief Inspector of Factories, Assam	
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 Applicable as no such notified Archaeological monument are existing	No objection certificate	Archaeological Dept. Gol, Indian Heritage Society and Indian National Trust for Art and Culture Heritage (INTACH).	Not Envisaged
Guidelines for evaluation of proposals / requests for	To regulate extraction of ground water for drinking	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

Name	Key Objective	Applicability	Type of permit and stage of applicability	Administrative Authority and indicative time frame for grant of permission	Responsibility
ground water abstraction for drinking and domestic purposes in Notified areas and Industry / Infrastructure project proposals in Non-notified areas, 2012	and domestic purpose				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	Precautions 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 Policies and Guidelines to ensure that all possible impacts 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) of supported projects to 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 and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural 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 resources from 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 for AIWT 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 any 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 environmental assessment	Applicable	This guideline applies to facilities or projects that generate emissions to air at any stage of the project life-cycle	Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, prevent or minimize impacts
WBG sector-specific EHS	The EHS Guidelines for ports, Harbours,	Applicable	The following section provides	Jetties and terminals to be



Name	Key Requirements	Project Applicability	Remarks	Management Plans
guidelines for Jetty, Harbours and Terminals.	and Terminals are applicable to marine and freshwater jetties, harbours, and terminals for cargo and passengers.		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	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	<p>International Maritime Dangerous Goods Code (IMDG Code)</p> <p>Environmental Impact Assessment of Disposal Operation (WG 10-2006)</p> <p>Biological Assessment Guidance for Dredged Material (WG 8-2006)</p> <p>Ecological and Engineering Guidelines for Wetland Restoration in relation to the Development, Operation and Maintenance of Navigational Infrastructure (WG 7-2003)</p> <p>Management of Aquatic Disposal of dredged material (WG 1-1998)</p> <p>Guidelines for sustainable Inland Waterways and Navigation WG 6-2003</p> <p>Environmental guidelines for aquatic, near shore and upland confined disposal facilities for contaminated dredged material WG 5-2002</p> <p>Environmental management framework for ports and related industries WG 4-1999</p>
International Maritime Organization Conventions	<p>Initial Assessment of Environmental Effects of Navigation and Infrastructure Projects (WG 143 -2014)</p> <p>Sustainable Waterways Within the Context of Navigation and Flood Management(WG 107 -2009)</p> <p>Climate Change and Navigation (TG3 -2008)</p> <p>International Labour Organization (ILO) Code of Practice for Safety and Health in Ports (2005);</p> <p>General Conference of the International ILO Convention concerning Occupational Safety and Health in Dock Work, C-152, (1979)</p> <p>General Conference of the ILO Recommendation concerning Occupational Safety and Health in Dock Work, R-160</p> <p>IMO Code of Practice for Solid Bulk Cargo (BC Code)</p> <p>International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk (IBC Code)</p> <p>International Code for the Safe Carriage of Grain in Bulk (International Grain Code)</p> <p>Code of Practice for the Safe Loading and Unloading of Bulk Carriers (BLU Code)</p> <p>International Maritime Dangerous Goods Code (IMDG Code)</p>



Name	Key Requirements
IFC, World Bank Group	General Environment Health & Safety Guidelines Environment Health and Safety Guidelines for Ports, Harbours and terminals
MARPOL Convention	<p>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.</p> <p>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.</p> <p>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.</p> <p>Annex I: Regulations for the Prevention of Pollution by Oil (entered into force 2 October 1983)</p> <p>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 oil tankers 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.</p> <p>Annex II: Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered into force 2 October 1983)</p> <p>Annex III: Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (entered into force 1 July 1992).</p> <p>Annex IV: Prevention of Pollution by Sewage from Ships (entered into force 27 September 2003)</p> <p>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 sewage treatment 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.</p> <p>Annex V: Prevention of Pollution by Garbage from Ships (entered into force 31 December 1988)</p> <p>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 the complete ban imposed on the disposal into the sea of all forms of plastics.</p> <p>Annex VI: Prevention of Air Pollution from Ships (entered into force 19 May 2005)</p> <p>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,</p>

Name	Key Requirements
	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)	<p>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.</p> <p>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.</p>

## 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 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, the following conditions applies to the proposed subprojects.

Consultations: 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. 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 with key stakeholders was carried out in Guwahati on 15<sup>th</sup> July, 2021 in the presence of key stakeholders as well virtual participation by representatives of local/national level NGOs, members of Sukreswar devalaya committee, Marwari Yuva Manch and government line departments. Although most of the environmental issues highlighted by the participants are already addressed by the EIA with appropriate mitigation measures, some concerns related to the devotees visiting the Sukreswar Temple for worshipping during the Ashokastami festival and Maha Shivratri as well as the regular performance of last rite rituals in the bank of the river Brahmaputra was highlighted. Measures related to prevent degradation of water quality during the construction period to avoid contamination as the river water is taken directly during the Ashokastami festival (March-April) and also at times of performing the last rites of people. The temple authorities also urged the AIWTDS to take proper measures during the construction period so that the devotees do not face trouble in visiting the temple during the peak festival time.

For Category A project, the draft 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. These include the following:

1. Institutional, Regulatory and Safety Strengthening
2. Fleet Safety Improvements and Modernization
3. Improvement in Terminal Infrastructure
4. Project Management

As discussed in introduction section, the proposed project involves:

1. Development & modernization of terminal infrastructure initially at one (1) location i.e. Gateway Guwahati Ghat (GGG).
2. Procurement of 20 vessels (10 numbers of 100-pax & 10 numbers of 50-pax vessels), with all modern amenities to meet safety, security & environmental standards.
3. 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.

However, this EIA Report is focused on point no. 1 mentioned above.

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 summarized in **Table 3-1**.

**Table 3-1: 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	
<b>Total project costs</b>	<b>110.0</b>	<b>88.0</b>	

### 3.1 Terminal Development

Planning considerations for the terminals describing utilities, jetty, navigation aide and other ancillary infrastructure as well as the repairing and maintenance area considerations under the AIWT Project are explained in **Annexure-3.1**

The proposed ferry terminal at Guwahati Gateway Ghat (GGG) will cater to the passenger and two-wheeler traffic traveling to and from North Guwahati ghat and other nearby terminal locations. The riverine and landside infrastructure proposed for the ferry terminal are robust structures and provide floating but permanent boarding/deboarding locations for passenger and vehicles. This also ensures a greater sense of safety among the passengers especially during high flood season when the currents are extreme. The boarding/deboarding location is accessible for all passengers and ample waiting areas are also provided for convenience of passengers. The terminal utilities and services are provided for ease of operation and maintenance during any water level.

Construction of the Guwahati Gateway Terminal and Riverine Infrastructure represents the first phase of works under AIWTD Project under the component, 'Improvement in Terminal Infrastructure'. The proposed terminal in Guwahati Gateway is on the left bank of Brahmaputra River. IWAI terminal at Pandu is about 5.8 km downstream of the proposed terminal. The proposed ferry terminal at Guwahati Gateway Ghat (GGG) will cater to the passenger and two-wheeler traffic traveling to and from North Guwahati ghat and other nearby terminal locations. Based on the traffic analysis and forecast, the terminal building area and infrastructure facilities are finalized. No tree cutting and dredging involved in the proposed project.

Summary of the infrastructure proposed in the Guwahati Gateway Terminal is presented in the Table below.

Sl. No.	Ghat Name	Proposed Components	Area Required [m²]/Area required in	No. of Passenger <sup>2</sup>		
				hour /peaks	average	Considered for Planning
1.	Guwahati Gateway Ghat	External Development (Parking, Plantation, Ramps)	1784	1561	600	961
		Utilities (DG Sets, Transformer, Water Tank)	470.25			
		Building Area (Ticket Counter, Office, Waiting Area, Toilets, Baby Room)	514			
		Total Area	2770			

**Table 3-2: Summary of the Infrastructure at Guwahati Gateway Ghat**



Figure 3- 1: Proposed location of GGG Terminal (\*source DPR Guwahati Gateway Ghat, July 2021)

### Project Activities

As discussed above, the project involve Terminal Development, which will include construction of jetty, navigation aide and other ancillary infrastructure as well as the repairing and maintenance area. The project activities during construction and operation phase are given below:

#### Construction Phase

1. Site Preparation/Leveling of Terminal Site
2. Piling
3. Transportation of vessels
4. Operation of DG Sets
5. Construction of Base-camp
6. Construction of Labour Camp

#### Operation (Maintenance) Phase

1. Removal of silt/sand or other debris
2. Disposal of silt/sand
3. Transportation of vessels

#### 3.1.1 Sewerage Treatment Plan

A package type STP of size 60KLD has been proposed for treating the waste water generated from the terminal at GGG. Waste water will undergo several steps of treatment before finally being stored in the treated water tank to be used in gardening and horticulture activities. An area of 50 sq.m has been earmarked in the layout for setting up the STP.



### 3.1.2 Renewable energy

For GGG, Solar lighting system is taken into consideration to save conventional energy consumption.

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

In Assam State 9 months 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.

### 3.1.3 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.

### 3.1.3 Landscaping and Beautification.

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

### 3.1.4 Labour Requirement

Details of labour requirement for Guwahati Gateway Gat has been given below-

**Table 3-3: Details of Labour Requirement for GGG (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
<b>Total Labour Force at any Given Instance</b>		<b>190 (+/- 10%)</b>

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

## 3. 4 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<sub>2</sub>, NO<sub>x</sub>, SO<sub>x</sub> and PM. CO<sub>2</sub> emissions from different public transport is given in **Table 3-4**.

**Table 3-4 CO<sub>2</sub> Emissions From Public Transport**

Type of vehicle	kg CO <sub>2</sub> /km	kg CO <sub>2</sub> /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<sub>2</sub>/ km for ferries are high then other vehicles. However, CO<sub>2</sub>/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 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 over populated Guwahati, North Guwahati which is also having 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
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.  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	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.  To provide facility for the passengers from Airport to Ferry location near North Guwahati within 2 km is very good option which can

Feature	Without Project	With Project
	main city by the State Public Works Department.	be time saving against 1 hour traveling to Guwahati City by road.  GGG 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 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 erosion restricts the expansion.	The project aims to improve passenger and vehicle accessibility across the Brahmaputra with improved infrastructure and ferry 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 comparison to Inland Water Transport.	There will be overall reduction in GHG emissions in IWT as this mode is energy efficient
	Ambient Air Quality is affected by emission from vehicles and rail. There will be increase transportation by rail/road, which is likely to deteriorate 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 exhausts will be reduced significantly.  Air quality in terminals will improve because of mitigative measures and plantation.
	Water Quality: Construction of more roads to fulfill traffic demand will result in more paved surfaces, thereby 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	Loss of agricultural land and top soil: Land requirement is minimal. Land requirement is much less than the land required for road & railway projects.

Feature	Without Project	With Project
	agricultural land and loss of top soil. Soils are also sourced by digging burrow pits.	
	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 impact on terrestrial ecology.	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.
	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 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- Guwahati Gateway Ghat

Development Site Location	Site Specific Findings	Advantages	Disadvantages	Remarks
				
<b>Gateway Guwahati Ghat (GGG) (On South Bank of Brahmaputra)</b>	<ul style="list-style-type: none"> <li>Ghat is muddy flat land.</li> <li>As per record daily average 800 Passenger travel from Ghat.</li> <li>Infrastructure facilities like passenger waiting area, toilets, parking area are provided.</li> <li>Toilet waste not treated and directly release into river</li> <li>Laboratory testing of the water quality confirmed the turbidity and contaminated nature of the water.</li> <li>Lacking of ramp, approach paved roads etc.</li> <li>Temporary bamboo ramps / structures which are big problem during rainy season.</li> <li>Solid waste is dumped and scattered on site.</li> </ul>	<b>Environment Considerations:</b> <ul style="list-style-type: none"> <li>No tree cutting is associated since land requirement is limited to access road to the terminal development at riverbank.</li> <li>Site is open sandy with no development in nearby areas.</li> <li>Small encroachments are observed</li> <li>High siltation is recorded</li> <li>Site is with IWT Assam.</li> <li>Site is accessible by MG Road and city roads which are already developed.</li> <li>Settlements located at an app. Distance of 400 m from site thus minimal impact due to project activities.</li> <li>Locally available raw material (sand)</li> <li>Site is not part of or close to any eco-sensitive location</li> <li>Availability of land required for berthing and supportive infrastructure.</li> </ul>	<b>Environment Considerations:</b> <ul style="list-style-type: none"> <li>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 Umananda Ghat and 2 km near Kacheri Ghat</li> <li>Approach from city roads to the Ferry Ghat is not developed. In rainy season the passengers face problem.</li> <li>Site not directly connected to any public paved road to MG road</li> </ul>	<ul style="list-style-type: none"> <li>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.</li> <li>No major environment, social or design issue associated</li> <li>All the negative impacts listed are manageable with proposed environment &amp; social management plans thus no major drawbacks associated with the site</li> </ul>

#### 4.1.1.1 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 maintenance services of vessels.
5. Ferry system has to comply with the existing applicable guidelines/legislations.

##### B. Vessel Performance Requirement & Ferry Types

Three different standard of ferry designs are being proposed. All ferry types follow the same 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 to be 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 due to 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 decisive advantages of catamarans when speed maximization is not an issue as it is in this case. The maximum 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 consists of 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 be implemented 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 will be implemented, ideally followed by effective penalisation schemes for violators when leaving litter inadequately on board or throwing any substances – liquid or solid - into open waters<sup>1</sup>. Bunkering

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<sup>1</sup> Monetary fine or banning from entering waters for a certain period

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 allow for uninterrupted operations but 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 solely 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;
- 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 draught 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;
- 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 the main base of ferry operations. 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 depart always at 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 than 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 devices.

## **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.

### **4.1.1.2 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 Gateway Guwahati Ghat as shown 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					180

#### 4.1.1.3 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.

#### 4.1.1.4 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)

#### 4.1.1.5 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 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.

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 appropriately by 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. The consultation framework 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 consultations encompass 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 living on 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 are also 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 will promote 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 state is regulated by IWT. Local bodies like



Panchayat or Municipal Corporation, Guwahati are also key stake holder. Other Govt. Departments such as Water resources, Revenue, Transport, Commerce are also important stakeholders.

#### 5.4 Institutional Stakeholders Consultations-Guwahati Gateway Ghat (screening, scoping stage)

Institutional stakeholders' consultation was conducted during screening and scoping stage on 8<sup>th</sup> October 2018. 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), BeltolaBasishta 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 responses are summerised in **Table 5-3**.

**Table 5-2: Summary of Institutional Stakeholders Consultation**

Comments/Suggestions	Remarks / Reply
• The presentation is more generalized and not to the point and specific	The presentation is prepared for the screening and scoping. The main objective was to receive the



Comments/Suggestions	Remarks / Reply
<ul style="list-style-type: none"> <li>More points should be included in the parameters for screening because location wise they are diversified.</li> </ul>	<p>comments from participants which can be taken into consideration for EIA studies. EIA will be in Public domain covering site specific details.</p>
<p>Following points are to be addressed</p> <ul style="list-style-type: none"> <li>Green engineering equipments are to be fitted (like solar engine, water jet engine etc.)</li> <li>Bio toilet for water pollution control</li> <li>All ferry services may be declared as pollution free zone.</li> <li>Community participation.</li> <li>River water protection by using Bio digester/septic tank for toilet waste</li> </ul>	<ul style="list-style-type: none"> <li>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.</li> <li>Proper solid waste management at Ghat will be implemented with community participations.</li> <li>Policy and protocols will be displayed at public domain for information.</li> </ul>
<p>Safety of aquatic animals should be given priority</p>	<p>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.</p>
<p>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.</p>	<p>Will be considered in designing of the terminals</p>
<ul style="list-style-type: none"> <li>Sustainable garbage management.</li> <li>Protect erosion of permanent structure with proper plantation.</li> <li>Pollution management/ control by proper way</li> <li>Protection of river fauna.</li> <li>Protection of bank erosions with plantation</li> <li>Pollution control of river water.</li> <li>Attention for oil spillage, garbage disposal etc.</li> </ul>	<ul style="list-style-type: none"> <li>Eco-friendly Erosion Control measures like Geo-tube embankment, piling up the geo-bags, Geo-textile Embankments etc. after feasibility will be implemented.</li> <li>All the sustainable solutions like green engine, STP with zero discharge system, closed fuelling system will be implemented for the pollution free operations.</li> <li>Proper solid waste management at Ghat locations will be implemented with community participations.</li> <li>Safety aspects will be covered as per the MORPOL, IWAI, EHS Ports protocols.</li> <li>Plantations will be taken up in consultation with concerned departments</li> </ul>
<ul style="list-style-type: none"> <li>What happens to the flora being displaced?</li> <li>How will it keep fauna like Dolphin &amp; fish away?</li> <li>In case of an oil spill what is the preparedness</li> <li>Suggestions: An integrated understanding of the endemic species found at the location.</li> </ul>	<ul style="list-style-type: none"> <li>Appropriate protocols and procedures will be prepared for conserving flora</li> <li>Necessary protective gadgets will be installed the vessels so that Dolphin and other aquatic animals are not affected</li> <li>Oil spill disaster management plan will be part of EIA</li> <li>Suggestion noted and will be covered in EIA report</li> </ul>
<p>Methodology of assessment of "Aquatic Biodiversity" needs to be properly explained.</p>	<ul style="list-style-type: none"> <li>Aquatic biodiversity will be studied in greater detail in EIA and appropriate mitigation measures will be suggested</li> </ul>
<p>Implementation of MARPOL Annexure I to VI</p>	<p>MARPOL implementation plan will be prepared and will be incorporated in EIA report.</p>
<ul style="list-style-type: none"> <li>The Baseline survey regarding the environment may kindly be provided.</li> <li>The EIA must come up with clear comments on how to go for preparation of EMP</li> </ul>	<ul style="list-style-type: none"> <li>Will be covered in EIA.</li> <li>EMP with implementation plan and responsibility matrix with costing will be incorporated in EIA report.</li> <li>Water quality issues at the terminal will be addressed and mitigation plan will be prepared.</li> </ul>

Comments/Suggestions	Remarks / Reply
<ul style="list-style-type: none"> <li>Water quality issues in the terminal are to be addressed.</li> <li>Sourcing of construction materials from nearby areas (of Ghats) are of concern. Thus, alternative arrangements must be suggested.</li> </ul>	<ul style="list-style-type: none"> <li>Noted. Construction material management plan will be prepared</li> </ul>
<ul style="list-style-type: none"> <li>What are the parameters you have studied in water quality analysis?</li> <li>How you address the problem</li> <li>What are the parameters you have studied in air quality parameter?</li> <li>Do you study the flood?</li> <li>How many samples you have studied for each location</li> </ul>	<ul style="list-style-type: none"> <li>Parameters for air and water quality studied are as per TOR given by World Bank.</li> <li>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.</li> <li>Flood management is already covered in the EIA scope.</li> </ul>
<ul style="list-style-type: none"> <li>Is the analysis of alternative was done during environmental screening exercise. If yes, then what is the criteria matrix?</li> </ul>	Covered in Screening and scoping report.
<ul style="list-style-type: none"> <li>How will be river ecosystem affected if the ferry will start?</li> <li>How new ferries will lead to sustainable development?</li> </ul>	<ul style="list-style-type: none"> <li>River ecosystem will be studied during EIA and conservation measures will be taken</li> <li>MARPOL implementation plan will be prepared and will be incorporated in safety aspect of EIA report.</li> <li>Erosion control plans will be prepared and implemented after technical feasibility</li> </ul>
<ul style="list-style-type: none"> <li>This project might effect upon river ecosystem will be disrupted by this project what will be the measures regarding this?</li> <li>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?</li> <li>Ferries can be the cause of Shoreline erosion.</li> </ul>	
<ul style="list-style-type: none"> <li>How is the increased no. of ferries going to affect the river ecosystem, as well as the surrounding areas (near the Ghats)</li> </ul>	
<ul style="list-style-type: none"> <li>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.</li> </ul>	
<ul style="list-style-type: none"> <li>IWTD may operate hybrid vessels to minimize water pollution</li> <li>Hybrid- Electric + Solar Diesel + Electric</li> <li>They may sought for Govt. assistance (found central+ state as these version scheme and Govt.) to provide fund to control pollution.</li> </ul>	This will be taken into consideration during finalisation of vessel design

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 highlighted were considered during the detailed EIA study for Guwahati Gateway Ghat as well as in the DPR for the terminal with best mitigation measures.

#### 5.4.1 Public Consultation in EMF Stage

Stakeholder consultations were conducted on 4<sup>th</sup> February 2019 in Guwahati Circuit house. Findings from EMF study and TOR were discussed in the forum. The important stakeholder's invited at Guwahati 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

Important Comments/Suggestions made during Public consultation at Guwahati is presented in **Table 5-4**

**Table 5-3: Summary of Stakeholder Consultation (EMF Stage), Guwahati**

Comments/Suggestions	Remarks / Reply
<ul style="list-style-type: none"> <li>• Energy saving practices should be implemented</li> <li>• Detailed EMP and costing should be prepared</li> <li>• EMP should be implemented and monitored during construction and operation stage</li> <li>• STP should be installed and monitored on Terminals for its operations</li> <li>• Solar energy should be thought of at terminals</li> <li>• Night navigation should be improved</li> <li>• All the environmental concerns should be considered in design of terminals by DPR consultants</li> <li>• Training requirements should be considered in EMF</li> </ul>	<ul style="list-style-type: none"> <li>• All the sustainable solutions like green engine, solar light panel shall be installed</li> <li>• Proper solid waste management at Ghat locations will be implemented with community participations.</li> <li>• Mechanism for review and monitoring of implementation of EMP will be established</li> <li>• Night navigation improvement is already considered by PP in the project</li> <li>• Training requirements are already considered at different stages of the project.</li> <li>• All the identified environmental issues will be considered during design of terminals and vessels</li> </ul>

#### 5. 4.2 Stakeholder Consultation at Draft EIA Stage

The Stakeholders meeting was conducted on 15<sup>th</sup> July, 2021 at AIWTDS office, Ulubari. The public were informed that a terminal will be constructed at Gateway Guwahati 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 was discussed in the forum. There was representation from local and national level NGOs (CARITAS India, OXFAM India, Scorpion), TISS, IIT-G, government line departments (Fishery Dept, PWD, IWT, Pollution Control Board) locals residing near the Ghat represented by the members of Marwari Yuva Mancha and Sukreswar Devalaya committee members. Due to the prevailing Covid protocol, meeting was conducted virtually. Senior officials of line departments, Sukreswar Devalaya committee and Marwari Yuva Mancha members joined the consultation at the office of AIWTD Society in person.

