MINISTRY OF ROAD TRANSPORT AND HIGHWAYS

NATIONAL HIGHWAY AND INFRASTRUCTURE DEVELOPMENT CORPORATION

THE PREPARATORY STUDY FOR NORTH EAST NETWORK CONNECTIVITY IMPROVEMENT PROJECT (PHASE-3) IN INDIA

PRELIMINARY DESIGN WORK FOR DHUBRI-PHULBARI BRIDGE IN THE STATE OF ASSAM / MEGHALAYA ON NH-127B (LENGTH OF 20KM)

ENVIRONMENT IMPACT ASSESSMENT

MAY 2018

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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TABLE OF CONTENTS

LIST OF TABLES

ABBREVIATIONS

ADT	Average Daily Traffic
BRDB	Border Roads Development Board
BRO	Border Roads Organization
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
DOEF	Departments of Environment and Forests
DOF	Department of Forest
DPR	Detailed Project Report
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GHG	Green House Gas
GOI	Government of India
GSDP	Gross State Domestic Products
IRC	Indian Road Congress
MOEFCC	Ministry of Environment, Forests & Climate Change
MORTH	Ministry of Road Transport & Highways
NABL	National Accreditation Board for Laboratories
NHAI	National Highway Authority of India
NHIDCL	National Highways and Infrastructure Development Corporation
NOAA	National Oceanic and Atmospheric Administration
NOC	No-objection Certificates
PAPs	Project Affected Persons

PCU	Passenger Car Unit
PIU	Project Implementation Unit
PUC	Pollution under Control Certificate
PWD	Public Works Department
RAP	Resettlement Action Plan
RO	Regional Offices
ROB	Road over Bridge
ROW	Right of Way
SC	Supervision consultants
SPCBs	State Pollution Control Boards

CHAPTER 1 Introduction

1.1 Background of the project

In India, roads are one of most important modes of ground transportation as they constitute 85% of passenger transportation and 60% of freight transportation in India. However, the development of the road network in mountainous regions of the Northeastern Region of India has been much worse than the rest of the country. This is due to financial and technical reasons. Thus, the Northeastern Region has suffered greater economic disparity compared to other regions.

While 63.4% of the roads in India have been paved, only 28.5% of the roads in Northeastern Regions are paved, out of which only 53% of the national highways are more than 2 lanes. This is because the Northeastern Region is located far from the major areas of India. Furthermore, the roads leading to neighboring countries have been underdeveloped due to security concerns.

The severe natural conditions of the Northeastern Region featured by steep mountains and a prolonged monsoon season have also been obstacles for appropriately developing the road network. Economic growth in this part of the country has therefore been very delayed. The regional connectivity of the road network should promote cross-border trade and commerce and help safeguard India's international borders. This would lead to the formation of a more integrated and economically consolidated South and Southeast Asia. In addition, there would be overall economic benefits for the local population and would promote the integration of the peripheral areas.

The approximate aggregate length of 10,000km of road in the Northeastern Region has been identified for development. The development of the road network envisages creating customized and specialized skills addressing issues like the complexities of geographical terrains and the extensive coordination with the central and state governments.

The Government of India (GOI) thus launched in recent years the "Special Accelerated Road Development Program for Northeastern Region" for which improvement of the road network is of great importance. The GOI stated in their "Twelfth Five Year Plan (from April, 2012 to March, 2017)" that the improvement of national highways in the Northeastern Region should interconnect major cities within the region. It is within this context that the GOI requested that the Government of Japan provides assistance in the carrying out of the design work of two/four lane bridge including approaches over river Brahamputra between Dhubri on the north bank and Phulbari on the south bank in the State of Assam / Meghalaya on NH-127B (length of 20km).

1.2 Outline of the project

The proposed Dhubri bridge will cross the Brahmaputra River and will be a 20-km long, four-lane bridge connecting Dhubri in the Assam State on the north bank and Phulbari in the Meghalaya State on the south bank. The construction site extends over two states, the Dhubri District on the north bank and the South Salmara-Mankachar District on the south bank belong to Assam State and the West Garo Hills Distrct belongs to Meghalaya State. It extends from the starting point (89 ° 55 '45.68 "E & 26 ° 2' 10.49" N) towards the southeast, crossing over the Brahmaputra River and some of the sandbars reaches the south end point (90 ° 1 '59.11 "E & 25 ° 53' 25.98" N).
The locality is a flat lowland with an altitude of 35 m to 42 m. Approximately 500 km from the mouth of Brahmaputra river, annual flow rate 571 × 109 m 3, flow rate 18,099 m 3 / s, flow rate varies greatly in the rainy season dry season and place, but on average 1 m / s in the vicinity of Duburi, the water depth at the deepest part across the bridge is about 10 m in the rainy season about 4 meters in dry season. The banks are naturally sloped towards the river. The yearly sediment load of the Brahmaputra River is 800 million tons. The sandbars are made of sand accumulated by the flooding of the river, and thierlocations and sizes are not constant due to hydrodynamic activity of the river. Some of the sandbars are inhabited by the local people conducting mainly agriculture, farming, fishing etc. Currently 20 to 30 small boats operate between Dhubri and Pulbari and to carry people and goods, but the time required to cross the river is about 2.5 hours.

A new bridge connecting Dhubri and Phulbari across the Brahmaputra river will improve the connectivity of the road and is the most important section. The construction of the new bridge will further connect the southwestern region of Meghalaya State and other parts of India at the shortest distance, and will greatly expand the transportation network of this region.

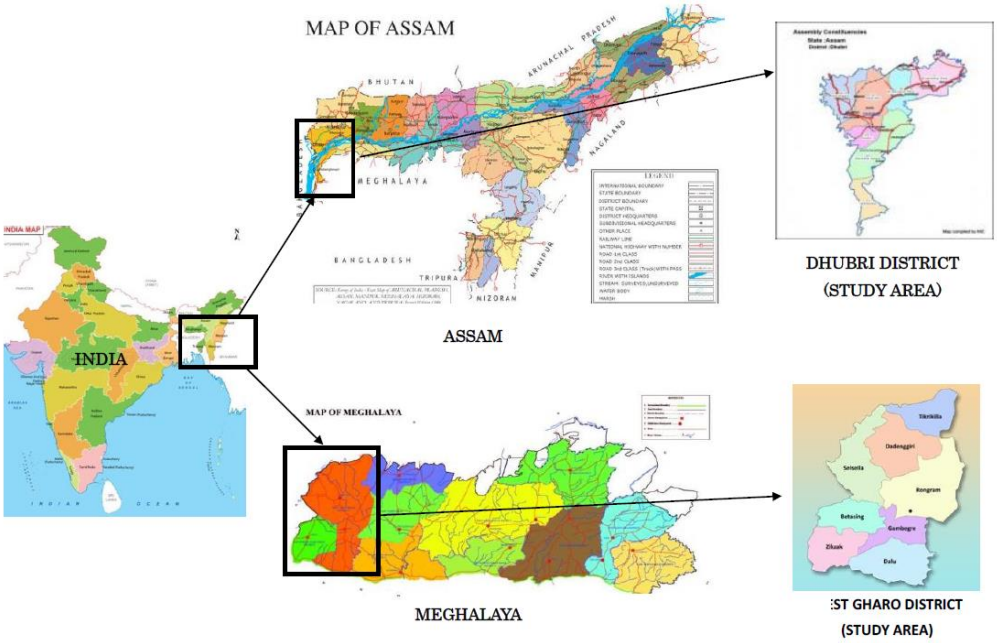


Figure 1-1 Project Location

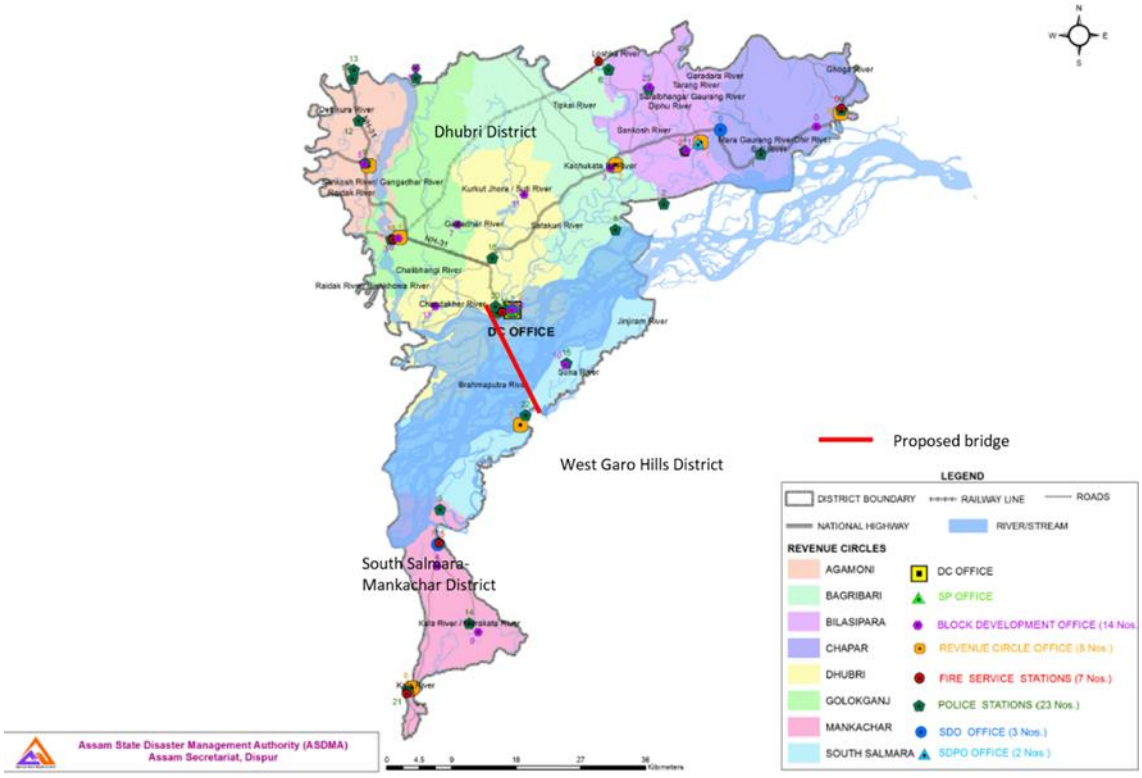


Figure 1-2 Project Site

1.3 Purpose of the Study

As per the MOEF & CC EIA Notification, dated 14.09.2006 (as amended in August 2013), any highway project falls under Category A if the project entails:
1) New National Highways; and
2) Expansion of National Highways greater than 100km involving additional right of way or land acquisition greater than 40m on the existing alignments and 60m on re-alignments and bypasses. The proposed Dhubri-Phulbari Bridge project does not require additional land acquisition beyond 60m and has length of approximately 20kmkm. and therefore, does not attract the provisions of the EIA Notification of 2013.

While a DPR consultant undertook a preliminary environmental assessment during the preparation of the DPR for Dhubri-Phulbari Bridge, the project does not require environmental clearance from MOEF & CC. On the other hand, the project has been classified as Category A per JICA's Guidelines for the Environmental and Social Considerations and the project requires a full EIA study including SIA and RAP surveys.

It is therefore the JICA Study Team's obligation to carry out EIA/SIA/RAP studies, which supplement the environmental studies carried out by DPR consultants. Thereby additional requirements short of JICA's guidelines are fulfilled.

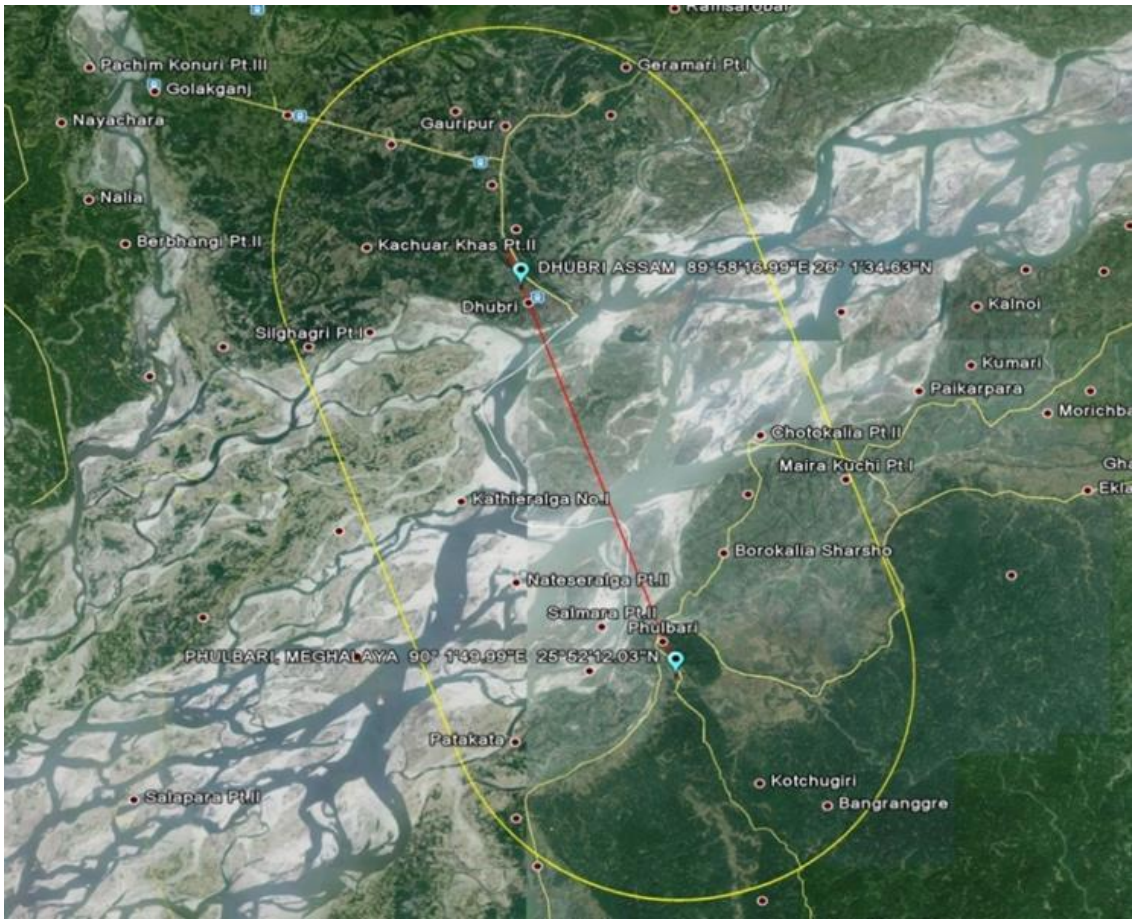
The EIA/SIA/RAP studies carried out by JICA Study Team aimed to:

- Review the environmental assessment undertaken as part of the DPR study;
- Identify gaps between Indian laws and regulations relating to the EIA study and JICA Guidelines for Environmental and Social Considerations;
- Study the baseline of social and environmental conditions along the areas directly and indirectly affected during design, construction operation and maintenance of the NH40 widening project;
- Carry out environmental impact analysis with respect to the proposed project;
- Identify environmental issues that require further studies;
- Carry out an analysis of alternatives including a comparison with a "no project' scenario;
- Develop cost effective measures for mitigating adverse environmental and social impacts and enhancing positive aspects;
- Develop an Environmental Management Plan (EMP) for the mitigation of environmental impacts and the monitoring of the implementation of mitigation measures during the operation and maintenance period;
- Consult and inform the project affected persons (PAPs) and other stakeholders concerned with the project to encourage their active participation.

1.4 Scope of the Study

1.4.1 Geographical Extent

The geographical extent of this study is the area within a 10km radius of the proposed bridge alignment as shown in the Figure below.



Source: JICA Study Team

Figure 1-3: Geographical Extent of the Environmental Study

1.5 Principles of the Study

(1) Study Components of Natural Environment and Socio-economic Environment

This bridge construction project entails to some extent a negative impact on the natural environment as well as a social impact including a relatively large-scale resettlement. The survey covers not only direct and immediate impact but also secondary and cumulative impacts in accordance with JICA guidelines. The survey items include air, water, soil, waste, ecology, involuntary resettlement, the poor, livelihood, occupational safety, etc.

(2) Legal Framework Related to the Project

The legal framework and principles adopted for environment and social consideration of the project have been guided by the existing legislation and policies of the Government of India (GOI), the State Government of Assam and Meghalaya. Since the project is considering getting assistance from JICA, the regulatory/legal framework should be consistent with the national, state, local, as well as JICA Guidelines for Environmental and Social Considerations.

(3) Scope of Resettlement

This project extends to two states, the Assam and Meghalaya states, across the Brahmaputra River. The Char lands (sand bars) in the Brahmaputra River which belong to the Assam state will also be within the scope of land acquisition and resettlement. The Char lands are unique in that the shapes change according to the changes in water level. The area of the Char lands becomes smaller due to a rise in water level during the rainy season (May to October) and expands in dry season (November to April). In this survey, a census survey was carried out based on the list of villages

and land plots prepared by the district governments from the land acquisition map produced by DPR consultant (prepared in June 2016). A Resettlement Action Plan (RAP) will be prepared in accordance with relevant Indian laws and regulations, World Bank's safeguard policy and JICA guidelines.

CHAPTER 2 Baseline Condition of the Natural and Social Environment

2.1 Natural Environment

2.1.1 Climate

The **Dhubri district** enjoys a subtropical humid climate with temperatures ranging between 10.5°C (minimum, in December/January) and 30°C (maximum, in July/August). A south west monsoon activates from May and continues up to September/October. The average annual rainfall of the district, as recorded in Dhubri, is 2,363mm with about 65% of rainfall occurring during the monsoon. The monthly evapotranspiration is about 40% of the rainfall, with the highest in August and lowest in January.

The **West Garo Hills** district has a mildly tropical climate. The climate of the district is largely controlled by the southwest monsoon and seasonal winds. The district being relatively lower in altitude compared to the rest of Meghalaya, experiences a fairly high temperature for most of the year. The average rainfall is 4203.8 mm, of which more than two-thirds occurs during the monsoon, with winter being practically dry. The district receives fairly high rainfall throughout the year. Most of the precipitation occurs during the rainy season, i.e. between April and October, due to the southwest monsoon. The average rainfall recorded at the Tura meteorological station is presented in the Table below.

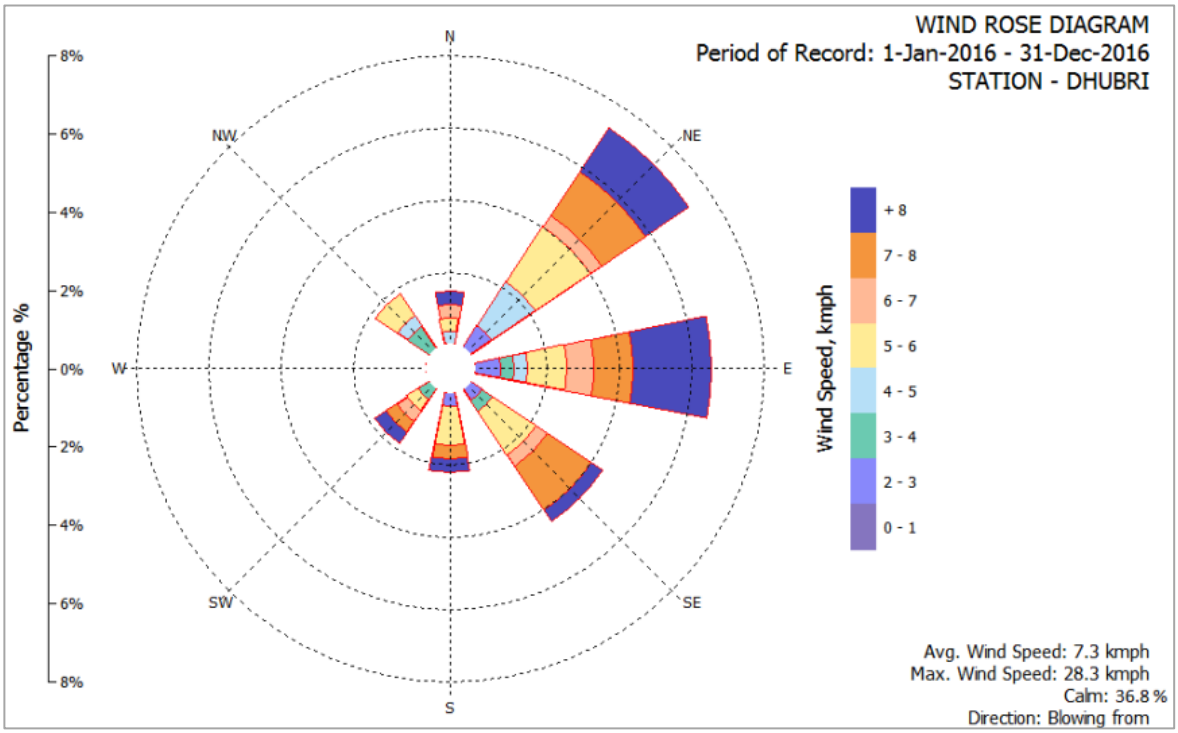
Generally, light to moderate winds prevail throughout the year with speeds ranging from 1 to 26.5kmph. Winds were light and moderate particularly during the morning hours, while during the afternoon hours the winds were stronger. The wind rose diagram developed during October - November (2016) shown in Figure 7-1 reveals that the pre-dominant wind direction occurs from the north-east direction in the Dhubri district with an average wind speed of 7.2 kmph.
The following Table 7-2 shows the Meteorological Data Parameters in the Dhubri district (January – December 2016).
The wind speed and direction data have been collected for Guwahati from the Indian Metrological Department (IMD) during January - December 2016 and wind rose diagram has been prepared and shown in Figure 7-1.

Table 2-1: Meteorological Data Parameters at Dhubri district (January – December 2016)

Date	Temperature, deg C			Humidity, %			Pressure, hPa			Wind Speed, km/Hr	Predo-Minant Wind Direction	Rainfall mm
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Avg		
January	9.3	26.3	17.8	63	86	74.5	1009.7	1013.6	1011.65	4.8	NE	6.7
February	10.2	30.2	20.2	52	76	64	1007.1	1013.4	1010.25	5.6	N	6.6
March	13.4	35.8	24.6	48	68	58	1003.9	1011.2	1007.55	7.7	E	42.5
April	17.2	36.7	26.95	62	74	68	1000.9	1008.6	1004.75	11	NE	133.2
May	19.2	35.3	27.25	75	82	78.5	998.3	1005.7	1002	10.1	NE	340.4
June	21.7	35.2	28.45	83	89	86	995.2	1002.3	998.75	8.6	E	514.2
July	22.8	34.1	28.45	54	87	70.5	994.7	998.2	996.45	6.9	E	432.5
August	23.4	34.2	28.8	52	85	68.5	996.2	997.6	996.9	6.6	NE	368.2
September	22.3	24.5	23.4	86	83	84.5	999.5	1003.2	1001.35	6.4	NE	263.7

October	19.5	32.6	26.05	78	84	81	1004.5	1006.1	1005.3	6.9	NE	140.5
November	14.1	29.3	21.7	72	82	77	1007.5	1011.3	1009.4	7.4	NE	18.7
December	10.5	25.8	18.15	66	86	76	1008.6	1013.2	1010.9	5.7	NE	3.4

Source: IMD



Source: IMD

Figure 2-1: Wind Rose Diagram

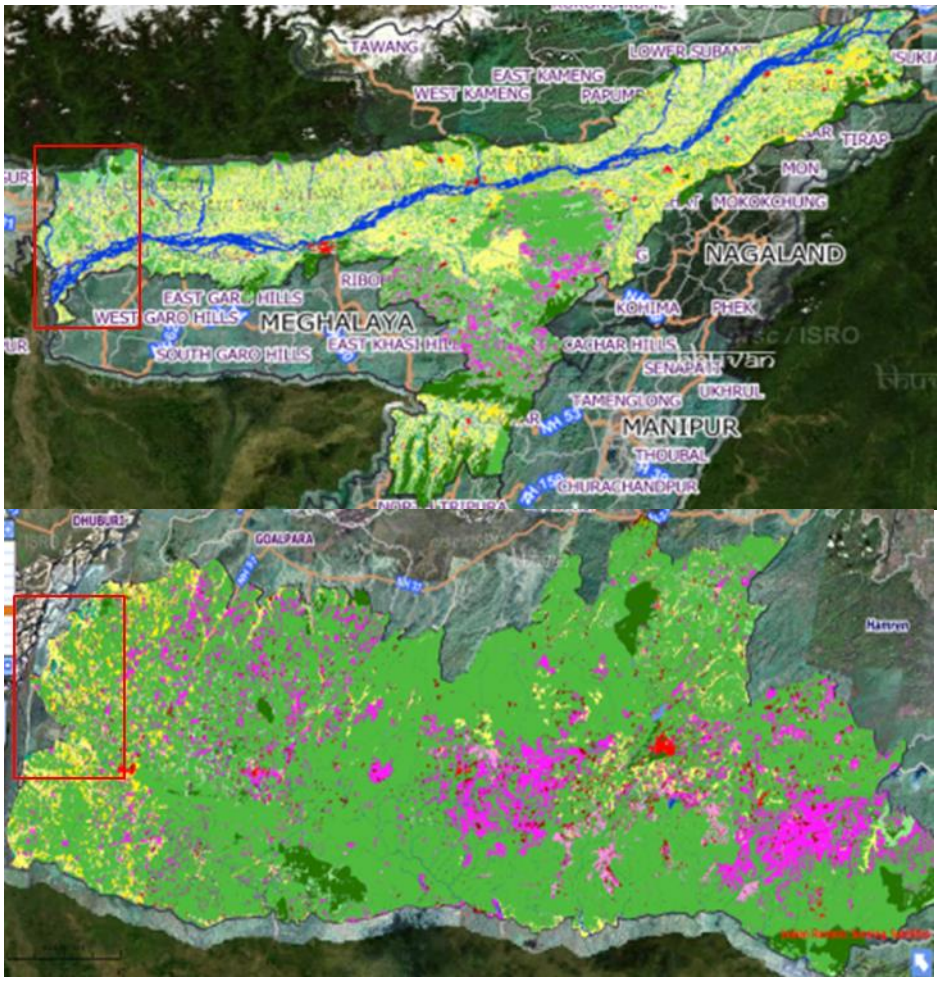
Table 2-2: Precipitation of West Garo Hills District in (mm)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
22.1	14.7	105	269	514	889	910	643	502	298	13.3	24.2	4203.8