The project team appraised the participants that the design for GGG is made more environment friendly with no tree cutting and dredging involved.

Advertisement in Newspaper in local and English language, Attendance sheets (including the virtual participation members list), Letters communicated to stakeholders, Meeting minutes are enclosed in **Annexure 5-1 and 5-2**. Some of the important feedback received from the participants are tabulated below:

**Table 5-5 Summary of Stakeholder Consultation at Draft EIA Stage for Guwahati Gateway Ghat**

Name of the Participant	Details of Feedback	Comments from AIWTDS
Sri. Suresh Ch. Bhattacharya Working President, Sukreswar Devalaya, Guwahati	When the work will start tentatively. He informed that there are various functions related to the Sukreswar temple such as Shivaratri, Ashoka Ashtami in the month of March-April and the month of Shravan (July-Aug) which is considered to be a holy month every year where devotees in large numbers take holy bath in the river and drink the water as part of rituals. Apart from that last rites of heavenly bodies are also performed by their family members every day. In the above circumstances Sukreswar Temple which is within the close vicinity of the terminal where the construction will take place the adequate measures should be adopted so as to keep the water pollution free in order to maintain safety standards for any health related hazards for the devotees. It was also suggested for a road from the terminal to the temple for the devotees coming via ferry.	Addl. SPD, AIWTD Society informed the tender will be floated very soon and construction work will start as soon as the work is awarded after completion of formalities.  He also elaborated on the various other issues and said adequate safety measures will be taken considering the various festivals related to Sukreswar Temple, Guwahati, regarding the issue it was informed that no such planning has been taken up as of now and after a patience hearing the Temple Authorities expressed their satisfaction.
Sri. S K Bordoloi, Centre for Rural Development	The following matters were highlighted: Adequate measures should be adopted in terms of Gender related issues during and after the construction and implementation period. Proper approach roads should be constructed keep in view all aspects such as Gender, Sr. Citizens etc. Alternative Skill trainings for loss of livelihoods for concerned. All safeguards issues should be addressed.	Addl. SPD, AIWTD Society informed that there is no loss of livelihoods in this project however they same will be considered for other projects when implemented and other issues as per feedback received will be strictly adhered during all phases of the project.
Sri. Debojit Goswami, Scorpion NGO, Guwahati	This is a wonderful initiative by the AIWTD Society and best wishes for early implementation.	AIWTDS expressed gratitude.
Er. K Bayan, Superintending Engineer, PWD, Guwahati	It was suggested that a Bus Lay Bay may be planned in between the vacant area from road to the terminal within the	Addl. SPD and Advisor AIWTD Society appreciated the suggestion and informed



	vicinity of the project if permitted or proposal may be sent to PWD for taking up the same. This would avoid the traffic congestion in the area to a great extent and regular ferry commuters can on board the bus immediately coming out of the terminal.	necessary initiative would be taken in a positive direction.
Vinuthna Patibandla, OXFAM India	<p>The following were the feedbacks:</p> <p>Erosion related issues in areas of terminal construction should be taken up with line departments.</p> <p>Proper approach road towards the terminals to be constructed as during floods and rainy season roads become very dilapidated making is difficult for users as in case of Dhubri and Majuli.</p> <p>Gender related issues should be given adequate importance.</p> <p>A study may be conducted for taking adequate measures to avoid disturbances in road connectivity to the terminal during flood reason.</p>	AIWTDS responded necessary initiative would be take up with all concerned departments.
Mr. Prabal Sen, CARITAS India	What are the measures taken by the project for prevention of water pollution during the construction phase as it will have an impact on the aquatic fauna including dolphins?	All measures for protecting the aquatic fauna including the dolphins are already incorporated in the EMP, and the contractor will need to strictly adhere to the EMP during the construction period.

## Chapter 6 : Current Environmental Scenario

### 6.1 Introduction

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

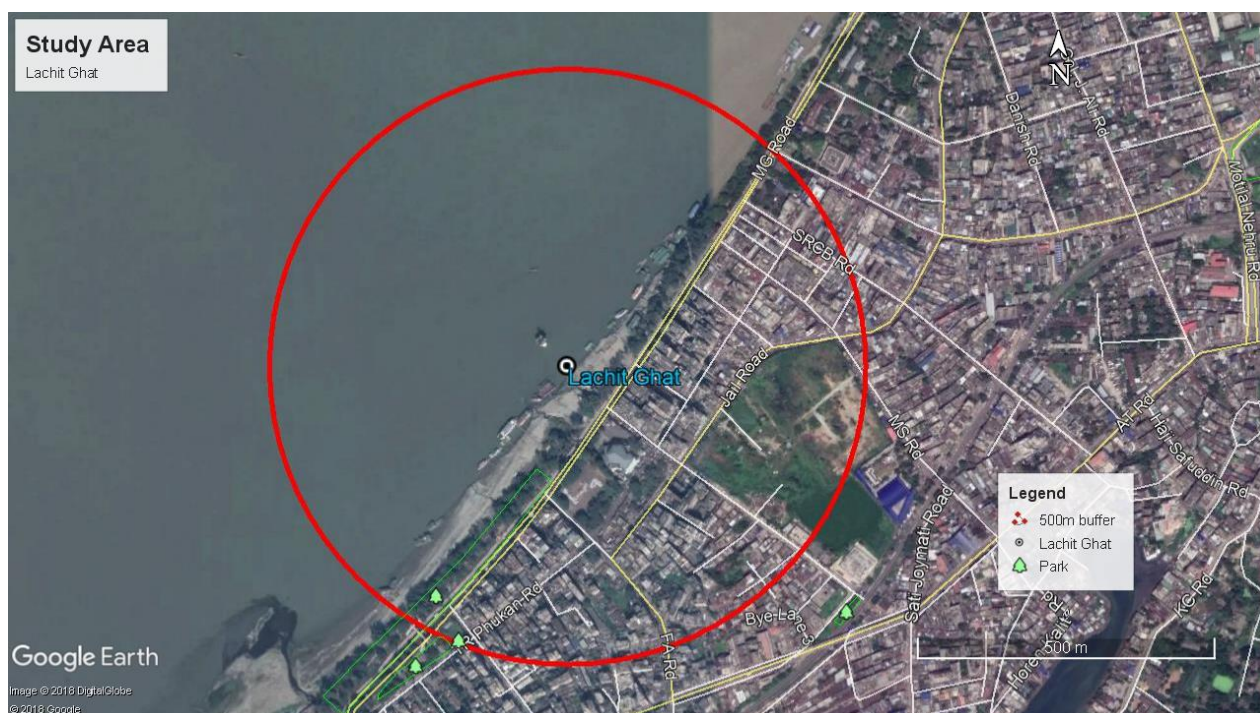
### 6.2 Study Area

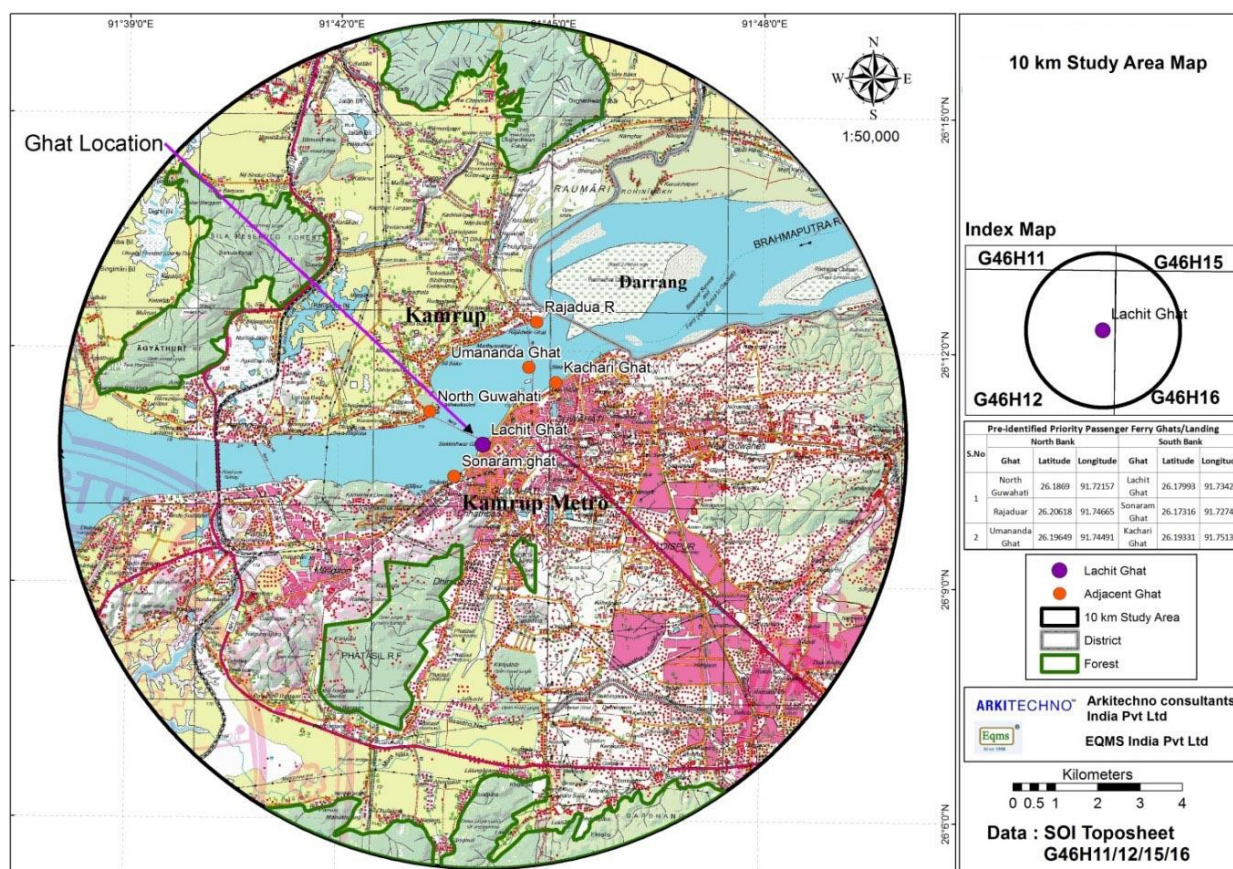
The study area is defined as the area over which the potential direct and indirect impacts of the proposed development are expected.

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 Gateway Guwahati Ghat 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**.

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





**Figure 6-2: Study Area– Gateway Guwahati Ghat (GGG)(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, Patuki 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 the region (Mahanta et al., 2004) leading to high turbidity values. Sediment load in rivers generally raises 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 transport report 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 Environmental 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	<ul style="list-style-type: none"> <li>PM 10 and PM 2.5</li> <li>Sulphur dioxide (SO<sub>2</sub>)</li> <li>Oxides of nitrogen (NO<sub>x</sub>)</li> <li>Carbon Monoxide (CO)</li> <li>Pb (Lead)</li> <li>NH<sub>3</sub>,</li> <li>C6H6, BaP,</li> <li>Arsenic &amp; Nickel.</li> </ul>	<ul style="list-style-type: none"> <li>At 3 locations at each Ghat within study area for one season</li> <li>Sampling locations are decided as per the wind direction and activities</li> </ul> <p>Frequency: 24 Hourly sampling (Day &amp; Night time) to be done on twice in a week basis for one season (except monsoon period)</p>	High Volume Sampler	<ul style="list-style-type: none"> <li>SO<sub>2</sub>( as per IS-5182) Part – II) – 1969)</li> <li>NO<sub>x</sub>( as per IS-5182 (Part VI)-1975)</li> <li>CO ( as per IS-5182 (Part X) 1975)</li> <li>Lead ( as per IS: 12074)</li> </ul>
2. Noise Level	<ul style="list-style-type: none"> <li>Max Noise Level (L<sub>max</sub>)</li> <li>Min noise level (L<sub>min</sub>)</li> <li>Maximum hourly Leq</li> <li>Minimum hourly Leq</li> <li>Day time Leq value (6 am to 10 pm)</li> <li>Day time Leq value (10 pm to 6 am)</li> </ul>	<p>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</p> <p>Frequency: 24 continuous hours of Hourly sampling (Day &amp; Night time)</p>	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,	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

Environmental Feature	Parameters Recorded	Duration and Frequency	Apparatus used	Remarks
	Hardness, COD, NO <sub>3</sub> , PO <sub>4</sub> , Cl, SO <sub>4</sub> , Na, K, Ca, Mg, Mn, Zn, Hg, Pb, Cu, Arsenic, Silica, Oil & grease, Phenolic compounds, Residual Sodium Carbonate. Biological parameters: Total Coliform. Aquatic biota like phytoplankton, zooplanktons			methods for examination of 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, NO <sub>3</sub> , PO <sub>4</sub> , Cl, SO <sub>4</sub> , 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 presence of pollutants or heavy metals 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 Spectrophotometer (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,	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
	IUCN Red List status; national or state / regional protection status. 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 GGG terminal covered under the project are shown in Maps in **Figure 6-3**



Figure 6-3. Environmental Monitoring Locations – Gateway Guwahati Ghat (GGG)



## 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

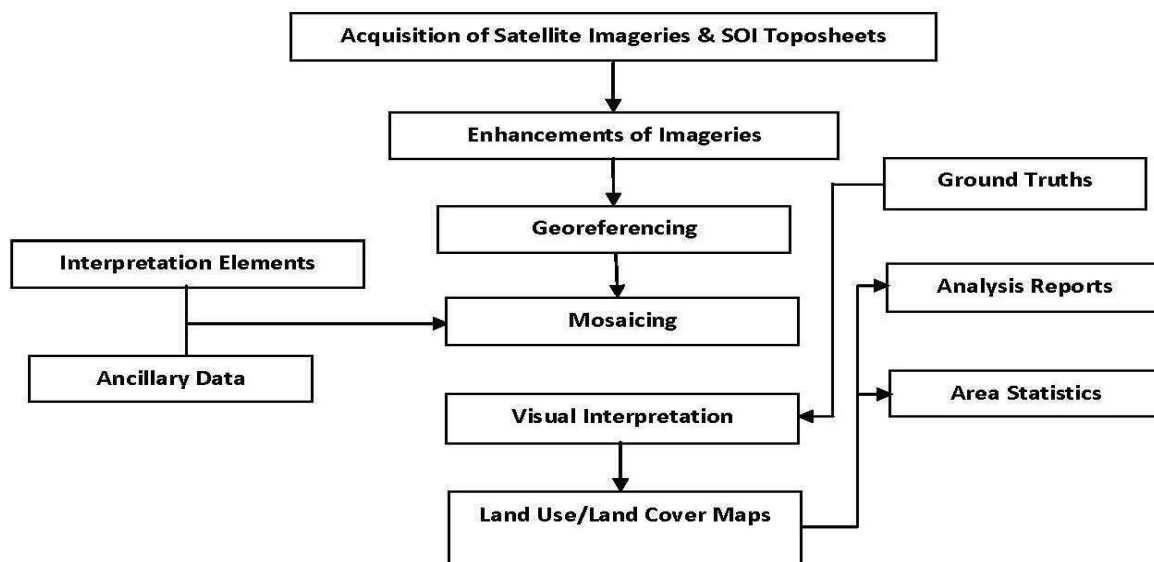
The objective of assessing the land use details of the area is to know the existing land use pattern of the area and enable one to know about the land that can be used for the proposed development activities in the study area. It also enables to envisage the scenario emerging due to the increase in demand 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 6-4**.



**Figure 6-4: 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 site Gateway Guwahati Ghat (GGG) is provided in **Figure 6-5** and the LULC map around the 10 Km radius of proposed project is provided as **Figure 6-6** 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
<b>Total</b>	<b>31415.31</b>	<b>314.15</b>	<b>100.00</b>

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.

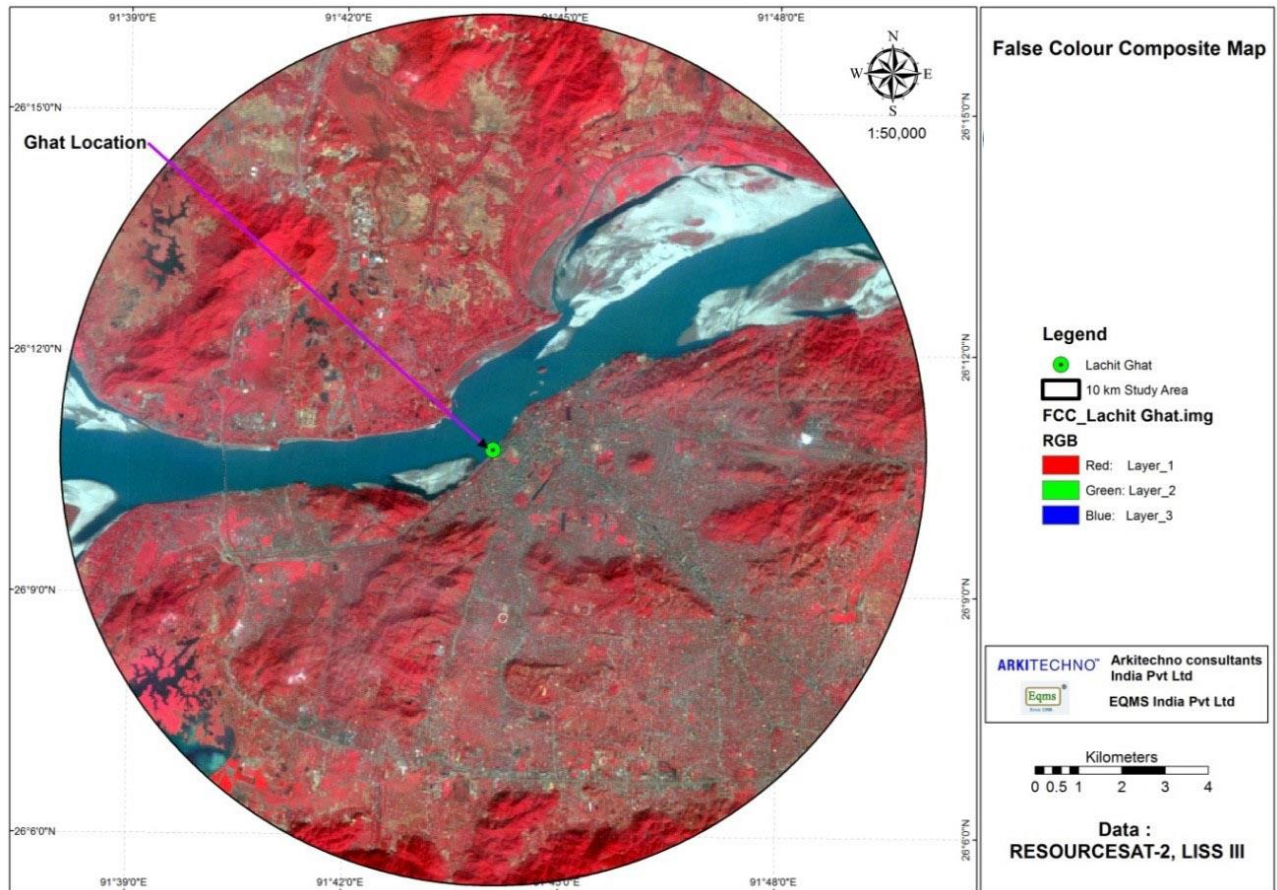


Figure 6-5: 10 Km radius False Color Composite Satellite Map

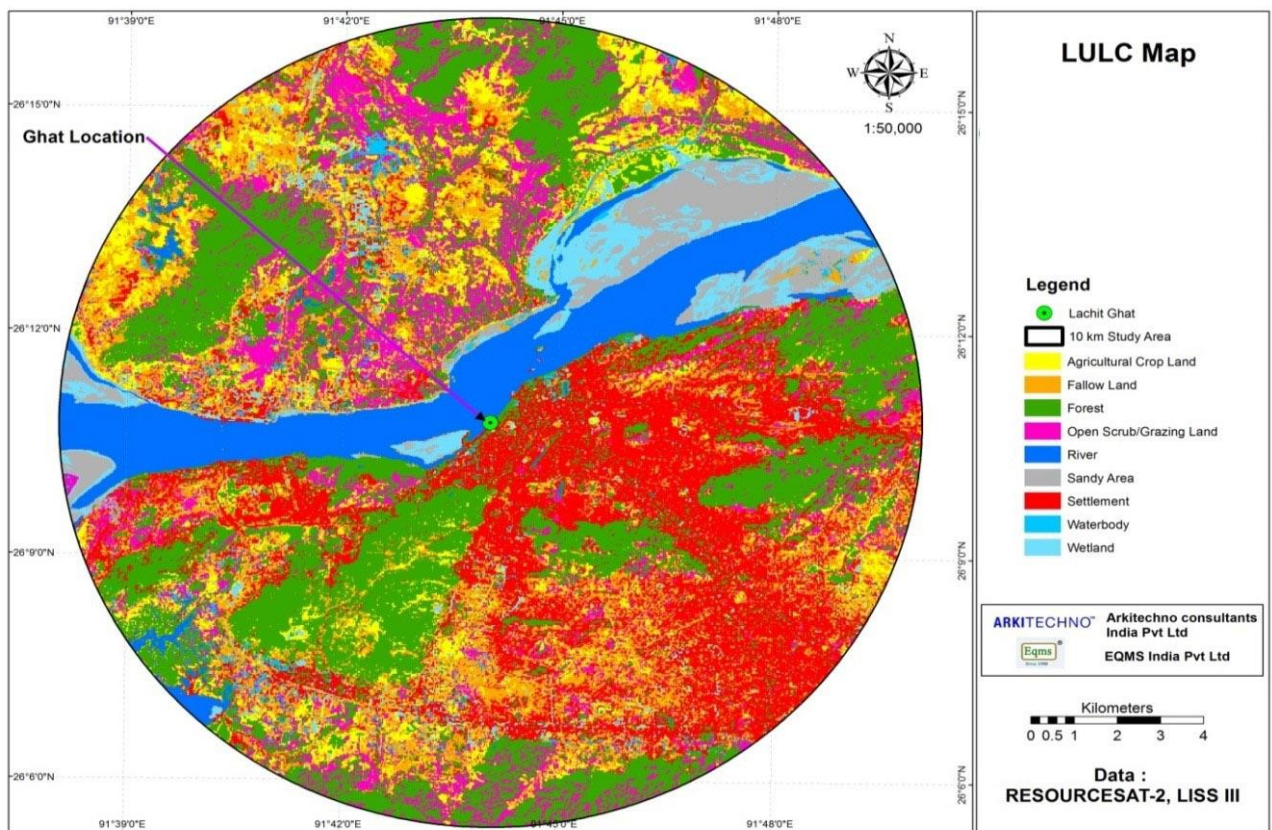


Figure 6-6: Land Use / Land Cover Map of Study Area (10 Km Buffer)



## 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 6-3**

**Table 6-3: 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
		-		-	-		26.917445	94.283241

Brahmaputra 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 **Table 6-1**. The results of samples are compared with CPCBs criteria of classification of river water. Water quality results at Gateway Guwahati Ghat (GGG) are given in Table 6-4

**Table 6-4: Brahmaputra River water quality at different locations in Assam <sup>2</sup>**

Sl. No.	Locations	Temp °C			DO mg/l			pH			Conductivity µS/cm			BOD m	
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
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	Brahmaputra at Dibrugarh	18	28	23.2	6.2	8.8	8.4	6.7	7.7	7.3	94	197	148	0.5	3.8
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
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
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
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

<sup>2</sup>(Source: Status of water quality report in 2011 CPCB)

Sl. No.	Locations	Temp °C			DO mg/l			pH			Conductivity $\mu\text{S/cm}$			BOD m	
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
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
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
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
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

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 6-5: Surface Water Quality – Guwahati Gateway Ghat

Sl. No.	Parameter Sampling Date	Unit	Gateway Guwahati Ghat (GGG)			
			Aug-18		Dec-18	
			Upstream	Downstream	Upstream	Downstream
1	Temperature	°C	22.5	20.6	23.6	22.8
2	Colour	Hazen	36	31	25	47
3	Electrical Conductivity	µS/cm	376.2	385.1	380.4	378.4
4	Turbidity	NTU	22	18	8	28
5	Salinity	PPT	0.08	0.08	0.07	0.09
6	pH Value @ 25°C	--	7.3	7.5	7.2	7.4
7	Total Hardness (as CaCO <sub>3</sub> )	mg/l	98.2	96	102	110
8	Dissolved Oxygen	mg/l	6.6	6.2	6.6	6.8
9	BOD for 3 days @ 27°C	mg/l	2.2	2.6	2.8	3.2
10	COD	mg/l	14	10	20	26
11	Chloride (as Cl)	mg/l	45	43	41	49
12	TSS	mg/l	28.6	32.9	25.6	56.2
13	TDS	mg/l	244.53	248.6	213	219
14	Calcium (as Ca)	mg/l	27.55	26.93	28.6	30.86
15	Magnesium (as Mg)	mg/l	7.15	6.99	7.4	8.02
16	Copper (as Cu)	mg/l	0.033	0.036	0.035	0.039
17	Manganese (as Mn)	mg/l	<0.05	<0.05	<0.05	<0.05
18	Sulphate (as SO <sub>4</sub> )	mg/l	22.7	23.6	18.8	17.7
19	Nitrate (as NO <sub>3</sub> )	mg/l	4.58	5.01	3.26	3.08
20	Phosphate (as PO <sub>4</sub> )	mg/l	0.21	0.26	0.56	0.48
21	Phenolic Compound (as C <sub>6</sub> H <sub>5</sub> OH)	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 SiO <sub>2</sub> )	mg/l	0.19	0.25	0.15	0.23
24	Arsenic (as As)	mg/l	<0.001	<0.001	<0.001	<0.001
25	Sodium (as Na)	mg/l	30.1	36.2	28.2	30.8
26	Potassium (as K)	mg/l	1.9	2.3	1.8	2.2
27	Lead (as Pb)	mg/l	0.14	0.2	0.15	0.19
28	Zinc (as Zn)	mg/l	6.3	6.9	2.5	4.1
29	Residual Sodium Carbonate	meq/l	1.1	1.3	1	0.9
30	Oil and Grease	mg/l	<5	<5	<5	<5
31	Total Alkalinity (as CaCO <sub>3</sub> )	mg/l	76	80	84	96
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 season. 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 locations of the proposed terminals/ jetty / landing points. Soil 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 6-6**

**Table 6-6: 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 @ 25°C	--	6.5-8.5	No relaxation	6.88	6.93	6.9	6.84	6.78	6.59
7	Total Hardness (as CaCO <sub>3</sub> )	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 <sub>4</sub> )	mg/l	200	400	12.5	10.3	14.4	11.5	12.7	10.9
19	Nitrate (as NO <sub>3</sub> )	mg/l	45	No relaxation	1.65	1.23	1.48	1.59	1.36	1.99
20	Phosphate (as PO <sub>4</sub> )	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
21	Phenolic Compound (as C <sub>6</sub> H <sub>5</sub> OH)	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 <sub>2</sub> )	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

Sl. No.	Parameter	Unit	Acceptable limit IS 10500	Permissible Limit	Gateway Guwahati Ghat (GGG)					
					Wet Season (August 18)			Dry Season (December 18)		
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	0.57	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 <sub>3</sub> )	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

### 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 water 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 conventional 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°C. From October onwards, temperatures begin to decline.

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

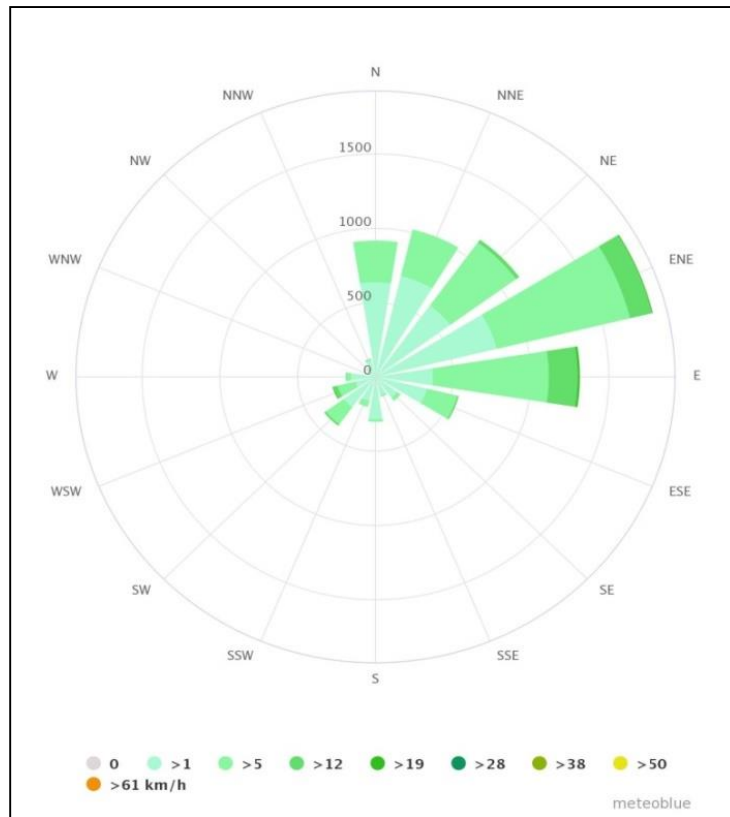
Meteorology contain following parameters which include

- 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** for Guwhati.



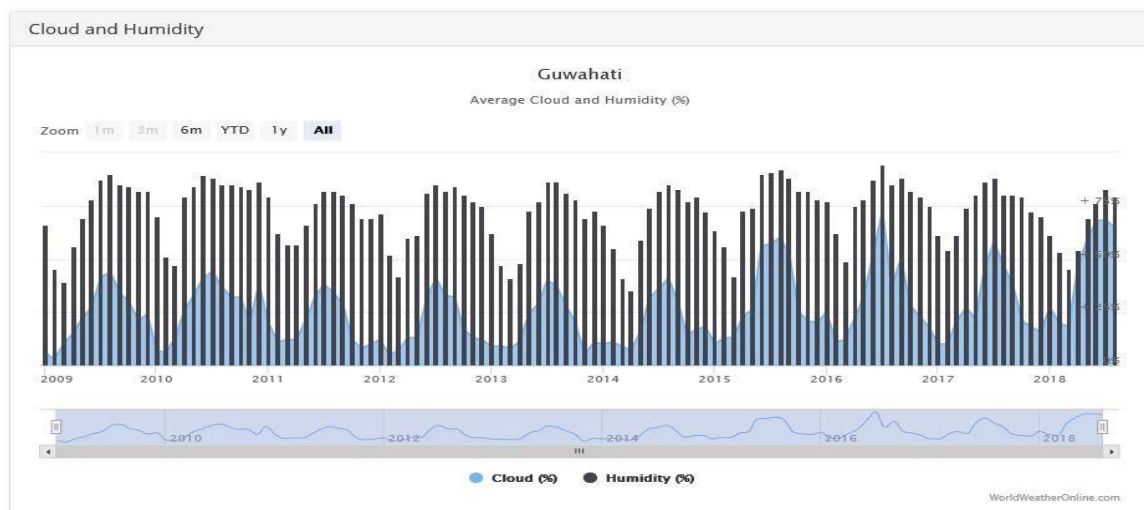


**Figure 6-7: The wind rose for Guwahati**

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 2018 of Guwahati is given in **Figure 6-8**



**Figure 6-8: Humidity Guwahati**

### 6.7.3 Rainfall

#### 6.7.3.1 Guwahati Region

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

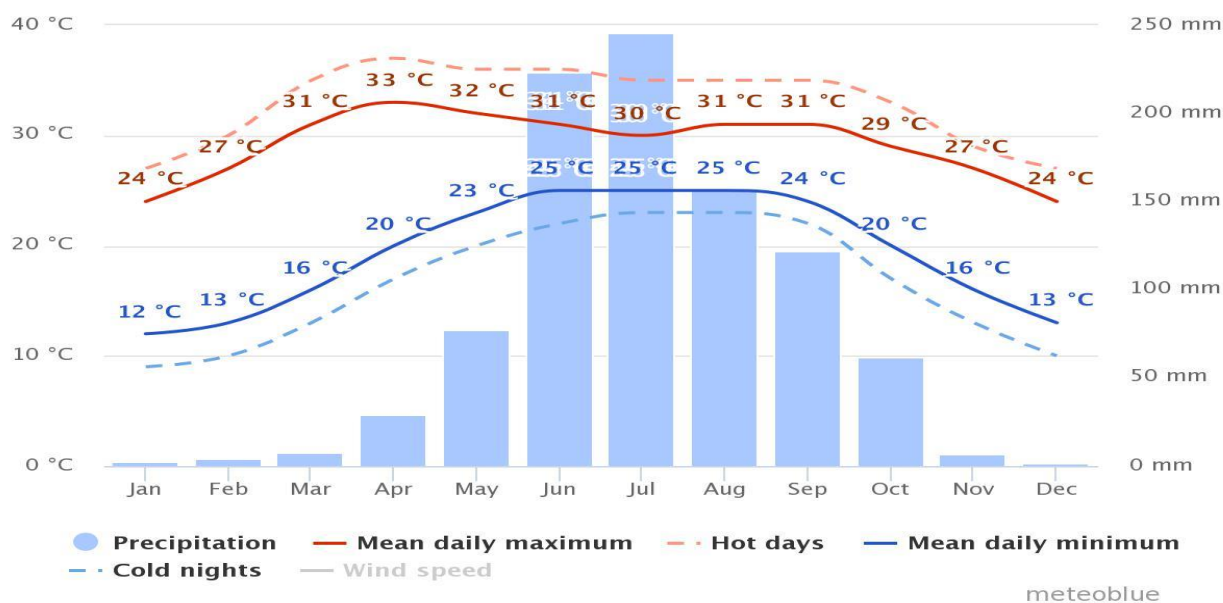


Figure 6-9: Average monthly temperature and precipitation of Guwahati

## 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 PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, NO<sub>x</sub>, CO, O<sub>3</sub>, NH<sub>3</sub>, 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 each sites for 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 6-7**.

**Table 6-7 Ambient Air Quality Monitoring Locations for GGG**

Sl. No.	Location/Ghat	Monitoring Station	1 <sup>st</sup> test in the week (Date)	Co-ordinate		2nd test in the week (Date)	Co-ordinate	
				Latitude	Longitude		Latitude	Longitude
1	Gateway Guwahati Ghat (GGG)	1 <sup>st</sup>	06.08.18	26.181658	91.736031	10.08.18	26.181658	91.736031
		2 <sup>nd</sup>	06.08.18	26.180770	91.736119	10.08.18	26.180770	91.736119
		3 <sup>rd</sup>	06.08.18	26.179979	91.736806	10.08.18	26.179979	91.736806
		3 <sup>rd</sup>	05.08.18	26.186794	91.721051	09.08.18	26.186794	91.721051

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

### 6.8.1 Ambient Air Quality

The Pollution Control Board Assam (PCBA) which has been monitoring the city's ambient air quality under the National Air Quality Monitoring Programme (NAMP) has recorded high levels of air pollution in its monitoring station at Pan Bazar which is close to the proposed Terminal location. As per the National Air Quality Index of the Central Pollution Control Board data for past six months i.e. January-June 2021 shows that average AQI recorded during this period range between "poor" category in January to Moderate to good category in June with an AQI of 46. In general, the mean AQI for all the stations in the city remains on higher side during January to May due to heavy particulate matter, which gets lowered due to rains during the monsoon period. There are no major polluting industries near the GGG Terminal location. Marginal contribution to air pollution near and around Gateway Guwahati Ghat is from domestic sources as well as vehicles plying in the busy Fancy Bazar area.

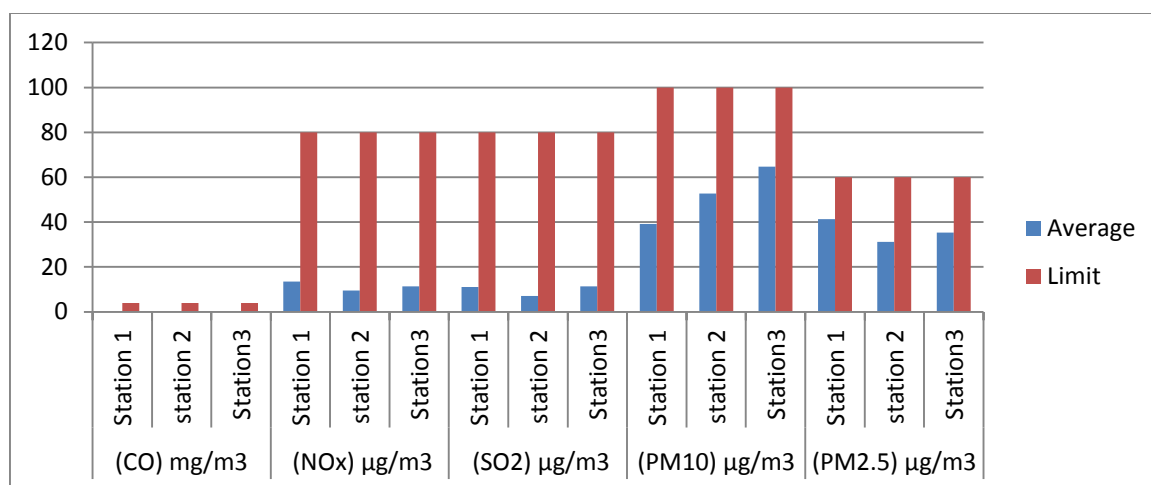
The ambient air quality monitoring was carried out for Particulate Matter (PM10& PM2.5), Sulphur dioxide (SO<sub>2</sub>), Oxides of Nitrogen (NO<sub>x</sub>), CO& all parameters as per NAAQS,2009. Sampling was carried out on 24 hourly twice a week for one week. Ambient Air Quality Monitoring data for Gateway Guwahati Ghat (GGG) is presented in Table 6-8. 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 6-8: 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 <sup>3</sup>	70.3	53.9	65.2	100
2	Particulate Matter (PM2.5) µg/m <sup>3</sup>	40.2	31.5	35.6	60
3	Sulphur Dioxide (SO <sub>2</sub> ) µg/m <sup>3</sup>	10.6	7.5	9.6	80
4	Nitrogen Oxides (NO <sub>x</sub> ) µg/m <sup>3</sup>	13.9	9.3	11.4	80
5	Carbon Monoxide (CO) µg/m <sup>3</sup>	0.25	<0.1	0.15	4
6	Ozone (O <sub>3</sub> ) µg/m <sup>3</sup>	<10	<10	<10	100
7	Ammonia (NH <sub>3</sub> ) µg/m <sup>3</sup>	<20	<20	<20	400
8	Lead (Pb) µg/m <sup>3</sup>	<0.06	<0.06	<0.06	1.0
9	Nickel (Ni) µg/m <sup>3</sup>	<0.6	<0.6	<0.6	20
10	Arsenic (As) µg/m <sup>3</sup>	<0.44	<0.44	<0.44	6
11	Benzene (C <sub>6</sub> H <sub>6</sub> ) µg/m <sup>3</sup>	<1	<1	<1	5
12	Benzo(a)Pyrene (BaP) µg/m <sup>3</sup>	<1	<1	<1	1
Monitoring - 10-08-2018					
1	Particulate Matter (PM10) µg/m <sup>3</sup>	70.3	53.9	65.2	100
2	Particulate Matter (PM2.5) µg/m <sup>3</sup>	40.2	31.5	35.6	60
3	Sulphur Dioxide (SO <sub>2</sub> ) µg/m <sup>3</sup>	10.6	7.5	9.6	80
4	Nitrogen Oxides (NO <sub>x</sub> ) µg/m <sup>3</sup>	13.9	9.3	11.4	80
5	Carbon Monoxide (CO) µg/m <sup>3</sup>	0.25	<0.1	0.15	4
6	Ozone (O <sub>3</sub> ) µg/m <sup>3</sup>	<10	<10	<10	100
7	Ammonia (NH <sub>3</sub> ) µg/m <sup>3</sup>	<20	<20	<20	400
8	Lead (Pb) µg/m <sup>3</sup>	<0.06	<0.06	<0.06	1.0
9	Nickel (Ni) µg/m <sup>3</sup>	<0.6	<0.6	<0.6	20

Sl. No.	Parameters	Station-1	Station-2	Station-3	NAAQ Standard
10	Arsenic (As) ng/m <sup>3</sup>	<0.44	<0.44	<0.44	6
11	Benzene (C <sub>6</sub> H <sub>6</sub> ) µg/m <sup>3</sup>	<1	<1	<1	5
12	Benzo(a)Pyrene (BaP) ng/m <sup>3</sup>	<1	<1	<1	1

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



**Figure 6-10: Graphical Presentation of Air Quality– Gateway Guwahati Ghat (GGG)**

It may be seen that ambient air quality in all locations are well within 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 PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, NO<sub>x</sub>, CO and therefore graphically presented. The other parameters are observed to be well within 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 units 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 6-9: 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

Noise level monitoring result for Gateway Guwahati Ghat is presented in **Figure 6-10**,

Figure 6-11 Graphical representation of Noise Levels-Gateway Guwahati Ghat (GGG)

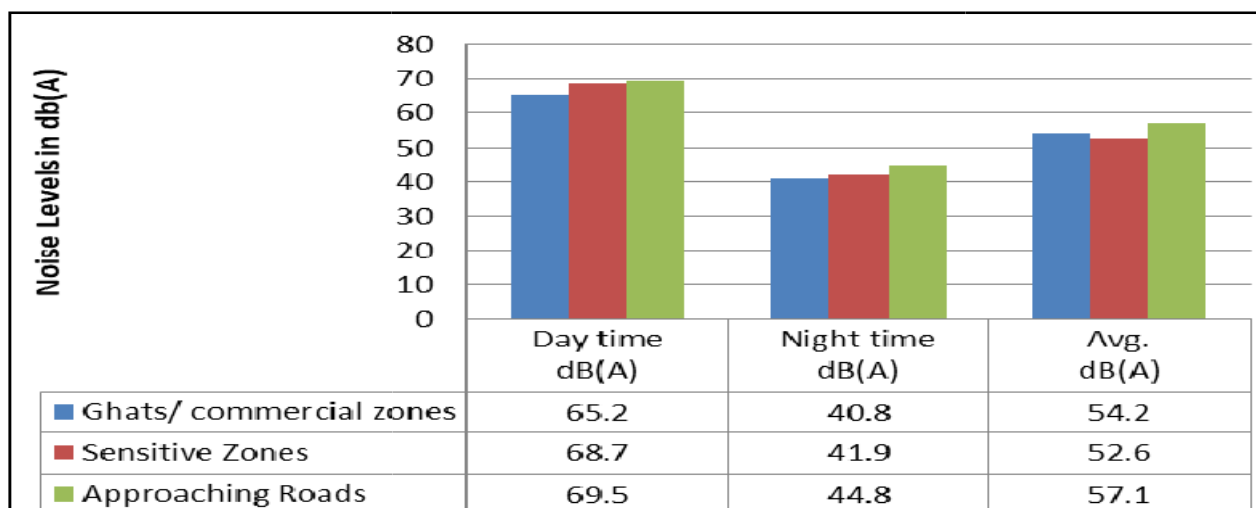


Table 6-10: Ambient Air Quality Standards in respect of Noise

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

Existing noise levels were monitored for 24 hours in 3 locations using Sound Level Meter during day time (06.00 AM to 10.00 PM) and night time (10.00 PM to 06.00 AM) for comparison with the standard values. Noise monitoring results for Gateway Guwahati Ghat site show that the day and night time noise levels at all sample locations meet the norms for commercial zone. 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 night time 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. Around four (4) numbers of dolphins were spotted at Guwahati Gateway-North Guwahati ferry route during the dry season. Although dolphins in the same location of Guwahati Gateway ghat was not spotted during the wet season, their presence cannot be ruled out.

### 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 is presented in **Table 6-11**. Dolphin Conservation Management Plan as secondary data is given in **Annexure 6.2**.

**Table 6-11: 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 91041/066/	-	-	3	3

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

Secondary data on Dolphin presence at Table 6-11 shows that dolphins have been sighted in the study area of Guwahati

Dolphins were also spotted during the recent dolphin surveys conducted for this EIA study, which confirms the presence of dolphin in the project site. Dolphin sighting depends on many factors such as river condition, availability of food, water depth etc.

#### 6.10.1 Ecological Profile of Gateway Guwahati

Gateway Guwahati Ghat is located on southern bank of river Brahmaputra. The ecological profile of the study area along with the details of available flora fauna, forest coverage is covered under the following section.

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:**

The terminal area location does not include any forest land. There will be no tree felling in the existing location for the civil works. Existing vegetation include few trees and scrub vegetation which are sparsely scattered.

There are four (4) reserved forest areas present within the study area in Gateway Guwahati Ghat and details are presented in **Table 6-12**. These will not be affected due to the construction activity which is restricted to the specific location of GGG.

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 6-12 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

Although there is no direct impact of the project on the above listed protected areas, the EIA assessed the potential of indirect impacts, and determined that such impacts are not significant, during construction or operation. Interventions that are proposed to mitigate the negative impacts on the environment will also help to reduce any harmful impact, even if the project's impacts are not significant. No rare/endangered and threatened species located in the area. The project interventions at GGG is not likely to affect the top flora and fauna. No impact on fauna of the area as no fragmentation of habitat is taking place.