Source: http://cgwb.gov.in/

2.1.2 Land Use

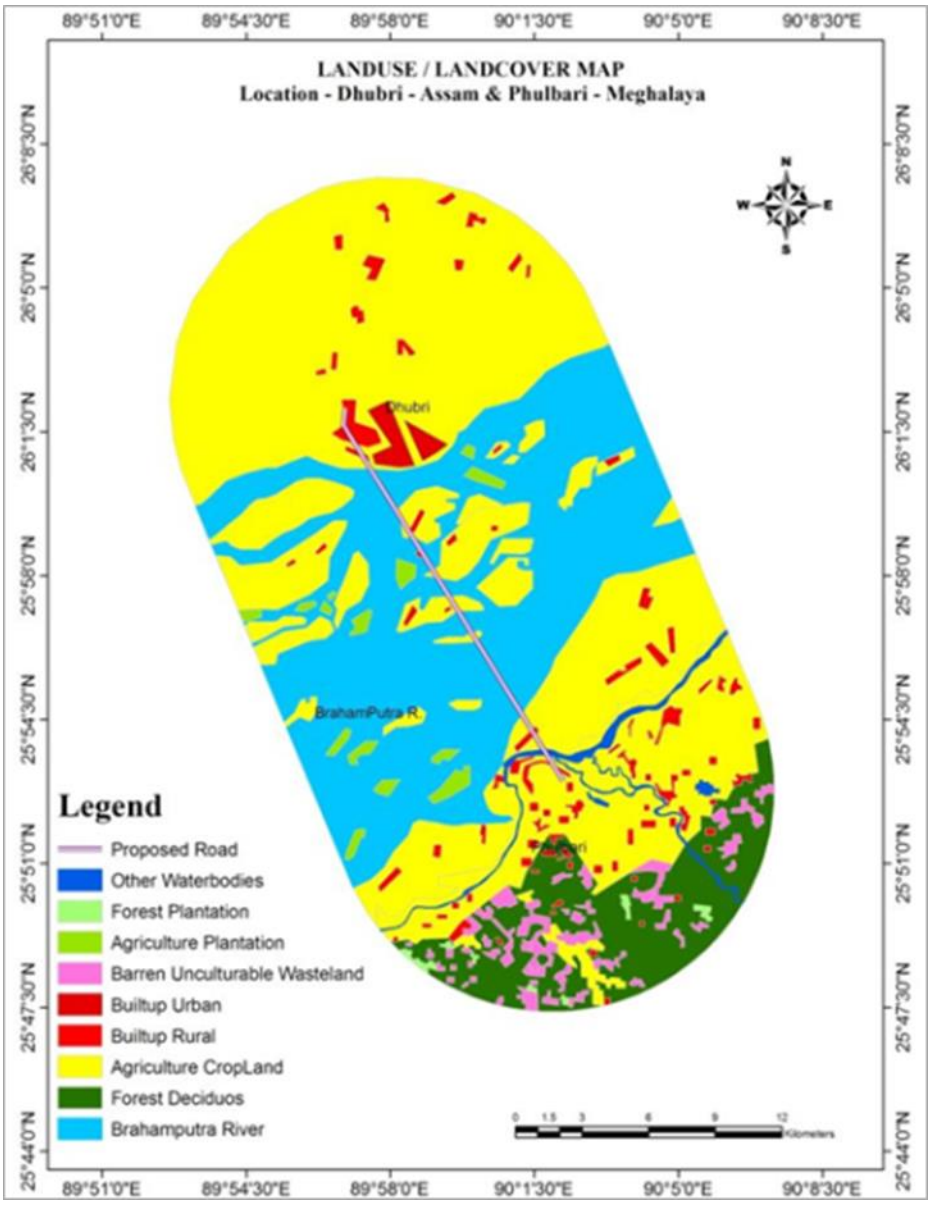
Current land use of the project's surrounding areas in Assam and Meghalaya State is shown in the following Figure. The majority of the areas in both Assam and Meghalaya State are agriculture land (yellow), forest deciduous (light green) and wastelands/shrublands (pink).



Source: bhuvan.nrsc.gov.in

Figure 2-2: Land Use of Assam and Meghalaya State

Figure 7-4 and Table 7-3 show the land use of a 5km radius of the project site. The area is composed of 45% agricultural land (yellow), 35% Brahmaputra River (light blue) and build up areas including residential structures (red) remains at 4%. The starting point of the approach road in the Dhubri District is planned to pass by the side of the residential area.



Source: Prepared by EIS based on Resourcesat I LISS-III

Figure 2-3: Land Use Pattern in 10km radius of the Project Area

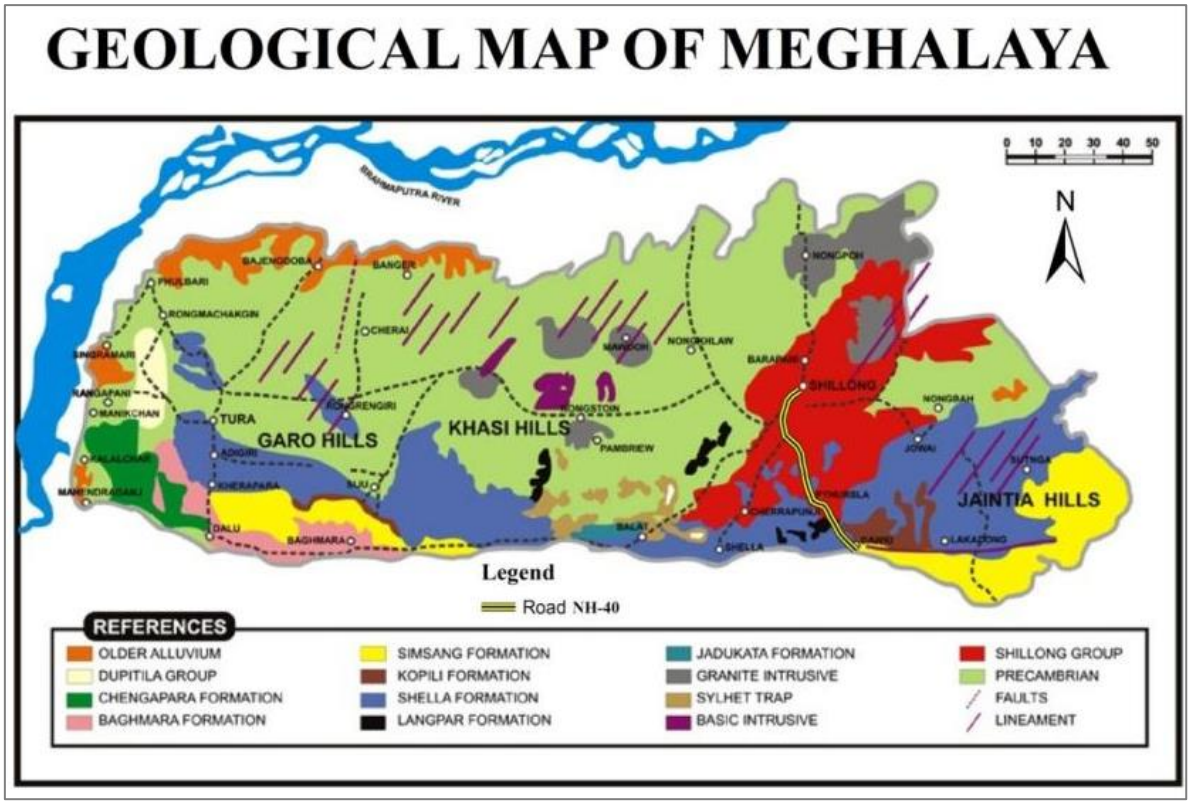
Table 2-3: Breakdown of the Land Use Pattern in 10km radius of the Project Area

Sl.No.	Land Use Class	% of Class
1	Proposed bridge	0.5%
2	Other Water bodies	1.5%
3	Forest Plantation	2.0%
4	Agriculture Plantation	2.0%
5	Barren Unculturable Wasteland	3.0%
6	Built up Urban	2.0%
7	Built up Rural	2.0%
8	Agriculture Crop Land	45.0%
9	Forest Deciduous	7.0%
10	Brahmaputra River	35.0%

Source: Prepared by EIS based on Resourcesat I LISS-III

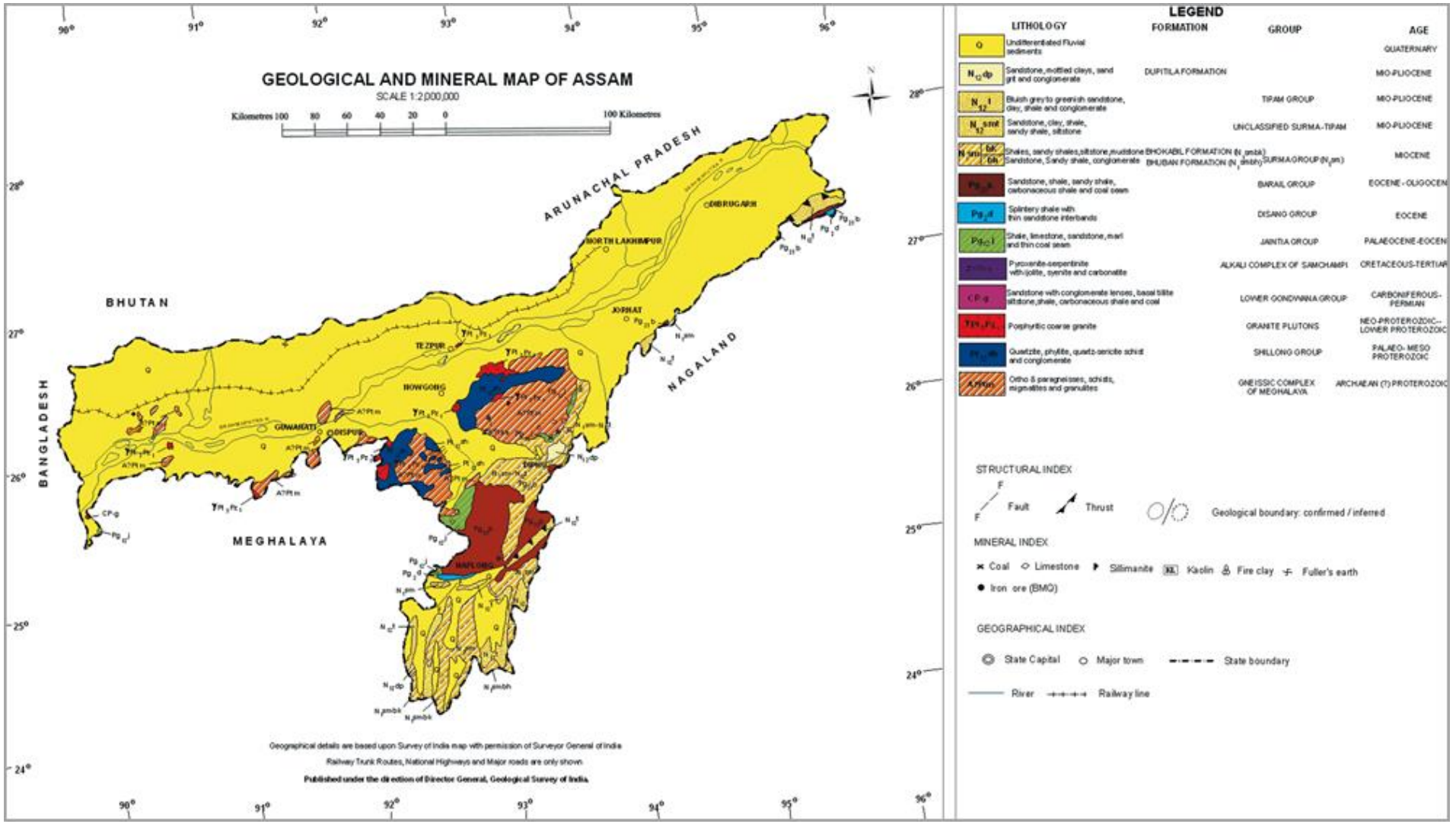
2.1.3 Geology and Geography

The proposed bridge alignment passes over the river Brahmaputra between Dhubri on the north bank and Phulbari on the south bank in the State of Assam and Meghalaya. The topography of the Dhubri/ South Salmara - Mankachar district is very peculiar. It has many rivers, small ranges of hillocks as well as several natural depressions. Physically, the greater part of the district is levelled plain land. Whereas in the West Garo Hills district with its undulating topography, the district constitutes the vast alluvial plains of the Brahmaputra River system. The monotony of the flat alluvial tract is interrupted by the presence of Archaean inliers in the form of disconnected hillocks referred to as inselbergs, and these occur especially in the eastern and southern parts of the district.



Source: Department of Mining & Geology, Government of Meghalaya

Figure 2-4: Geological map of Meghalaya



Source: Department of Mining & Geology, Government of Assam

Figure 2-5: Geological map of Assam

The Soil type of an area is dependent on factors like geology, relief, climate and vegetation. The soil of the Dhubri/South Salmara - Mankachar district has been found to be heterogenous in character. Most of the places, particularly the riverine identifies that loamy to sandy-loam soil is predominant. In some areas, clay to heavy clay soil are also present. Soil reaction is acidic and found to vary from 5.6 to 6.5 in pH scale. Whereas in greater parts of West Garo Hills district Soils are sandy and silty loam, or clay loam. It is found to be highly acidic to slightly alkaline in nature, is moderately permeable and characterised by the presence of low organic carbon and low soluble salts. Soils restricted to inselberg areas are more clayey, lateritic, less permeable and are highly acidic in nature. From an agricultural point of view, the soils in major parts of the area are suitable for all sorts of crops cultivation.
In the proposed Dhubri – Phulbari bridge of the study area, loamy to sandy-loam soil is predominant. In some areas, clay to heavy clay soil also present.

2.1.4 Geohydrology

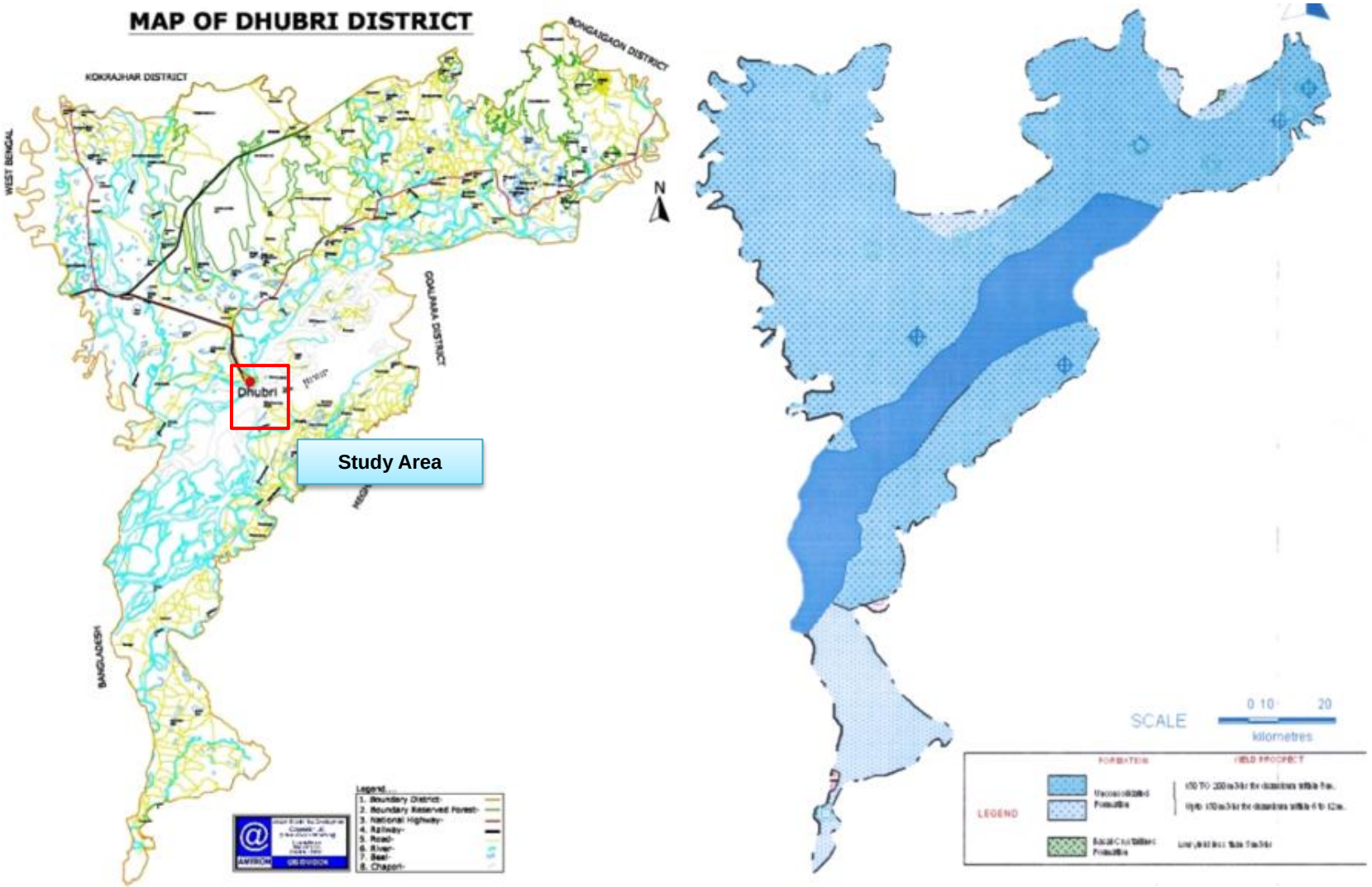
The Dhubri / South Salmara-Mankachar district covers an area of 1664.10 sq.km. It is situated in the extreme south-west corner of the state and has an international boundary with Bangladesh in the west and south west and is bounded by the Kokrajhar district in the north, Goalpara district in the east and north-east, the Garo Hills district of Meghalaya in the south and the Kochbehar and Jalpaiguri districts of West Bengal in the north-west.

Surface Water source in the Dhubri / South Salmara - Mankachar District:
The district spreads on both sides of the Brahmaputra River. A number of perennial streams flow through the district from north to south and join the Brahmaputra River. The major streams that drain the area are the Gadadhar, Sankosh, Silai and Gouranga Rivers. A River map showing the regions of Dhubri and South Salmara – Manakchar is given below in Figure. 7-7.

Ground Water source in the Dhubri / South Salmara - Mankachar District:
Ground water conditions in the district can be described using either of two distinct hydrogeological units, i.e. conditions prevailing in the consolidated formations, and the conditions prevailing in the unconsolidated formations. The net ground water availability estimated in the year 2009 is 1635.61 mcm. The existing gross ground water draft is 181.12 mcm and the stages of development are 11% only. Future provision for domestic and Industrial use is 65.35mcm and for Irrigation use is 1432.85 mcm. A Hydrogeological map showing the regions of Dhubri and South Salamara - Manakchar is given below in Figure. 7-7.

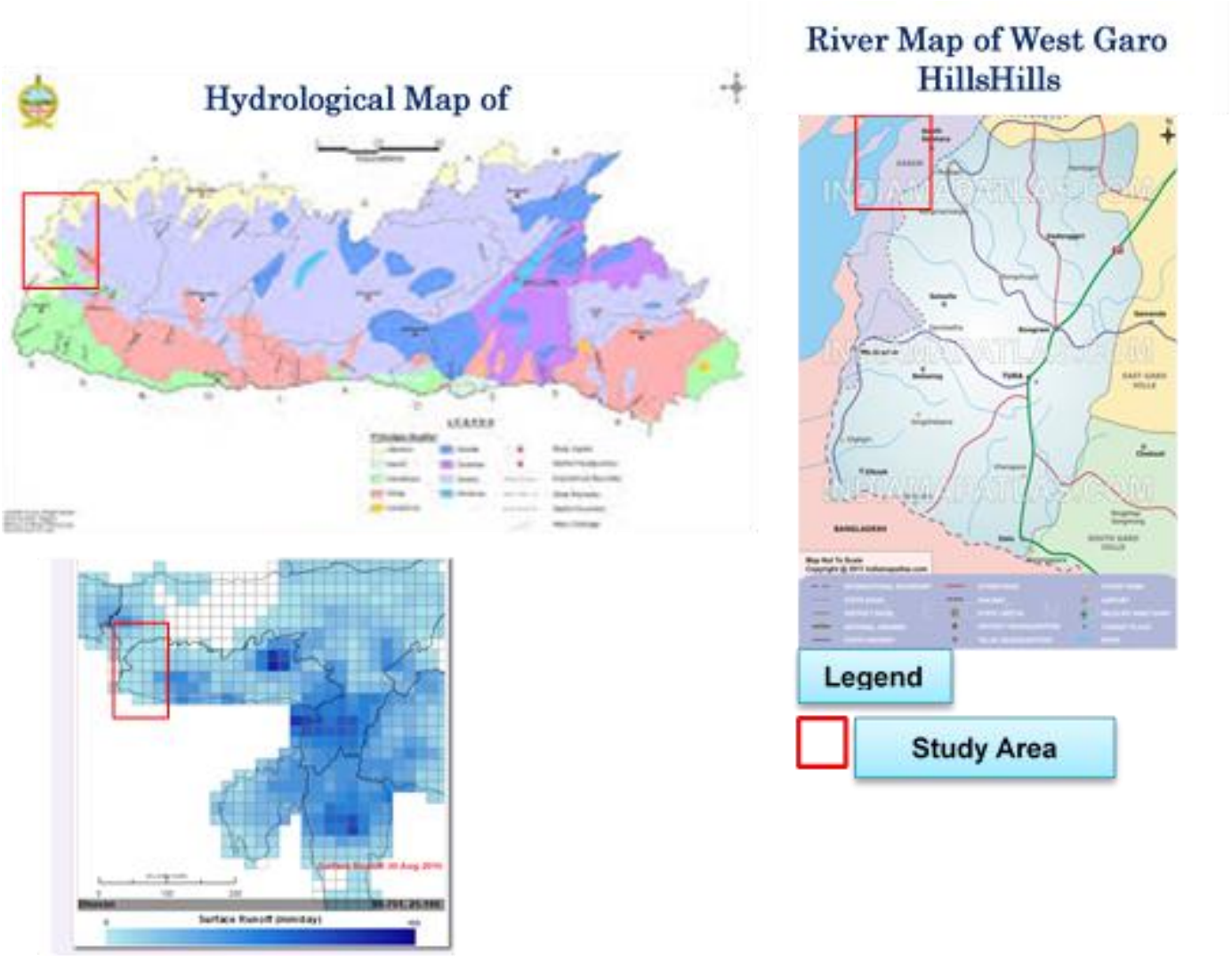
Surface Water source in the West Garo Hills District:
The topography controls the drainage system as it divides the state into two watersheds, namely the **Brahmaputra system** in the North and the Meghna /Surma system in the South. The Tura system range from watersheds in the West Garo Hills district, from which the rivers flow towards the Bangladesh plains in the south and the Brahmaputra valley in the north and west. A River map showing the regions of West Garo Hills district is given below in Figure. 7-8.

Ground Water source in the West Garo Hills District:
Hydro-geologically, the district can be divided into three units, namely, consolidated, semi consolidated and unconsolidated formations. The depth of the water level varies from 0.53 m bgl to 8.3 m bgl. The aquifer comprises sand and sand with gravel, while clay forms leaky aquitard. The maximum cumulative aquifer thickness is encountered around Ichaguri, Borkona, Barengapara and Betasing in alluvial areas of the West Garo Hills district. The granitic basement is encountered at a very shallow depth (less than 50 m.bgl) in the northern part of the district, while in the western and southern part of the district; basement has not even met a depth of 225 m.bgl. A Hydrogeological map showing the regions of the West Garo district is given below in Figure. 7-8.



Source: http://dhubri.gov.in/DMPLan & http://cgwb.gov.in

Figure 2-6: River Brahmaputra and Geohydrological Map of Dhubri District in Assam



Source: http://cgwb.gov.in & http://bhuvan.nrsc.gov.in/

Figure 2-7: Geohydrological & River Map of West Garo Hills, Meghalaya

2.1.5 Ecology

Interviews with the DPR Consultants and Dhubri District Forest Department have confirmed that there are no national parks, nature reserves or protected forests around the planned site of construction. The land portion of the Study area is mainly used as an agricultural land and residential area, so there is no primary forest or pristine ecosystem. However, the Brahmaputra River is a habitat for the Ganges river dolphins, and several of them were observed during the field survey.

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

(1) The Biological Diversity Act, 2002

The Biological Diversity Act is a law stipulated on the conservation, utilization, and benefit sharing of genetic resourcest and the Biodiversity Board has been established for each state based on this law. The main function of the Board is to give appropriate advice to the state government on issues concerning biodiversity conservation. The designation of Biodiversity Heritage Sites is also stipulated.