**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 Ipomea sps. 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 (*Ficus benghalensis*), siris (*Albizia* sp.), bakain (*Melia azedarach*), kadamba (*Bauhinia malabarica*), bakain (*Melia azedarach*), sissoo (*Dalbergia sissoo*), imli (*Tamarindus indica*), rubber tree (*Ficus elastica*), 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 (*Pragmites karkar*), congress grass (*Parthenium hysterophorus*), dub grass (*Cynodondactylon*), jimson weed (*Datura stramonium*), barnyard grass



(*Echinochloa crus galli*), Johnson grass (*Sorghum halepense*), *Echinochloa colona*, 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 agrarian 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 (*Ficus benghalensis*), siris (*Albizia sp.*), bakain (*Melia azedarach*), kadamba (*Bauhinia malabarica*), bakain (*Melia azedarach*), sissoo (*Dalbergia sissoo*), imli (*Tamarindus indica*), rubber tree (*Ficus elastica*), 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 camara*), *Pragmites* (*Pragmites karkar*), congress grass (*Parthenium hysterophorus*), dub grass (*Cynodon dactylon*), jimson weed (*Datura stramonium*), barnyard grass (*Echinochloa crus galli*), Johnson grass (*Sorghum halepense*), *Echinochloa colona*, 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*, *Semecarpus anacardium*, *Albizia lebbek*, *Dalbergia stipulacea*, *Lagerstroemia speciosa* and *Bombax ceiba*. *Albizia lucida*, *Artocarpus lakoocha*, *Alstonia scholaris*, *Cedrela toona*, *Dalbergia assamica*, *Pterospermum acerifolium* the herbs and shrubs observed are *Ageratum conyzoides*, *Alocasia odorata*, *Justicia adhatoda*, *Justicia japonica*, *Panicum auritum*, *Phlogacanthus curviflorus*, *Polygonum auriculatum*, *Saccharum ravennae*, *Sidaria rhombifolia*, *Solanum nigrum*, *Urena lobata* etc.

#### d. Agrarian 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 6-13**

**Table 6-13: List of flora in Study Area**

Sl. No.	Scientific Name	Local Name	Family	Core zone	Buffer zone
Trees					
1	<i>Acacia auriculiformis</i>	Akashmoni	Fabaceae	+	+
2	<i>Acacia catechu</i>	Khair	Fabaceae	-	+
3	<i>Acacia nilotica</i>	Babul	Fabaceae	+	+
4	<i>Adina cordifolia</i>	Karam	Rubiaceae	-	+
5	<i>Aegle marmelos</i>	Bel	Rutaceae	+	+
6	<i>Albizia lebbek</i>	Siris	Mimosaceae	+	+
7	<i>Albizia odoratissima</i>	Jung siris	Mimosaceae	-	+
8	<i>Albizia procera</i>	Safed Siris	Mimosaceae	+	+
9	<i>Anogeissus latifolia</i>	-	Combretaceae	-	+
10	<i>Areca catechu</i>	Supari	Arecaceae	+	+
11	<i>Artocarpus Hitrophyllum</i>	Kathal	Moraceae	-	+
12	<i>Azadirachta indica</i>	Neem	Meliaceae	+	+
13	<i>Bauhinia variegata</i>	Kachnar	Caesalpiniaceae	-	+
14	<i>Bischofia javanica</i>	Uraim	Phyllanthaceae	-	+
15	<i>Bombax ceiba</i>	Semal	Bombacaceae	+	+
16	<i>Boswellia serrata</i>	Salia	Burseraceae	-	+

Sl. No.	Scientific Name	Local Name	Family	Core zone	Buffer zone
17	<i>Buchnanialanjan</i>	Piar	Anacardiaceae	-	+
18	<i>Butea monosperma</i>	Palas	Fabaceae	-	+
19	<i>Cassia fistula</i>	Dharanj/Amaltash	Caesalpiniaceae	+	+
20	<i>Cocus Nucifera</i>	Nariyal	Arecaceae	+	+
21	<i>Cordia dichotma</i>	Bahuar	Ehertiaceae	-	+
22	<i>Dalbergia sissoo</i>	Sheesham	Fabaceae	+	+
23	<i>Delonix regia</i>	Gulmohar	Fabaceae	-	+
24	<i>Eugenia jambolana</i>	Jamun	Myrtaceae	-	+
25	<i>Ficusbengalensis</i>	Bar	Moraceae	+	+
26	<i>Ficuselastica</i>	Ruber	Moraceae	-	+
27	<i>Ficus religiosa</i>	Pipal	Moraceae	+	+
28	<i>Gmelina arborea</i>	Gamhar	Verbenaceae	+	+
29	<i>Holopteleaintegrifolia</i>	Chilbil	Ulmaceae	-	+
30	<i>KydiacalycinaRoxb.</i>	Puda	Malvaceae	-	+
31	<i>Lagerstoemiaparviflora</i>	Sida/Dauli	Lythraceae	-	+
32	<i>Mangiferaindica.</i>	Aam	Anacardiaceae	+	+
33	<i>Phoenix sylvestric</i>	Khajur	Arecaceae	+	-
34	<i>Pongamiapinnata</i>	Kranj	Fabaceae	+	+
35	<i>Pterocarpus marsupium</i>	Piasal	Fabaceae	-	+
36	<i>Schimawallichii</i>	Ghugra	Theaceae	-	+
37	<i>Shorearobusta</i>	Sal/ SaKhua	Depterocarpaceae	+	+
38	<i>Stereospermumprsonatum</i>	Paruli	Bignoniaceae	-	+
39	<i>Tectonagrandis</i>	Saguan	Verbenaceae	+	+
40	<i>Terminalia arjuna</i>	Arjun	Combretaceae	+	+
41	<i>Terminalia bellirica</i>	Bahera	Combretaceae	-	+
42	<i>Terminalia tomentosa</i>	Asan	Combretaceae	-	+
43	<i>Toona ciliate</i>	Pooma	Meliaceae	-	+
44	<i>Zizyphusmauritiana</i>	Ber	Rhamnaceae	+	+
Shrubs					
1	<i>Asparagus racemosus</i>	Satawar	Liliaceae	+	+
2	<i>Agave americana</i>	Rambas	Asparagaceae	-	+
3	<i>Calotropis gigantea</i>	Akaon	Asclepiadaceae	+	+
4	<i>Carissa carandas.</i>	Kanwar	Apocynaceae	-	+
5	<i>Cannabis sativa</i>	Bhang	Cannabaceae	+	-
6	<i>Casiaalata</i>	-	Fabaceae		
7	<i>Catharanthus roseus</i>	-	Apocynaceae		
8	<i>Datura metal</i>	Dhatura	Solanaceae	+	+
9	<i>Dichrostachyscinerea</i>	-	Mimosaceae	-	+
10	<i>Cyperusrotundus</i>	-	Cyperaceae	+	+
11	<i>FlacourtiaRamontchi</i>	Salpani	Flacourticeae	-	+
12	<i>Indigoferapulchela</i>	Jirhul	Fabaceae	+	+
13	<i>Ipomoea carnea</i>	-	Convolvulaceae	+	+
14	<i>Lantana camara</i>	Putus	Verbenaceae	+	+
15	<i>Phoenix acaulis</i>	Khejur	Arecaceae	+	+
16	<i>Randiadumetorum</i>	Mowar	Rubiaceae	+	+
17	<i>Thespesia lampas</i>	Ban kapasi	Malvaceae	-	+
18	<i>Vitex negundo</i>	Sindwar	Verbenaceae	+	+
19	<i>Bougainvillea spectabilis</i>	Voganvila	Victaginaceae	+	-
20	<i>Zizyphusoenoplia</i>	-	Rhamnaceae	-	+
21	<i>Ricinus communis</i>	Arandi	Euphorbiaceae	+	+
Herbs					
1	<i>Achyranthes aspera</i>	Chirchiri	Amaranthaceae	-	+
2	<i>Aervalanata</i>	-	Amaranthaceae	+	+
3	<i>Ageratum conyzoides</i>	-	Asteraceae	+	+
4	<i>Alternanthera sessilis</i>	-	Amaranthaceae	-	+
5	<i>Boerhaviadiffusa</i>	-	Nyctaginaceae	+	+
6	<i>Cassia tora</i>	Chakor	Fabaceae	+	+
7	<i>Elephantopusscaber</i>	-	Asteraceae	-	+

Sl. No.	Scientific Name	Local Name	Family	Core zone	Buffer zone
8	<i>Euphorbia hirta</i>	-	Euphorbiaceae	+	+
9	<i>Hygrophila spinosa</i>	-	Acanthaceae	-	+
10	<i>Justicia procumbens.</i>	-	Acanthaceae	-	+
11	<i>Leonotis nepetaefolia</i>	-	Lamiaceae	-	+
12	<i>Mimosa pudica</i>	-	Mimosaceae	+	+
13	<i>Parthenium hysterophorus.</i>	-	Asteraceae	+	+
14	<i>Sida acuta</i> Burm.	-	Malvaceae	+	+
15	<i>Sida rhombifolia</i>	-	Malvaceae	+	+
16	<i>Solanum nigrum</i>	Makoi	Solanaceae	+	+
17	<i>Solanum surattense</i>	-	Solanaceae	+	+
18	<i>Sphaeranthus indicus</i>	-	Asteraceae	-	+
19	<i>Tridax procumbens</i>	-	Asteraceae	-	+
20	<i>Xanthium strumarium</i>	-	Asteraceae	+	+
Grasses and Climbers					
1	<i>Vetiveria zizanioides</i>	Khus-Khus	Poaceae	+	+
2	<i>Apludavaria</i>	Dudhiasauri	Poaceae	-	+
3	<i>Arundinella setosa</i>	Jharu/Motaminjhar	Poaceae	-	+
4	<i>Bambusa arundinacea</i>	Bara bans	Poaceae	-	+
5	<i>Cymbopogon martini</i>	-	Poaceae	-	+
6	<i>Cynodon dactylon</i>	Dhoob	Poaceae	+	+
7	<i>Dendrocalamus strictus</i>	Bans/Bamboo	Poaceae	+	+
8	<i>Eulaliopsis binata</i>	-	Poaceae	-	+
9	<i>Heteropogon contortus</i>	Kher/Sauri	Poaceae	+	+
10	<i>Imperata cylindrica</i>	-	Poaceae	-	+
11	<i>Saccharum munja</i>	Munj	Poaceae	-	+
12	<i>Mukia maderaspatana</i>	Bilari	Cucurbitaceae	-	+
13	<i>Abrus precatorius</i>	Karjani	Fabaceae	+	+
14	<i>Acacia pinnata</i>	Arar	Mimosaceae	-	+
15	<i>Butea parviflora</i>	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 proposed 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 6-14, 6-15 and 6-16.**

**Table 6-14: Mammals within Core Zone of study area**

Sl.	Local Name	Common Name	Scientific Name	Feeding Status	Schedule
1.	Gilagri	Striped squirrel	<i>Funambulus pennant</i>	H	IV
2.	Chuha	Field rat	<i>Bandicota bengalensis</i>	H	V
3.	Nevala	Mongoose	<i>Herpestes edwardsi</i>	C	IV

H – Herbivorous, C – Carnivorous, O – Omnivorous

**Table 6-15: 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 6-16 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	<i>Corvus splendens</i> <i>Dicrurus macrocerus</i> <i>Passer domesticus</i> <i>Streptopelia chinensis</i> <i>Centropus sinensis</i> <i>Acridothera tristis</i> <i>Saxicola leucurus</i> <i>Bubulcus ibis</i> <i>Venetus indicus</i>

## 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 6-17** and **Table 6-18**

Table 6-17: Mammals in Buffer Zone of study area

Sl.	Local Name	Common Name	Scientific Name	Feeding Status	Red Data Status
1.	Lomdi	Fox	<i>Vulpes bengalensis</i>	C	Least Concern
2.	Gilahi	Striped squirrel	<i>Funambulus pennanti</i>	H	Least Concern
3.	Chuha	Field rat	<i>Bandicota bengalensis</i>	H	Least Concern
4.	Sehi	Porcupine	<i>Hystrix indica</i>	C	Least Concern
5.	Khargosh	Hare	<i>Lepus nigricollis</i>	H	Least Concern
6.	Jangli Billi	Jungle cat	<i>Felis chaus</i>	C	Least Concern
7.	Nevala	Mongoose	<i>Herpestes edwardsi</i>	C	Least Concern
8.	Langoor	Langur	<i>Presbytis entellus</i>	H	Least Concern
9.	Golden Langoor	Langur	<i>Trachypithecus geei</i>	H	Endangered
10.	Bandar	Rhesus macaque	<i>Macaca mulatta</i>	H	Least Concern
11.	Chamgadam	fruit bat	<i>Cynopterus sphinx</i>	C	Least Concern
12.	Spotted Deer	Deer	<i>Axis axis</i>	H	Least Concern
12.	Bay Bamboo Rat	-	<i>Cannomys badius</i>	H	Least Concern
13.	Bamboo Rat	-	<i>Rhizomys pruinosus</i>	H	Least Concern

H – Herbivorous, C – Carnivorous, O – Omnivorous

Table 6-18: 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						

S.No.	Common Name	Scientific Name	Vernacular Name	Family	Feeding Status	Red Data Status
Amphibians						
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 zeylanicus	-	Chamaeleonidae	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 inhabited 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 6-19**

**Table 6-19: 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	<i>Acridotheresginginianus</i>	IV/LC
2.	Baya Weaver	<i>Ploceusphilippinus</i>	IV/LC
3.	Black Drongo	<i>Dicrurusadsimilis</i>	IV/LC
4.	Blossom headed Parakeet	<i>PsittaculaCyanoccephala</i>	IV/LC
5.	Ble throated Barbet	<i>Megalaimaasiatica</i>	IV/LC
6.	Cattle Egret	<i>Bubukus ibis</i>	IV/LC
7.	Crow Pheasant	<i>Centropussinensis</i>	IV/LC
.8.	Common Swallow	<i>Hirundorustica</i>	IV/LC
.9.	Common Kingfisher	<i>Alcedoatthis</i>	IV/LC
10.	Dove	<i>Streptopeliadecaoccto</i>	IV/LC
11.	Greater cookoo	<i>Centropussinensis</i>	IV/LC
12.	Grey backed shrike	<i>Laniustephronotus</i>	IV/LC
13.	House Crow	<i>Corvussplendens</i>	IV/LC
14.	House Swift	<i>Apus affinis</i>	LC
15.	Hoopoe	<i>Upupa spops</i>	IV/LC
16.	House Sparrow	<i>Passer domesticus</i>	IV/LC
17.	Indian Roller	<i>Coracias benghalensis</i>	IV/LC
18.	India Tree Pie	<i>Dendocittavagabunda</i>	IV/LC
19.	Indian Ring Dove	<i>Streptopelia Capicola</i>	IV/LC
20.	Jungle crow	<i>Corvusmacrorhynchus</i>	IV/LC
21.	Jungle Babler	<i>Turdoidesstriatus</i>	IV/LC
22.	Koel	<i>Eudynamysscolopacea</i>	IV/LC
23.	Kingfisher - White throated	<i>Halcyon smyrnensis</i>	IV/LC
24.	Kingfisher - Whitebreasted	<i>Halcyon smyrnensis</i>	IV/LC
25.	Little Brown Dove	<i>Streptopelia senegalensis</i>	IV/LC
26.	Lesser Goldenbacked Woodpecker	<i>Dinopiumbenghalensis</i>	IV/LC
27.	Large Pied Wagtail	<i>Motacillamaderaspatensis</i>	IV/LC
28.	Magpie Robin	<i>Copsychussaularis</i>	IV/LC
29.	Mayna - Brahminy	<i>Sturnus pagodarum</i>	IV/LC
30.	Mayna - Common	<i>Acridotherestristis</i>	IV/LC
31.	Mayna - Jungle	<i>Acridotheresfuscus</i>	IV/LC
32.	Pied Cuckoo	<i>Clamatorjacobinus</i>	IV/LC



Sl. No.	Common Name	Scientific Name	Schedule as per wild life Protection Act 1972 and IUCN status
33.	Pond Heron	<i>Ardealagrayii</i>	IV/LC
34.	Redwattled Lapwing	<i>Vanellus indicus</i>	IV/LC
35.	Rose ringed Parakeet	<i>Psittaculakrameri</i>	IV/LC
36.	Redvented bulbul	<i>Pycnonotuscafer</i>	IV/LC
37.	Spotted Dove	<i>Streptopeliachinensis</i>	IV/LC

#### a. Migratory Birds:

Migratory birds from Siberia visit the area during winter. They arrive at Deepor Beel. 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 Deepor Beel 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.

##### 6.10.1.1 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 6-20**)

**Table 6-20 Turtle reported in Study Area**

Sl.No.	Common Name	Scientific Name	Red Data Status
1	Indian Roofed Turtle	<i>Pangshura tecta</i>	Least Concern
2	South Asian Box Turtle	<i>Cuoraamboinensis</i>	Vulnerable
3	Indian Soft-Shell Turtle	<i>Nilssoniagangetica</i>	Vulnerable
4	Peacock soft shell Turtle	<i>Nilssoniahurum</i>	Vulnerable
5	Indian Flap-shell Turtle	<i>Lissemyspunctata</i>	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; bacillariophyceae (diatoms) is dominant and has maximum abundance as compared to chloophyceae 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 photosynthesis 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 6-21**

**Table 6-21: Phytoplanktons in Study area**

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

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-6.22**.

**Table 6-22: Zooplankton in study area**

Taxa		Brahmaputra River upstream (10 km upstream)	Brahmaputra River downstream (10 km downstream)
PROTOZOA			
1.	<i>Arcellasp.</i>	+	+
2.	<i>Chilodonellasp.</i>	+	-
3.	<i>Diffugiiasp.</i>	+	+
4.	<i>Globigerina sp.</i>	+	+
5.	<i>Noctiluca sp.</i>	+	-
6.	<i>Paramecium sp.</i>	+	+
7.	<i>Vorticella sp.</i>	+	+
ROTIFERA			
1.	<i>Brachionus sp.</i>	+	+
2.	<i>Filinia sp.</i>	+	-
3.	<i>Horaella sp.</i>	+	+
4.	<i>Keratella sp.</i>	+	+
5.	<i>Lecanosp.</i>	+	-
6.	<i>Notholca sp.</i>	+	+
7.	<i>Rotaria sp.</i>	+	+
8.	<i>Testudinella sp.</i>	+	-
COPEPODA			
1.	<i>Cyclops sp.</i>	+	+
2.	<i>Nauplii</i>	+	-
CLADOCERA			
1.	<i>Bosmina sp.</i>	+	+
2.	<i>Ceriodaphnia sp.</i>	+	+
3.	<i>Cydorussp.</i>	+	-
4.	<i>Daphnia sp.</i>	+	+
5.	<i>Diphanosomasp.</i>	+	+
6.	<i>Moinasp.</i>	-	+
7.	<i>Simocephalus sp.</i>	+	-

Note: + denotes Present and – denotes Absent

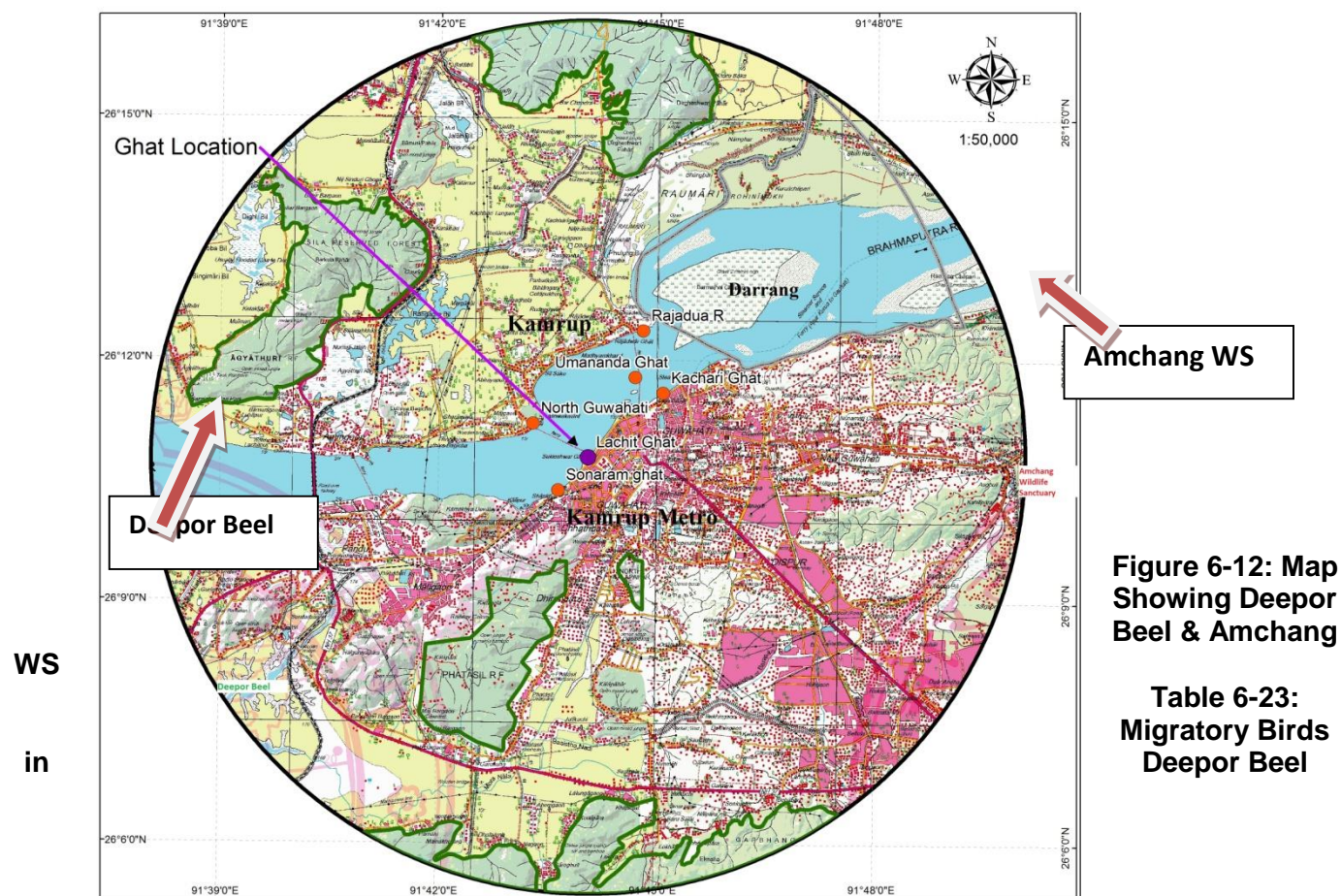
## C. Wetland/ Ramsar Site

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 6-23**

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 6-12: Map Showing Deepor Beel & Amchang**