As a national policy for conserving biodiversity, the National Biodiversity Action Plan was formulated in 2008, which covers the conservation of biodiversity, its sustainable use, the equal distribution of profits arising from the use of biodiversity, the protected area network focused on the conservation of species, and so forth. Furthermore, it recognize the importance of regulation on the introduction of alien species, eradication of alien species, and consideration on biodiversity in economic development projects. Assam State has formulated the state forest policy in 2004, among which, in addition to conservation and recovery of forests, strengthening of protected area network, conservation of wetlands, conservation of wetlands, conservation of wildlife as ways to preserve biodiversity preservation of habitats of living beings, promotion of research and research, etc. are listed.

For the sake of aquatic organisms living in the Brahmaputra river including in the Ganges Dynasty, it is necessary to carefully examine the impact of the implementation of the project, especially after conducting detailed surveys in the future.

2.2 Living Environment

2.2.1 Water Quality

There are many low wetlands around the planned construction site, and the Brahmaputra River which also boasts abundant water flow also flows. The turbidity of the Brahmaputra River was very high at the time of field survey in October 2016. As seen in other states in India, unprocessed domestic wastewater flows into the Brahmaputra River, and there are the residents who are bathing in the river and washing. As a result, some degree of artificial contamination (especially organic matter, etc.) is occurring. Sampling and analysis of the surface water and groundwater was conducted by the DPR survey in March 2016, and the results are shown below. The number of microorganisms exceeds the environmental standard, but others are within the reference value.

Table 2-4: Results of Water Quality Analysis

Sl. No.	Parameter	Unit	CPCB standard for drinking water (desirable limit/ permissible limit)	Chagalchora Bore Well (Ground Water)	Motichora Handpump (Ground Water)	Motichora Brahmaputra (Surface Water)	Savodari Handpump (Ground Water)	Chaitarchar Brahmaputra (Surface Water)
1	Temperature	C	-	22.0	22.6	23.8	23.0	23.0
2	pH value	-	6.5 – 8.5/no relaxation	7.38	7.20	7.56	7.52	7.72
3	Conductivity	µS/cm	-	571.47	593.23	185.09	559.80	182.26
4	Total dissolve solid (TDS)	mg/l	500/2000	371.45	385.60	120.31	363.87	118.26
5	Dissolve Oxygen	mg/l	-	4.3	4.2	6.1	4.8	6.8
6	Turbidity	NTU	5/10	<1.0	<1.0	1.0	<1.0	1.2
7	Salinity	ppt	-	4.8	4	3.8	4	4
8	Alkalinity	mg/l	-	212	221	68	203.90	66
9	Calcium as (CaCO3)	mg/l	75/200	162	192.84	50.3	173.60	48.8
10	Magnesium As (CaCO3)	mg/l	-	35.6	27.16	16.59	25.40	17.2
11	Total hardness as (CaCO3)	mg/l	200/600	197.60	220.0	66.89	199.0	66.0
12	Chloride as (Cl)	mg/l	250/1000	26.80	26.4	0.19	29.70	0.21
13	Iron (as Fe)	mg/l	0.3/1.0	0.238	0.261	0.258	0.252	0.261
14	Manganese (as Mn)	mg/l	0.1/0.3	BDL	BDL	BDL	BDL	BDL
15	Arsenic (as As)	mg/l	0.05/no relaxation	0.02	0.02	<0.01	0.01	<0.01
16	Fluoride (as F)	mg/l	1.0/1.5	0.85	0.98	0.34	0.71	0.38

Source: DPR Study

2.2.2 Air Quality

Air quality analysis was conducted by DPR consultants in March 2016. The results of the analysis are shown below. At all sampling points the air quality was good and parameters were within the national environmental standards.

Table 2-5: Results of Air Quality Analysis

Ambient Air Quality Data March 2016				Location 1 : AQ1 (Village-Chagal Chora)		
S.No	Date	PM2.5,µg/m3	PM10,µg/m3	SO_2 µg/m3	NO_2 µg/m3	CO, µg/m3
		Gravimetric	IS:5182:Pt-23	IS:5182:Pt-2	IS:5182:Pt-6	IS:5182:Pt-10
1	01.03.2016	36.5	82.5	9.3	16.8	502
2	05.03.2016	32.3	80.6	8.6	15.9	460
3	09.03.2016	44.9	90.3	10.2	22.2	582
4	13.03.2016	39.8	84.5	9.8	18.9	516
	Min	32.3	80.6	8.6	15.9	460
	Max	44.9	90.3	10.2	22.2	582
	Average	38.4	84.5	9.5	18.5	515.0
	98 Percentile	44.6	90.0	10.2	22.0	578.0
NAAQS, For 24 hourly monitoring (except CO for One hour)		60	100	80	80	4000

Ambient Air Quality Data March 2016				Location 2: AQ2 (Village-Savodari)		
S.No	Date	PM2.5,µg/m3	PM10,µg/m3	SO_2 µg/m3	NOx µg/m3	CO, µg/m3
		Gravimetric	IS:5182:Pt-23	IS:5182:Pt-2	IS:5182:Pt-6	IS:5182:Pt-10
1	01.03.2016	22.3	73.3	6.8	12.3	312
2	05.03.2016	24.8	65.7	5.9	12.9	230
3	09.03.2016	23.6	69.8	6.4	14.2	345
4	13.03.2016	26.8	75.9	7.2	13.6	308
	Min	22.3	65.7	5.9	12.3	230
	Max	26.8	75.9	7.2	14.2	345
	Average	24.4	71.2	6.6	13.3	298.8
	98 Percentile	26.7	75.7	7.2	14.2	343.0
NAAQS, For 24 hourly monitoring (except CO for One hour)		60	100	80	80	4000

Ambient Air Quality Data March 2016				Location 3: AQ3(Village-Motichora)		
S.No	Date	PM2.5,µg/m3	PM10,µg/m3	SO_2 µg/m3	NO_2 ,µg/m3	CO, µg/m3
		Gravimetric	IS:5182:Pt-23	IS:5182:Pt-2	IS:5182:Pt-6	IS:5182:Pt-10
1	01.03.2016	37.8	83.7	9.7	17.3	527
2	05.03.2016	30.1	76.1	8.7	15.2	482
3	09.03.2016	41.3	88.6	10.1	20.8	561
4	13.03.2016	33.5	82.6	9.3	16.4	432
	Min	30.1	76.1	8.7	15.2	432
	Max	41.3	88.6	10.1	20.8	561
	Average	35.7	82.8	9.5	17.4	500.5
	98 Percentile	41.1	88.3	10.1	20.6	559.0
NAAQS, For 24 hourly monitoring (except CO for One hour)		60	100	80	80	4000

Ambient Air Quality Data March 2016				Location 4 : AQ4 (Village-Chaitarchar)		
S.No	Date	PM2.5,µg/m3	PM10,µg/m3	SO_2 µg/m3	NOx µg/m3	CO, µg/m3
		Gravimetric	IS:5182:Pt-23	IS:5182:Pt-2	IS:5182:Pt-6	IS:5182:Pt-10
1	01.03.2016	22.8	56.8	BDL	8.7	220
2	05.03.2016	23.2	60.5	BDL	9.8	283
3	09.03.2016	18.6	54.9	BDL	8.3	212
4	13.03.2016	21.8	58.8	BDL	9.2	249
	Min	18.6	54.9	BDL	8.3	212
	Max	23.2	60.5	BDL	9.8	283
	Average	21.6	57.8	BDL	9.0	241.0
	98 Percentile	23.2	60.4	BDL	9.8	281.0
NAAQS, For 24 hourly monitoring (except CO for One hour)		60	100	80	80	4000

Source: DPR Study

2.2.3 Noise and Vibration

According to the DPR Study, the ambient noise level in the study area is below the national environmental standard. There is no data for vibration.

Table 2-6: Ambient Noise Level in the Study Area

Location	Eq. Noise levels dB(A) , Day.(Leq).	Eq. Noise levels dB(A), Night.(Leq)	National Ambient Air quality standard w.r.t. Noise, 2000 in dB(A) Day. (Leq)	National Ambient Air quality standard w.r.t. Noise, 2000 in dB(A) Night. (Leq)
Chagalchora (Residential)	53.2	38.8	55	45
Motichora (Commercial)	60.2	50.8	65	55
Savodari (Residential)	51.8	40.6	55	45
Chaitarchar (Residential)	48.9	36.7	55	45

Source: DPR Study

2.2.4 Soil Quality

During the DPR Study, soil samples were collected from 4 locations and analyzed. The result is as follows.

Table 2-7: Results of Soil Quality Analysis

S.No	PARAMETERS	TEST METHOD	UNIT	Chagal chora	Moti chora	Savodari	Chaitarchar
1.	pH(1:5 suspension)	IS:2720(Part-26)	-	7.38	7.21	7.43	7.28
2.	Electrical Conductivity at $25^{O}C$ (1:5suspension.)	IS:2720(Part-21)	µS/cm	449	458	418	435
3.	Calcium Sulphate	STP/SOIL	mg/kg	BDL	BDL	BDL	BDL
4.	Magnesium(as Mg)	STP/SOIL	mg/kg	145.34	130.7	123.5	139.80
5.	Organic Matter	IS:2720(Part-22)	% by mass	6.28	5.25	4.61	5.65
6.	Potassium(as K)	STP/SOIL	mg/kg	133.15	127.6	123.5	119.83
7.	Water holding Capacity	STP/SOIL	% by mass	34.65	30.6	29.5	31.18
8.	Porosity	STP/SOIL	% by mass	29.40	25.1	23.8	26.46
9.	Sand	STP/SOIL	% by mass	42.40	38.59	43.70	40.16
10.	Clay	STP/SOIL	% by mass	50.32	54.27	46.82	53.32
11.	Silt	STP/SOIL	% by mass	7.28	7.14	9.48	6.52
12.	Sodium Sulphate	STP/SOIL	mg/kg	15.12	14.8	13.24	13.60
13.	Sodium Absorption Ratio	STP/SOIL	-	4.89	4.61	4.03	4.40
14.	Nitrogen	STP/SOIL	% by mass	0.064	0.060	0.051	0.057
15.	Phosphorus	STP/SOIL	mg/kg	23.4	25.4	20.5	21.06
16.	Bulk Density	STP/SOIL	gm /cc	1.32	1.46	1.26	1.18
17.	Texture	STP/SOIL	-	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay
18.	Moisture Retention Capacity	STP/SOIL	% by mass	22.0	20.5	24.6	19.8
19.	Infiltration Rate	STP/SOIL	mm/hr	24.0	26.4	20.3	21.6
20.	Moisture	STP/SOIL	%	16.20	15.64	13.81	14.58
21.	Sulphates	STP/SOIL	mg/1000g	14.24	15.2	13.64	12.81
22.	Sulphur(as S)	STP/SOIL	mg/kg	0.082	0.087	0.077	0.073
23.	Manganese (as Mn)	STP/SOIL	mg/kg	0.052	0.049	0.040	0.046
24.	Iron (as Fe)	STP/SOIL	mg/kg	0.70	0.75	0.67	0.63
25.	Exchangeable Sodium Percentage	STP/SOIL	mg/kg	0.062	0.066	0.051	0.055

Source: DPR Study

2.3 Socio-economic Environment

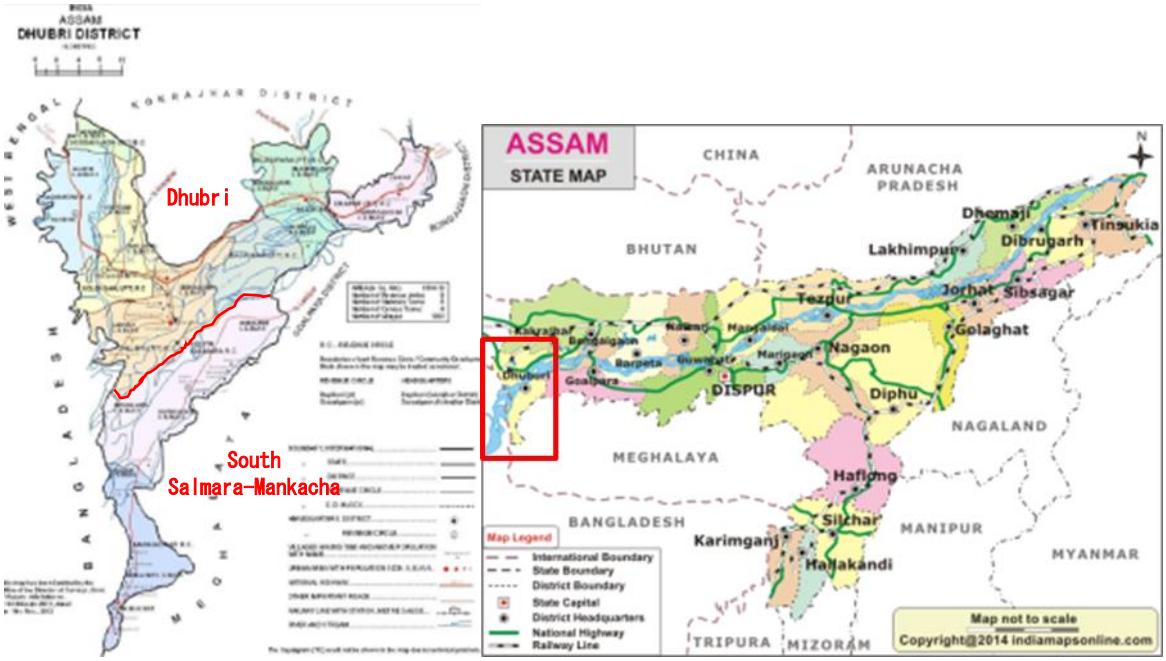
This project is located in the Dhubri District and South Salmara-Mankachar District of Assam State and the West Garo Hills District in Meghalaya State. The western end of the bridge is at Dhubri and it goes across the Brahmaputra River and ends at Phulbari in the north of West Garo Hills. There are Char lands formed in the Brahmaputra River by the sand/silt from the upper stream. This Char land also belongs to the Dhubri and South Salmara-Mankachar Districts.

2.3.1 Assam State

1) Administrative Division

Assam State is located in the northeastern part of India and is bounded on the north by Bhutan and the west by Bangladesh. The Dhubri and South Salmara-Mankachar Districts are situated in the extreme western corner of Assam State. Administratively, the Dhubri District has two sub-divisions namely Dhubri and Bilasipara along with eight revenue circles and seven tehsils. The South Salmara-Mankachar District is a newly formed district carved out from the Dhubri District in 2015 and officially became an administrative district in February 2016. It was formerly a sub-division of the Dhubri District. The South Salmara-Mankachar District has 2 revenue circles and 2 tehsils.

The distance from Dhubri town to the capital of Assam State, Dispur is approximately 290km. The distance between Hasingmari town, the capital of South Salmara-Mankachar District located across the Brahmaputra River, and Dispur is approximately 245km by the route through Meghalaya State.



Source: JICA Study Team

Figure 2-8: Map of Assam State

2) Demographic Situation

The total area of the Dhubri District is 2,176km2 with the population of 1,949,258. The population density is 896 persons/km2, which is more than double compared to the Assam State average (398 people/km2). The population growth during 2001-2010 is 24.4% which is much higher than the Assam State average (17.1%). The literacy rate of the Dhubri District is 58.3% which shows quite a lower rate than that of the state average (72.2%).

The South Salmara-Mankachar District covers 568kmkm2, holding a population of 555,114. Out of which, rural population consists of around 95%. The population density of the district is 869

persons/km2, which is similar to the Dhubri District. The literacy rate is 39.9%, which is significantly low compared to the state average as mentioned above.

The following Table shows the demographic data of Assam State and two districts in the project sites.

Table 2-8: Demographics of Assam State and Districts in the Project Site

Item	Assam State	Dhubri District	South Salmara-Mankachar District
Area (km^2)	78,438	2,176	568
Population (no.)	31,205,576	1,949,258	555,114
Male-female ratio (no.) (1,000 men)	958	953	—
Population density (ppl/km^2)	398	896	869
Population growth rate (2001-2010)	17.1%	24.4%	—
Urban population	14.1%	10.5%	4.7%
Literacy rate	72.2%	58.3%	39.9%

Source: Census 2011

3) Ethnic Group and Religion

Assam State is home to the Assamese, Bodo and Ahom people. The official languages used in Assam State are Assamese and Bodo. Other than that, Bengali is also used in the project area which is similar to Assamese. The following Table shows the population ratio of the Scheduled Caste (SC)[1] and Scheduled Tribe (ST)[2] . The ratio is lower in the Dhubri District and South Salmara-Mankachar District compared to the Assam state average. Based on the survey, it is confirmed that minority groups, including the Bodo tribes[3], are not included in the project affected households.

Table 2-9: Scheduled Caste and Scheduled Tribe in Assam State

Item	India average	Assam State	Dhubri District	South Salmara-Mankachar District
SC population	16.2%	7.2%	3.6%	1.4%
ST population	8.2%	12.5%	0.3%	1.8%

Source: Census 2011

The Dhubri District has a large population of Muslims. Approximately 80% of the population is Muslim and the remaining 20% is Hindu. The South Salmara-Mankachar District is also Muslim dominant, composed of 95% Muslims and 5% Hindu.

4) Economy and Industry

The GSDP of Assam State in 2013-14 accounts for Rs. 885.4 billion and per capita GSDP is Rs. 50,558. The average annual growth rate during the past 10 years was approximately 6%. Industry wise ratio of GSDP in 2013-14 shows that service sector accounts for 60%, agriculture and industry sector shares 20% respectively. The shares of the agriculture and industry sectors have been decreasing over the past 10 years while the contribution of the service sector is increasing.

[1] Scheduled Caste (SC) refers to the group of people formerly known as Dalit (the lowest class in Hindu society) designated by the Indian Constitution.

[2] Scheduled Tribe (ST) is a group of tribes designated by the Indian Constitution who has a distinctive culture, are geographically isolated and are socio-economically lagging.

[3] For a reference, the Bodo tribe is one of the tribes designated in the sixth schedule in India having its roots in Tibeto-burman languages and call themselves "Bodosa". A majority of the Bodo tribe are Hindu. The Bodo tribe continued armed conflict for their political independence, and Bodoland Autonomous Council was established in western Assam in 1993, and Bodoland Territorial Autonomous District was established in 2003.

Sector-wise annual growth rate is 3.8% for agriculture, 2.8% for the industry sector and growth of the service sector is the highest at 10.3%.

Table 2-10: Economic Trend in Assam State

Item		2004-05	2008-09	2013-14	Annual growth (10year average)
GSDP (Rs. in billion)		534.0	640.3	885.4	6.6%
Ratio in GSDP	Agriculture (%)	25.6	23.4	21.3	3.8%
	Industry (%)	27.5	25.9	21.3	2.8%
	Service (%)	46.9	58.1	57.5	10.3%

Note: GSDP in Constant Price (2004-05)
Source: Planning Commission, Government of India

The composition of workers shows that majority of the workers in Assam State are engaged in agriculture related work accounts for 56.2% out of which 25.6% are the landless agriculture labors. At the project site, a majority of the population is cultivating paddies along with pulses and vegetables, in the Char land jute is also one of the major crops. In this area, animal husbandry, fishery and boat operation are also the income source for the population.

Table 2-11: Workers Ratio in Assam State

Item	Assam State	Dhubri District
Worker population (%)	38.4	34.4
Cultivator (%)	33.9	30.7
Agriculture worker (%)	15.4	25.6
Domestic worker (%)	4.1	4.2
Other worker (%)	46.6	39.7

Source: Directorate of Census Operations Assam, 2011

5) Char Lands

One of the peculiar features of the Brahmaputra River which flows in Assam State is the presence of riverine silt islands (the Char lands). The geographical spread of the Char lands is over 14 districts of Assam State and the major part of the project area falls under these Char lands.

The landform of the Char lands changes according to the erosion and deposition of silts and sands over the years. The areas also change in size and shape due to the changes of water level in the rainy season (May to October) and dry season (November to April). The origin of the populations in the Char lands dates back to the colonial period when the British administrators induced a large number of agriculture labors from East Bengal (former Bangladesh). Due to this historical background, the majority of the population in the Char lands is Muslim.

The official surveys focused on the Char lands were carried out in 1992-93 and 2003-04. According to the survey in 2003-04[4] , the total population of the Char lands is 2,490,097 and the population in Dhubri and the South Salmara-Mankachar District alone (former the Dhubri District) is 689,909. The result of those surveys shows that the Char lands represents one of the most backwards areas in the state showing high population growth, high poverty level and a low literacy rate. The population of Below Poverty Line (BPL) is 69% and a literacy level is 14.6%; both of which have worsened in 10 years.

[4] Socio-Economic Survey Report, 2003-04, Directorate of Char Areas Development, Govt. of Assam.

Table 2-12: Demographics of Char Area in Dhubri / South Salmara-Mankachar district

Year	Population	Population Growth	Household	BPL Household	Literacy
1992-93	233,206	–	–	54.2%	19.1%
2003-04	689,909	51.1%	109,748	69.0%	14.6%

Source: Socio-Economic Survey Report, 2003-04, Directorate of Char Areas Development, Govt. of Assam

In some areas, there are land registration records and private lands are allocated to villagers in the Char lands. However, the villagers in the Char lands are living in movable temporary structures so that they're able to shift their locations as necessary. Based on the interview survey conducted during the site visits, villagers who live on the land that will be under water during the rainy season will move their location to a neighboring area or other village in the Char land. During the dry season, some come back to the original place and others continue to stay in the shifted land.

Temporary residents in the Char Land

Erosion of the Char Land

In terms of basic amenities in the villages of the Char lands, hand pumps are introduced in some areas and some areas are sourcing the drinking water from the river. In a majority of the areas, electricity and sewage systems are unavailable. Lower primary and middle schools are established in the villages, however for higher education, the children must go to nearby towns. Medical sub-centres were provided in some areas, however, there are only visiting doctors available. The infrastructures and facilities are very much limited in those areas.

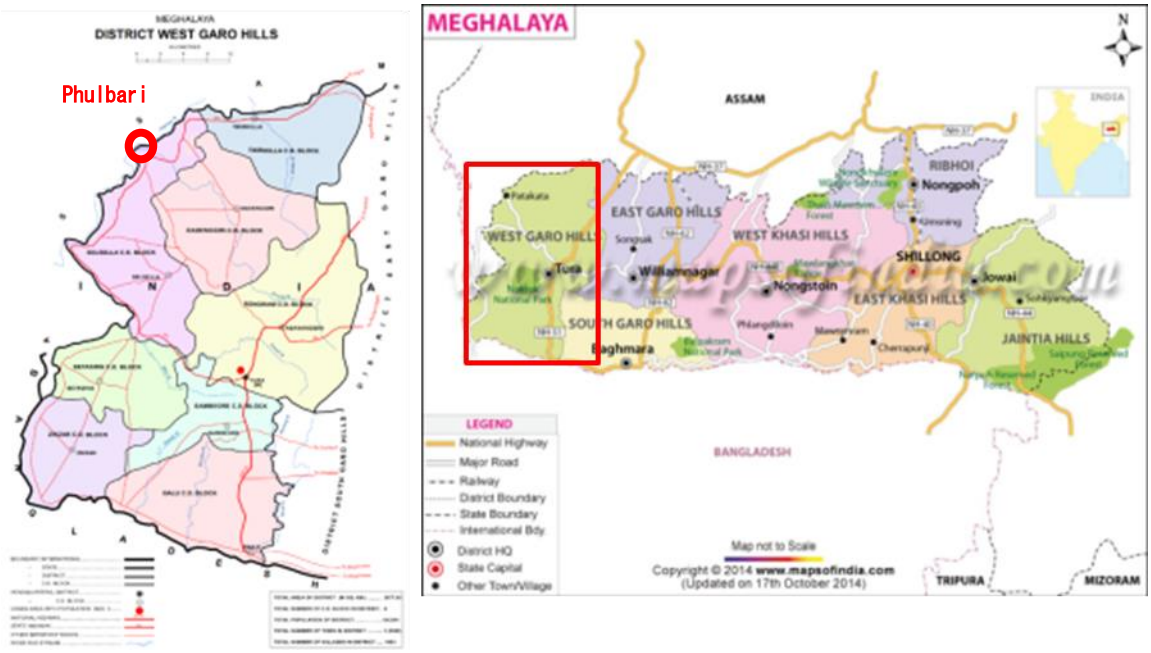
Hand pump in Char land

Primary School in Char land

2.3.2 Meghalaya State

1) Administrative Division

Meghalaya State was a part of Assam State before 1970. It was founded as autonomous state in April 1970 and gained its status as an independent State in January 1972. The State shares the border with Assam State in the north and Bangladesh in the south and west. It is composed of 11 Districts. The West Garo Hills District is situated in the western corner of Meghalaya State. The state's capital, Tura, holds the second largest population in the State. The Phulbari village, at the end of the bridge, is located at the north end of the West Garo Hills District. The distance from Phulbari to Tura is approximately 80km, however, due to poor road conditions, it will take 3-4 hours to travel the distance by car.



Source: JICA Study Team

Figure 2-9: Map of West Garo Hills District

2) Demographic Situation

Total area of the West Garo Hills District is 1,650kmkm2, which is 7.4% of the total area of Meghalaya State. The district holds a population of 642,923, which is approximately 20% of the state population. The population growth rate of 2001-2010 was 26.7%, which is slightly lower than the state average (28.0%). The literacy rate of the West Garo Hills District is 67.6%, which is lower than the state average of 74.4%. The following Table shows the demographic situation of Meghalaya State and the West Garo Hills District.

Table 2-13: Demographic Situation of Meghalaya State

Item	Meghalaya State	West Garo Hills District
Area (km^2)	22,429	1,650
Population (no.)	2,966,889	642,923
Male-female ratio (no.) (1,000 men)	28.0%	26.7%
Population density (ppl/km^2)	132	173
Population growth rate (2001-2010)	20.0%	11.6%
Urban population	74.4%	67.6%

Source: Census 2011

3) Ethnic Group and Religion

The main tribes in Meghalaya State are Kashi, Garo and Jaintia who reside in the hills of a different area. The official languages in the state are Kashi, Garo and English. Around the project area, Garo tribes are dominant in the hill area. However, since the end of the bridge locates at the border of Assam State and it is plain area along the Brahamputra River, Muslims are the main residents. Therefore, the common language used in the project area is Bangali.

Meghalaya State holds large populations of Scheduled Tribe (ST) which is a common feature of the states in North Eastern India. The population of ST in Meghalaya State is 86.2% while Scheduled Caste (SC) population is 0.6%, which is significantly low compared to the Indian average. In the case of the West Garo Hills District, ST accounts for 73.7%, out of which 71.2% is the Garo tribe. However, as described above, Garos are not included in the project affected people.

Table 2-14: Population Ratio of Scheduled Caste and Scheduled Tribes

Item	Phulbari Village	West Garo Hills District	Meghalaya State	India (average)
SC population (%)	11.2%	1.4%	0.6%	16.2%
ST population (%)	1.3%	73.7%	86.2%	8.2%

Source: Census 2011

Owing to the propagation of Christianity under the English colonial era, majority of the population in Meghalaya State is Christians. In the West Garo Hills District, 61% is Christian, 19% is Hindu, 17% is Muslim and other religions such as Buddhist and Shikh constitute 4%.

4) Economy and Industry

The GSDP of Meghalaya State in the 2013-14 accounts for Rs. 65.6 billion and the annual average growth rate in the past 10 years is 10.5%. The industry wise contribution to GSDP in 2013-14 shows that the service sector accounts for 54.1%, industry sector 31.4% and agriculture sector 14.6%. The trend over 10 years demonstrates that the contribution of agriculture sector in GSDP is decreasing while the ratio of the service and industry sectors is increasing.

Table 2-15: Economic Trend of Meghalaya State

Item		2004-05	2008-09	2013-14	Annual growth (10-year average)
GSDP (Rs. in billion)		65.6	90.0	134.7	10.5%
Ratio in GSDP	Agriculture (%)	23.3%	18.6%	14.6%	2.9%
	Industry (%)	26.1%	30.1%	31.4%	14.6%
	Service (%)	50.6%	55.6%	54.1%	11.9%

Note: GDP in Constant Price (2004-05)
Source: Planning Commission, Government of India

The composition of the working population in the West Garo Hills District is 39.8%, which is almost the same as Meghalaya the state average. 62.8% of the workers are engaged in agriculture related work. The agriculture in the West Garo Hills District is predominantly paddy cultivation and animal raring is the secondary occupation in the area.

Table 2-16: Workers Composition in Meghalaya State

Item	Meghalaya State	West Garo Hills District
Worker population (%)	40.0	39.8
Cultivator (%)	41.7	47.2
Agriculture worker (%)	16.7	15.5
Domestic worker (%)	1.7	3.0
Other worker (%)	39.8	34.3

Source: Directorate of Census Operations Meghalaya, 2011

Since the project area is located at the north-western end of Meghalaya state and is distant from the major cities, transportation infrastructures are not properly maintained and economic activities in this area are limited.

CHAPTER 3 Legal Framework

3.1 Major Laws and Regulations Relevant to the Project

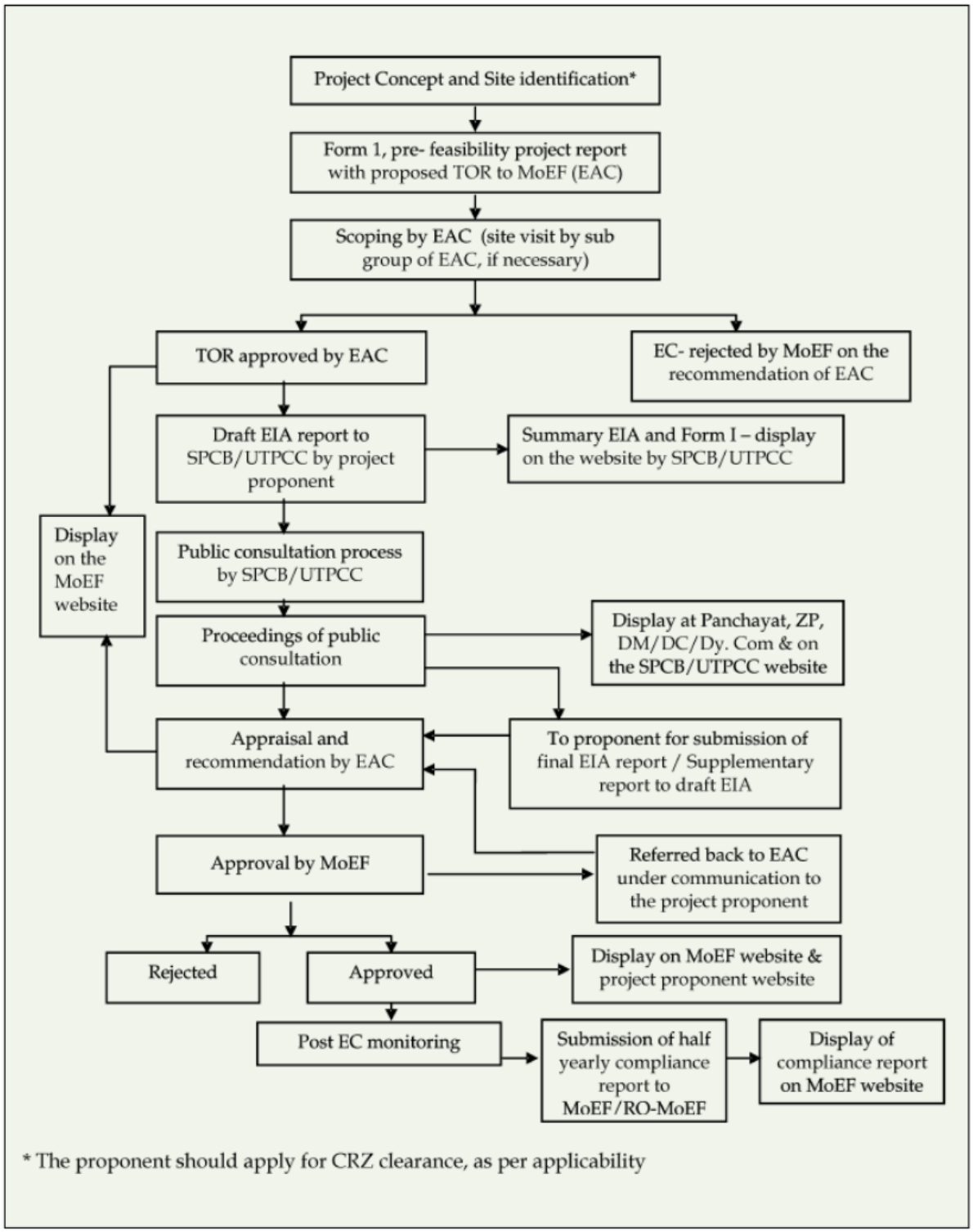
Within the framework of environmental laws of India, the Environmental (Protection) Act of 1986 and its enforcement rights have been given to the Ministry of Environment, Forest & Climate Change (MOEFCC). It has overall authority over the administration and implementation of the EIA related policies, laws and regulations, sustainable development and the pollution control in India. MOEFCC identifies the need to enact new laws and to issue amendment to the existing environmental legislations when required, in order to continue to conserve and protect the environment in India. The Central Pollution Control Board (CPCB) and respective State Pollution Control Board (SPCB) implement the acts. At state level, the Department of Environment and Forest of Assam / Meghalaya perform a role similar to that of MOEFCC.

3.1.1 The Environment (Protection) Act, 1986

The Environment (Protection) Act, 1986 is the umbrella legislation which aims to protect the environment of India. Subject to the provisions of the Act, the Central Government has the power to take all measures as deemed necessary or expedient for the purpose of protecting and improving the quality of the environment and preventing, controlling and abating environmental pollution.
The implementation of Environment (Protection) Rules, which was formulated in 1986, provides various standards for the emission and discharge of environmental pollutants (Schedule I to IV).
The central government has delegated the power vested on it under the Section 5 of the Act to the State Government. This law is applicable to this project for environment protection in general.

3.1.2 Notification of the Environmental Impact Assessment of Development Projects

The Environmental Impact Assessment Notifications in 2006 have been subject to amendments in 2009, 2012, 2013, and 2014. The Expert Appraisal Committee or State Level Expert Appraisal Committee are given power to and are requested to establish recommendations for decision making at the central government level. The Expert Appraisal Committee of the central government and the State Level Expert Appraisal Committee are to meet once every month for screening, scoping and the appraisal of development projects.
Those projects intended to promote economic development at the national level as well as projects for each industrial sector in India are obliged to follow the EIA notification guidelines.



Source: Environmental Impact Assessment Guidance Manual for Highways, 2010

Figure 3-1: Environmental Clearance Process for Category A Projects

3.1.3 Wildlife Protection Act, 1972

Amendments were made to the Wildlife Protection Act in 1982, 1986, 1991, 1993, 2002, 2006 and 2013 in order to protect wildlife in India. Code of conduct in terms of wildlife protection, trade of wildlife products, punishment for illegal hunting etc. have been amended from time to time.

3.1.4 The Biological Diversity Act, 2002

The Biological Diversity Act is a law stipulated on the conservation, utilization, and benefit sharing of genetic resourcest and the Biodiversity Board has been established for each state based on this law. The main function of the Board is to give appropriate advice to the state government on issues concerning biodiversity conservation. The designation of Biodiversity Heritage Sites is also stipulated.

As a national policy for conserving biodiversity, the National Biodiversity Action Plan was formulated in 2008, which covers the conservation of biodiversity, its sustainable use, the equal distribution of profits arising from the use of biodiversity, the protected area networkfocused on the conservation of species, and so forth. Furthermore, it recognizes the importance of regulation on the introduction of alien species, eradication of alien species, and consideration on biodiversity in economic development projects. Assam State has formulated the state forest policy in 2004, among which, in addition to conservation and recovery of forests, strengthening of protected area network, conservation of wetlands, conservation of wetlands, conservation of wildlife as ways to preserve biodiversity preservation of habitats of living beings, promotion of research and research, etc. are listed.

3.1.5 The Forest (Conservation) Act, 1980 (amended in 1988)

The Forest (Conservation) Act, 1980 amended in 1988, pertains to the cases of diversion of the use of forest area and the felling of roadside trees and those in the plantation areas. Depending on the size of the area subject to clearing, a license for felling trees should be obtained. The level of governments that is empowered to issue permission differs depending on the type of forest clearance:

- If the area of forests subject to clearing exceeds 20ha (or 10ha in the hilly area) then prior permission of the Central Government is required;
- If the area of forest clearance has a forest density of more than 40%, permission to undertake any work is needed from the Central Government, irrespective of the area to be cleared;
- If the area of forest subject to clearing is between 5ha to 20ha, the Regional Office of Chief Conservator of Forests is empowered to approve it; and
- If the area of forest subject to clearing is below or equal to 5ha, the State Government can issue permission.

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

The Water (Prevention and Control of Pollution) Act, 1974 resulted in the establishment of the central and state level Pollution Control Board (CPCB/SPCB). Their responsibilities include managing water quality and effluent standards as well as prosecuting offenders and issuing licenses for construction and the operation of certain facilities.

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

The CPCB and the SPCB are empowered to set air quality standards, monitor and prosecute offenders under this Act. Powers have also been conferred to give instructions to the concerned authority in charge of vehicle registration under the Motor Vehicles Act, 1988, with regards to ensuring emission standards for automobiles.

3.1.8 The Motor Vehicles Act, 1988

The Indian Motor Vehicles Act empowers the State Transport Authority to enforce standards for the control of vehicular pollution and prevention of air pollution. The authority also checks

emission standards of registered vehicles, collects road taxes, and issues vehicular licenses. In August 1997, the Pollution under Control Certificate (PUC) program was launched in order to control vehicular emissions in all states of India.

3.1.9 The Land Acquisition Act, Rehabilitation and Resettlement Act, 2013

The new "Rights to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (LARR 2013)" replaced the Land Acquisition Act of 1894. It has so far served as the basic policy document on which the GOI passes resolution to acquire land for different projects, while traditionally it did not allow for compensation on a placement basis. The LARR 2013 came into force on January 1st, 2014, and the Assam/ Meghalaya States put the act into practice.

3.2 JICA/WB/ADB's Guidelines for Environment and Social Considerations

3.2.1 JICA Environmental and Social Guidelines

Application of JICA's Guidelines for Environment and Social Considerations (ESCs) is required if a project is funded by JICA. If a significantly adverse impact on the environment or society has been identified during a JICA-assisted project, the following has to be thoroughly considered and studied.

(1) ESCs are Pre-Requisite

a. JICA will take necessary measures to ensure that the appropriate ESC is given;
b. When JICA reviews a project proposal and finds that the project could cause negative impacts on the environment or society, JICA advises that the project proponents provide appropriate ESC;
c. If the negative impact of the project cannot be avoided or mitigated to an acceptable level, JICA will not support its implementation.

(2) Respect Human Rights

a. Development project should aim for fair distribution of its benefits and must not burden or exclude certain stakeholders for the sake of others;
b. The project proponents must respect the rights of all people concerned, and pay special attention to vulnerable social groups such as women, elderly, the poor, people with disabilities, indigenous peoples, ethnic minorities, and other minority groups to ensure that they are involved in decision-making processes and that they benefit from the project;
c. JICA's ESC Guidelines define 'stakeholders' as local residents including non- titleholders who are affected by the project as well as local NGOs. By involving local stakeholders from the early stage of the project, the project proponents can receive their inputs and plan appropriate measures to address their concerns, avoid conflict, and achieve higher results with their support. For this reason, the project proponents should conduct a series of consultations with local stakeholders in an interactive and meaningful manner. During this process, appropriate consideration must be given to socially vulnerable people such as women, children, the elderly and ethnic minorities.

(3) Avoid Adverse Impacts

a. Priority should be given to the avoidance of adverse impacts on the environment or society when a project is planned;
b. Minimization or mitigation of impacts should be considered only if avoidance is not feasible

and if the benefit of the project outweighs the cost of mitigation measures;

c. The project proponents must assess the environmental and social impacts at the earliest possible stage of planning, and implement ESC measures in accordance with the ESC Guidelines 9.

(4) Information on ESC Must be Disclosed to the Public

a. Information disclosure is key in ESC. Project proponents must proactively release relevant information to the public;

b. Sharing information with a wide range of stakeholders from the early stage, the project proponents can utilize their feedback to improve the plan/project. In addition, the project proponents can ensure that unnecessary concerns and misunderstandings among the stakeholders are ameliorated.

(5) Host Country's Laws, Standards, Policies and Plans

a. A JICA-funded project must comply with the laws, standards, policies, and plans of the host country;

b. If the standard set by the host country differs from the international standard, the project proponents are advised to adopt an international standard that better serves the purpose of attaining a higher level of ESC.

(6) The World Bank's Safeguard Policies

ESC in a JICA project must be in line with the World Bank's Safeguard Policies including:

a) Operational Policy on Environmental Assessment (OP 4.01);
b) Natural Habitats (OP 4.04);
c) Involuntary Resettlement (OP 4.12);
d) Indigenous Peoples (OP 4.10), and other relevant policies.

3.2.2 World Bank's Environment Safeguard Policy

In respect to the Safe Guard Policies as listed above, the World Bank Performance Standards are imposed on the borrowers in terms of the requirement of the environmental impact assessment and resettlement action plan as guidelines for environmental study. It is a compulsory requirement for financing economic development projects that developing countries borrow funds from the World Bank. Major points of concern of its Performance Standards are summarized as follows:

a. PS 1: Assessment and Management of Environmental and Social Risks and Impacts

Performance Standard 1 underscores the importance of managing environmental and social performance throughout the life of the project.

b. PS 2: Labour and Working Conditions

The requirements labour and working conditions set out in part guided by a number of international conventions and instruments, including those of the International Labour Organization (ILO) and the United Nations (UN).

c. PS 3: Resource Efficiency and Pollution Prevention

This Performance Standard outlines a project-level approach to resource efficiency and pollution prevention and control in line with internationally disseminated technologies and practices. The Performance Standard promotes the ability of private companies to adopt such technologies and

practices as far as their use is feasible in the context of a project that relies on commercially available skills and resources.

d. PS 4: Community Health, Safety, and Security

Performance Standard 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. In addition, communities that are already subjected to impacts from climate change may also experience an acceleration and/or intensification of impacts due to project activities. While acknowledging the public authorities' role in promoting the health, safety, and security of the public, this Performance Standard addresses the client's responsibility to avoid or minimize the risks and impacts on community health, safety, and security that may arise from project related-activities, with particular attention to vulnerable groups.

e. PS 5: Land Acquisition and Involuntary Resettlement

Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement as a result of project-related land acquisition and/or restrictions on land use. However, where involuntary resettlement is unavoidable, it should be minimized and appropriate measures to mitigate adverse impacts on displaced persons and host communities should be carefully planned and implemented.

f. PS 6: Biodiversity Conservation and Sustainable Management of Natural Resources

This Performance Standard recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and the sustainable management of living natural resources are fundamental to sustainable development. The requirements set out in this Performance Standard have been guided by the Convention on Biological Diversity. This Performance Standard addresses how clients can sustainably manage and mitigate impacts on biodiversity and ecosystem services throughout the project's lifecycle.

g. PS 7: Indigenous Peoples

Performance Standard 7 recognizes that Indigenous Peoples are social groups with identities that are distinct from mainstream groups in national societies.

h. PS 8: Cultural Heritage

Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to ensure that clients protect cultural heritage in the course of their project activities.

3.2.3 Safeguard Policy of Asian Development Bank

(1) Latest Development of ADB Operations

The ADB's Environment Policy mandates the consideration of environment in all aspects of ADB's operations. The "Environment Policy and Operations Manual (OM) 20: Environmental Considerations in ADB Operations" outlines ADB's environmental assessment procedures and requirements. In 2003, ADB updated the old guidelines of 1993 and the contents are summarized as follows:

a. Introduced a check-list system of the Rapid Environmental Assessment (REA) for determining

the environment category;

b. Introduction of the Country Environmental Analysis (CEA) as a requirement in preparation of the Country Strategy and Program (CSP);
c. Introduction of the Strategic Environmental Assessment (SEA) as an optional tool for the environmental assessment for program loans, sector development program loans, and sector loans;
d. Establishing a new category FI for lending activities to financial intermediaries and other intermediaries and outlining the environmental assessment requirements to apply to this category;
e. Strengthening the requirements of Environmental Management Plans (EMP);
f. Recommending environmentally responsible procurement; and
g. Strengthening public consultation as an integral part of environmental assessment and management.

(2) General Contents of EIA Study

a. Coordinate with environment and government concerned agencies;
b. Prepare a project description, define the study area, collect environmental baseline data, prepare site maps, and other relevant maps for the study area;
c. Identify potential environmental impacts based on the information obtained on the proposed project and the baseline environmental conditions of the study area;
d. Identify alternatives and analyse the environmental impacts of each alternative and propose measures to avoid or prevent impacts;
e. Estimate the magnitudes of environmental impacts and assess the significance of the impacts;
f. Recommend environmental mitigation measures and estimate the mitigation costs;
g. Prepare an EMP to be implemented by the executing agency during project implementation, operation and abandonment;
h. Prepare the EIA and SEIA reports;
i. Conduct public consultation and ensure information disclosure; and develop plans for public consultation and information disclosure during project implementation;
j. Assess the executing agency's capacity to undertake an environmental review of the environmental assessment report and EMP recommendations, and recommend measures for capacity building if necessary; and
k. Ensure that the proposed project, with EIA and EMP implementation, conforms to the Government and ADB environmental assessment requirements, policies and regulations.
l. Economic assessment that should be carried out includes i) the costs and benefits of environmental impacts; ii) the costs, benefits, and cost effectiveness of mitigation measures; and iii) for environmental impacts that have not been expressed in monetary values, a discussion of such impacts, if possible, in quantitative terms.

3.3 Comparison of JICA/WB/ADB Guidelines and EIA Regulations of India

The JICA guidelines, World Bank and ADB Operational Manual and Environmental Safeguard policies, procedures & practices described in the Section 9.3.7 to 9.3.9 are compared to the following Government of India's guidelines in order to find the differences and elaborate on a way to fill in the gaps if any.

- "Environmental Guidelines for Selected Infrastructure Projects";
- "Project Terms of Reference (TOR)";
- "Environmental guidelines for Road/Rail/Highway Projects", Government of India, 1989
- "Handbook of environmental procedures and guidelines", 1994, Government of India
- "Guidelines for Environmental Impact Assessment of Highway Projects" (IRC:104-1988); and
- The Environmental (Protection) Act, 1986 and a series of its amendments as follows:

S.O.695, [4/04/2011] - Amendment to EIA Notification, 2006,
S.O.156, [25/01/2012] - Amendment to EIA Notification, 2006,
S.O.945, [11/06/2007] - Environmental Impact Assessment Notification-2007,
S.O.948, [12/06/2007] - Environmental Impact Assessment Notification-2007,
S.O.1105, [4/07/2007] - Environmental Impact Assessment Notification-2007,
S.O.1134, [12/07/2007] - Environmental Impact Assessment Notification-2007,
S.O.1203, [23/07/2007] - Environmental Impact Assessment Notification-2007,
S.O.1735, [11/10/2007] - Environmental Impact Assessment Notification-2007,
S.O.1736, [11/10/2007] - Environmental Impact Assessment Notification-2007,
S.O.1737, [11/10/2007] - Environmental Impact Assessment Notification-2007,
S.O.2674, [17/11/2008] - Environmental Impact Assessment Notification-2008,
S.O.2244, [22/11/2008] - Environmental Impact Assessment Notification-2008,
S.O.195, [19/01/2009] - Environmental Impact Assessment Notification-2009,
S.O.3067, [01/12/2009] - Environmental Impact Assessment Notification-2009
S.O.1850, [14/08/2012] - Environmental Impact Assessment Notification, 2012

Based on the above, a study on India's laws and regulations, and comparing them to the JICA/WB/ADB Guidelines is carried out in the following stages:

- The baseline environmental information in the study area such as; climate, physiographic features, drainage, geology, flora, fauna, ambient air, water and noise and socio-economic conditions.
- Reviews of the literature, laws and guidelines and discussions with concerned agencies and organizations, National/State Authorities
- A reconnaissance survey along with public consultation that occurred from October 2016 to July 2017 and processes of public consultation continued until the completion of the study to inform the people about the project and collect the information/suggestions on environmental issues.
- The monitoring network with regard to air, water, soil and noise pollution.
- Assessment of the potential significant impacts and identification of the mitigate measures to address impacts adequately.
- Field observations including public consultation.
- Screening, testing and monitoring of environmental factors like air, water, soil and the noise level.
- Collection of secondary data from various departments.
- Compilation, analysis and presentation of the report.

Table 3-1: Comparison between JICA Guideline and Laws in India regarding EIA

No.	Items	JICA Guideline	Laws in India	Principle for this Project
1	Requirement of EIA	Environmental and social surveys at the EIA level (Category A projects) Proposed projects likely to have significant adverse impacts on the environment and society. Category A includes projects in sensitive sectors (ex. Roads, railways, and bridges), projects that have characteristics that are	Projects requiring EIA (Category A projects) i) New National Highways ii) Expansion of National Highways greater than 100km involving an additional right of way or land acquisition greater than 40m on the existing alignments and 60m on re-alignments and	EIA will be prepared as category A in accordance with JICA Guidelines though not required by Laws in India

No.	Items	JICA Guideline	Laws in India	Principle for this Project
		liable to cause adverse environmental impacts (ex. Large-scale involuntary resettlement), and projects located in or near sensitive areas. IEE level (Category B projects) Projects whose potential adverse impacts on the environment and society are less adverse than those of Category A projects.	bypasses. Projects whose requirements of EIA are judged by the state level Environment Impact Assessment Authority (Category B projects) i) State Highway ii) State highway Expansion projects in hilly terrain (above 1,000 m AMSL) and or ecologically sensitive areas	
2	Scope of Impacts to Be Assessed	In addition to the direct and immediate impacts of projects, their derivative, secondary, and cumulative impacts as well as the impacts of projects that are indivisible from the project are also to be examined and assessed to a reasonable extent.	Factors which could lead to environmental effects or the potential for cumulative impacts shall be identified. Indirect impacts on the avifauna of the area shall be examined.	Derivative, secondary, and cumulative impacts as well as the impacts of projects that are indivisible from the project are also to be examined.
3	Stakeholder meetings/ Public consultation	Stakeholder meetings shall be held at the stages of the scoping draft and report draft.	Public consultation shall be conducted after submission of draft report.	To hold Stakeholder meetings at the stages of scoping draft and report draft.
4	Disclosure of EIA	EIA reports are required to be made available to local residents of the country in which the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders such as local residents; and copying must be permitted.	MOEFCC shall display the Summary of the draft EIA report on its website, and also make the full draft EIA available for reference at a notified place during normal office hours at the Ministry in Delhi.	To disclose EIA in accordance with JICA Guidelines.
5	Certificate regarding the environment and society	If the project requires a certificate other than an EIA regarding the environment and society, indicate the title of said certificate and confirm the approval.	Forest Clearance will be required. The Contractor has to obtain permits from MSPCB for setting up hot-mix plants, batching plants, etc., under the Air	To confirm requirement of permits in accordance with the laws in India.