**Table 6-23: Migratory Birds Deepor Beel**

Sl. No	English Name	Scientific Name
1	Spotted Billed Pelican	<i>Pelecanthus philippensis</i>
2	Baers Pochards	<i>Aythya baeri</i>
3	Lesser adjutant stork	<i>Leptoptilos javanicus</i>
4	Greater adjutant stork	<i>Leptoptilos dubius</i>
5	Palas Sea Eagle	<i>Haliaeetus leucogaster</i>
6	Sibarian crane	<i>Grus leucogeranus</i>
7	Greater flamingo	<i>Phoenicopterus roseus</i>
8	Northern pintail	<i>Anas acuta</i>
9	Ruff	<i>Philomachus pugnax</i>
10	Yellow wagtail	<i>Motacilla flava</i>
11	White wagtail	<i>Motacilla alba</i>
12	Godwall	<i>Anas atrepera</i>
13	Northern shoveler	<i>Anas clypeata</i>
14	Rosy pelican	<i>Pelecanus onocrotalus</i>
15	Spotted billed pelican	<i>Pelecanus philippensis</i>
16	Spotted sandpiper	<i>Actitis macularia</i>

Sl. No	English Name	Scientific Name
17	Blue troat	<i>Lusciniasvecica</i>

#### 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 6-24**

**Table 6-24: Fish in Study area**

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

#### 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:



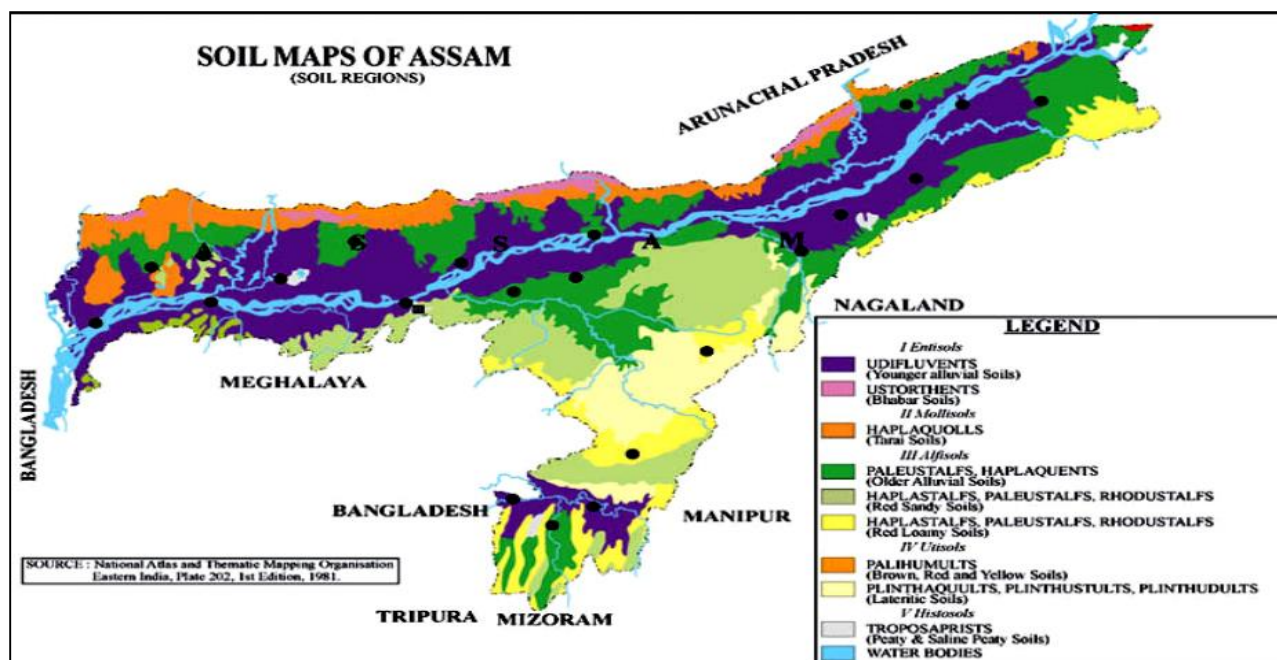
- Newer alluvial soil,
- Valley fill/older alluvial soil, and
- Soils over forest and hilly terrain.

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 activities and 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 6-13**



**Figure 6-13: Soil Map of Assam**

Three samples of soils were collected from proposed GGG site. Location of sampling points are given in **Table 6-25**

**Table 6-25: Soil Monitoring Locations**

Sl. No.	Location/Ghat	Station	Date of Monitoring	Co-ordinate	
				Latitude	Longitude
1		1st	08.08.2018	26.179464	91.734187

Sl. No.	Location/Ghat	Station	Date of Monitoring	Co-ordinate	
				Latitude	Longitude
	Gateway Guwahati Ghat (GGG)	2nd		26.179392	91.734047
		3rd		26.179711	91.734478

Soils, collected from three proposed terminal sites were collected and analysed for physical parameters. The soil analysis results of Gateway Guwahati Ghat is presented in **Table 6-26**

**Table 6-26: 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
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

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 / adsorb natural and anthropogenic toxic substances from the water. The sediment quality 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 6-27** and **6-28** respectively.

**Table 6-27: Riverbed Sediment Quality – Wet Season**



Parameters	Unit	GGG
Salinity	%	0.021
Mg	%	0.295
Ca	%	0.179
Na	%	0.010
K	%	0.099
Organic Carbon (TOC)	%	0.223
PO <sub>4</sub> <sup>3-</sup>	%	0.232
NO <sub>3</sub>	ppm	8.00
As	ppm	0.34
Cd	ppm	0.13
Hg	ppm	BDL
Pb	ppm	0.12
Cr	ppm	11.38
Zn	ppm	12.16
Ni	ppm	56.19

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 6-28 Riverbed Sediment Quality – Dry Season**

Parameters	Unit	GGG
Salinity	%	-
Mg	%	-
Ca	%	-
Na	%	-
K	%	-
Organic Carbon (TOC)	%	0.32
PO <sub>4</sub> <sup>3-</sup>	%	0.188
NO <sub>3</sub>	ppm	5.67
As	ppm	15.04
Cd	ppm	0.00
Hg	ppm	0.041
Pb	ppm	16.0
Cr	ppm	18.9
Zn	ppm	59.2
Ni	ppm	21.0

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 6-29: Demographics 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%
SC population			67014 (7%)	18.46%
ST			38294 (4%)	10.97%
Others			852044 (89%)	70.56%
Religious Composition	Hindu	Muslim	Others	Hindus- 79.8%
	815499 (84.44%)	119825 (12.45%)	22028 (3.11%)	Muslims-14.2%
				Others-6%

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.

Lachit Ghat, 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.

The following **Table 6-30**. Describes the cross-cutting mitigation measures related to labour influx to be adopted for GGG Terminal:

**Table 6-30: Labour influx-cross-cutting issues**

Elements	Measures
<b>Assess the magnitude of labour influx, relevant contextual factors, and related legal &amp; institutional framework</b>	<ul style="list-style-type: none"> <li>Unskilled workers are expected to be largely recruited locally in the project area. All these locally recruited will continue living in their homes, except where work sites are far away from their settlements, in which case they would reside in the labour camps, as would workers from outside the immediate alignment.</li> </ul>
<b>Contractually bind the Contractor to carry out social impact mitigation</b>	<ul style="list-style-type: none"> <li>The Contractor is explicitly required under its contract to abide by the provisions of the site-specific SMP.</li> <li>Before work begins, the Contractor is required to obtain approval for its Contractor's camp, including plan for implementation of social and environmental risks, including labour influx.</li> <li>The works contract specifies the sanctions that the Contractor will face if the contractor-related provisions of the site-specific SMP is not adhered to, including by sub-contractors.</li> <li>The Contractor is required to have specific and qualified key staff (Social expert) to manage social mitigation and implement the project's safeguard instruments. The contractor safeguards expert will be responsible to verify compliance with and implementation of all mitigation measures. Physical works can only commence once these key staff are engaged.</li> </ul>
<b>Establish a mandatory Code of Conduct for workers</b>	<ul style="list-style-type: none"> <li>The Contractor must establish and enforce the employees' Code of Conduct (CoC), including prevention of HIV/AIDS/STCs, prohibition of gender-related violence, treatment of minors, and other behaviours affecting community residents. PMU will review and approve the CoC before physical works commence.</li> <li>The Contractor is required to implement the CoC.</li> <li>The Contractor's social team is required to provide training to all workers on the CoC. The training will be applied to 100% of the workers. PMU will monitor compliance.</li> </ul>
<b>Reporting and auditing</b>	<ul style="list-style-type: none"> <li>The PMU will prepare regular reports on the Contractor's compliance with all social impact mitigation plans.</li> </ul>
<b>SOCIAL IMPACTS</b>	
<b>Potential Adverse Impacts</b>	<b>Mitigation Measures</b>
<b>Aggravation or exploitation of social conflicts</b>	The SIA of the pre-identified sites have carefully analysed and taken into account pre-existing cultural or social differences among groups in the project area.
<b>Increased burden on public service provision, increasing costs to or crowding</b>	Labor camps will provide their own water supply, electricity, wastewater treatment, solid waste disposal, medical services and transportation services, with no negative impacts on the supply of such services to local residents.

out the local population	
Resettlement, compensation related to labour camps	Sites for labour camps in project areas are most often on land leased for the duration of project execution, thereby avoiding any land acquisition.
Increased risk of communicable diseases	The Contractor's social team is required to provide training to all workers on HIV/AIDS/STD prevention, in coordination with the local health service and with additional support of specialized entities in the project area. The training will be applied to 100% of the workers. PMU monitoring agent will monitor compliance.
Gender-based violence and misconduct  Illicit behaviour and crime affecting the local population	<p>The Contractor is required to fully enforce compliance by its workers with the Code of Conduct, GBV action plan, including application of sanctions.</p> <ul style="list-style-type: none"> <li>• The Contractor is required to monitor the entry and exit of all personnel and visitors in and out of the labour camp.</li> <li>• PMU and the Contractor will maintain outreach to law enforcement and legal services for women, children and teenagers, to facilitate prompt and effective responses when needed.</li> <li>• The Grievance Redress Mechanism includes a specific mandate to address any kinds of gender-based violence.</li> </ul>
Child labour and school dropout	<ul style="list-style-type: none"> <li>• The works contract includes a clause prohibiting the economic exploitation of minors and employment that is deemed dangerous, which interferes with education and/or risks their health or physical mental, spiritual moral or social development.</li> </ul>
Camp-related traffic and safety	<ul style="list-style-type: none"> <li>• The Contractor in and around the camps, must provide signage, traffic control personnel, barriers, lighting, reflectors, proper pedestrian access, and public information on grievances.</li> <li>• In reviewing the terminal design, the PMU will undertake a safety audit.</li> <li>• Contractor will prepare a Traffic Management Plan which will require approval by the PIUs.</li> </ul>
Labour conditions	<ul style="list-style-type: none"> <li>• The Contractor will be required to prepare and obtain approval of an Occupational Safety and Health (OHS) plan for its workers at the work site and in the labour camps.</li> <li>• The Contractor must abide by the applicable labour laws of India and the norms for design, construction and management of labour camps per "Labour Accommodation: Processes and Standards", a Guidance Note by IFC and the EBRD, found at the following link: <a href="http://www.ebrd.com/downloads/about/sustainability/Workers_accomodation.pdf">http://www.ebrd.com/downloads/about/sustainability/Workers_accomodation.pdf</a></li> </ul>

<b>Closure and site restoration</b>	The work camps' closure and site restoration, including removal of buildings and ancillary facilities, rehabilitation of access ways, removal of all materials and equipment, restoration of the topography to its original state, and replanting of trees and other vegetation should be a part of the contractor's Workers' Camp Management Plan.
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### Other measures for response to Covid-19 Pandemic

Considering the recent Covid-19 pandemic, the following are few measures to be taken by the contractor to prevent and protect the community and workers from a potential outbreak:

1. Contractor will prepare an **assessment of workforce employed at the site**. The assessment must include detailed profile on workforce such as breakdown of workers who reside at home (i.e. workers from the community), workers who lodge within the local community and workers in on-site accommodation. Where possible, it should also identify workers that may be more at risk from COVID-19, those with underlying health issues or who may be otherwise at risk.
2. Contractor will provide a detailed plan on Covid-19 Prevention and Response. These include -
  - Precaution taken to ensure that there is **minimal exposure** among workers and contact with the community
  - **Response mechanism** in case of potential breakout of Covid-19
  - Safeguards to ensure that all project workers are protected from exploitative work conditions. It would also be important to ensure that all **eligible workers are given Building and Other Construction Workers( BOCW) registration**, to be able to avail of benefits which are either under existing welfare schemes or provided as a part of the Covid-19 relief package. The Contractor must also ensure **registration for contract labour and inter-state migrant workers as per the Contract Labour Act, 1970 and Inter-State Migrant Workmen Act, 1979**; including their registration for coverage under the Employee State Insurance Corporation (ESIC)/Employee Provident Fund Organisation (EPFO).
  - Strengthen the use of **project grievance mechanism by workers to report concerns relating to COVID-19** including concerns about the health of their co-workers and other staff.
3. Contractor and Supervision Consultant to **designate senior personnel as a focal point to deal with COVID-19 issues**. This person can be responsible for coordinating preparation of the site and making sure that the measures taken are communicated to the workers, those entering the site and the local community.

## 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 work force 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 6-31: 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.

### **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.

### 6.15 Health Facilities

**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 Mohan 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.

### 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.

### 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.

## 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.

### 6.18 Cultural Heritage and Archaeological Sites

Kamakhya Temple, Umananda Temple, Sukreswar 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.

#### 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.

### 6.19 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.

### 6.20 Spiritual & Other Practices Associated with Waterways of Local Significance

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. Sukreswar temple is a historic site located in Panbazar close to the project location where people visit regularly to conduct last rites of their close ones, performed mostly in the bank of the river. Devotees also visit the temple in large numbers during the time of ‘Maha Shivratri’ and Ashokastami.

## 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 on river Brahmaputra. 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 the basis of final feasibility report, it has been observed that there will be no change in drainage pattern & channel hydraulics due to the project activities.

Social Factors:

- i. Land availability/requirement;
- ii. Loss of structures
- iii. Loss of livelihood
- iv. 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 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 undertaken at 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,
- Operation of vessels.

These 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	Pre-Construction/ Construction	Operations
Climate	No	No
Micro-climate	Yes	Yes
Aquatic Ecology	Yes	Yes
Dolphins & Turtles	No	No
Water Flow	No	Yes
Water Quality	Yes	Yes
Terrestrial Flora / Cutting of Trees	Yes	Yes
Avifauna	Yes	Yes
Ambient Noise Levels	Yes	No
Air Quality	Yes	Yes
Land use	Yes	No
Water resources	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 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.

### 7.5.1 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.

### 7.5.2 Construction Materials

The excavation of quarries and borrow pits, used for obtaining rocks, soil and aggregate materials for the construction passenger terminals and other 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.

### 7.5.3 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 scaffolding 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.

#### **7.5.4 Generation of Dust (Air Pollution):**

There would not be any crushing activities at the project sites and 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:

- Land levelling and ground clearance;
- Movement of vehicles carrying construction materials;
- Construction materials handling (Loading, unloading, 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 suppress 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

#### **7.5.5 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-degradable and non-biodegradable wastes shall be separately collected and taken to the nearby waste collection point of GuwhatiMunicipal Corporation for their disposal. The guideline on establishing the construction camp will be followed



### 7.5.6 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 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.

### 7.5.7 Loss of vegetation and tree cutting:

Clearance of vegetation, bushes is involved in the project but there will be no tree cutting in the proposed design of the Terminal. 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.

### 7.5.8 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 noise level to go outside will be provided
- No piling and 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 machineries will be fitted with silencers and maintained properly.
- All equipment will be 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.

### 7.5.9 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

Measures will 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

- Usage of silt or air bubble screens/curtains will be explored to minimize the sediment release during construction activity.
- Provision will be made of emergency response equipment like floating booms to deal with any emergency of oil spills or leakages.
- Domestic Wastewater from the toilets will be treated in septic tank and soak pit.

- No -Construction Period will be maintained from Mid March to Mid June as suggested by the Dolphin study report conducted under the project. During this time construction activities will be restricted in the water part.

## 7.6 Impact on Biological Environment

### 7.6.1 Impacts During Design and Construction Phase: Terrestrial Ecology

Small land area is required for the proposed terminal development. As per the site visit records there are no trees present on identified land. However, the development of the proposed terminal 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.

In Gateway Guwahati Ghat, Amchag wildlife sanctuary and Deepor Beel Ramsar site are within 10 km area of the proposed terminal. The proposed terminal site itself does not fall within eco-sensitive zone of Amchag wildlife sanctuary and Deepor Beel 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 Deepor Beel wet land. There are locations where migratory birds visit – close to the Deepor Beel site. However, these sites are located far away from the proposed terminal site. 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 prohibit hunting 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 accidentally
- 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 piling 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.

#### 7.6.1.1 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 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. As per a recent research, "*Interacting effects of vessel noise and shallow river depth elevate metabloic stress in Ganges River Dolphin*" by Dey et al, 2019 underwater noise from vessel traffic, SONAR application, dredging, pile driving for construction etc could negatively affect animal specis'. However dredging is not anticipated in the GGG Terminal location. Other 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 for holding the floating pontoon and gangway. As a behavioral 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 anym 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 behavior and physiology of the 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 shorterperiods of time, may result in auditory tissue damage in fish, though recovery is generally possiblewithin 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.
- Impact of piling during the construction period will be managed by adoption of vibratory piling and usage of bubble curtain to disperse the fauna and reduce noise level
- Fish exclusion devices 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 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 construction 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. 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.
- Wherever bentonite slurry is used, the contractor shall be responsible for prompt removal from site and safe disposal. No muck, bentonite slurry will be allowed to be discharged into 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.
- 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.

#### 7.6.2 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 sites where 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

As per the study "*Interacting effects of vessel noise and shallow river depth elevate metabolic stress in Ganges river dolphins*", it is inferred that dolphins shows enhanced activity during acute noise exposure and suppressed activity during chronic exposure, also increase in ambient noise levels alters the acoustic responses of dolphins.

**Mitigation Measures** During the project activities (construction and operation phase), adequate measures such as- maintainng the ecological flow, downscaling the vessel traffic, and modification in propeller for reduction in cavitation noise, shall be taken, so that the impacts on river dolphins can be mitigated effectively.

Further the movement of vessels shall be on pre-designated routes and as per the designated path which will be monitored using the appropriate technology.

Apart from this, 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.

## 7.7 Environmental Impact and Mitigation Measures-Operation Stage

### 7.7.1 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.

### 7.7.2 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.

### 7.7.3 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.

### 7.7.4 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. 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
- 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.



- SOP will be developed for reception of vessel waste, its storage and treatment and disposal at terminal facilities.
- Further a waste management plan is required to 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 will have 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 disposal of 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 at GGG. Washing should be undertaken only at the maintenance facility proposed at Pandu slipway. Standards for discharge of washing water from the vessels carrying noxious chemicals (vessel washing water) as per MARPOL is given in **Annexure 2-1**.
- Sludge will be disposed of in municipal waste disposal facility or hazardous waste disposal facility depending on the quality of sludge.

#### 7.7.5 Solid Waste Generation

The projected population in each terminal after the completion of the project is expected to be around 7000 persons per day. Quantum of waste generation could be around 0.2kg/capita at terminal location, about 0.75 ton wastes will be generated per day.

#### Mitigation Measures:

Separate storage containers for this purpose will be provided both for bio-degradable and non-biodegradable wastes. Garbage containers will be covered with lids and will be washed at frequent intervals. These will be stacked in designated place and when sufficient quantity accumulates, these will be disposed off through covered trucks to landfill site designated and authorised by GMC. 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.

### 7.7.6 Air Environment

Air emission during operation stage are expected from

- Increased vehicular movement
- Emission from vessels
- DG

The impact is likely to be localised and confined to a smaller 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 Sulphur dioxide and Nitrogen oxides. The concentration of 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 will 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

### 7.7.7 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.

### 7.7.8 Economic Development & Employment generation

The development of terminals, deployment of new vessels, repairing facilit 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

#### **7.7.8.1 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

#### **7.7.8.2 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. 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
- Impacts of underwater noise and risk of ship strikes can be mitigated by routing ship traffic away from critical dolphin habitats and implementing speed regulations and technology
- Ship speed should be controlled to 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.