No.	Items	JICA Guideline	Laws in India	Principle for this Project
			and the Water Acts, whose results shall be reported to the Project proponents.	
6	Monitoring	After projects begin, project proponents etc. monitor whether any unforeseeable situations occur and whether the performance and effectiveness of mitigation measures are consistent with the assessment's prediction. They then take appropriate measures based on the results of such monitoring. In cases where sufficient monitoring is deemed essential, project proponents etc. must ensure that project plans include feasible monitoring plans. Project proponents etc. should make efforts to make the results of the monitoring process available to local project stakeholders.	Project proponents are required to submit environmental management plan & monitoring programme. It shall be mandatory for the project management to submit every half a year compliance reports in respect to the stipulated prior environmental clearance terms and conditions.	To implement environmental monitoring in accordance with the laws in India.

Source: JICA Study Team

3.4 Central Level Institutions

(1) National Highways Authority of India

The proposed Dhubri-Phulbari Bridge has been initiated and is being carried out by the National Highways and Infrastructure Development Corporation Limited (NHIDCL), under the auspice of the Ministry of Road Transport & Highways (MORTH). Though the primary responsibility of the Project rests with the NHIDCL, there are various institutions involved in the Project and their level of responsibilities in the project implementation are as follows:

The National Highway Authority of India (NHAI) and Regional Offices under the Ministry of Road Transport and Highway (MORTH) promote the national highway development project while the Border Roads Organization (BRO) under the Border Roads Development Board (BRDB) have control over roads in border regions. The NHIDCL was established for promoting the development of National Highways in North East and border areas of India, and started operation from January 1st , 2015.

The NHAI has been established under the National Highways Authority of India Act of 1988. It is the main nodal agency responsible for developing, managing and maintaining India's network of national highways. It became an autonomous body in 1995. NHAI maintains 70,934km of national highways and expressways across India.

The development of the Dhubri-Phulbari Bridge project has been promoted by NHIDCL, which is a company fully owned by the Ministry of Road Transport & Highways of the Government of India. The function of the NHIDCL is to promote the surveying, designing, building, operating, maintaining and upgrading of national highways and the development of strategic roads such as interconnecting roads in various parts of the country including those in areas with international boundaries with the neighboring countries.
The company also proposes to improve road connectivity and the efficiency of the international trade corridors by expanding about 500km of roads in the North Bengal and Northeastern Region of India.

(2) Ministry of Environment, Forest, and Climate Change (MOEFCC)

The primary responsibility for administration and implementation of the Government of India's (GOI) policy with respect to environmental management, conservation, ecologically sustainable development and pollution control rests with the Ministry of Environment, Forest and Climate Change (MOEFCC). Established in 1985, the MOEFCC is the agency primarily responsible for the review and approval of EIAs pursuant to GOI legislation.

(3) Central Pollution Control Board (CPCB)

Statutory authority attached to the MOEFCC, the main responsibilities of CPCB include the following:

- Planning and implementing water and air pollution control programs;
- Advising the central government on water and air pollution control programs;
- Setting air and water standards; and
- Coordinating the various State Pollution Control Boards.

The role of the CPCB for this Project will only be in an advisory capacity while the Project shall adhere to the norms and standards set up by the Meghalaya State Pollution Control Board (MSPCB).

3.5 State Level Institutions

(1) Public Works Department

The Public Works Department (PWD) is the premier agency of the state government engaged in planning, designing, construction, and maintenance of the government assets in the field of infrastructure development. Assets in infrastructure development include roads, bridges, urban centers, footpaths, new capital complexes, and airports. Assets such as hospitals, schools, colleges, technical institutes, police buildings, prisons, and courts among others are also under the PWD's jurisdiction. PWD Assam / Meghalaya also sustains and preserves these assets through a system of maintenance, which includes specialized services such as rehabilitation works, roads signage, and aesthetic treatments like interiors, landscaping etc.

(2) MOEFCC Regional Offices

MOEFCC has set up regional offices that cover the Northeastern Region including Assam / Meghalaya. It is located in Shillong, Meghalaya. This office is responsible for collecting and furnishing information relating to the EIA of various projects in respect to pollution control measures, methodology, and status, legal and enforcement measures and environmental protection in special conservation areas such as wetlands, mangroves and biosphere reserves.

(3) State Pollution Control Board, Assam / Meghalaya State Pollution Control Board

The State Pollution Control Boards have the mandate for environmental management at the state level, with emphasis on air and water quality. It is responsible for the planning and executing of

state-level air and water initiatives, advising the state government on air, water and industry issues, establishing standards based on the National Minimum Standards, the enforcing and monitoring of all activities within the state under the Air Act, the Water Act and other relevant acts pertaining to pollution control.

They also conduct and organize public hearings for projects as defined by the various Acts and as stipulated by the amendment related to the EIA Act. It also issues No-objection Certificates (NOC) for environment clearance for industrial development defined in such a way as to include road projects' quarrying etc., which usually relate to water and soil contamination.

(4) Assam / Meghalaya State Forest and Environment Department

The Assam / Meghalaya Forest and Environment Department is responsible for the protection and management of the forest areas in the states that are designated for protection, conservation and production purposes. The Forest and Environment Department follows what is laid out in the Forest Working Plans for the various forest divisions to manage and protect the forest resources. These plans form the basis for managing the forest resources. is the department is responsible for granting licenses for clearances of the forest areas for various projects, according to the provisions of the Forest (Conservation) Act, 1980. The State Forest and Environment Department performs functions similar to those of the MOEFCC at the state level but more specific to forestry activities including social forestry and production forestry development and licensing.

3.6 Requirements of Environmental Clearance

Environmental Clearance is not required for this project as per the MoEFCC notification, 2013.
Other clearances required are as follows:

1) The Contractor has to obtain permits from State Pollution Control Board for setting up hot-mix plants, batching plants, etc., under the Air and the Water Acts;
2) Clearance from the State Department of Mining is required for establishing quarries;
3) Clearance from the Water resource department/Authorities is required for establishment of new tube-wells/bore-holes in case they are required during construction work;
4) The provisions as laid down in the Factories Act, 1948, Labor Act, 1988 and the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 with respect to hygiene and health during the construction stage would apply to the project's implementation works; and
5) The provisions of the Hazardous Wastes (Management and Handling) Rules, 1989 and the Chemical Accidents (Emergency Planning, Preparedness, and Response) Rules, 1996 may also be applied during the construction and the operation period.

Table 3-2: Applicable Environmental Clearance

No.	Activity	Statute	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance	Time Required
Pre-Construction Stage (Responsibility: MORTH)						
1	Road-side tree cutting and clearing forest	Forest Conservation Act1980 & MOEF Letter Dt.18.02.1998	Permission for Road-side tree cutting	State and Central Government	MORTH	2-3 months
2	Filling of Roadside water bodies (ponds and borrow pits)	State Fisheries Policy Draft Wetlands (Conservation & Management) Rules, 2008	Permission for filling of water bodies	State Irrigation Department State Fisheries Department State Wetlands Conservation Committee	MORTH	2-3 months
Construction Stage (Responsibility: Contractor)						
1	Establishing stone crusher, hot mix plant, wet mix plant and Diesel Generator Sets	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environmental Protection Action of 1986 and as Amended	Consent-forest abolishment	States Pollution Control Boards for respective section	Contractor	4-6 months
2	Operating stone crusher, hot mix plant, wet mix plant and Diesel Generator Sets	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environmental Protection Action of 1986 and as Amended	Consent-for operation	States Pollution Control Boards for respective section	Contractor	4-6 months
3	Use and storage of explosive for quarry blasting work	India Explosive Act 1984	Explosive license for use and storage	Chief Controller of Explosives	Contractor	2-3 months
4	Storage of fueloil, lubricants, diesel etc. at construction camp	Manufacture storage and Import of Hazardous Chemical Rules 1989	Permission for storage of hazardous chemical	States Pollution Control Boards for respective section and or Local Authority (DC)	Contractor	4-6 months
5	Quarry Operation	State Minor Mineral Concession Rules, The Mines Act of1952, Indian Explosive Act of1984, Air Act of1981 and Water Act of 1974	Quarry Lease Deed and Quarry License	State Department of Mines and Geology	Contractor	4-6 months
6	Extraction of ground water	Ground Water Rules of 2002	Permission for extraction of ground water for use in road construction activities	State Ground Water Board	Contractor	4-6 months
7	Engagement of labor	Labor Act	Labor license	Labor Commissioner	Contractor	2-3 months

Source: JICA Study Team

3.7 Environmental Standards of India

Based on the Acts and Rules above, CPCB has set up various environmental standards as follows:

1) National Ambient Air Quality Standards
2) Water Quality Criteria
3) Vehicular Exhaust
4) Auto Fuel Quality
5) Noise and Emission Limits for Diesel Engines for Generators
6) Noise Standards

In addition to the above, there are a large number of environmental standards set up for each sector of the manufacturing industries. Since this is a road construction project consisting of the construction of a new bridge, during the construction period, construction debris, soil contamination, air and water pollution, noise and vibration are subject to monitoring in order to maintain emissions and discharges within the standards set up by the CPCB. During the operation and maintenance period, increasing traffic could cause noise and vibration. However, standards on the disposal of construction debris, soil contamination, and vibration that could be caused by the Project are not

clearly defined. The following is a set of environmental standards the Government of India has imposed to date.

Table 3-3: Standards for Ambient Air Quality

Indian Ambient Air Quality Standards					**WHO Ambient Air Quality Standards**	
S. No.	**Pollutant**	**Time Weighted Average**	**Concentration in Ambient Air**		**Averaging Period**	**Guideline value in µg /m^3**
			Industrial Residential, Rural and Other Areas	**Ecologically Sensitive Area (notified by Central Government)**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(1)**	**(2)**
1.	**Sulphur Dioxide (SO_2), µg /m^3**	Annual* 24 hours**	50 80	20 80	24 hours 10 minutes	125 (Interim target 1) 50 (Interim target 2) 20 (guideline) 500 (guideline)
2.	**Nitrogen Dioxide (NO_2), µg /m^3**	Annual* 24 hours**	40 80	30 80	1-year 1-hour	40 (guideline) 200 (guideline)
3.	**Particular Matter (size less than 10µm) or PM_{10} µg /m^3**	Annual* 24 hours**	60 100	60 100	1-year 24-hour	70(Interim target 1) 50 (Interim target 2) 30 (Interim target 3) 20 (guideline) 150(Interim target 1) 100 (Interim target 2) 75(Interim target 3) 50 (guideline)
4.	**Particular Matter (size less than 2.5µm) or $PM_{2.5}$ µg /m^3**	Annual* 24 hours**	40 60	40 60	1 – year 24-hour	35(Interim target 1) 25 (Interim target 2) 15 (Interim target 3) 10 (guideline) 75(Interim target 1) 50 (Interim target 2) 37.5 (Interim target 3) 25 (guideline)
5.	**Ozone (O_3) µg/m^3**	8 hours** 1 hour**	100 180	100 180	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

Source: Central Pollution Control Board, India

Table 3-4 Ambient Air Quality Standard by WHO

Table 1.1.1: WHO Ambient Air Quality Guidelines[7,8]		
	Averaging Period	Guideline value in µg/m³
Sulfur dioxide (SO_2)	24-hour 10 minute	125 (Interim target-1) 50 (Interim target-2) 20 (guideline) 500 (guideline)
Nitrogen dioxide (NO_2)	1-year 1-hour	40 (guideline) 200 (guideline)
Particulate Matter PM_{10}	1-year 24-hour	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline) 150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter $PM_{2.5}$	1-year 24-hour	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline) 75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

Source: IFC

Table 3-5: Vehicle Emission Standards (1991 to Date)

Norms	Passenger Car	Heavy Diesel Vehicles			
	CO (g/km)	CO (g/km)	HC (g.km.hr)	NOx (g.km.hr)	PM (g.km.hr)
1991Norms	14.3-27.1	14	3.5	18.0	-
1996 Norms	8.68-12.40	11.2	2.4	14.4	-
1998Norms	4.34-6.20	-	-	-	-
India stage 2000 norms	2.72	4.5	1.1	8.0	0.4
Bharat stage-II	2.2	4.0	1.1	7.0	0.2
Bharat Stage-III	2.3	2.1	1.6	5.0	0.1
Bharat Stage-IV	1.0	1.5	1.0	3.5	0.0

Source: Central Pollution Control Board, India
Note: Bharat indicates Indian nomenclature of vehicular emission which is the same as the Euro Stage.

Table 3-6: Water Quality

Designated best use	Class	Criteria
Drinking water source without conventional treatment but after disinfections	A	Total coliform organisms MPN/100ml shall be 50 or less pH between 6.5 and 8.5 Dissolved oxygen 6 mg/l or more Biochemical oxygen demand 2 mg/l or Less
Outdoor bathing (organised)	B	Total coliform organisms MPN/100ml shall be 500 or less pH between 6.5 and 8.5 *Dissolved oxygen 5 mg/l or more Biochemical oxygen demand 3 mg/l or Less
Drinking water source with conventional treatment followed by disinfection	C	Total coliform organisms MPN/ 100ml shall be 5000 or less pH between 6 and 9 Dissolved oxygen 4 mg/l or more Biochemical oxygen demand 3 mg/l or less
Propagation of wild life, fisheries	D	pH between 6.5 and 8.5 Dissolved oxygen 4 mg/l or more *Free ammonia (as N) 1.2 mg/l or less
Irrigation, industrial cooling, controlled waste disposal	E	pH between 6.0 and 8.5 Electrical conductivity less than 2250 micro mhos/cm Sodium absorption ratio less than 26 Boron less than 2mg/l

Source: Central Pollution Control Board, India

Compared to the EHS guideline set forth by the International Financial Corporation (IFC) shown in table 2.1-4 below, the Class A Water Quality Standard of India is lacking a few items such as COD, Total Nitrogen, Total Phosphorus, Oil and Grease. Other parameters are set at equal level or below the EHS Guideline of IFC.

Table 3-7: Water quality standard for international EHS Guideline

Table 1.3.1 Indicative Values for Treated Sanitary Sewage Discharges[a]		
Pollutants	**Units**	**Guideline Value**
pH	pH	6 – 9
BOD	mg/l	30
COD	mg/l	125
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Total coliform bacteria	MPN[b] / 100 ml	400[a]
Notes: [a] Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation. [b] MPN = Most Probable Number		

Source: IFC

Table 3-8: Fuel Quality

Diesel Specification

Contents	1996	2000	2005	2010
Cetane No, Min	45	48	48	51
Sulphur % W/w, Max	0.5	0.25 0.25(metro)	0.05	0.035
Distillation T95	-	370	370	360
Polyaromatic	-	-	-	11

Gasoline Specification

Contents	1996	2000	2005	2010
RVP at 38 Deg.c,kpa	35-70	-	35-60	60
Benzine % by Vol.,Max	5	5.0 3.0(metro)	3.0 (all) 1.0 (metro)	1
Lead G/m3, Max	0.15% (low Pb) 0.013% (unleaded)	0.013	0.013	0.005
Sulphur % by mass, Max	0.10 (low Pb) 0.20 (unleaded)	0.1	0.05	0.015
Aromatics % v/v., Max	-	-	45	42
Oxygen %by Vol., Max	-	-	2	2.7

Source: Central Pollution Control Board, India

Table 3-9: Noise Standard for Diesel Generator

No.	Description
1	The maximum permissible sound pressure level for new diesel generator (DG) sets with rated capacity upto 1000 KVA, manufactured on or after the 1st January, 2005 shall be 75 dB(A) at 1 metre from the enclosure surface.
2	Noise limits for diesel generator sets not covered by 1, shall be as follows:-
	2.1 Noise from DG set shall be controlled by providing an acoustic enclosure or by treating the room acoustically, at the users end.
	2.2 The acoustic enclosure or acoustic treatment of the room shall be designed for minimum 25 dB (A) insertion loss or for meeting the ambient noise standards, whichever is on the higher side (if the actual ambient noise is on the higher side, it may not be possible to check the performance of the acoustic enclosure/acoustic treatment. Under such circumstances the performance may be checked for noise reduction upto actual ambient noise level, preferably, in the night time). The measurement for Insertion Loss may be done at different points at 0.5 m from the acoustic enclosure/ room, then averaged.
	2.3 The DG set shall be provided with proper exhaust muffler with insertion loss of minimum 25 dB (A).
	2.4 Guidelines for the manufacturers/ users of Diesel Generator sets shall be as under:-
	2.4 (1) The manufacturer shall offer to the user a standard acoustic enclosure of 25 dB (A) insertion loss and also a suitable exhaust muffler with insertion loss of 25 dB(A).
	2.4 (2) The user shall make efforts to bring down the noise levels due to the DG set, outside his premises, within the ambient noise requirements by proper citing and control measures.
	2.4 (3) Installation of DG set must be strictly in compliance with the recommendations of the DG set manufacturer.
	2.4 (4) A proper routine and preventive maintenance procedure for the DG set should be set and followed in consultation with the DG set manufacturer which would help prevent noise levels of the DG set from deteriorating with use.

Source: Central Pollution Control Board, India

Table 3-10: Vehicle Emission Standards (1991 to Date)

Norms	Passenger Car	Heavy Diesel Vehicles			
	CO (g/km)	CO (g/km)	HC (g.km.hr)	NOx (g.km.hr)	PM (g.km.hr)
1991Norms	14.3-27.1	14	3.5	18.0	-
1996 Norms	8.68-12.40	11.2	2.4	14.4	-
1998Norms	4.34-6.20	-	-	-	-
India stage 2000 norms	2.72	4.5	1.1	8.0	0.4
Bharat stage-II	2.2	4.0	1.1	7.0	0.2
Bharat Stage-III	2.3	2.1	1.6	5.0	0.1
Bharat Stage-IV	1.0	1.5	1.0	3.5	0.0

Source: Central Pollution Control Board, India

Note: Bharat indicates Indian nomenclature of vehicular emission which is the same as the Euro Stage.

Table 3-11: Noise Emission Standards

S. No.	Type of vehicle	Noise Limits from 1st January, 2003, dB(A)
1.0	**Two wheeler**	
1.1	Displacement upto 80 cc	75
1.2	Displacement more than 80 cc but upto 175 cc	77
1.3	Displacement more than 175 cc	80
2.0	**Three wheeler**	
2.1	Displacement upto 175 cc	77
2.2	Displacement more than 175 cc	80
3.0	**Vehicles used for carriage of passengers and capable of having not more than nine seats, including the driver's seat**	74
4.0	**Vehicles used for carriage of passengers having more than nine seats, including the driver's seat, and a maximum gross Vehicle Weight(GVW) of more than 3.5 tonnes**	
4.1	With an engine power less than150 KW	78
4.2	With an engine power of 150 KW or above	80
5.0	**Vehicles used for carriage of passengers having more than nine seats, including the driver's seat: Vehicles used for carriage goods.**	
5.1	With maximum GVW not exceeding 2 tonnes	76
5.2	With maximum GVW greater than 3 tonnes but not exceeding 3.5 tonnes	77
6.0	**Vehicles used for transport of goods with a maximum GVW exceeding 3.5 tonnes.**	
6.1	With an engine power less than 75 KW	77
6.2	With an engine power of 75 KW or above but less than 150 KW	78
6.3	With an engine power of 150 KW or above,	80"

Source: Central Pollution Control Board, India

Table 3-12: Ambient Noise Standards

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

Note:- 1. Day time shall mean from 6.00 a.m. to 10.00 p.m.
2. Night time shall mean from 10.00 p.m. to 6.00 a.m.
3. Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority
4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

Source: Central Pollution Control Board, India

Indian noise standards are at the same level as the EHS guideline of IFC.

CHAPTER 4 Analysis of Alternatives

4.1 Alternatives Subject to Analysis

There are four options that must be considered in terms of impact mitigation measures and are as follows:

(1) Zero Option

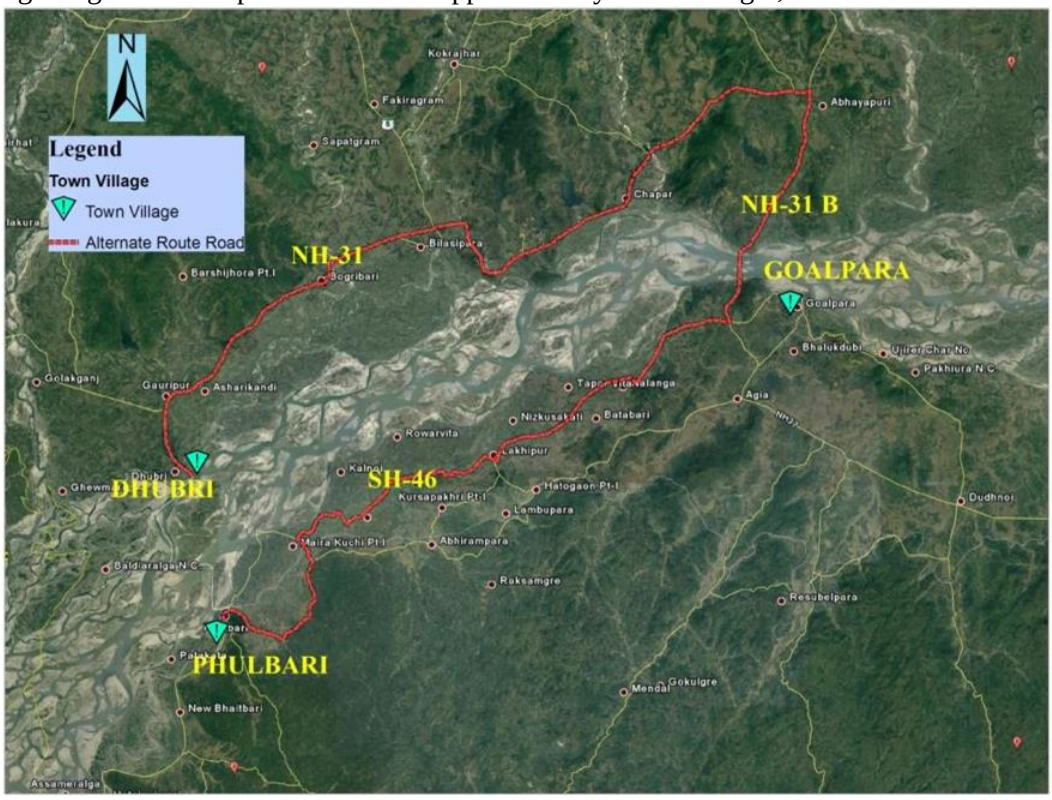
No project intervention is implemented, i.e. present status i.e. transportation by boats, is to be continued to be used;

(2) Alternative mode of transportation such as ferry

As an alternative to the construction of a new bridge, capacity by boat transportation across Brahmaputra River can be increased by constructing ferry terminals at Dhubri and Phulbari.

(3) The Alternative Route connects Dhubri and Phulbari by widening of existing NH-31 B and SH-46 through existing bridge near Goalpara

The Alternative Routes to connect Dhubri and Phulbari through NH-31 B and SH-46 and utilize the existing bridge near Goalpara would have approximately 200km length,

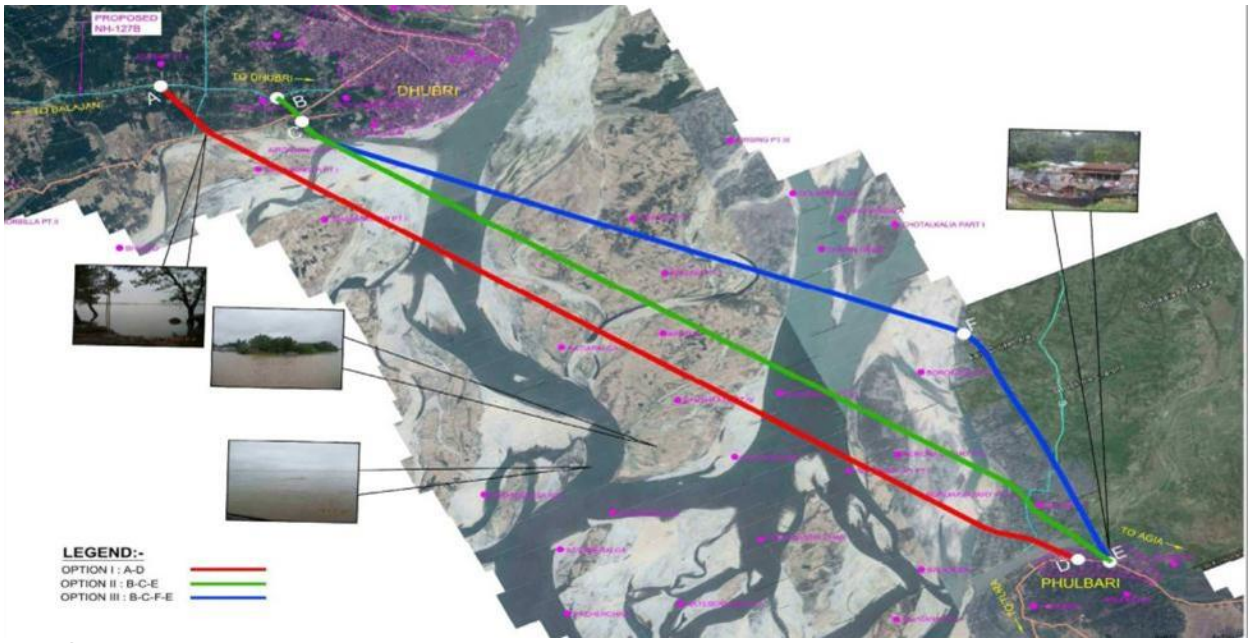


Source: JICA Study Team

Figure 4-1: The Alternative Route connects Dhubri and Phulbari by widening of existing NH-31 B and SH-46 through existing bridge near Goalpara

(4) The Proposed Bridge Option – DPR Design

The proposed Bridge is the construction of two Four-lane bridges including approaches over River Brahamputra between Dhubri on the North Bank and Phulbari on the South Bank in the state of Assam/Meghalaya on NH-127B (Length: 20km) with minimum PAPs. In this option, three alternative alignments were compared in order to minimize the social and environmental impacts.



Source: DPR Inception Report

Figure 4-2: Alignment of Two / Four lane bridge between Dhubri and Phulbari

4.2 Criteria for Analysis of the Alternatives

Criteria for the analysis of the selected four alternatives are shown in the following Table. These criteria are based on the importance of the Project being a bridge project running through the Dhubri, South Salmara-Mankachar districts in Assam State and Phulbari in Meghalaya State.

Table 4-1: Criteria for the Evaluation of the Alternatives

No.	Alternative Models	Criteria of Evaluation
1	Zero Option (No project is implemented)	Connectivity - Road Connectivity as a means of infrastructure for communication or transportation of goods - If current connectivity should be improved - Contribution to the development of local/state economy Environmental Pollution - CO2 emission could increase/decrease with the road - Noise and vibration - Health conditions could be improved/worsened Socio-economic Conditions - Contribution to road accidents - Contribution to improve/worsen living standard - If resettlement was involved - If land acquisition is involved Natural Environment - impacts on fisheries and other aquatic life - Effects on the ecological conditions Others - If it is worth implementing the project despite effects on
2	Alternative mode of transportation such as a ferry	
3	The Alternative Route connects Dhubri and Phulbari by widening of existing NH-31 B and SH-46 through existing bridge near Goalpara	
4	The Proposed Bridge Option – DPR Design alignment AD	
5	The Proposed Bridge Option – DPR Design alignment BE	
6	The Proposed Bridge Option – DPR Design alignment BFE	

		the natural/social environment, or economic conditions - Technical viability of the bridge construction

Source: JICA Study Team

4.3 Results of the Analysis of Alternatives

(1) Zero Option

The Zero option of the project is to take no project intervention. This option is assessed as follows:

a. Advantages

- There will be no involuntary resettlement involved in the Zero Option
- No tree cutting and agricultural areas lost to the road / bridge construction works
- No construction works and no pollution
- No impact on Aquatic Fauna

b. Disadvantages

- No road network between Dhubri and Phulbari
- Existence boat transportation takes more time and inconveniences the people
- No local area development
- No Economic development in project districts

(2) Alternative mode of transportation such as ferry

Alternative to the construction of a new bridge, capacity by boat transportation across Brahmaputra River can be increased by constructing ferry terminals at Dhubri and Phulbari. However constructing ferry terminals will require large-scale change in geology, topography and hydrology of the existing river banks of the Brahmaputra which may cause negative impacts on the habitat of the endangered river dolphins.

a. Advantage

- Provide transport connectivity to Dhubri and Phulbari
- Land acquisition and involuntary resettlement will be incurred but on a smaller scale

b. Disadvantage

- Significant negative impacts on the ecosystem of the Brahmaputra River by the dredging of ferry terminals
- High maintenance and operation cost for ferry boats
- Susceptible to natural disasters such as flooding
- Travel time is dependent on ferry time schedule

(3) The Alternative Route connect Dhubri and Phulbari by widening of existing NH-31 B and SH-46 through existing bridge near Goalpara

The Alternative Routes to connect Dhubri and Phulbari through NH-31 B and SH-46 and utilize the existing bridge near Goalpara will have approximately 200km length.

a. Advantages

- Better connectivity to villages / towns falling in the 200km alignment
- Overall economic development of the project area
- No impact on Aquatic ecology of Brahmaputra River

b. Disadvantage

- Very high resettlement as settlements are all along the existing highway
- Acquisition of land and cutting of large numbers of trees
- Construction works likely to cause significant traffic jams throughout the construction period, dust during dry season and muddy roads during rainy season.
- Very high construction cost due to long length

(4) The Proposed Bridge Option – DPR Design

The proposed Bridge is the construction of two Four-lane bridges including approaches over Brahamputra River between Dhubri on the North Bank and Phulbari on the South Bank in the state of Assam/Meghalaya on NH-127B (Length: 20km) with minimum PAPs, this option is assessed as follows:

a. Advantage

- Provide easy and short distance connectivity to Dhubri and Phulbari
- Less number of PAPs
- Overall infrastructure development and economic development of the area.
- Negative ecological impacts on Brahmaputra are smaller compared to other options.
- No need for deforestation

b. Disadvantage

- Involuntary resettlement of the local residents will be reduced, however, in acquisition of approximate 65 Ha of land and significant number of PAPs.
- Construction works should cause significant traffic jams throughout the construction period, dust during dry season and muddy roads during rainy season.
- Increase of traffic volume including heavy load vehicles likely to cause noise, air pollution, and increase in traffic accidents along the road while some traffic is diverted to bypasses.
- Impact on aquatic fauna in Brahmaputra River during construction phase.

Given the above analysis results, the results of comparing and examining each option were ranked and are shown in the table below. Furthermore, the score was allocated according to the rank, and the option with the highest total score was selected as the best. The main objective of this project is to bring positive influence on the regional economy, so the "impact on local economy" was given a double score. As a result, **The Proposed Bridge Option** is recommended.

Table 4-2: Analysis of alternatives

Sr. No	Factors	Without Project Impacts	With Project Impacts		
			Alternative mode of transportation such as ferry	**The Alternative Route connect Dhubri and Phulbari by widening of existing NH-31 B and SH-46 through existing bridge near Goalpara**	**With Proposed bridge**
1	Involuntary resettlement	+++ No involuntary resettlement is incurred.	++ Land acquisition and involuntary resettlement will be incurred around ferry terminal area but on smaller scale.	-- Large scale of involuntary resettlement is expected due to upgrading of 200km of existing road.	+ Middle scale of involuntary resettlement is incurred along the alignment of the proposed bridge.
	Score	**4**	**1**	**3**	**2**
	Weighted score	**4**	**1**	**3**	**2**
2	Impact on natural ecosystem	+++ No direct impacts on natural ecosystem.	- Significant negative impacts are caused on the ecosystem of the Brahmaputra River by dredging of ferry terminals and navigation channels.	+ Natural environment is altered along the existing road for 200km, but no impacts on the Brahmaputra River.	++ Some impacts are caused on Brahmaputra River ecosystem during construction phase, but there will be little impact during operation phase.
	Score	**4**	**2**	**1**	**3**
	Weighted score	**4**	**2**	**1**	**3**
3	Pollution	+ Present status is continued.	- Possibility of water pollution such as oil	++ Air pollution and CO2 emission may decrease	+++ Overall air pollution and CO2 emission will

			leak from ferries.	due to improved road conditions.	be greatly reduced because travel distance between Dhubri and Phulbari is shortened by the bridge.
	Score	**2**	**3**	**1**	**4**
	Weighted score	**2**	**3**	**1**	**4**
4	Impact on local economy	- No positive or negative impact on local economy.	+ Connectivity between Dhubri and Phulbari is improved by the ferry, but it is susceptible to natural disasters such as flooding.	++ Connectivity between Dhubri and Phulbari is improved to some extent.	+++ Transport between Dhubri and Phulbari takes less time and becomes efficient, and it will enhance the local economy.
	Score	**1**	**3**	**2**	**4**
	Weighted score	**2**	**6**	**4**	**8**
	Total score	12	12	9	17
	Rank	2	2	4	1
	Evaluation	Local economic development is obstructed by the lack of road connectivity.	Expected positive impact is small while significant negative social and environmental impact is anticipated.	Scale of involuntary resettlement can be kept relatively small, but serious negative impacts on natural environment are anticipated.	Involuntary resettlement and impact on natural environment is anticipated. However, improvement of transportation will contribute to the development of local socioeconomic development.

Legend
+++ : best (most desirable) option; score 4 points
++: second-best option; score 3 points
+ : third-best option; score 2 points
-: worst (least desirable) option; score1 point
Source: JICA Study Team

4.3.2 Comparison of bridge alignment options

In order to minimize the social and environmental impacts, three alignment options were compared. The three options were set as follows. Each line is a line connecting the following combinations of the six points in the table below.

i) Option 1 represented by line AD: This option is designed to avoid residential areas in the Dhubri town and the islands as much as possible. The total length of the bridge and approach road will be longer, but the negative social impacts can be minimized.
ii) Option 2 represented by line BE: This option is designed to connect Dhubri and Phulbari in the shortest distance. The total length of the bridge and approach road can be minimized, but the start point of the bridge falls on the dense residential area of Dhubri town, alignment passes through residential area of the islands.
iii) Option 3 represented by line BFE: This option is designed to cross Brahmaputra River at a right angle. The navigable section of the bridge can be shortened and residential area on the islands can be avoided, but the start point of the bridge falls on the dense residential area of Dhubri town and the alignment is composed of more curves.

The proposed alignment option was finalized based on a desk study of satellite imageries available from "Google Earth" and a reconnaissance survey at site. The alignment options are detailed, node-wise in Figure 7-12 and the nodes are described below.

Table 4-3: Location of Nodes for the Bridge Alignment Alternatives

NODE	LOCATION
Node-A	At km 55+200 on proposed NH-127B, near Adabari Junction
Node-B	At Balajan Dhubri road, near Choto Bashjani (1.3km east of Adabari Junction)

Node-C	At College Road Junction with the bund road, near Bidyapara
Node-D	At Agia-Tura NEC Road, 400 m from Phulbari Ghat towards Agia
Node-E	At Agia-Tura NEC Road, 1km from Phulbari Ghat towards Agia
Node-F	On Southern Bank of Brahmaputra, near Borokalia Surjyamara

Source: DPR Inception Report

The methodology is adopted to review these three alignments by covering the following aspects.

Table 4-4 Evaluation Criteria

	Parameter	Evaluation	Data collection
Social Aspects	Affected structures	Larger number will cause larger impact	Satellite image and land survey
	Land to be acquired	Larger number will cause larger impact	Satellite image and land survey
	Permanent Char Land	Larger number will cause larger impact	Satellite image and land survey
Environmental Aspects	Total Length	Larger number will cause larger impact	Construction design by DPR consultants
	Agriculture Land	Larger number will cause larger impact	Construction design by DPR consultants
	Total Length over Brahmaputra River	Larger number will cause larger impact	Satellite image
Engineering Aspects	Total Length	Smaller number is preferable	Construction design by DPR consultants
	Length of bridge approach	Smaller number is preferable	Construction design by DPR consultants
	Horizontal Geometry : Total no. of curves	Smaller number is preferable	Construction design by DPR consultants
	Horizontal Geometry: Total length of curves	Smaller number is preferable	Construction design by DPR consultants
Indicative Cost Aspects	Total Approximate Civil Construction Cost	Smaller number is preferable	Construction design by DPR consultants

Social Aspects

The number of affected structures is considered as an equivalent to the scale of resettlement expected from the Project. Size of Land to be acquired is indicative of the scale of possible losses of livelihood considering that the population in the area is largely dependent on their land. The length of alignment passing through Permanent Char Land is also included in the parameters to evaluate the impact on Char people whose socio-economic status is lower than that of the inland communities.

Environmental Aspects

Total length is indicative of negative impacts such as noise, vibration, and air pollution at operation phase. As the total length increases, vehicles need to travel longer distances and larger negative impacts are anticipated.

Agriculture Land that overlaps with the alignment will be lost due to the construction of the bridge and cause negative environmental impacts such as loss of environmental services. Total Length over the Brahmaputra River is indicative of negative impacts of the project on the river ecosystem and endangered aquatic species such as Ganges river dolphins. The longer the length over Brahmaputra River is, the larger the damage on the river ecosystem will be.

Engineering Aspects

With regard to the total length of the bridge, because of higher construction technologies and costs of bridges compared with embankments, a shorter bridge length is rated favorable. With regard to the length of the approach, because of the necessity of new road constructions of approaches to

connect the bridge and the existing roads, a shorter approach length is rated favorable. With regard to the number of curves, because of easier drivability of roads with fewer curves, the fewer is rated favorable. With regard to the total length of curves, because of the requirement of complex structures and higher construction technologies, a shorter length is rated favorable.

Based on the above aspects, the parameter scores for various aspects and options are as follows. The numerical score was calculated by the following equation:

Score for Option X = 10 * value of Option X / Max value for 3 options

Table 4-5 Evaluation and Comparison of the Alternatives

Item	Unit	Max. Score	Option 1		Option 2		Option 3	
			Qty	Score	Qty	Score	Qty	Score
Social Aspects								
Affected structures	No.	10.0	122	6.52	170	9.09	187	10.00
Land to be acquired	ha	10.0	55.20	7.69	63.00	8.77	71.76	10.00
Permanent Char Land	km	10.0	6.30	9.40	6.70	10.00	5.10	7.61
Total Score		**30.0**		**23.61**		**27.86**		**27.61**
Evaluation				++		+		+
Environmental Aspects								
Total Length	km	10.0	19.282	10	17.847	9.26	18.797	9.75
Agriculture Land	ha	10.0	0.012	3.42	0.018	5.14	0.035	10
Total Length over Brahmaputra River	km	10.0	2.85	10	2.67	9.36	2.20	7.72
Total Score		**30.0**		**23.42**		**27.76**		**37.47**
Evaluation				++		+		-
Engineering Aspects								
Total Length	km	10.0	18.360	10.00	17.01	9.26	17.995	9.80
Length of bridge approach	km	10.0	0.471	10.00	0.465	9.87	0.430	9.13
Horizontal Geometry : Total no. of curves	no.	10.0	3	6.00	5	10.00	5	10.00
Horizontal Geometry: Total length of curves	M	10.0	983.2	3.24	2054.15	6.77	3035.09	10.00
Total Score		**40.0**		**29.24**		**35.90**		**38.93**
Evaluation				++		+		-
Indicative Cost Aspects								
Total Approximate Civil Construction Cost	Cr.	10.0	2858	9.47	3018	10.00	2889	9.57
Total Score		**10.0**		**9.47**		**10.00**		**9.57**
Evaluation				++		+		++
Total Rank			**1**		**2**		**3**	

As for the social aspects, Option 1 has less impact with respect to the number of affected structures and the size of the land to be acquired. Although Option 3 has less impact on the poor, the total score shows Option 1 as the most favorable option.

As for the environmental aspects, differences among the three options were relatively small for the total length and the total length over Brahmaputra, but impacts on agriculture land were most significant for Option 3.

As for the engineering aspects, although Option 1 is unfavorable with respect to a longer bridge length and approaches, it has a fewer curves and a shorter curve length deemed to be favorable. The comprehensive rating gives Option 1 the highest score.

Based on the above, Option 1, i.e. proposed bridge over river Brahmaputra between Dhubri on North Bank and Phulbari on South Bank in the state of Assam/Meghalaya on NH-127B, alignment AD (Length: 20km), is recommended.

CHAPTER 5 Scoping Analysis

5.1 Procedures of Scoping Analysis

Depending on the scale and nature of works during the various stages of the project, there are positive and negative impacts to the natural and social environment. These impacts are different in the intensity, in the spatial reach, and in whether it is irrevocable or temporary.

The scoping matrix highlights anticipated impacts that occur on various environmental and social components during the scoping stage of the project. The project may affect the aquatic ecosystem in terms of the impacts to the natural environment. Also, the ROW for this project is 60m in width, and social impacts such as land acquisition and resettlement are anticipated.

5.2 Scoping Matrix: Preliminary Analysis of the Environmental Impacts

The scoping matrix is shown in the table below. According to the JICA Guideline (2010), the impacts are rated as follows:

"A" denotes that severe/irrevocable impact is expected (+: Positive impact, -: Negative impact)

"B" denotes that significant impact is expected (+: Positive impact, -: Negative impact)

"C" denotes that impact is relatively small (+: Positive impact, -: Negative impact)

"D" denotes that impact with little significance occurs (+: Positive impact, -: Negative impact)

Table 5-1: Scoping Matrix for the Proposed Bridge Option

Item	Scoping Analysis of the Anticipated Environmental Impacts			
	Pre-construction	Construction Stage	Operation Stage	Rational of the Impact Assessment
Pollution				
Air Pollution	D	B-	B-	P: No impact is expected.
				C: Some negative impacts are expected due to the operation of construction equipment and vehicles. One example is dust incidental to earthwork especially during the dry season.
				O: Air pollution is expected to increase due to increase traffic volume on the road.
Water Pollution	D	B-	D	P: No impact is expected.
				C: Turbid water due to the earthworks, bridge pier construction work and wastewater effluents from construction workers' camps / yards are expected to pollute the Brahmaputra river to some extent.
				O: No impact is expected.
Wastes / Hazardous Materials	D	B-	D	P: No impact is expected.
				C: Waste will be generated from construction workers' camps. Waste generated from construction and demolition work may include hazardous materials that must be treated before final disposal.
				O: No impact is expected.
Soil Contamination	D	B-	D	P: No impact is expected.
				C: Impacts on soil from deposition of pollutants from construction materials in the construction site are expected to be small. Since there is no major industrial activity along the road, it is unlikely that soil along the road is already polluted.
				O: No impact is expected.
Noise and Vibration	D	B-	B-	P: No impact is expected.
				C: Noise and vibration generated by the operation of construction equipment and vehicles, although they are temporary. Construction schedule should take into account the location of schools, hospitals and religious facilities that require silence during parts of the day.
				O: Noise and vibration level are likely to increase due to greater traffic volume along the road. Specific measures may be required to minimize impacts on schools, hospitals and religious facilities.
Ground Subsidence	D	D	D	P/C/O: No impact is expected.
Offensive Odor	D	D	D	P/C/O: No impact is expected.
Bottom sediment	D	C	C	P: No impact is expected.
				C/O: The piers may cause slight change in the hydrodynamics and cause erosion of bottom sediment.

Item	Scoping Analysis of the Anticipated Environmental Impacts			
	Pre-construction	Construction Stage	Operation Stage	Rational of the Impact Assessment
Natural Environment				
Wildlife Reserve/ protected area	D	D	D	P: No impact is expected. C: No protected area exists within 10km radius of project area. O: No protected area exists within 10km radius of project area.
Eco-system/ Bio-diversity	D	A-	B-	P: No impact is expected. C: During the construction period, ecosystem in the project area including local flora and fauna will be damaged to some extent. O: Increase of traffic volume will cause negative impacts on the ecosystem including fauna and flora along the project road.
Topography/ Geology	D	B-	D	P: No impact is expected. C: Changes in topographic conditions over the project area takes place due to the need for cutting and filling work. O: No impact is expected.
Hydrology	D	B-	B-	P: No impact is expected. C: Construction work may cause minor and temporary impacts on hydrology because of pier construction, or the local use of water. O: Cutting and / or filling should result in minor changes of local hydrology.
Eco-system/ Bio-diversity	D	A-	B-	P: No impact is expected. C: During the construction period, ecosystems in the project area including local flora and fauna are damaged to some extent. O: Increase of traffic volume will cause negative impacts on the ecosystem including fauna and flora along the project road.
Social Environment				
Involuntary Resettlement	A-	D	D	P: The project will likely affect over 700 families. C: Resettlement will be completed before construction begins and thus no resettlement is expected during operation. O: No impact is expected, as relocation will be completed before construction begins.
Poor People	A-	B+	B+/B-	P: Given the limited coping capacity of the poor, it is necessary to assess their vulnerability and develop appropriate mitigation measures. C: The poor can benefit from employment opportunities during construction work. P: In the long-term, economic development in the region is likely to benefit the poor. However, the poor may not be able to receive benefits from the project due to the lack of skills and coping capacity.
Ethnic Minorities/ Indigenous People	C	C	C	P/C/O: According to initial site survey, there are no ST/SCs in the project area. However, the presence of ethnic minorities will be confirmed during the census survey.
Local	A-	B+	B+	P: Loss of income sources and livelihood due to involuntary

Item	Scoping Analysis of the Anticipated Environmental Impacts			
	Pre-construction	Construction Stage	Operation Stage	Rational of the Impact Assessment
Economy and Livelihood		/B-	/B-	resettlement are expected to negatively affect the local economy and livelihood.
				C: Economic activity of fishermen may have negative impact during construction period. On the other hand, employment opportunities of various skill levels will be created by the project.
				O: Economic activity of boat operators may be affected. On the other hand, by improving transportation network, access to market and public facilities will be improved and positive impact on regional development can be expected.
Land Use	B-	B-	D	P: Land acquisition and involuntary resettlement are likely to cause changes in the existing land use patterns.
				C: Land use is expected to change for the construction of construction yards and workers' camps, however the impact is temporary.
				O: Land usage along the alignment will be permanently changed, however a negative impact is not expected. Construction yard will be restored to their original conditions by the contractors.
Utilization of Local Resources	D	B-	D	P: No impact is expected.
				C: The use of local resources such as sand, crushed stone, etc. for the construction activities may have negative impact on the local use.
				O: No impact is expected as use of local resources is not expected during operation.
Water Usage, Water Rights and Communal Rights	D	D	D	P/C/O: No impact is expected.
Social Infrastructure and Services	B-	B-	B+/B-	P: One school may be affected and require relocation.
				C: If the school will be relocated to the area close to the alignment, noise from increased traffic is expected.
				O: If the school will be relocated to the area close to the alignment, noise from increased traffic is expected. In the long term, the project is expected to improve access to social infrastructure and services by providing a better transport network.
Social Institutions and Local Decision-making Institutions	D	D	D	P/C/O: Land acquisition and involuntary resettlement will be implemented based on existing social and local decision-making institutions so no impact will be expected.
Unequal Distribution	B-	B-	B-/B+	P: Land acquisition and involuntary resettlement will lead to unequal distribution of benefits and damage between those who

Item	Scoping Analysis of the Anticipated Environmental Impacts			
	Pre-construction	Construction Stage	Operation Stage	Rational of the Impact Assessment
of Benefit and Damage				are directly affected by the project and those who are not.
				C: Those who are affected by Land acquisition and resettlement should have preference in access to employment opportunities by the construction work.
				O: There is a possibility of uneven distribution of benefits between bridge connection site and Char land. In the long term, the project is expected to have a positive impact on the local economy through an improved transportation network.
Local Conflicts of Interests	D	D	D	P/C/O: No impact is expected.
Cultural and Historical Heritage	D	D	D	P/C/O: The proposed bridge does not traverse or run near major cultural or historical heritage sites.
Landscape	D	D	D	P/C/O: No impact is expected.
Gender	B-	B-	D	P: Involvement of women should be ensured during the course of the land acquisition and resettlement process.
				C: Equal opportunity should be sought for employment during construction work.
				O: No impact is expected.
Children's Rights	B-	D	D	P: One school playground will be affected by land acquisition.
				C/O: Child labor is unlawful according to Article 24 of the Indian Constitution. Only adults are eligible for potential employment opportunities created by the project.
Public Health (sanitation and infectious diseases)	D	B-	D	P: No impact is expected.
				C: Influx of construction workers is likely to increase the health risk, particularly that of STD / STI and HIV / AIDS.
				O: No impact is expected.
Occupational Health and Safety (OHS)	D	B-	B-	P: No impact is expected.
				C: Occupational health and safety of construction work should be properly managed through adequate EMP.
				O: Maintenance and repair work should take into account the occupational health and safety of the workers.
Others				
Accidents	D	B-	B-	P: No impact is expected.
				C: Increased risk of accidents associated with construction activities is expected due to the operation of heavy equipment and vehicles.
				O: Risks of accidents is expected to increase due to greater traffic volume and speed.
Climate Change	D	D	D	P: No impact is expected.
				C: The use of construction machines and operation of vehicles will result in an increase of GHG emissions, though the impact is small and short-term.

Item	Scoping Analysis of the Anticipated Environmental Impacts			
	Pre-construction	Construction Stage	Operation Stage	Rational of the Impact Assessment
				O: The new bridge will shorten the truck transportation distance which reduces GHG emission. On the other hand, traffic volume is expected to increase. However, it is not significant enough to have impact on climate change and transboundary effects.

Source: JICA Study Team

5.3 TOR of Natural and Socio-economic Environment Survey

TOR of the Natural Environment and Socio-economic Survey is shown in the table below.