The overall impact along with mitigation measures are presented in Table 7-2 below:

Table 7-2 Potential Impact and Mitigation Measures

S. No.	Component	Potential Impacts	Mitigation Measure
<b>CONSTRUCTION PHASE: Environmental Impacts</b>			
<b>1.</b>	<b>Site Preparation</b>		
1.1	Levelling of Terminal site and Construction of Labour & Camps	<p>Loss of top soil. Loss of natural resource (Earth/soil)</p> <ul style="list-style-type: none"> <li>Dust Generation due to construction activities and material handling.</li> <li>Emission from machinery, DG and vehicular movement.</li> </ul>	<ul style="list-style-type: none"> <li>Top soil (15 cm) would be stripped and kept separately in stockpiles for use in landscaping.</li> <li>Excavated materials would be preferably used for site filling/low lying area filling and the surplus material would be disposed as per norms.</li> <li>Green belt/landscaping would be developed at the site and as per the Green Belt management Plan.</li> <li>Survival rate of tree would be regularly monitored. It should be minimum of 70%.</li> <li>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.</li> <li>Shore protection works like stone pitching along the bank shall be undertaken.</li> <li>No crushers or Batching plants will be located at the sites. Ready mix concrete will be used. These considerably reduce the emission.</li> <li>Low sulphur diesel would be used for operating DG sets and construction equipment.</li> <li>Periodic monitoring of air quality for PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>x</sub>, NO<sub>x</sub>, and CO shall be carried out quarterly at construction site</li> <li>Regular water sprinkling/fogging to suppress the dust generated at site, approach road &amp; haulage roads.</li> <li>Proper servicing and maintenance of earth moving vehicles and other machinery to minimize the emission generation</li> <li>Vehicles transporting the loose and fine materials like sand and aggregates shall be covered.</li> <li>Masks and other PPE shall be provided to workers in high dust generation area</li> <li>Loading and unloading of construction materials shall be made at designated locations with provisions of water sprinkling.</li> <li>Construction vehicle, machinery &amp; equipment shall be regularly serviced and maintained and would have valid PUC certificate</li> <li>Monitoring of air quality shall be carried out on quarterly basis to check the level of pollutants and effectiveness of mitigative measures</li> </ul>

S. No.	Component	Potential Impacts	Mitigation Measure
		Impact on terrestrial ecology	<ul style="list-style-type: none"> <li>• Caution sign shall be placed to prohibit hunting of animals</li> <li>• Construction activities shall be restricted to 6:00 Am-10:00 Pm especially noise generating activities.</li> <li>• Workers should not use any timber or firewood as fuel for any purpose. LPG should be made available to workers in construction camp.</li> <li>• No hazardous material or waste shall be disposed in the other land or nearby area as it may harm the animals, if consumed accidentally.</li> </ul>
		Contamination of land and water resources from waste generation.	<ul style="list-style-type: none"> <li>• Labour camps would be located close to the construction sites to the extent possible.</li> <li>• Excavated materials would be preferably used for site filling/low lying area filling and the surplus material would be disposed as per norms.</li> </ul>
		Unhygienic and unsafe living and working condition.	<ul style="list-style-type: none"> <li>• Hygiene in the camps would be maintained by providing good sanitation and cleaning facilities.</li> <li>• Camp would be well ventilated with adequate provision for illumination, kitchen and safe drinking water. Proper drainage to be maintained around the sites to avoid water logging.</li> <li>• 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</li> <li>• Preventive medical care to be provided to workers</li> <li>• 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.</li> <li>• LPG will be used for cooking in construction camps</li> <li>• Provision would be made for day crèche for children</li> <li>• 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 emergency case, if any</li> <li>• Rest area would be provided at the site where workers can rest after lunch and should not lie on site anywhere</li> <li>• Working hours of labourers would not exceed than standard norms as per Factory Act</li> <li>• 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</li> <li>• Temporary storm water drainage system would also be provided at camp site so that no water logging takes place</li> </ul>



S. No.	Component	Potential Impacts	Mitigation Measure
		Generation of solid, liquid and hazardous waste	<ul style="list-style-type: none"> <li>Arrangement should be made for segregation of waste into recyclable and non-recyclable waste</li> <li>Non-recyclable waste generated should be disposed regularly through authorized agency. Recyclable waste should be sold to authorized vendors.</li> <li>Construction waste generated should be segregated at site into recyclable, reusable &amp; 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</li> <li>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 &amp; manage for the same as per the Debris Management Plan.</li> <li>Any waste oil generated from construction machinery, should be stored on concrete platform and disposed off to authorized recyclers.</li> </ul>
		<ul style="list-style-type: none"> <li>Noise generation from construction activity.</li> <li>Noise generation from operation of vehicle, equipment and machinery.</li> </ul>	<ul style="list-style-type: none"> <li>Protection devices (earplugs or ear muffs) shall be provided to the workers operating near high noise generating machines.</li> <li>Barricading (Temporary noise barrier) around the construction site to minimize the noise level</li> <li>Restriction of high noise generating activity between 10:00 PM to 6 AM.</li> <li>Restriction on Honking at the project site</li> <li>Job rotations systems for workers, working in high noise level areas</li> <li>Periodic monitoring of noise levels to check the level of pollutants and effectiveness of proposed EMP</li> </ul>
		<ul style="list-style-type: none"> <li>Surface water pollution and Depletion of Groundwater due to abstraction for construction purpose.</li> <li>Siltation due to construction of terminal and contamination due to disposal of domestic waste</li> </ul>	<ul style="list-style-type: none"> <li>Preference would be given to use river water for construction with permission from concerned authorities</li> <li>In case of use of ground water, permission will be obtained from CGWA/CGWB</li> <li>Water monitoring to be carried out as per monitoring plan.</li> <li>Natural Drainage pattern of area shall be maintained by making a proper drainage network in project site.</li> <li>Washing of vehicle and equipment shall not be carried out in river or nearby place.</li> <li>Storage of debris and raw materials would be in designated area clearly demarcated.</li> <li>Site would be regularly cleaned</li> <li>Septic tank/soak pit shall be provided for the toilets at both construction site as well as workers camp. Adequate toilets &amp; 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.</li> </ul>

S. No.	Component	Potential Impacts	Mitigation Measure
			<ul style="list-style-type: none"> <li>Fuel shall be stored in leak proof containers and containers shall be placed on paved surface under shed.</li> <li>The piling work in river shall be undertaken during low flow period.</li> <li>Turbidity traps/curtains/ Geo-Textile synthetic sheet curtain would be placed around piling and construction area to prevent movement of sediments and construction waste.</li> <li>Sedimentation tanks shall be provided for treating run-off from site before discharging into the river.</li> <li>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</li> <li>Monitoring of surface water quality shall be carried out on quarterly basis to check the level of pollutants and effectiveness of proposed EMP.</li> </ul>
		Accident and Incident risk from construction activities and safety of workers Impact on Social life.	<ul style="list-style-type: none"> <li>Local labour would preferably be employed for construction.</li> <li>Site would be barricaded and would have security guards.</li> <li>Resister would be maintained for entry to the construction sites. No unauthorized person would be allowed to enter the site.</li> <li>A board in local language at entrance of site would display name of project, area and hazards associated for public awareness</li> <li>Adequate illumination would be provided at site during evening and night time till the work is being carried out</li> <li>Rest area for workers would be provided.</li> <li>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</li> <li>Noise level in the work zone would be maintained and followed as per OSHAS norms</li> <li>Contractors would adopt and maintain safe working practices. SOPs would be prepared and followed for all activities under supervision of site engineer</li> <li>Training would be given to workers to handle the heavy equipment so as to prevent accidents</li> <li>Complete medical check-up would be done for workers prior to joining and after six months of joining</li> <li>Emergency telephone nos.of hospitals, ambulance and doctors would be displayed in first aid room.</li> <li>Working hours of labour should not exceed norms as per state factory law</li> </ul>

S. No.	Component	Potential Impacts	Mitigation Measure
			<ul style="list-style-type: none"> <li>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 &amp; timings.</li> <li>Arrangement of fire-fighting would be made at site and workers would be trained on their use.</li> <li>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.</li> </ul>
<b>2.</b>	<b>Piling Activity</b>		
<b>2.1</b>	<b>Installation of Piles for holding the floating pontoon and gangway</b>	Impacts on Aquatic ecology due to underwater noise Generation	<ul style="list-style-type: none"> <li>The area in which the piling is planned, advisable to carefully determine drop sites before anchor placement to ensure that Dolphin and fish communities are not there.</li> <li>Before starting piling allow some time to aquatic fauna to displace from the piling area.</li> <li>Adequate measures such as- maintaining the ecological flow, downscaling the vessel traffic, and modification in propeller for reduction in cavitation noise, shall be taken to minimise the impact of underwater noise.</li> <li>Impact of piling during the construction period will be managed by adoption of vibratory piling and usage of bubble curtain to disperse the fauna and reduce noise level.</li> <li>Construction activities shall be restricted to 6:00 Am-10:00 Pm especially noise generating activities.</li> </ul>
		Loss of Aquatic Fauna and macrophytes.	<ul style="list-style-type: none"> <li>Caution sign shall be placed to prevent hunting of animals</li> <li>No hazardous material or waste shall be disposed in the land or nearby area as it may harm the animals, if consumed accidentally</li> <li>Site should be barricaded to prevent entry of the animal in the site</li> <li>Illumination at the night time should be reduced (if no activity is going on) as it may disturb the nocturnal animals</li> <li>Workers should not use any timber or firewood as fuel for any purpose</li> <li>The river 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.</li> <li>Before starting piling allow some time to aquatic fauna to displace from the piling area.</li> </ul>

S. No.	Component	Potential Impacts	Mitigation Measure
			<ul style="list-style-type: none"><li>Impact of piling during the construction period will be managed by adoption of vibratory piling and usage of bubble curtain to disperse the fauna and reduce noise level.</li><li>The piling activities must be carried out in shortest possible timeframe.</li><li>All the debris should be disposed away from river course.</li><li>Noise reducing devices like mufflers, enclosures shall be fitted with the equipment as much as feasible.</li><li>Fish exclusion devices shall be installed in water column around the pile driving area to prevent fish access</li><li>Geo Textile synthetic sheet curtain &amp;turbidity traps shall be placed around piling and construction area to prevent movement of sediments and construction waste</li><li>Piling should be stopped for some time, if any dolphin/turtle/RET species is sighted in activity area</li><li>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.</li><li>No-construction Period : It is recommended to stop the construction activities in water part between Mid-March to Mid-June</li></ul>
		Impact due to release of sediments Piling and other construction	<ul style="list-style-type: none"><li>Silt screens will be placed to avoid the construction debris, wash or blown into the water the area.</li><li>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</li><li>Piling shall not be carried out during breeding and spawning season means during rainy season. It will be carried out in low water season, i.e. pre-monsoon.</li></ul>
		Impacts on Dolphins	<ul style="list-style-type: none"><li>Adequate measures such as- maintaining the ecological flow, downscaling the vessel traffic, and modification in propeller for reduction in cavitation noise, shall be taken, so that the impacts on river dolphins can be mitigated effectively.</li><li>The movement of vessels shall be on pre-designated routes and as per the designated path which will be monitored using the appropriate technology.</li></ul>
CONSTRUCTION PHASE: Social Impacts			
3.	Cultural & Heritage Resources	<ul style="list-style-type: none"><li>Temporary diversion of access towards cultural resources, temples;</li></ul>	Adequate diversion signs shall be displayed in the access route for the devotees towards these cultural heritage and temples.

S. No.	Component	Potential Impacts	Mitigation Measure
		<ul style="list-style-type: none"> <li>Safety issues to devotees during the construction stage various construction activities. etc.</li> <li>Chances of vibration impact to these cultural resources during the construction work;</li> </ul>	Warning signs shall be given if there is any large excavation work done or scaffolding put thereof
4.	Labour Influx	<ul style="list-style-type: none"> <li>Influence in the demographic composition</li> <li>Increased demand and competition for local social and health services</li> <li>Social conflicts between the local community and the construction migrant workers.</li> <li>Increased rates of illicit behaviour and crime against women, which is a real threat for Assam where gender-based violence is rampant</li> <li>Increase competition for jobs and have an impact on wage distribution</li> </ul>	<ul style="list-style-type: none"> <li>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</li> <li>The project contractor needs to prepare a site-specific Labour Influx Management Plan and/or a Workers' Camp Management Plan.</li> <li>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.</li> <li>Awareness camps on HIV/AIDS for both, construction workers and neighbouring villages must be organised at regular intervals by NGOs empanelled with NACO.</li> <li>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</li> </ul>

S. No.	Component	Potential Impacts	Mitigation Measure
			<p>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.</p> <ul style="list-style-type: none"> <li>• In case work schedule extends up till night, it should be ensured that women workers are exempted night shifts.</li> </ul>
<b>OPERATION PHASE: Environmental Impacts</b>			
1.	Influx of passengers and vessel maintenance activities	Water Pollution	<ul style="list-style-type: none"> <li>• Sewage from the public convenience facilities will be treated in septic tank/STP constructed at the terminal.</li> <li>• 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.</li> <li>• Treated wastewater will be used for plantation, gardening, toilet flushing etc</li> <li>• Used oil and waste oil will be collected through spill proof system and collected &amp; stored separately so that it does not get discharged to river.</li> <li>• Wash water generated from repairing shops shall be treated adequately in STP.</li> </ul>
		Air emissions	<ul style="list-style-type: none"> <li>• Vehicles only with PUC will be allowed</li> <li>• High efficient combustion engine for vessels will be selected so that the emission will be minimum.</li> <li>• DG with CPCB emission norm and acoustic enclosures</li> <li>• Plantation along the terminals for reducing the effect</li> </ul>
		Noise Generation	<ul style="list-style-type: none"> <li>• DG will be with acoustic enclosures</li> <li>• Vessels will be designed for acceptable noise</li> <li>• Plantation around the site for further reduction of impact</li> <li>• 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.</li> </ul>
		Terrestrial Ecology	<ul style="list-style-type: none"> <li>• Proper aftercare and monitoring of the green belt &amp; avenue plantation</li> <li>• Maintaining survival rate of plantation to minimum 70%</li> <li>• Regular watering and cleaning of the leaves to remove the accumulated dust on the leaves.</li> </ul>
		Aquatic Ecology	<ul style="list-style-type: none"> <li>• 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</li> </ul>



S. No.	Component	Potential Impacts	Mitigation Measure
			<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• Instruction should be given to vessel operator that in case any accident with dolphin occurs that should be reported immediately to terminal authority.</li> <li>• Waiting time of vessel should be reduced at the terminal by providing the adequate loading and unloading equipment and vehicles.</li> <li>• Vessel should be instructed for not using sharp lights and sounds as they may disturb aquatic organisms</li> <li>• Impacts of underwater noise and risk of ship strikes can be mitigated by routing ship traffic away from critical dolphin habitats and implementing speed regulations and technology.</li> </ul>
		Solid Waste Generation	<ul style="list-style-type: none"> <li>• Separate storage containers for this purpose will be provided both for bio-degradable and non-biodegradable wastes.</li> <li>• Garbage containers will be covered with lids and will be washed at frequent intervals.</li> </ul>
<b>OPERATION PHASE: Social Impacts</b>			
1.	<b>Gender based Violence</b>	Influx of Passengers	<ul style="list-style-type: none"> <li>• Potential for sexual harassment of women and girls on IWT can be addressed by limiting overcrowding, providing sufficient seats and well-lit spaces.</li> <li>• All terminals will 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, would be considered as well.</li> <li>• 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.</li> </ul>

## 7.8 Climate Change Impacts and Mitigation Measures

Inland water Transport is considered to be more energy efficient and emit less CO<sub>2</sub> per ton-km, compared to other transport modes namely road or rail transport. The average emissions from IWT mode range from 25 gm CO<sub>2</sub>/ton-km to 70 gm CO<sub>2</sub>/ton-km. Whereas, from road transport by truck, it varies from 60-120 gm CO<sub>2</sub>/ton-km and in the case of rail, it varies from 20-80 g CO<sub>2</sub>/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 GGG Terminal
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.

## 7.9 Socio Economic Profile of Project Affected Households

As per the DPR prepared by the design consultant M/s TRACTEBEL ENGINEERING Pvt. Ltd.. for Gateway Guwahati Ghat (GGG), Land required for the land side development of the project in South Guwahati Ghats, belongs to Govt and no non title holders is existing, Land measuring 0B-2K-5L covered by Dag no: 33 and 0B-1K-5L covered by Dag no: 41 total being 0B-3K-10L village Sahar Guwahati Part III under Guwahati mouza belongs to Govt. And no private land is required nor exists any non title holders or any encroachers for livelihoods activities is being carried out. There is no such impact on any livelihood in the area of construction of the ferry terminal.

## 7.10 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 procurement 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 vessels had 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 a MoU 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.

## 7.11 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. 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 extends up till night, it should be ensured that women workers are exempted night shifts.

## **7.12 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 Brahmaputra. 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

Brahmaputra 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 Brahmaputra. 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 Water 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):

- Regular: ~1.0 m/s
- Flood season: ~2.5 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.

### 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 8-1 to 8-3** 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 8-1: River bank at GGG Ghat on 13<sup>th</sup> May 2018**



**Figure 8-2: River bank at GGG Ghat on 25<sup>th</sup> November 2010**



**Figure 8-3: River bank at GGG Ghat on 10<sup>th</sup> March 2003**

## 8.1.5 Erosion Control Measures

### 8.1.5.1 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	+	+	+	-	+	-	-	<ul style="list-style-type: none"><li>• Bank and bed protection</li><li>• Installation above and below water level</li></ul>	
1.2	Stone Pitching	+	+	+	-	+	+	-	<ul style="list-style-type: none"><li>• Short bank reaches</li><li>• Repair of existing revetments</li></ul>	
1.3	Cement ground stone	+	+	+	+	+	+	-	<ul style="list-style-type: none"><li>• Areas of attack by strong currents</li></ul>	
1.4	Bitumen grouted stone	+	+	+	+	+	+	-	<ul style="list-style-type: none"><li>• Areas of attacks by strong currents</li><li>• Installation above water level</li></ul>	
2.Gabions										
2.1	Mattresses (brick or stone fill)	+	+	+	+	+	-	-	<ul style="list-style-type: none"><li>• Bank protection of large areas</li><li>• Installation above water level</li></ul>	
2.2	Box Gabions (stone/rock fill)	+	+	+	+	+	+	+	<ul style="list-style-type: none"><li>• Retaining wall for bank protection</li><li>• Installation above water level</li></ul>	
2.3	Gabions Sacks (stone / rock fill)	+	+	+	+	+	-	-	<ul style="list-style-type: none"><li>• Toe protection</li><li>• Installation above and below water level</li></ul>	
3.Concrete (pre-cast units)										
3.1	CC-slabs	+	+	-	-	+	+	-	<ul style="list-style-type: none"><li>• Slope protection</li><li>• Installation above water level</li></ul>	
3.2	CC-Interlocking slabs	+	+	-	-	+	+	-	<ul style="list-style-type: none"><li>• Slope protection</li><li>• Installation above water level</li></ul>	
3.3	Hand pitched CC-blocks	+	+	+	+	+	+	+	<ul style="list-style-type: none"><li>• Slope protection</li><li>• Installation above and below water level</li></ul>	
3.4	Dumped CC-blocks	+	+	+	+	+	+	-	<ul style="list-style-type: none"><li>• Bed and bank protection in case of strong current and wave attack</li><li>• Installation above and below water level</li></ul>	
4.Articulating Mattresses										
4.1	Gabions mattresses, (with stone fill)	+	+	+	-	+	+	-	<ul style="list-style-type: none"><li>• Launching apron</li><li>• Slope protection</li><li>• Construction above water level (limited water depth)</li></ul>	
4.2	CC-blocks attached to geotextile filter mat, steel wire linked	+	+	+	-	+	+	-	<ul style="list-style-type: none"><li>• Launching apron</li><li>• Slope protection</li><li>• Construction above water level</li><li>• (cast in place)</li></ul>	

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							
4.3	Tubular geotextile fabric mattress; sand Filled or bitumen-sand filled	+	+	-	-	+	+	-	<ul style="list-style-type: none"><li>• Launching apron</li><li>• Slope protection</li><li>• installation above water level</li></ul>
4.4	Collapsible sand filled geotextile mattress	+	+	-	-	+	+	-	<ul style="list-style-type: none"><li>• Launching apron</li><li>• Slope protection</li><li>• Installation above water level</li></ul>
4.5	Collapsible concrete filled geotextile mattress	+	+	+	-	+	+	-	<ul style="list-style-type: none"><li>• Launching apron</li><li>• Slope protection</li><li>• installation above water level</li></ul>
5.Sand containers									
5.1	Geotextile-Sand bags (up to 250kg)	+	-	-	-	+	+	+	<ul style="list-style-type: none"><li>• falling apron and toe protection</li></ul>
5.2	Geotextile – Sand	+	+	+	-	+	+	+	<ul style="list-style-type: none"><li>• Installation above and below water level</li></ul>
6.Bio-Engineering									
6.1	Durba grass sods	+	-	-	+	-	-	-	<ul style="list-style-type: none"><li>• Upper reaches of banks above mean water level</li><li>• Preferably on land-side</li><li>• On river - side prone to wave erosion</li><li>• Installation above water level</li></ul>
6.2	Vetiver plantation	+	+	-	-	+	-	-	<ul style="list-style-type: none"><li>• Toe protection of upper reaches of banks</li><li>• Installation above water level</li></ul>

It is recommended that repairing of embankments in the island should be reconstructed immediately using latest technology.

## Risk Assessemnt

### 8.1.6 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).

### 8.1.7 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.

### 8.1.8 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.

### 8.1.9 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.

### 8.1.10 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 capsizes / 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.

#### 8.1.11 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

## 8.2 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
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

Hazard	Control Measures
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 vests, high-visibility fleeces, and raincoats and trousers. 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.

### 8.3 Emergency Response and Preparedness Plan and Contingency Response Plan

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.

#### 8.3.1 Objectives

The objectives of Emergency Management Plan shall be to;

- 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
- Ensure all appropriate and relevant resources are identified in advance and made available as quickly as possible during an emergency.

#### 8.3.2 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 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

- Major fire within the general bay area
- Major oil spill
- Major spill of hazardous material
- A vehicle accident involving hazardous material
- Chemical incidents (e.g. toxic cloud).
- Major incident in an oil, gas or hazardous material storage facility.

### 8.3.3 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

#### 8.3.3.1 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	

#### 8.3.3.2 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.

### 8.3.4 Response Strategy

To mitigate any possible oil spill/incident/accident during the voyage, the following actions are suggested.

#### 8.3.4.1 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.

#### 8.3.4.2 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 IWA 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

#### **8.3.4.3 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

### 8.3.5 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 representation 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), 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

### 8.3.6 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.

### 8.3.7 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..

## 8.4 Action Sequence Strategy

### 8.4.1 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
- Resuscitator Water 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

#### **8.4.2 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;

### 8.4.2.1 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.

### 8.4.2.2 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.

### 8.4.2.3 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-occurrences of the same incident. They shall be responsible to keep all relevant evidence records of incident.

#### **8.4.2.4 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

#### **8.4.3 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

#### **8.4.4 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

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;

##### **8.4.4.1 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.

##### **8.4.4.2 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).

##### **8.4.4.3 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.

### **8.4.5 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

#### **8.4.5.1 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

#### **8.4.5.2 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.

#### **8.4.5.3 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 statutes.
- 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.

#### **8.4.6 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.

#### **8.4.7 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.

#### **8.4.8 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 will arrange an alternate arrangement for each function.