Table 5-2: TOR of Natural and Socio-economic Environment Survey

Item	Locations	Items Subject to Investigation	Method of Assessment and Estimation of Impacts
Air Quality	3-4 locations along the bridge alignment (approximately every 10km)	• PM2.5, PM10, NOx, SO2	• Review of DPR environmental study • Continuous 24 hours per location (1 weekday) • Accordance with environmental standards in India • General trend of increase in traffic and vehicles is taken into account and CO_2 increase is qualitatively analysed.
Water Quality	3-4 locations along the bridge alignment	• Water temperature, turbidity (NTU), pH、 BOD5, COD	• Review of DPR environmental study • Accordance with environmental standards in India • Impacts during the construction period and operation and maintenance period are qualitatively analysed based on construction plan and similar projects
Solid Waste		• Solid waste production and disposal during the construction period • Solid waste produced during the maintenance works of the Project	• Review of DPR environmental study • Impacts during the construction period and operation and maintenance period are qualitatively analysed based on construction plan and similar projects
Soil Contamination	3-4 locations along the bridge alignment	• pH, Manganese, Iron, etc.	• Review of DPR environmental study • Soil sampling and laboratory analysis • Impacts during the construction period and operation and maintenance period are qualitatively analysed based on construction plan and similar projects
Noise and Vibration	3-4 locations along the bridge alignment	• Noise level	• Review of DPR environmental study • Accordance with environmental standards in India • Impacts during the construction period and operation and maintenance period are qualitatively analysed based on construction plan and similar projects
Bottom Sediment		• Hydrodynamic analysis	• Review of DPR environmental study • Impacts during the construction period and operation and maintenance period are qualitatively analysed based on construction plan and similar projects
Ecosystem/ Biological Diversity	Entire Project Area	• Presence/absence of rare species	• Field Survey • Document survey • Hearing Survey on local NGO/ experts. • Impacts during the construction period and operation and maintenance period are qualitatively analysed based on construction plan and similar projects
Hydrogeography	Entire Project Area	• Existing waterways such as rivers, streams and agricultural canals as well as sewage channels	• Review of DPR environmental study • Document survey • Field survey, map location study of the disaster-prone areas • Impacts during the construction period and operation and maintenance period are qualitatively analysed based on construction plan and similar projects
Geography/	Entire Project Area	• Areas subject to cut and fill	• Review of DPR environmental study

Item	Locations	Items Subject to Investigation	Method of Assessment and Estimation of Impacts
Geomorphology		slope creation	• Document survey • Field survey • Impacts during the construction period and operation and maintenance period are qualitatively analysed based on construction plan and similar projects
Involuntary Resettlement	Within ROW	• Population, asset inventory, livelihood • Resettlement and rehabilitation cost	• Census Survey • Focused Group Discussion • Estimate the quantitative impact of affected households, land and properties. • Estimate the cost of resettlement and rehabilitation, restoration program
Poor People	Within ROW	• Livelihood and employment status • Literacy	• Census Survey • Socio-economic Survey • Estimate the impacts based on result of Field Survey, Review of Document plus Similar Examples
Ethnic Minorities/ Indigenous People	Within ROW	• Ethnicity, Language • Livelihood	• Census Survey • Socio-economic Survey • Estimate the impacts based on result of Field Survey, Review of Document
Local Economy and Livelihood	Within ROW and area surrounding the proposed alignment	• Regional economic situation • Social structure • Income and livelihood	• Census Survey • Socio-economic Survey • Focused Group Discussion • Estimate likely impacts on the local economy based on Review of Document plus Similar Examples • Estimate the impact on livelihoods based on the quantitative data of the socioeconomic status of PAPs
Land Use	Within ROW	• Land utilization • Extent of Impact by the project	• Socio-economic Survey • Review project content • Estimate the impacts based on result of Field Survey, Review of Document plus Similar Examples
Utilization of Local Resources	Area surrounding the proposed alignment	• Volume of local resource use • Extent of Impact by the project	• Socio-economic Survey • Review project content • Estimate the impacts based on result of Field Survey and Review of Document
Social Infrastructure and Services	Area surrounding the proposed alignment	• Target facilities • Distant from ROW, location • Accessibility	• Socio-economic Survey • Estimate the impacts based on information of utility infrastructure and public facilities (medical, school, religious facilities)
Unequal Distribution of Benefit and Damage	Within ROW and area surrounding the proposed alignment	• Livelihood of PAP and surrounding area • Utilization of Affected Land	• Census Survey • Focused Group Discussion • Estimate the impacts based on result of income sources of PAPs and other villagers plus Similar Examples
Gender	Within ROW and area surrounding the proposed alignment	• Social Structure • Livelihood and employment status	• Socio-economic Survey • Focused Group Discussion

Item	Locations	Items Subject to Investigation	Method of Assessment and Estimation of Impacts
		• Literacy	• Documents and reports of similar projects in the neighbouring areas. • Estimate the impacts based on result of Field Survey, Review of Document plus Similar Examples
Children's Rights	Within ROW and area surrounding the proposed alignment	• Number of students • Facilities nearby	• Socio-economic Survey • Estimate the impacts based on result of Field Survey plus Similar Examples
Public Health (sanitation and infectious diseases)	100m from the proposed alignment	• Rate of disease, epidemic and tendency	• Review of documents of the similar projects. • Estimate the epidemic of diseases and tendency through Review of Document plus Similar Examples
Occupational Health and Safety (OHS)	Area surrounding the proposed alignment	• Risk of Safety and Health, countermeasure	• Review of documents including EMP of the similar projects. • Estimate the impacts based on Similar Examples
Accidents	Area surrounding the proposed alignment	• Traffic demand • Accident risk and measures	• Review of documents including EMP of the similar projects. • Estimate accident risk, tendency and measures based on Review of Plan plus Similar Examples

Source: JICA Study Team

CHAPTER 6 Anticipated Environmental Impacts

6.1 Impacts on the living environment

6.1.1 Survey Results

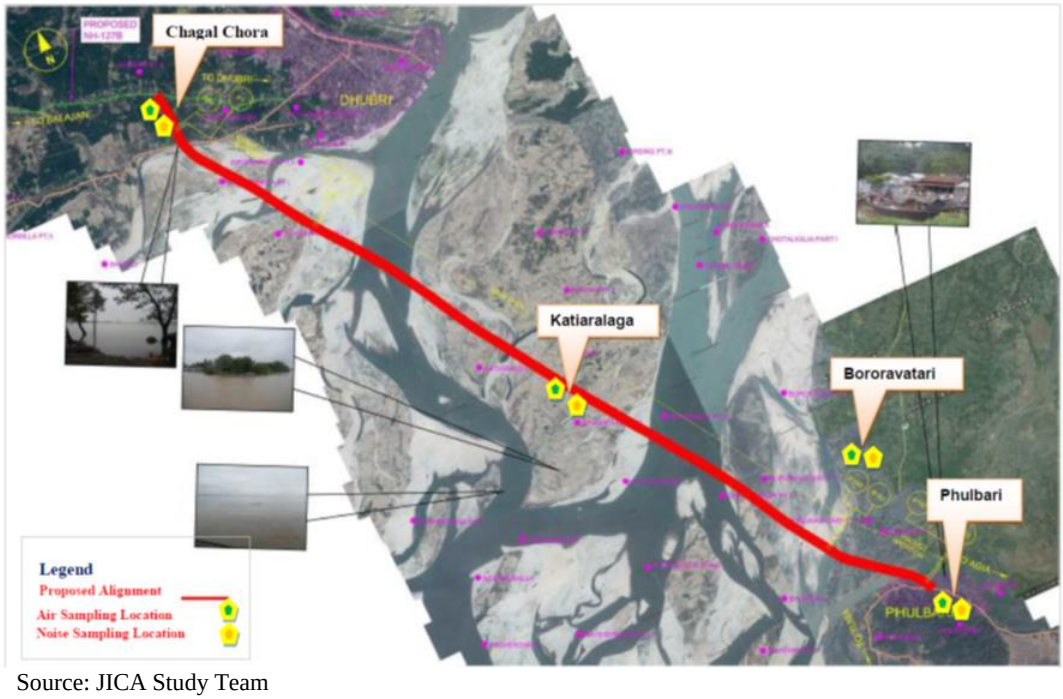
1) Air Quality

Ambient air samples were collected and analyzed at 4 locations along the proposed alignment of the bridge in October 2016. The results are shown below. At all sampling locations, the concentrations of air pollutants were below the national environmental standards.

Table 6-1: Ambient Air Quality along proposed Dhubri – Phulbari bridge

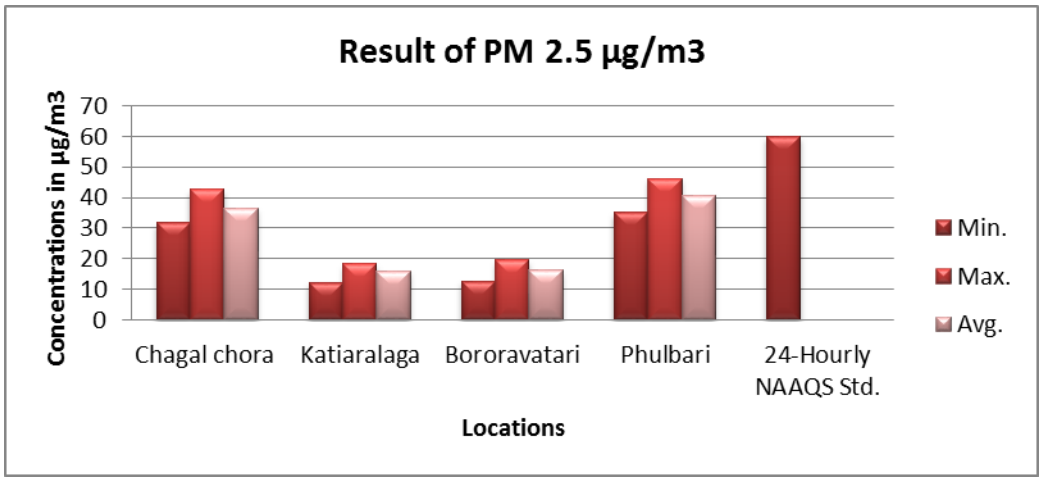
Chagal chora (Latitude 26°02'0.32"N & Longitude 89°56'15.67"E)					
	$PM_{2.5}$,µg/m3	PM_{10},µg/m3	SO_2 µg/m3	NOx ,µg/m3	CO, µg/m3
Min	31.7	78.6	8.2	15.2	450
Max	42.6	86.3	10.2	22.4	750
Average	36.6	81.8	9.0	18.6	567.1
Katiaralaga (Latitude 25^0 57' 49.90" N & Longitude 89^0 58'38.26" E)					
	$PM_{2.5}$,µg/m3	PM_{10},µg/m3	SO_2 µg/m3	NOx ,µg/m3	CO, µg/m3
Min	12.2	45.2	BDL	8.2	220
Max	18.3	56.4	BDL	10.4	290
Average	16.0	50.8	BDL	9.2	251.3
Bororavatari (Latitude 25^0 55' 03.91" N & Longitude 90^0 00' 53.50" E)					
	$PM_{2.5}$,µg/m3	PM_{10},µg/m3	SO_2 µg/m3	NOx ,µg/m3	CO, µg/m3
Min	12.8	47.2	BDL	8.8	230
Max	19.6	59.4	BDL	11.6	310
Average	16.2	54.2	BDL	9.9	270.0
Phulbari (Latitude 25^0 53' 21.04" N & Longitude 90^0 02' 13.40" E)					
	$PM_{2.5}$,µg/m3	PM_{10},µg/m3	SO_2 µg/m3	NOx ,µg/m3	CO, µg/m3
Min	35.2	79.6	8.9	16.2	460
Max	46.2	88.7	11.5	23.7	780
Average	40.7	83.2	10.1	19.6	576.3

Source: JICA Study Team



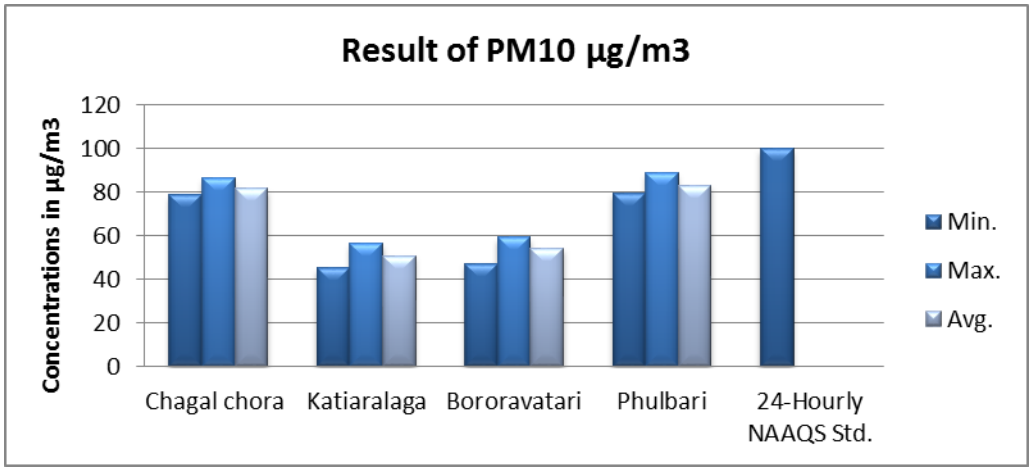
Source: JICA Study Team

Figure 6-1: Sampling locations for ambient air quality and noise level



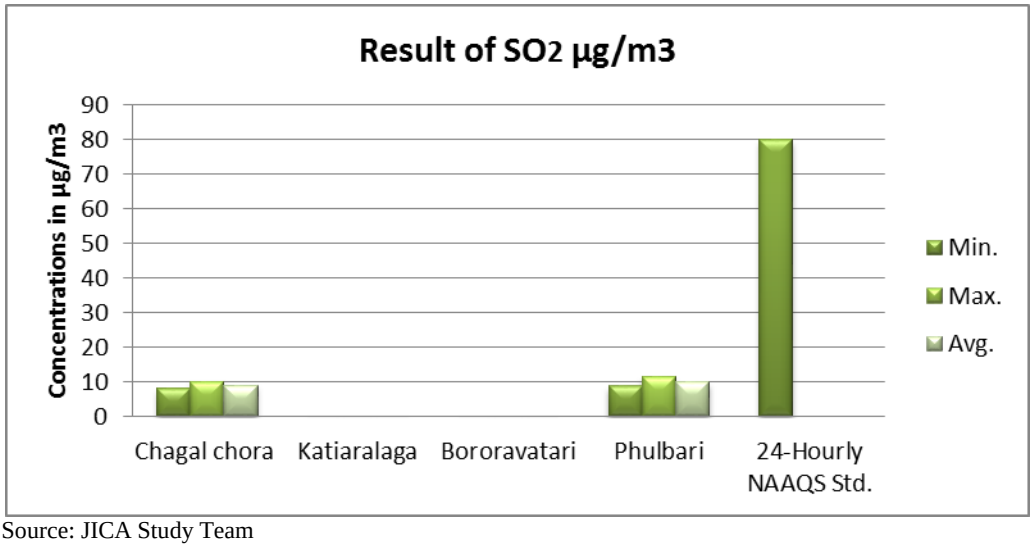
Source: JICA Study Team

Figure 6-2: Concentration of PM2.5 at locations along proposed Dhubri – Phulbari bridge on NH-127B



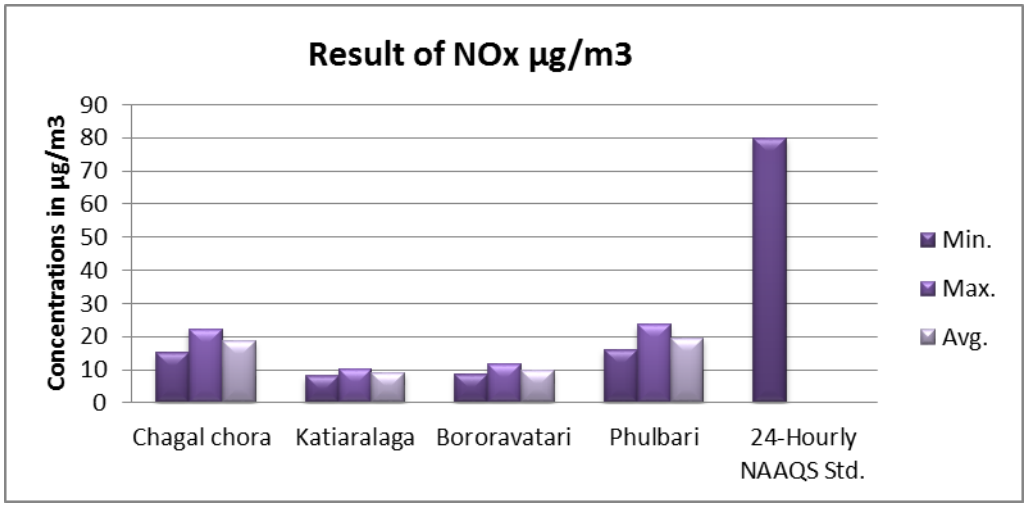
Source: JICA Study Team

Figure 6-3: Concentration of PM10 at locations along proposed Dhubri – Phulbari bridge on NH-127B



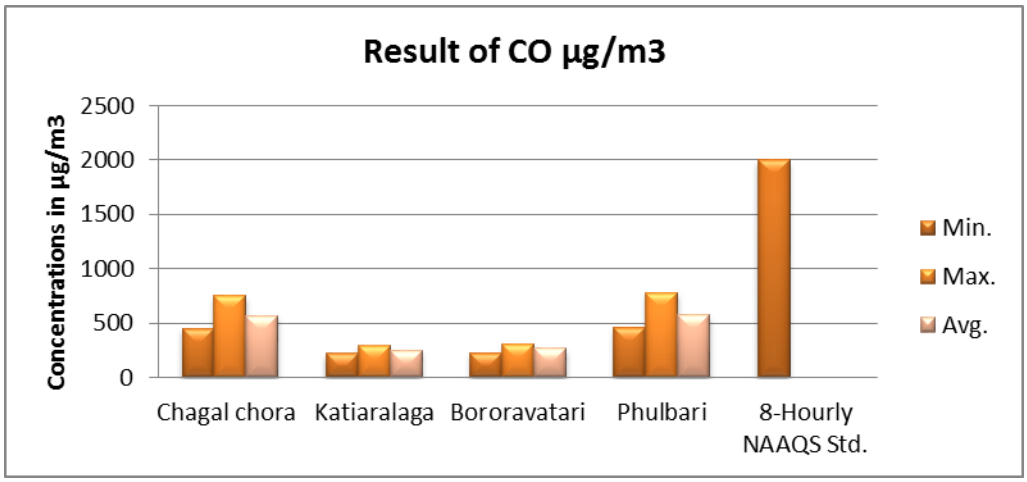
Source: JICA Study Team

Figure 6-4: Concentration of SO_2 at locations along proposed Dhubri – Phulbari bridge on NH-127B



Source: JICA Study Team

Figure 6-5: Concentration of NO_X at locations along proposed Dhubri – Phulbari bridge on NH-127B

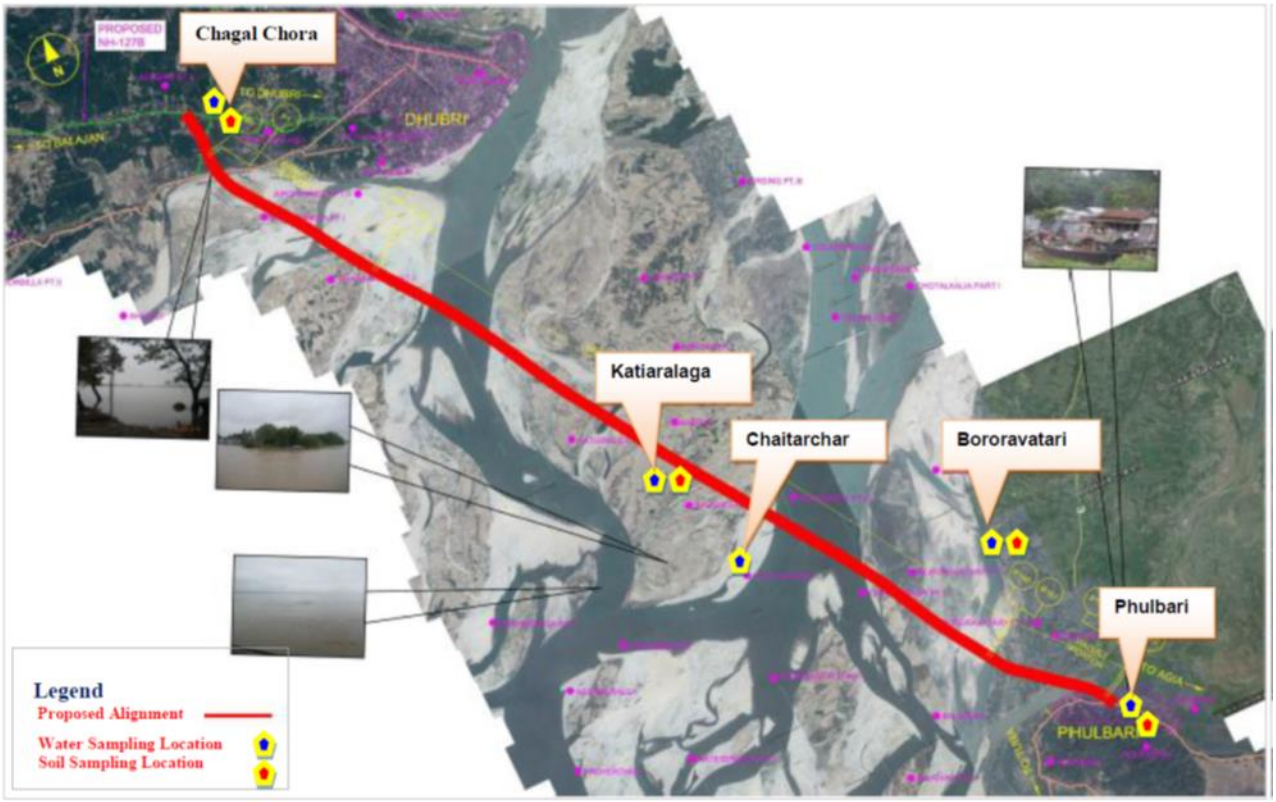


Source: JICA Study Team

Figure 6-6: Concentration of CO at locations along proposed Dhubri – Phulbari bridge on NH-127B

2) Water and Soil Quality

The monitoring of the water quality (surface and ground water) was performed at five identified locations in October 2016, in accordance to the Indian Standard Drinking Water Specification – IS 10500: 2012 and the quality met the IS Standards except for the pH, which is mildly acidic in Phulbari (dug well) and found to be 6.2 in pH scale. The bacteriological parameters are well within the standard limit except at Bororavatari perhaps due to waste from human intervention in the form of release of untreated waste. As for the soil quality, the results indicate no pollution.



Source: JICA Study Team

Figure 6-7: Sampling locations for water and soil quality

Table 6-2: Water quality (Surface and Ground water) along proposed Dhubri – Phulbari Bridge on NH-127B

Sl. No.	Parameters	Unit	Limit (as per IS:10500-2012)		Chagal Chora (Latitude 26°02'0.58"N & Longitude 89°56'15.22"E) (Bore well)	Chaitarchar (Latitude 25°55'49.65"N& Longitude 89°59'30.77"E) (Brahmaputra River)	Katiaralaga (Latitude 25^0 57' 48.71" N & Longitude 89^0 58'34.52" E) (Hand pump)	Bororavatari (Latitude 25^0 55' 00.77" N & Longitude 90^0 01' 45.56" E) (Jinger River)	Phulbari (Latitude 25^0 53' 21.04" N & Longitude 90^0 02' 13.40" E) (Dug well)
			Desirable Limit	Permissible Limit					
1	pH	-	6.5-8.5	No Relaxation	6.56	7.54	7.29	6.63	6.02
2	Colour	Hazen	5	25	<5	<5	<5	<5	<5
3.	Turbidity	NTU	5	10	BDL	5.5	BDL	6.5	BDL
3	Dissolved Oxygen	% By Mass	5	10	7.2	6.5	6.5	7.0	6.0
4	BOD (at 27^0C 3-Days)	mg/l	-	-	<2.0	3.8	<2.0	4.2	<2.0
5	COD	mg/l	-	-	BDL	10.6	BDL	16.0	BDL
6	TKN	mg/l	-	-	3.1	3.2	2.5	3.5	2.0
7	Total Hardness (as $CaCO_3$)	mg/l	200	600	204.30	60.4	186.60	45.6	120
8	Calcium (as $CaCO_3$)	mg/l	75	200	168	44.40	153	34.6	94
9	Magnesium (as $CaCO_3$)	mg/l	30	100	38.3	16.0	33.6	11	26
10	Ammonia (NH_3)	mg/l			BDL	BDL	BDL	BDL	BDL
11	Electrical Conductivity	Microm/hos/cm	-	-	649.87	184.17	660.99	177.91	598.06
12	Chloride (as Cl)	mg/l	250	1000	23.99	0.5	27.3	4.49	50.99
13	Sulphate (as SO_4)	mg/l	200	400	46.52	8.4	38.4	19.6	41.0
14	Phosphates	mg/l	-	-	BDL	BDL	BDL	BDL	BDL
15	Nitrate (as NO_3)	mg/l	45	No Relaxation	10.68	3.8	8.32	2.6	9.6
16	Fluoride (as F)	mg/l	1	1.5	0.45	0.32	0.31	0.28	0.23
17	Arsenic (As)	mg/l	-	-	<0.01	<0.01	<0.01	<0.01	<0.01
18	Lead (as Pb)	mg/l	-	-	<0.01	<0.01	<0.01	<0.01	<0.01
19	Mercury(as Hg)	mg/l	-	-	<0.001	<0.0001	<0.001	<0.001	<0.001

Sl. No.	Parameters	Unit	Limit (as per IS:10500-2012)		Chagal Chora (Latitude 26°02'0.58"N & Longitude 89°56'15.22"E) (Bore well)	Chaitarchar (Latitude 25°55'49.65"N& Longitude 89°59'30.77"E) (Brahmaputra River)	Katiaralaga (Latitude 25^0 57' 48.71" N & Longitude 89^0 58'34.52" E) (Hand pump)	Bororavatari (Latitude 25^0 55' 00.77" N & Longitude 90^0 01' 45.56" E) (Jinger River)	Phulbari (Latitude 25^0 53' 21.04" N & Longitude 90^0 02' 13.40" E) (Dug well)
			Desirable Limit	Permissible Limit					
20	Phenols	mg/l	-	-	<0.01	<0.01	<0.01	<0.01	<0.01
21	Cyanides	mg/l	-	-	BDL	BDL	BDL	BDL	BDL
22	TDS	mg/l	500	2000	422.41	119.71	429.64	115.64	388.74
23	Iron (as Fe)	mg/l	0.3	1.0	0.165	0.24	0.18	0.54	0.14
24	Alkalinity as ($CaCO_3$)	mg/l	200	600	221	68	216	51	168
25	Sodium (as Na)	mg/l	-	-	32.6	12	56.7	16.30	62.5
26	Potassium (as K)	mg/l	-	-	1.8	1.33	3.5	2.2	3.8
27	Total Organic Carbon (TOC)	mg/l	-	-	3.2	0.092	2.7	1.9	2.6
28	Zinc	mg/l	5	15	<0.05	0.044	<0.05	<0.05	0.208
29	Cadmium	mg/l	0.003	No Relaxation	<0.001	<0.01	<0.001	<0.001	<0.001
30	Chromium	mg/l	0.05	No Relaxation	<0.05	<0.01	<0.05	<0.05	<0.05
31	Manganese (as Mn)	mg/l	0.1	0.3	<0.1	<0.1	<0.1	<0.1	<0.1
32	Nitrite (as No_2)	mg/l	<0.01	No Relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
Bacteriological Parameters									
1.	Fecal Coliform	MPN/100 ml	Shall Not be Detectable		Absent	168	Absent	210	Absent
2.	Total Coliform	MPN/100 ml	Shall Not be Detectable		Absent	655	Absent	740	Absent