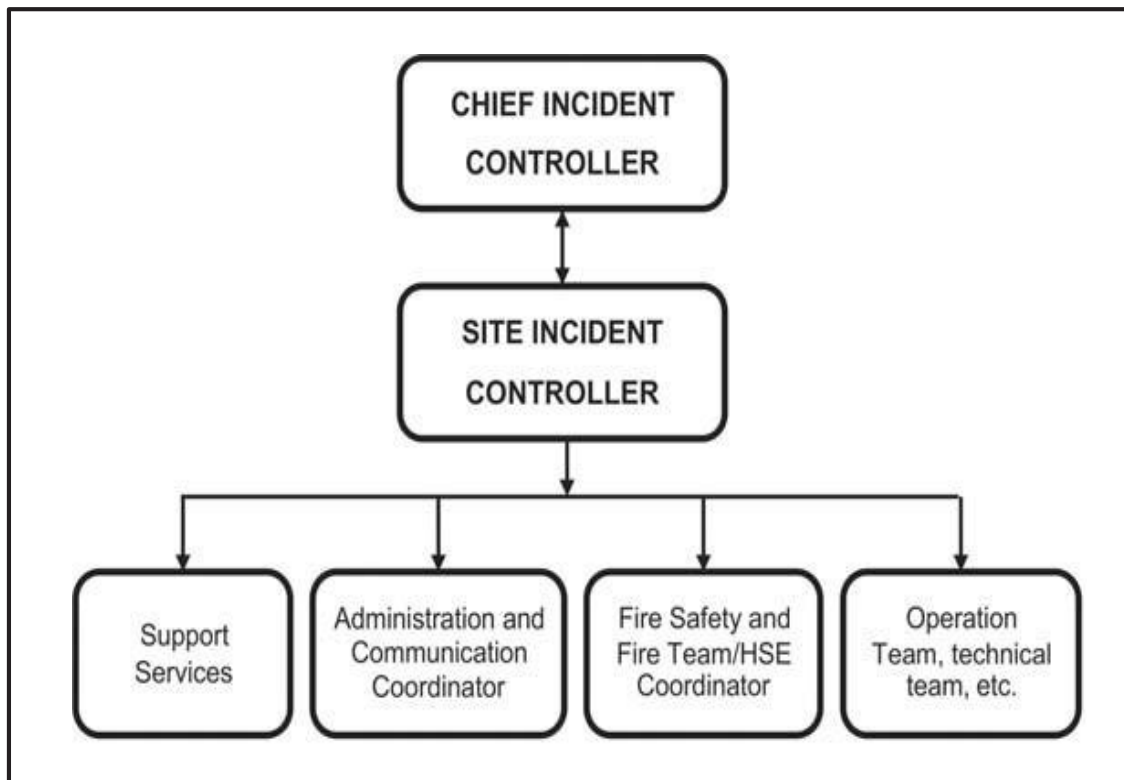


Figure 8-4: Typical facility level IMT (Incident Management team) for control of an oil spill

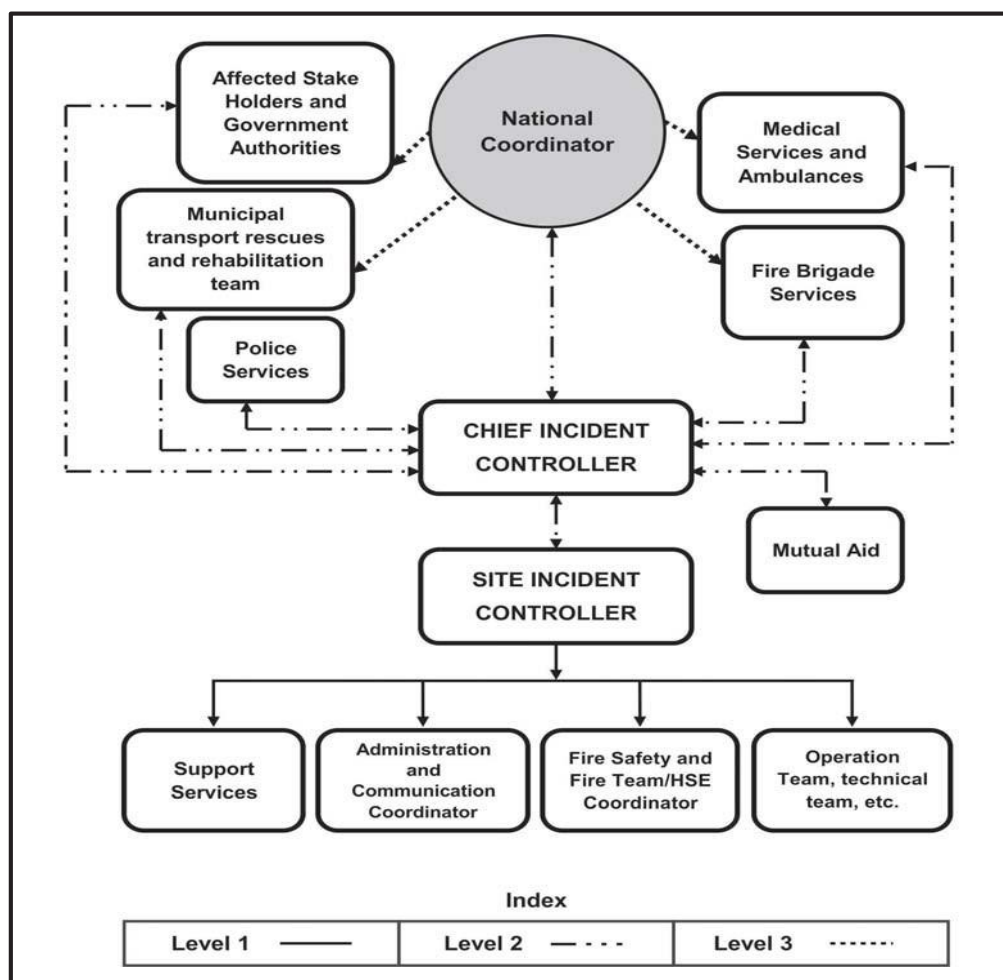


Figure 8-5: Basic oil spill emergency organogram

#### 8.4.8.1 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 life saving 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

#### **8.4.8.2 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.

**8.4.9 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 exits
  - Assembly points
  - Truck parking area
  - Surrounding location
- Reference Books/ Chemical Dossiers
- Copies of Disaster Management Plan

#### 8.4.10 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

#### 8.4.11 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).

#### 8.4.12 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) <a href="http://envfor.nic.in">http://envfor.nic.in</a>

## 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 was prepared for all the phase I activities proposed earlier under Assam Inland Water Transport Project. However, the project will now cover only one (1) large terminal i.e the Guwahati Gateway Ghat in the current phase. Therefore the project is in the process of hiring a consultant for carrying out the CIA study covering the revised scope of the project. It is expected that the CIA study for the activities of the overall project to be completed by December, 2022.

Some of the Identified major existing/ proposed/planned/anticipated development near the project location which may have some impact on the development activities around GGG location includes the following:

1. Proposed Brahmaputra River Front Development Project by Guwahati Smart City Limited.
2. Passenger Ropeway project connecting South and North Guwahati by Guwahati Metropolitan Development Authority.
3. Pandu Port by IWAI (Existing).
4. Proposed Navigation development from Neamati Port to Pandu Port by IWAI.
5. Guwahati- North Guwahati Bridge is the major upcoming project within 300 m w.r.t project site connecting Guwahati city to North Guwahati.
6. Proposed Elevated Road from the Guwahati City End of Guwahati-North Guwahati Bridge to Kachari Ghat over the River Brahmaputra.

As far as the impacts of above listed and other projects are concerned, it is envisaged that implementation of many projects would exert negative stress on river water ecosystem and dolphins, However the detailed analysis of overall impacts and mitigation measures will be discussed in the CIA report.



## 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

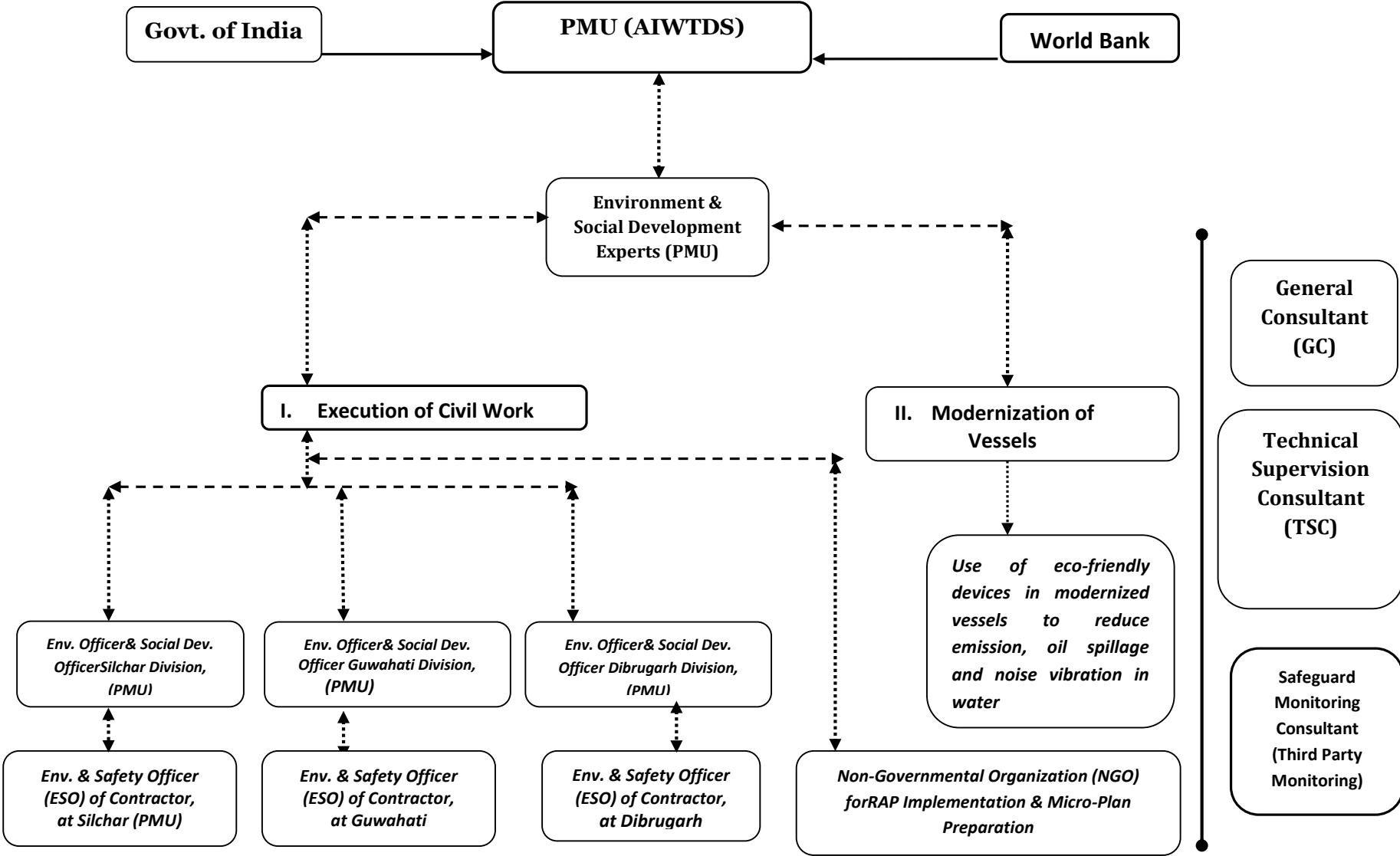
The activities to be performed by the contractor to implement the EMP shall comprise the following:

- 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 the EMP

### 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 Environment Management Plan deals with the mitigation measures applicable for and encompasses, the design, construction and operation phases of the proposed terminal at Guwahati Gateway Ghat. The generic mitigation measures which are already covered in the previous chapters need to be complied for better implementation of EMP. Site-specific environment and social mitigation measures related to the construction of GGG Terminal and riverine infrastructure along with the roles and responsibilities of the key persons involved at different phases of the proposed development are described below:

The Environmental Management Plan for proposed Terminal Project for both construction and operational phase is given in **Table 9-1** and **9-2** respectively.

Table 9-1: Environment Management Plan for proposed Guwahati Gateway 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 camp, Construction Camp & Labour camp							
1.1 C & G and levelling of site	<ul style="list-style-type: none"><li>Loss of top soil. Loss of natural resource (Earth/soil)</li></ul>	<ul style="list-style-type: none"><li>Top soil (15 cm) would be stripped and kept separately in stockpiles for use in landscaping.</li><li>Excavated materials would be preferably used for site filling/low lying area filling and the surplus material would be disposed as per norms.</li><li>Green belt/landscaping would be developed at the site and as per the Green Belt management Plan.</li><li>Survival rate of tree would be regularly monitored. It should be minimum of 70%.</li><li>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.</li><li>Shore protection works like stone pitching along the bank shall be undertaken.</li></ul>	<p>Solid Waste Management Rules, 2016, Hazardous &amp; Other Waste (Management and Transboundary) Rules, 2016</p> <p>C &amp; D waste Rules, 2016.</p> <p>The Water (Prevention &amp; Control of Pollution) Act, 1974 and amendments thereof.</p>	<p>Construction site</p> <p>Labour and construction Camp Locations</p>	<p>During design and Construction Stage</p>	<p>Contractor</p>	<p>TSC &amp; PMU</p>

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
1.2 Setting of Labour & Construction Camps:	Contamination of land and water resources from waste generation.	<ul style="list-style-type: none"> <li>Construction camp location would be as per proposed Construction &amp; Labour Camp Management Plan.</li> <li>Labour camps would be located close to the construction sites to the extent possible.</li> <li>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.</li> </ul>	<p>Solid Waste Management Rules, 2016, Hazardous &amp; Other Waste (Management and Transboundary) Rules, 2016</p> <p>C &amp; D waste Rules, 2016.</p> <p>The Water Prevention &amp; Control of Pollution) Act, 1974 &amp; amendments thereof.</p>	Labour and construction Camp Locations	Construction Stage	Contractor	TSC & PMU
1.3 Sanitation, Health & Safety:	Unhygienic and unsafe living and working condition.	<ul style="list-style-type: none"> <li>Hygiene in the camps would be maintained by providing good sanitation and cleaning facilities.</li> <li>Camp would be well ventilated with adequate provision for illumination, kitchen and safe drinking water. Proper drainage to be maintained around the sites to avoid water logging.</li> <li>Proper sanitation with toilet and bathing facilities would be provided at the sites and labour camps. Wastewater generated</li> </ul>					

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		<p>from these facilities would be disposed through septic tanks and soak pit</p> <ul style="list-style-type: none"> <li>• Preventive medical care to be provided to workers</li> <li>• 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.</li> <li>• LPG will be used for cooking in construction camps</li> <li>• Provision would be made for day crèche for children</li> <li>• 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 emergency case, if any</li> <li>• Rest area would be provided at the site where workers can rest after lunch and should not lie on site anywhere</li> <li>• Working hours of labourers would not exceed than standard norms as per Factory Act</li> <li>• Wastewater from construction site would not</li> </ul>					

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		<p>be allowed to be accumulated as it may lead to breeding of mosquitoes. Septic tanks/soak pits would be provided for its disposal</p> <ul style="list-style-type: none"> <li>• Temporary storm water drainage system would also be provided at camp site so that no water logging takes place</li> </ul>					
1.4 Waste Management	Generation of solid, liquid and hazardous waste	<ul style="list-style-type: none"> <li>• Arrangement should be made for segregation of waste into recyclable and non-recyclable waste</li> <li>• Non-recyclable waste generated should be disposed regularly through authorized agency. Recyclable waste should be sold to authorized vendors.</li> <li>• Construction waste generated should be segregated at site into recyclable, reusable &amp; 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</li> </ul>					



Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		<ul style="list-style-type: none"> <li>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 &amp; manage for the same as per the Debris Management Plan.</li> <li>Any waste oil generated from construction machinery, should be stored on concrete platform and disposed off to authorized recyclers.</li> </ul>					
<b>2. Climate</b>							
2.1 Climate Change	Project is unlikely to cause negative effect on climate. However, project can contribute positively for climate	<ul style="list-style-type: none"> <li>Daily monitoring of the CWC Gauge data at Pandu Ghat (for GGG Ghat)</li> <li>Regular interaction mechanism with Indian Meteorological Department (IMD) for early forecasting to avoid casualties</li> <li>Working jointly with State Disaster Management Authority, State Disaster Response Force (SDRF) &amp; National Disaster Response Force (NDRF) during emergency situation</li> <li>Awareness programme with staff, passengers and</li> </ul>	Kyoto Protocol, Forest Conservation Act & National Forest Policy	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
		contractors on Climate Change. • Shifting to alternative energy options like solar energy • Adoption of best practices to cut down resources and energy requirement					
<b>3. Air Pollution/ Emissions of dust and gasses.</b>							
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 <sub>10</sub> , PM <sub>2.5</sub> , SO <sub>x</sub> , NO <sub>x</sub> , and CO shall be carried out quarterly at construction site • Regular water sprinkling/fogging to suppress the dust generated at site, approach road & haulage roads. • Proper servicing and maintenance of earth moving vehicles and other machinery to minimize the emission generation	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
		<ul style="list-style-type: none"> <li>Vehicles transporting the loose and fine materials like sand and aggregates shall be covered.</li> <li>Masks and other PPE shall be provided to workers in high dust generation area</li> <li>Loading and unloading of construction materials shall be made at designated locations with provisions of water sprinkling.</li> <li>Construction vehicle, machinery &amp; equipment shall be regularly serviced and maintained and would have valid PUC certificate</li> <li>Monitoring of air quality shall be carried out on quarterly basis to check the level of pollutants and effectiveness of mitigative measures</li> </ul>					
<b>4. Noise pollution</b>							
4.1 Noise Pollution	<ul style="list-style-type: none"> <li>Noise generation from construction activity.</li> <li>Noise generation from operation of vehicle, equipment and machinery.</li> </ul>	<ul style="list-style-type: none"> <li>Protection devices (earplugs or ear muffs) shall be provided to the workers operating near high noise generating machines.</li> <li>Barricading (Temporary noise barrier) around the construction site to minimize the noise level</li> </ul>	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
		<ul style="list-style-type: none"> <li>• Restriction of high noise generating activity between 10:00 PM to 6 AM.</li> <li>• Restriction on Honking at the project site</li> <li>• Job rotations systems for workers, working in high noise level areas</li> <li>• Periodic monitoring of noise levels to check the level of pollutants and effectiveness of proposed EMP</li> </ul>					
<b>5. Water Pollution/Contamination of water source</b>							
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	<ul style="list-style-type: none"> <li>• Preference would be given to use river water for construction with permission from concerned authorities</li> <li>• In case of use of ground water, permission will be obtained from CGWA/CGWB</li> <li>• Water monitoring to be carried out as per monitoring plan.</li> <li>• Natural Drainage pattern of area shall be maintained by making a proper drainage network in project site.</li> <li>• Washing of vehicle and equipment shall not be carried out in river or nearby place.</li> </ul>	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
		<ul style="list-style-type: none"> <li>Storage of debris and raw materials would be in designated area clearly demarcated.</li> <li>Site would be regularly cleaned</li> <li>Septic tank/soak pit shall be provided for the toilets at both construction site as well as workers camp. Adequate toilets &amp; 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.</li> <li>Fuel shall be stored in leak proof containers and containers shall be placed on paved surface under shed.</li> <li>The piling work in river shall be undertaken during low flow period.</li> <li>Turbidity traps/curtains/Geo-Textile synthetic sheet curtain would be placed around piling and construction area to prevent movement of sediments and construction waste.</li> </ul>					

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		<ul style="list-style-type: none"> <li>Sedimentation tanks shall be provided for treating run-off from site before discharging into the river.</li> <li>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</li> <li>Monitoring of surface water quality shall be carried out on quarterly basis to check the level of pollutants and effectiveness of proposed EMP</li> </ul>					
<b>6. Accident, Incident and Safety Risks</b>							
6.1 Health & Safety	Accident and Incident risk from construction activities and safety of workers Impact on Social life.	<ul style="list-style-type: none"> <li>Local labour would preferably be employed for construction.</li> <li>Site would be barricaded and would have security guards.</li> <li>Resister would be maintained for entry to the construction sites. No unauthorized person would be allowed to enter the site.</li> <li>A board in local language at entrance of site would display name of project, area and hazards</li> </ul>	BOCWA & BOCWR  Central Motor Vehicle Act 1988  EP Act 1986 Noise Rules 2002	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
		<p>associated for public awareness</p> <ul style="list-style-type: none"> <li>• Adequate illumination would be provided at site during evening and night time till the work is being carried out</li> <li>• Rest area for workers would be provided.</li> <li>• 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</li> <li>• Noise level in the work zone would be maintained and followed as per OSHAS norms</li> <li>• Contractors would adopt and maintain safe working practices. SOPs would be prepared and followed for all activities under supervision of site engineer</li> <li>• Training would be given to workers to handle the heavy equipment so as to prevent accidents</li> <li>• Complete medical check-up would be done for workers prior to joining and after six months of joining</li> </ul>					



Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		<ul style="list-style-type: none"> <li>Emergency telephone nos.of hospitals, ambulance and doctors would be displayed in first aid room.</li> <li>Working hours of labour should not exceed norms as per state factory law</li> <li>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 &amp; timings.</li> <li>Arrangement of fire-fighting would be made at site and workers would be trained on their use.</li> <li>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.</li> </ul>					
<b>7. Protection of Flora and Fauna</b>							
7.1 Loss of Biodiversity	<ul style="list-style-type: none"> <li>Loss of terrestrial flora &amp; fauna.</li> <li>Loss of Aquatic Fauna including Dolphins and macrophytes.</li> </ul>	<ul style="list-style-type: none"> <li>Caution sign shall be placed to prevent hunting of animals</li> <li>Construction activities shall be restricted to 6:00 Am-10:00 Pm especially noise generating activities.</li> </ul>	Wild Life (Protection) Act, 1972, Bio-diversity Conservation Act, 2002	Terminal site/construction camps Around Piling 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
	<ul style="list-style-type: none"> <li>Impact of underwater noise.</li> </ul>	<ul style="list-style-type: none"> <li>No hazardous material or waste shall be disposed in the land or nearby area as it may harm the animals, if consumed accidentally</li> <li>Site should be barricaded to prevent entry of the animal in the site</li> <li>Illumination at the night time should be reduced (if no activity is going on) as it may disturb the nocturnal animals</li> <li>Workers should not use any timber or firewood as fuel for any purpose</li> <li>The river 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.</li> <li>Before starting piling allow some time to aquatic fauna to displace from the piling area.</li> <li>Adequate measures such as- maintainng the ecological flow, downscaling the vessel</li> </ul>					

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		<p>traffic, and modification in propeller for reduction in cavitation noise, shall be taken to minimise the impact of underwater noise.</p> <ul style="list-style-type: none"> <li>• Impact of piling during the construction period will be managed by adoption of vibratory piling and usage of bubble curtain to disperse the fauna and reduce noise level.</li> <li>• The piling activities must be carried out in shortest possible timeframe.</li> <li>• All the debris should be disposed away from river course.</li> <li>• Noise reducing devices like mufflers, enclosures shall be fitted with the equipment as much as feasible.</li> <li>• Fish exclusion devices shall be installed in water column around the pile driving area to prevent fish access</li> <li>• Geo Textile synthetic sheet curtain &amp; turbidity traps shall be placed around piling and construction area to prevent movement of</li> </ul>					

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		sediments and construction waste <ul style="list-style-type: none"> <li>Piling should be stopped for some time, if any dolphin/turtle/RET species is sighted in activity area</li> <li>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.</li> <li>No-construction Period : It is recommended to stop the construction activities in water part between Mid-March to Mid-June</li> </ul>					
<b>Cultural &amp; Heritage Resources</b>	<ul style="list-style-type: none"> <li>Temporary diversion of access towards cultural resources, temples;</li> <li>Safety issues to devotees during the construction stage various construction activities. etc.</li> <li>Chances of vibration impact to these cultural</li> </ul>	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 scaffolding 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
	resources during the construction work;						
<b>Labour Influx</b>	<ul style="list-style-type: none"> <li>• Influence in the demographic composition</li> <li>• Increased demand and competition for local social and health services</li> <li>• Social conflicts between the local community and the construction migrant workers.</li> <li>• Increased rates of illicit behaviour and crime against women, which is a real threat for Assam where gender-based violence is rampant</li> <li>• Increase competition for jobs and have an impact on wage distribution</li> </ul>	<ul style="list-style-type: none"> <li>• 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</li> <li>• The project contractor needs to prepare a site-specific Labour Influx Management Plan and/or a Workers' Camp Management Plan.</li> <li>• Security personnel will be deployed at the construction sites, and emergency nos. including contact details of local law</li> </ul>		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
		<p>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.</p> <p>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.</p>					

Component	Environmental Attribute and potential impacts	Remedial Measure	Relevant laws and Contract Documents	Approximate Location	Time Frame	Institutional Responsibility	
						Implementation	Supervision
		<ul style="list-style-type: none"> <li>Awareness camps on HIV/AIDS for both, construction workers and neighbouring villages must be organised at regular intervals by NGOs empanelled with NACO.</li> <li>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.</li> <li>In case work schedule extends up till night, it should be ensured that women workers are exempted night shifts.</li> </ul>					



Table 9-2: Environment Management Plan for proposed Guwahati Gateway Terminal Project (Operation Phase)

Component	Environmental Attribute and potential impacts	Remedial Measures	Relevant laws/ Contracts	Approximate Location	Time Frame	Institutional Responsibility	
						Implementat ion	Supervision
1.0 Climate							
Climate Change	Project is unlikely to cause negative effect on climate. However, project can contribute positively for climate	<ul style="list-style-type: none"><li>Greenbelt shall be developed all along the terminal premises.</li><li>Energy efficient measures in the terminal buildings will be implemented</li><li>Solar power will be used in potential area</li></ul>	Kyoto Protocol, Forest Conservation Rules & National Forest Policy	Terminal site	Operation and maintena nce	IWT	IWT
2.0 Air Quality							
Air Pollution	Emission from machinery, ferry, DG and vehicular movement.	<ul style="list-style-type: none"><li>Only Passenger ferry will be handled in the terminal hence no dust pollution anticipated.</li><li>Green belt shall be developed and maintained as per lay out</li><li>Local Species selected for development of green belt.</li><li>Water sprinkling would be provided in dust generating areas</li><li>DG exhaust will be minimised by regular maintenance in AMC</li><li>Monitoring of air quality shall be carried out on quarterly basis to check the level of pollutants and effectiveness of EMP</li><li>Ferries, deployed, will have efficient fuel combustion system with minimum emission</li></ul>	Environment al Protection Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981	Terminals	Operation and maintena nce	IWT	IWT

Component	Environmental Attribute and potential impacts	Remedial Measures	Relevant laws/ Contracts	Approximate Location	Time Frame	Institutional Responsibility	
						Implementat ion	Supervision
3.0 Soil Erosion							
Soil Erosion and manageme nt.	<ul style="list-style-type: none"><li>Soil erosion of embankment during heavy rainfall.</li></ul>	<ul style="list-style-type: none"><li>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</li></ul>	Project requirement	Along river bank and Embankme nt	Regular surveillan ce during operation	IWT	IWT
4.0 Wastewater Management							
Water pollution	<ul style="list-style-type: none"><li>Surface water pollution.</li><li>Siltation and erosion and contamination due to disposal of domestic waste</li></ul>	<ul style="list-style-type: none"><li>STP (60KLD) would be provided to treat the sewage generated. Treated water would be used for horticulture and plantation purpose at the site</li><li>Storm water drainage system would be provided at the site.</li><li>Rain water harvesting facility would be developed and maintained</li><li>Oil interceptors shall be provided with the storm water drains in the parking lots &amp; loading &amp;unloading areas</li><li>Fuel shall be stored in leak proof containers and containers shall be placed on paved surfaces so that no spill occurs</li><li>Fuelling of vessels will be leak proof system</li><li>Quarterly Monitoring of surface water quality shall</li></ul>	Project requirement	Terminal and vessels	Operatio nal Phase	IWT	IWT

Component	Environmental Attribute and potential impacts	Remedial Measures	Relevant laws/ Contracts	Approximate Location	Time Frame	Institutional Responsibility	
						Implementat ion	Supervision
		be carried out to check the level of pollutants and effectiveness of EMP					
<b>5.0 Noise Control</b>							
Noise Pollution	<ul style="list-style-type: none"> <li>Noise generation from operation of vehicle, equipment and machinery.</li> <li>Impact of underwater noise and risk of ship strikes</li> </ul>	<ul style="list-style-type: none"> <li>Timely maintenance and servicing of transportation vehicles and the machinery/pumps/vessels to be used during operation phase to reduce the noise generation.</li> <li>Honking shall be prohibited at the project site</li> <li>Hearing test for the workers shall be undertaken before employing them and thereafter shall be done after every six months</li> <li>DG sets shall be provided with acoustic enclosure</li> <li>Monitoring of Noise levels shall be carried out on quarterly basis to check the level of pollutants and effectiveness of proposed EMP</li> <li>Impacts of underwater noise and risk of ship strikes can be mitigated by routing ship traffic away from critical dolphin habitats and implementing speed regulations and technology adaptation for the vessels involved.</li> </ul>	Noise Pollution (Regulation and Control) Rules, 2000	Access Road & Terminal Site	Operationa l phase	IWT	IWT

Component	Environmental Attribute and potential impacts	Remedial Measures	Relevant laws/ Contracts	Approximate Location	Time Frame	Institutional Responsibility	
						Implementat ion	Supervision
6.0 Accidental Risk							
Accident and Incident.	Accident risks associated with traffic movement.	<ul style="list-style-type: none"><li>Traffic control measures, including speed limits should be enforced strictly.</li></ul>	Project requirement	Access Road	Operationa l phase	IWT	IWT
	Accidents due to Movement of Vessels and other hazards associated with site	<ul style="list-style-type: none"><li>Further encroachment of squatters within the ROW of approach road will be prevented.</li><li>Monitor/ensure that all safety provisions included in design and construction phase are properly maintained</li><li>Adequate illumination should be provided at the site during evening</li></ul>	Project requirement	Throughout the Project route	Operationa l phase	IWT	IWT
7.0 Flora & Fauna							
Biodiversity loss	Loss of Aquatic Fauna including Dolphins and other macrophytes	<ul style="list-style-type: none"><li>Propeller shall have net system to avoid any accident with dolphins and other aquatic animals.</li><li>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</li><li>Run-off from stockpile area, storage yards, parking</li></ul>	Forest Conservation Act 1980, Wild Life Protection Act, 1972	Project tree plantation sites. Terminal site and surrounding area	Operationa l phase	IWT	IWT

Component	Environmental Attribute and potential impacts	Remedial Measures	Relevant laws/ Contracts	Approximate Location	Time Frame	Institutional Responsibility	
						Implementat ion	Supervision
		<p>areas &amp; roads shall not be disposed directly in to river.</p> <ul style="list-style-type: none"> <li>• 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</li> <li>• Instruction shall be given to vessel operator that in case any accident with dolphin occurs that should be reported immediately to terminal authority</li> <li>• Waiting time of vessels shall be reduced at the terminal/lock sites by providing the adequate loading and unloading equipment and vehicles.</li> <li>• Vessels shall be instructed for not using sharp lights and sounds all the time as they may disturb aquatic organisms.</li> </ul>					

## 9.4 EMP Monitoring Programme

EMP Monitoring Programme is very important and 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 to ensure that all the key entities including E&S Construction 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	<ul style="list-style-type: none"> <li>On completion of design of project</li> </ul>	<ul style="list-style-type: none"> <li>Design documents and drawings</li> </ul>
2.	Review of bid documentation and bid process	<ul style="list-style-type: none"> <li>Review of documentation</li> <li>During bidding process initiation</li> </ul>	<ul style="list-style-type: none"> <li>Proof of advertisement, letters, and correspondence</li> <li>Bid Documents, contract agreements</li> </ul>
3.	Review of site preparation and clearances	<ul style="list-style-type: none"> <li>Prior to start of construction</li> </ul>	<ul style="list-style-type: none"> <li>Inter departmental correspondences</li> <li>Official records</li> </ul>
4.	Review of Project Management Systems	<ul style="list-style-type: none"> <li>After deployment of Project Management Systems</li> </ul>	<ul style="list-style-type: none"> <li>As per official records</li> <li>Observations</li> <li>Discussions with PIU</li> </ul>
5.	Report on Physical progress of EMP implementation	<ul style="list-style-type: none"> <li>After handing over the site to contractor/ during Construction period</li> </ul>	<ul style="list-style-type: none"> <li>Reports and documents submitted by PIU</li> <li>Review of milestones as per Contract agreement</li> <li>Discussions with PIU</li> </ul>
6.	Compliance to the statutory requirements	<ul style="list-style-type: none"> <li>Pre-Construction, during Construction and Post-Construction</li> </ul>	<ul style="list-style-type: none"> <li>As per the MoEFCC guidelines</li> <li>EMP document for the project.</li> <li>Compliance with relevant legislation / rules</li> </ul>
7.	Safety and Health	<ul style="list-style-type: none"> <li>Construction and Post-Construction stage</li> </ul>	<ul style="list-style-type: none"> <li>As per relevant standards/ good practices / contracts</li> </ul>
8.	Progress of Resettlement and Rehabilitation	<ul style="list-style-type: none"> <li>During Pre-Construction and Construction stage if the Land acquisition process is not completed.</li> </ul>	<ul style="list-style-type: none"> <li>As per R&amp;R Action Plan submitted along with PR/Land acquisition proposal submitted, Records of Competent Authority</li> <li>No. of court cases against land acquisition for the project</li> </ul>

### 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

## 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	<ul style="list-style-type: none"> <li>• Ensure that all project activities are well-managed and coordinated.</li> <li>• Recruitment of consultants for EIA and engineering designs;</li> <li>• Procurement of works and goods.</li> <li>• Payment of compensation to the project affected</li> <li>• Recruitment and supervision of external monitor and independent Panel of Experts</li> </ul>
Environmental Expert &	<ul style="list-style-type: none"> <li>• Responsible for screening and determining scope of EA work required for Component B activities and studies, assisting PD with developing</li> </ul>

Organizations	Responsibilities
Social Development Expert within PIU	<p>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,</p> <ul style="list-style-type: none"> <li>• Ensuring inclusion of EMP in bidding documents</li> <li>• Closely coordinate with other concerned agencies, local governments and communities to support implementation of EMP</li> <li>• Preparation of progress reports on implementation of EMP.</li> <li>• 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.</li> <li>• Commissioning and oversight/review of consultant reports for EIAs/EMPs to be developed for the subcomponents of the Project</li> </ul>
EIA Consultants	<ul style="list-style-type: none"> <li>• Carrying out EIA studies in compliance with the MoEF&amp;CC and World Bank guidelines following the EMF</li> <li>• Preparing EMP for inclusion in the bid documents</li> </ul>
Design Consultant	<ul style="list-style-type: none"> <li>• Prepare Detailed Project Report (DPR), Front End Engineering Design (FEED) and tender document</li> <li>• (as per World Bank guidelines) for development works amounting to approx. US \$100 million, selected based on assessment of output provided by ISDP Consultant.</li> <li>• <input type="checkbox"/> Task 1 - Detailed Design, Engineering &amp; Preparation of DPR</li> <li>• <input type="checkbox"/> Task 2 - Preparation of Bid Document</li> <li>• <input type="checkbox"/> Task 3 - Draft TOR for Supervision of Works</li> <li>• Modularization of design elements for passenger (and cargo) ferry terminals &amp; development of customizable design models for future interventions</li> <li>• For the sake of clarity, the above scope will involve carrying out the following basic tasks / activities:</li> <li>• 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.</li> <li>• b) Based on the finalized sites as per ISDP Consultant / Client, carry out site surveys and investigations to</li> <li>• assess the underlying soil conditions, river bed levels and topographic levels for the adjacent land.</li> <li>• c) Planning and Design of fixed / floating infrastructure for terminal development to cater primarily for passengers (including those with cargo facilities).</li> <li>• 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.</li> <li>• e) Preparation of Detailed Project Report based on activities listed from (a) to (d) above along with FIRR and EIRR.</li> <li>• f) Preparation of Tender Documents for each of the sites.</li> <li>• 1.4 Project Organization and Deployment Details</li> <li>• 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.</li> </ul>
TSC	<ul style="list-style-type: none"> <li>• Supervise and monitor Environmental and Social safeguard components as per the management Frameworks, during implementation phase</li> </ul>

Organizations	Responsibilities
	<ul style="list-style-type: none"> <li>Supervising contractors for EMP implementation</li> <li>Prepare monthly reports and submit to PMU</li> <li>GC will have dedicated environmental and social staff</li> <li>Supervise civil works, ensuring compliance with all design parameters including quality requirements</li> <li>Supervising contractors for EMP implementation</li> <li>Prepare monthly reports and submit to PIU</li> </ul>
Contractor	<ul style="list-style-type: none"> <li>Responsible for implementation of mitigation and monitoring measures proposed in the EMP</li> <li>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.</li> </ul>
Safeguard Monitoring Consultant(3 <sup>rd</sup> party)	<ul style="list-style-type: none"> <li>Independent monitoring of implementation of EMP</li> <li>External Monitoring and evaluation</li> </ul>

**Table 9-5: Proposed Roles & Responsibility on Environmental Management of Key Expert as per Organogram**

SL.No	Expert Position	Roles & Responsibilities
1	Environmental Specialist	<ul style="list-style-type: none"> <li>Environmental Specialist will be overall responsible to provides direction, instructions and guidance to other experts under the E&amp;S Cell working on this project</li> <li>Responsibility to execute &amp; implement EMF, EIA &amp;EMP through design DPR Consultant, contractors etc.</li> <li>Assist the Environmental Specialist of the Design Consultants and Contractor in preparation of the training materials and in conducting training;</li> <li>To obtain mandatory statutory clearances. related to project</li> <li>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</li> <li>Carry out site inspections, check and undertake periodic environmental monitoring and initiate necessary follow-up actions;</li> <li>Document the good practices in the project on incorporation and integration of environmental issues into engineering design;</li> <li>Facilitate and coordinate with the Safeguard monitoring consultant (3rd Party).</li> <li>Assist in the preparation of periodic reports for dissemination to the PIU, and World Bank.</li> <li>Any other tasks specified by the SPD</li> </ul>
2	River Specialist/ Hydrologist	<ul style="list-style-type: none"> <li>Carry out site inspections, check and undertake periodic environmental monitoring and initiate necessary follow-up actions</li> <li>Measure the properties of bodies of water, such as volume and stream flow at regular interval</li> <li>Collect water and soil samples to test for certain properties, such as the pH or pollution levels, sediment load etc.</li> <li>Analyse data on the environmental impacts of pollution, erosion, drought, and other problems</li> </ul>

		<ul style="list-style-type: none"> <li>• Research ways to minimize the negative impacts of erosion, sedimentation, or pollution on the environment</li> <li>• Looking after the hydrology properties in the project at different stages and report the findings and recommendation to Environmental Specialist.</li> <li>• Review, evaluate, and analyse work environments and design programs and procedures to control erosion</li> <li>• Any other tasks specified by the SPD and Senior Environmental Specialist</li> </ul>
3	Marine Expert/IWT Specialist:	<ul style="list-style-type: none"> <li>• Responsible for all Marine Design related works.</li> <li>• Responsible for policy / guidelines of Central / State Govt. Related to IWT matter.</li> <li>• Responsible for supervising /marine works related to IWT Projects.</li> <li>• Technical and contractual aspects of the projects.</li> <li>• Supervise project clearances for the project.</li> </ul>

### 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 grievance submission mechanism should be online or through 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 the field activities. (To be repeated as needed.)
EMP; Waste disposal;	Construction crew	Contractors	Prior to the start of the construction 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 the field operations. (To be repeated as needed.)
Camp operation; Waste disposal; Natural resource conservation; Housekeeping.	Camp staff	Contractors	Before and during the field 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 should include 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

### 9.8.6 Stakeholder Engagement

It is expected that the stakeholders will have an opportunity to comment on the content of the EIA report.

## 9.9 Environment Monitoring Programme

Environmental Monitoring Programme 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<sub>10</sub>, PM<sub>2.5</sub>, NO<sub>x</sub>, SO<sub>2</sub> and CO at selected locations to assess 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 monitoring	3 Samples/ Location/Quarter (i.e.,12 Samples/Year)		
Water Quality (Drinking water)	pH, temperature, DO, BOD, COD, Oil & Grease, Total Suspended Solid, turbidity, Total Hardness.	Labour camp / Base camp	3 sample/location/ quarterly	Contractor through a nationally recognized laboratory Contractor through a nationally	Construction supervisor External Monitor Construction supervisor

Environmental component	Parameters to be monitored	Location	Frequency	Responsible Agency	
				Implemented by	Supervised by
	Chlorine, Iron, As, Total Coliform			recognized laboratory	
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
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
<b>Operation Stage</b>				
Ambient Air Quality	PM <sub>10</sub> , PM <sub>2.5</sub> , SO <sub>x</sub> , NO <sub>x</sub> , CO	Terminal Site	1 sample/location/Quarter (i.e., 4 Samples/Year)	AIWTDS

Environmental component	Parameters to be monitored	Location	Frequency	Responsible Agency
		Along Stretch	1 sample/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
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. Environmental budget for Guwahati Gateway Ghat is estimated as Rs. 35 lacs .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 Estimate for Gateway Guwahati Ghat

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
<b>CONSTRUCTION STAGE</b>					
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			
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			
	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			
	Water Sprayer / Watering for Dust suppression	To be covered in project design and engineering cost			

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
Air Quality – Dust Management during construction	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 for 12 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 for 12 samples will be 12X15000	15,000/ sample	180000
	Surface Water Quality	Surface water resources	As per the standard norms, sample may	12,000/ sample	108000

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
			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		
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			0



COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
		anyalysis drinking water quality since the project activities have no direct impact on drinking water in the nearby area.			
	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. Then, 9X8000will be total cost per terminal.	8,000/ sample	72000
<b>SUB TOTAL (CONSTRUCTION STAGE)</b>					<b>1302000</b>
<b>OPERATION STAGE</b>					

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
	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		
	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

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
		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 for 3 season per year at 3 locations per site for 1 year for 1 ghat i.e. 3X3X3X4000	4,000/ sample	1,08,000

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
		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
<b>SUB TOTAL (OPERATION PHASE)</b>					<b>1116000</b>
<b>ESTABLISHMENT, TRAINING &amp; MANAGEMENT SYSTEM</b>					
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 training 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 driving/sailing;Waste disposal;	Drivers;boat/launch crew,	Contractors		10000
	Camp operation; Waste disposal;Natural resource conservation;Housekeeping.	Camp staff	Contractors		10000

COMPONENT	ITEM	UNIT	QUANTITY	RATE	Amount (in INR)
	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

## 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, Construction of Terminal and Riverine Infrastructure at Gateway Guwahati Ghat is considered. 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 mitigative measures for minimising the environmental impact have been worked out.

The results of the environmental investigation are presented in the EIA report. Public consultations at different stages during the course of study both formally and informally has been conducted to take into account the views of the key stakeholders and common public in general. 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 overall aesthetics of the area. EMP has been formulated to mitigate the negative impacts during various phases. The main monitoring parameters 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. AIWTDS will follow the EMP for improvement of navigation and environment quality of the area. It is expected that with the construction/improvement of terminal and other infrastructural facilities, the quantum of traffic is expected to increase and thus benefit the local economy as well as vehicles crossing the river Brahmaputra.

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MARPOL Convention	<p>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.</p> <p>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.</p> <p>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.</p> <p>Annex I: Regulations for the Prevention of Pollution by Oil (entered into force 2 October 1983)</p> <p>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 oil tankers 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.</p> <p>Annex II: Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered into force 2 October 1983)</p> <p>Annex III: Prevention of Pollution by Harmful Substances Carried by Sea in</p>	

Type of Data	Report/source Name	Source
	<p>Packaged Form (entered into force 1 July 1992).</p> <p>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 sewage treatment 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.</p> <p>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 the complete ban imposed on the disposal into the sea of all forms of plastics.</p> <p>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 SO<sub>x</sub>, NO<sub>x</sub> and particulate matter. A chapter adopted in 2011 covers mandatory technical and operational energy efficiency measures aimed at reducing greenhouse gas emissions from ships.</p>	
References from Research Papers	<p>Clarke, D., Miller-Way, T. (1992). "An environmental assessment of the effects of open-water disposal of maintenance dredged material on benthic resources in Mobile Bay, Alabama." U.S. Army Engineer Waterways Experiment Station Environmental Laboratory. Miscellaneous Paper D-92-1, NTIS No. AD-A254 534, San Francisco.</p> <p>of Marine Science 34:170-174.</p> <p>Ray, G.L. and Clarke, D.G. (1999). "Environmental assessment of open-water placement of maintenance dredged material in Corpus Christi Bay, Texas." Final report. Waterways Experiment Station, Vicksburg, Mississippi, pp. 1-203.</p> <p>Bolam, S. G. and Rees, H.L. (2003). "Minimizing impacts of maintenance dredged material disposal in the coastal environment: A habitat approach." Environmental Management 32, 171-188.</p> <p>Zajac, R.N., Whitlatch, R.B., and Thrush, S.F. (1998) "Recolonization and succession in soft-sediment infaunal communities: the spatial scale of controlling factors." Hydrobiologia, 375/376, 227–240.</p> <p>Schratzberger, M., Rees, H.L. and Boyd, S.E. (2000) "Effects of simulated deposition of dredged material on structure of nematode assemblages – the role of burial." Marine Biology 136, 519-530</p> <p>Dey, Mayukh, Krishnaswamy, Jagdish, Morisaka, Tand Kelkar, N (2019). Interacting effects of vessel noise and shallow river depth elevate metabolic stress in Ganges River dolphins</p>	