Source: JICA Study Team

Table 6-3: Soil quality (Surface and Ground water) along proposed Dhubri – Phulbari Bridge on NH-127B

S.No.	PARAMETERTS	TEST METHOD	UNIT	Chagal chora (Latitude 26°01'59.13"N & Longitude 89°56'16.42"E)	Katiaralaga (Latitude 25^0 57' 48.75" N & Longitude 89^0 58'34.64" E)	Bororavatari (Latitude 25^0 55' 07.21" N & Longitude 90^0 00' 56.29" E)	Phulbari (Latitude 25^0 53' 20.24" N & Longitude 90^0 02' 14.60" E)
1.	pH(1:5 suspension)	IS:2720(Part-26)	-	6.2	5.9	5.4	6.5
2.	Electrical Conductivity at 25^OC (1:2suspension.)	IS:2720(Part-21)	µS/cm	449	490	378	461
3.	Calcium Sulphates	STP/SOIL	mg/kg	BDL	BDL	BDL	BDL
4.	Magnesium (as Mg)	STP/SOIL	mg/kg	132.85	123.4	145.6	115.0
5.	Organic Matter	IS:2720(Part-22)	% by mass	6.36	5.12	5.76	6.67
6.	Potassium (as K)	STP/SOIL	mg/kg	128.5	114.3	122.7	137.9
7.	Water Holding Capacity	STP/SOIL	% by mass	31.1	22.8	29.36	26.71
8.	Porosity	STP/SOIL	% by mass	23.3	17.3	22.82	32.7
9.	Sand	STP/SOIL	% by mass	38.0	37.8	39.3	36.4
10.	Clay	STP/SOIL	% by mass	54.6	55.2	52.7	54.4
11.	Silt	STP/SOIL	% by mass	7.4	7.0	8.0	9.2
12.	Sodium Sulphates	STP/SOIL	mg/kg	13.9	12.20	15.76	12.5
13.	Sodium Absorption Ratio	STP/SOIL	-	4.12	4.49	4.51	5.23
14.	Nitrogen	STP/SOIL	% by mass	0.062	0.057	0.051	0.076
15.	Phosphorus	STP/SOIL	mg/kg	22.7	18.4	16.20	21.93
16.	Bulk Density	STP/SOIL	gm/cc	1.30	1.37	1.52	1.45

S.No.	PARAMETERTS	TEST METHOD	UNIT	Chagal chora (Latitude 26°01'59.13"N & Longitude 89°56'16.42"E)	Katiaralaga (Latitude 25^0 57' 48.75" N & Longitude 89^0 58'34.64" E)	Bororavatari (Latitude 25^0 55' 07.21" N & Longitude 90^0 00' 56.29" E)	Phulbari (Latitude 25^0 53' 20.24" N & Longitude 90^0 02' 14.60" E)
17.	Texture	STP/SOIL	-	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay
18.	Moisture Retention capacity	STP/SOIL	%by mass	20.6	18.9	22.3	19.6
19.	Infiltration Rate	STP/SOIL	mm/hr	23.4	21.0	19.66	24.2
20.	Moisture	STP/SOIL	%	16.82	14.3	13.28	15.6
21.	Sulphates	STP/SOIL	mg/1000g	13.4	15.7	17.9	14.62
22.	Available Sulphur (as S)	STP/SOIL	mg/kg	0.081	0.072	0.060	0.078
23.	Available Manganese (as Mn)	STP/SOIL	mg/kg	0.048	0.040	0.051	0.059
24.	Available Iron(as Fe)	STP/SOIL	mg/kg	0.63	0.71	0.68	0.076
25.	Exchangeable Sodium Percentage	STP/SOIL	mg/kg	0.076	0.052	0.067	0.059

Source: JICA Study Team

3) Noise Levels

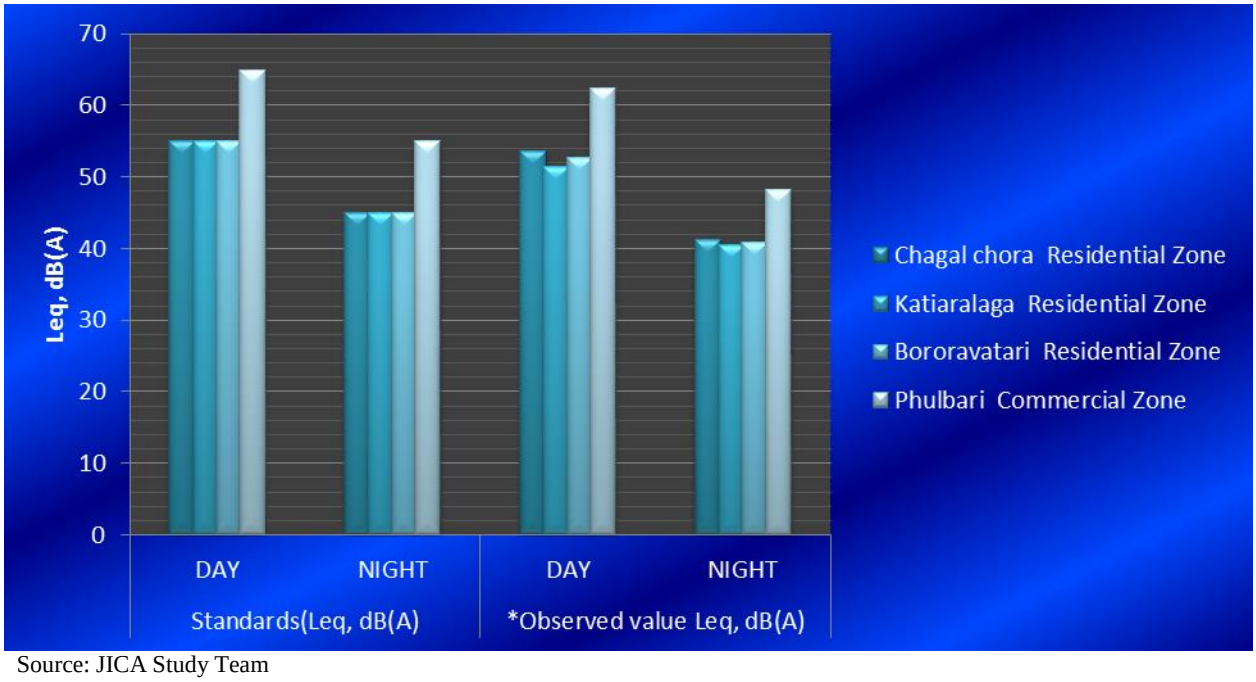
Monitoring of the noise levels were done at four identified locations along the proposed Dhubri – Phulbari bridge on NH-127B during October 2016, as per Ambient Air Quality standards with respect to noise, (2000). Results of noise levels are presented in Table below, a map of ambient noise locations is presented in Figure 7-21 and a location wise comparative chart for noise levels is presented in Figure 7-21.

Currently there is no source of vibration in the project area. Therefore vibration data was not measured.

Table 6-4: Noise Levels along proposed Dhubri – Phulbari Bridge on NH-127B

Sl. No	Date of Monitoring	Location	ZONE	Standards (Leq, dB(A)		*Observed value Leq, dB(A)	
				DAY	NIGHT	DAY	NIGHT
1	04.10.2016	Chagal chora (Latitude 26°02'0.58"N & Longitude 89°56'15.22"E)	Residential Zone	55	45	53.6	41.2
2	04.10.2016	Katiaralaga (Latitude 25^0 57' 48.75" N & Longitude 89^0 58'34.64" E)	Residential Zone	55	45	51.4	40.5
3	05.10.2016	Bororavatari (Latitude 25^0 55' 05.21 N & Longitude 90^0 00' 54.81" E)	Residential Zone	55	45	52.7	40.8
4	05.10.2016	Phulbari (Latitude 25^0 53' 20.91" N & Longitude 90^0 02' 15.30" E)	Commercial Zone	65	55	62.4	48.2

Source: JICA Study Team



Source: JICA Study Team

Figure 6-8: Ambient Noise Quality Results at locations along proposed Dhubri – Phulbari bridge on NH-127B

6.1.2 Anticipated Impacts and Mitigation Measures

1) Air Quality

Impacts

During the construction phase, the short-term and localized degradation of air quality will occur from dust generation due to the procurement and transportation of raw materials from quarries and borrow pits, site clearance, use of heavy vehicles, machinery/ equipment, stone crushing handling and the storage of aggregates and generation of fine particulate matter (smoke) in asphalt processing. Dust would be generated from the haulage of materials and detouring of traffic on non-permanent, temporary pavement etc. Hot mix plants contribute substantially to the deterioration of air quality due to emissions of oxides of Sulphur, Hydrocarbons and particulate matter. During the construction period, temporary impacts include the generation of Odor from construction activities as well as from construction camps. During the construction of the road, the movement of different types of construction machinery and vehicle will increase. This in another way increases the fuel consumption. From the results of the ambient air quality monitoring conducted along the road, it is noted that the monitoring parameters are within the standards as prescribed by the Central Pollution Control Board. The concentration of the air pollutants will further increase during construction period but for a limited period only. The impacts on the air quality during construction will be mostly localized and concentrated within the ROW. The impacts due to dust generation may be felt downwind of the site rather than the site itself due to local wind patterns.

During the operation phase, the project road is mostly passing through the rural areas with alluvial soil. Dust generation due to the movement of vehicles is envisaged along the project road, but not in significant amount. Due to increase in speed and volumes of vehicular traffic on the project corridor, marginal increase in the air pollutant levels is expected but not significant. Construction of the bridge will attract larger communities to use this corridor which in-turn increases the fuel consumption and can have direct impact on the national economy and local ecosystem.

Mitigation Measures

The hot mix plants, crushers and the batching plants will be sited at least 500m in the downwind direction from the nearest settlements and forest areas. All precautions to reduce the level of dust emissions from the hot mix plants, crushers and batching plants will be taken. The hot mix plant will be fitted with a dust extraction system. Asphalt and concrete plants will be operated in conformity with government pollution control legislation, and located away from the settlements as far as possible. All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the SPCB norms. Regular monitoring of particulate matter at crusher sites, during the construction, will be conducted. Regular water sprinkling will be done on the cement and earth mixing sites, asphalt mixing site and temporary service and access roads. After compacting the earthwork, water will be sprayed to prevent dust emission. The vehicles delivering construction material will be covered to avoid spilling. Planting of trees/vegetation on the periphery of the construction site will be taken.

During the operation stage of the project, vehicular emissions of critical pollutants (PM2.5, PM10, CO, HC, SO2, and NOx) will be monitored and roadside tree plantation will be maintained. Over the long-term, projected increase in traffic volume, particularly ones of heavy trucks, may pose health threat to roadside community. The peak hourly estimated traffic volumes for the years 2020 and 2035 have been considered to project future air quality scenarios to provide an indication of long-term variations in air quality. The future level of air pollution, modeled based on the projected increase in traffic volume indicates that the level of pollution (CO and NOx levels) will remain below the standard during the projected period (2035). Nevertheless, mitigation measures such as introducing speed limit and other measures to control congestion in built-up area may be necessary in the longer term. The RSPM values may increase as the traffic volume increases, however

implementation of new Euro Norms in vehicle & Air Pollution control measures will ensure that values do not exceed the limit during operation stages.
Also, local communities should be well informed of the risk of air pollution. Awareness raising campaigns may include distribution of facemask to mitigate risk of air pollution and other information kits. Finally, relevant data (e.g. actual/projected traffic volume and likely emissions) shall be shared with relevant State authorities so that mitigation measures can be developed.

2) Water Quality

Impacts
Bridge projects may marginally lead to increased run-off during construction stages, which will increase sediment accumulation in nearby water bodies, the impacts due to the increased run-off would be negligible due to the project road. During construction, the disposal of solid and liquid waste from labor camps, fuel and lubricant spills, or leaks from construction vehicles, pollution from fuel storage and distribution sites and that from hot-mix plants is likely to affect water quality unless adequate mitigation measures are designed. Hence, change in natural drainage pattern is very insignificant to the present state of the project. No chemical pollution is expected since no hazardous materials will be used during the construction phase.

Use of water for construction activities such as compaction, suppression, concrete work may pose pressure on local water supplies; the demand would be met from surface water bodies like ponds, canal and rivers. Municipal water supply will be used only for drinking purposes (for construction camps), if available, and if permitted by the local municipal authority. No local/municipal water supply would be used for construction purposes.

Road and bridge projects may marginally lead to increased run-off during operational stages due to increases in impervious surfaces and sediment will accumulate in water bodies.

In the operation stage, pollutants from vehicles, and accidental fuel spills may make their way into the receiving environment. The major pollutants of concern are suspended solids, oil and grease, lead etc. No adverse direct impact on the water quality (both underground and surface water bodies) is expected during the operation period. The change in natural drainage pattern is expected to be very insignificant from the present state of the project.

Mitigation Measures
To avoid contamination of the various water bodies and drainage channels, construction work close to the watercourses or other water bodies will be avoided, especially during monsoon period. All necessary precautions will be taken to construct temporary or permanent devices to prevent water pollution due to increased siltation and turbidity. All wastes arising from the project will be disposed of, as per the State Pollution Control Board/Central Pollution Control Board norms, so as not to block the flow of water in the channels. The wastes will be collected, stored and taken to approve disposal sites.

To avoid contamination of the water body and drainage channels from fuel and lubricants, the vehicles and equipment will be properly maintained and refueled only at designated places. The slopes of embankment leading to water bodies will be modified and re-canalized so that contaminants do not enter the water body. Oil and grease traps will be provided at fueling locations, to prevent contamination of water.

Discharge of oil and grease is most likely from construction vehicle parking areas, vehicle repair areas and workshops. An oil interceptor shall be provided to ensure that all wastewater flows into the interceptor prior to its discharge. The device has a chamber for separation of oil and water and can handle 200 L/hour of wastewater. The oil float appearing on the surface is removed by periodic cleaning once a week by skimming off the oil film from the surface.

The sewage system (including septic tanks and soak pits) for construction camps will be properly designed and built so that no water pollution takes place in any water body or watercourse. The workplace will have proper medical approval by local medical, health or municipal authorities. The contractor will make arrangements for water required for construction in such a way that the water availability and supply to nearby communities remains unaffected. Due to the non-availability of water required for construction, if a new tube-well is to be bored, prior sanction and approval by the Central Ground Water Board (CGWB) will be obtained. Wastage of water during the construction will be minimized.

3) Wastes/Hazardous Materials

Types of construction waste which are expected to be generated include asphalt chunks, chunks of concrete, surplus soil, construction scrap materials and organic waste generated by construction workers. The amount and percentage composition of construction waste will depend on the final design and the schedule of the construction, and thus generic mitigation measures proposed in EMP should be updated once the final ROW drawing is completed. All other construction wastes are also planned to comply with relevant central or State laws pertaining to waste management.

Candidate locations with sufficient and necessary conditions for spoil bank construction have been screened with the following criteria:

To minimize the transportation of surplus soil, spoil banks should be located using the following conditions:

- Ground shape with concavity topography
- Ground gradient less than 22 degrees which is assumed as an average angle for spoil banks slope with necessary steps
- Not in built-up area
- Not in protected forest/private forest

4) Soil

Impacts

The contamination of soil during construction stage is primarily due to construction and allied activities. The soil contamination may take place due to solid waste from the labor camps set-up during the construction stage. This impact is significant at locations of construction camps; stockyards, hot mix plants, etc. The sites where construction vehicles are parked and serviced are likely to be contaminated because of leakage or spillage of fuel and lubricants. The contamination of soils can also occur at the site of hot-mix plants from leakage or spillage of asphalt or bitumen. At the site of batching plants, because of spillage of cement and leakage of curing agents, soil contamination can occur. The contamination of soil may take place due to dumping of solid waste in an unscientific manner, leaching of fuel/oil & grease from workshops, or petrol stations and DG sets.

During the operation stage, soil pollution due to accidental vehicle spills or leaks is a low probability but potentially disastrous to the receiving environment, should they occur. These impacts can be long term and irreversible depending upon the extent of the spill.

Mitigation Measures

At construction yards, the vehicles/equipment will be maintained and refueled in such a fashion that oil/diesel spillage does not occur and contaminate the surrounding soil. It will be ensured that the fuel storage and refueling sites are kept away from drainage channels and important water bodies. At wash-down and refueling areas, "Oil Water Separators" shall be provided. All spills and discarded petroleum products shall be disposed of in accordance to the Hazardous Waste Management and Handling Rules. Fuel storage and re-fueling areas will be located at least 500m

away from all water bodies near the road alignment. The fuel storage and refueling areas shall not be located on agricultural lands or productive lands to avoid topsoil contamination. The earthwork will be carried out strictly in accordance with the design so that no excess earth is borrowed. The construction waste generated will be reused in the construction of the highway.
Bituminous waste will be used after milling and in the case of bituminous waste being required to be disposed of it shall be disposed in a secured way by providing a 50mm thick layer of clay. The solid waste generated during the construction phase, which includes municipal waste both organic and inorganic in nature, shall be stored/treated/disposed of in accordance with Municipal Solid Waste (Management & Handling) Rules. The hazardous waste may include oil waste, biomedical waste, E-waste etc. This shall be disposed of in accordance with the Hazardous Waste (Management, Handling & Trans boundary Movement) Rules, Biomedical Waste (Management and Handling) Rules and E-Waste (Management and Handling) Rules respectively.
In the operation stage, the petrol pumps and vehicle washing area located along the ROW will be monitored regularly for any spillage, and corrective remedial measures like the spread of sand, and the provision of oil and grease separators for the passing of wash water from petrol pumps and vehicle washing areas, before diverting it to water bodies. The solid waste generated from the way side amenities will include Municipal Waste both organic and inorganic, hazardous waste (like used batteries), will be treated in accordance with Municipal Solid Waste (Management & Handling) Rule and Hazardous Waste (Management, Handling & Trans boundary Movement) Rules.

5) Noise and vibration

Impacts
During the construction, the major sources of noise pollution is the movement of vehicles transporting the construction material to the construction yard and the noise generating activities at the yard itself. Mixing, casting and material movement are primary noise generating activities in the yard and will be uniformly distributed over the entire construction period. Construction activities are expected to produce noise levels in the range of 80 - 95 dB (A). The major work will be carried out during the daytime. The noise levels in the project area during the construction stage will be intermittent and temporary in nature. Typical noise levels associated with the various construction activities and construction equipment are presented in the table below.

Table 6-5: Typical Noise Levels of Construction Equipment

Construction Equipment	Noise Level dB(A)
Bulldozer	80
Front end loader	72-84
Jack hammer	81-98
Crane with ball	75-87
Crane	75-77
Bulldozer	80
Backhoe	72-93
Front end loader	72-84
Cement & Dump trucks	83-94
Jack hammer	81-98
Scraper	80-93
Welding generator	71-82
Grader	80-93
Roller	73-75
Concrete mixer	74-88
Concrete pump	81-84
Concrete vibrator	76
Paver	86-88
Truck	83-94
Tamper	74-77

Air compressor	74-87
Pneumatic tools	81-98

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

At the moment, the noise level is within the desired level. The noise level will increase during the construction period, which may have significant impact for a limited period on the surrounding environment. The noise levels in the working environment are compared with the standards prescribed by the Occupational Safety and Health Administration (OSHA-USA) which in-turn are being enforced by the Government of India through Model rules framed under the Factories Act. The acceptable limits for each shift being of 8 hours in duration, the equivalent noise level exposure during the shift is 90 dB(A). Hence, noise generated due to various activities in the construction camps may affect workers, if an equivalent 8-hour exposure is more than the safety limit. ACGIH (American Conference of Government Industrial Hygienists) proposed an 8-hour Leq limit of 85 dB(A). Exposure to impulses or impact noise should not exceed 140 dB(A). The workers in general are likely to be exposed to an equivalent noise level of 80-90 dB(A) in an 8-hour shift for which all statutory precautions as per the law should be taken into consideration.

During the operation stage of the project, reduction of vehicular engine noise (as a result of reduced congestion from the earlier, smoother flow of traffic due to 2 separate lanes), vehicular body noise (as a result of reduced development roughness) and the reduction of blowing of horns will bring the noise levels down, but as the volume of traffic, mainly heavy duty traffic, will increase in the future due to rapid development and industrialization along the road corridor, the noise may increase slightly.

Mitigation Measures

The high noise levels may cause discomfort for local residents and workers. Following mitigation measures shall be adopted to keep the noise and vibration levels under control.

- The plants and equipment used for construction will strictly conform to Central Pollution Control Board (CPCB) noise standards. Vehicles, equipment and construction machinery shall be monitored regularly with particular attention to silencers and mufflers to maintain noise levels to a minimum;
- Workers in the vicinity of high noise levels must wear ear plugs and helmets and should be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90 dB(A);
- In construction sites within 150 m of human settlements, noisy construction will be stopped between 10 PM and 6 AM except in the case of laying of cement concrete pavement for which a lower working temperature is a requirement;
- Hot mix plants, batching or aggregate plants shall not be located within 500m of sensitive land use for schools and hospitals;
- For places close to the sensitive receptors such as hospitals and schools, noise barriers such as earth, concrete, wood, metal or double-glazing of windows for façade insulation shall be used;
- Phase demolition, earthmoving, and ground-impacting operations are not to occur in the same time period. Unlike noise, the total vibration level produced could be significantly less when each vibration source operates separately;
- Construction machinery will be located away from the settlements;
- Careful planning of machinery operation and scheduling of operations can reduce the noise levels. Use of equipment, emitting noise not greater than 90 dB(A) for the eight-hour operations shift, and the locating of construction yards at a distance of at least 500m from any residential areas can be adhered to;
- Use of noise shields to construction machinery and provision of earplugs to the heavy machine operators are some of the mitigation measures, which should be followed by the contractors during the civil works;

- The noise control measures include limitations on allowable grades. Open-graded asphalt and avoidance of surface dressings to reduce tire noise in sensitive areas. Maintenance of proper road surface repairs will also help in reducing noise levels;
- Use of air horns should be minimized on the highway during nighttime. During daytime hours, use of horns should be restricted to the sensitive locations. This can be achieved through the use of sign boards along the roadside;
- Future development along the road should follow correct land use norms so that sensitive receptors are not located along the road, specifically along the bypasses; and
- The development of greenbelt along the main road can also bring about a considerable reduction in noise levels. The area available on both sides of the road should be used to develop greenbelt, comprised of selected species of trees with high canopies to provide added attenuation of noise.

6) Bottom Sediment

Impacts

During the pre-construction phase, surveying of the riverbed during pre-construction activity could affect the bottom sediment quality. However, the expected level of impact is low, temporary, and limited.

During construction activity, when foundations and piers of the bridge are constructed, there may be mobilization of the bottom sediments causing high, temporary, yet localized environmental impacts. Constructed foundations and piers may produce scour around them when the velocity of water becomes high due to flooding during and after construction. However, the expected level of impact is low, temporary, and limited.

Mitigation Measures

Mobilization of bottom sediments will require the EPC Contractor to install turbidity curtains around the foundation and pier under construction. Minimization of scour will require the EPC Contractor to suspend construction during flooding. Those scours will naturally be filled up and stabilize after the flooding. The EPC Contractor will monitor the velocity of water flow for a flood warning.

6.2 Natural Environment

6.2.1 Survey Results

1) Ecology

The survey was conducted in October 2016. Primary information was collected by geo-spatial survey using GPS for land use and land cover in the area and visual survey during site visit of the floral and faunal biodiversity both in land and water, and threats to biodiversity.

The secondary source of data collection included on-site discussion with local people, boatmen, fishermen, knowledgeable people, local NGO, the faculty of Department of Zoology, Guwahati University, Guwahati, Assam, as well as information collection from published studies available as research and development publications, reports and bulletin of individual faculty and research institutions like Forest Department, BSI, ZSI, IUCN, CPCB, etc..

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The area includes predominantly the flood plain or riparian ecosystem of the river Brahmaputra. In certain places, island habitation or small villages, e.g., Armari, Balughat, etc., are evident in the region.

Local people (rural inhabitants) practice conventional, natural living based on resources. Agriculture of subsistence nature, and fishing are the major economic activities of these people.

Habitation towards Dhubri and South Salmara-Mankachar consists of land based plantation of plantation crops and forest species, buildup areas and water bodies; while the area towards Phulbari includes scattered patches of barren land or waste land, forestry plantations of sal, sagaun or teak and occasionally eucalyptus. Natural forest is totally obscured in the bridge impact area. Deciduous forest (Champion and Seth 1968) is recorded only in the West Garo Hills near Phulbari (beyond 15km distance).

Biodiversity of agricultural species of plants is enumerated in the following Table. A total of 37 species of diverse economic use were recorded in the island habitations predominantly including vegetable crops (16 species). The Animal husbandry includes rearing of goats, cows and buffalo, rarely pigs or ducks. Backyard poultry is also practiced on a small scale by some inhabitants. The practice of aquaculture (rearing fishes and prawn) is altogether absent.

Table 6-6: Domesticated agro-biodiversity in the Study Area

Scientific Name	**Family**	**Crop Type**	**Local/ English Name**
Allium cepa	Amaryllidaceae	Vegetable	Piyaj
Allium sativum	Amaryllidaceae	Spice	Lahsun
Amaranthus sp.	Amaranthaceae	Vegetable	Lalsag
Anacardium occidentalis	Anacardiaceae	Plantation Crop	Kaju
Ananas comosus	Bromeliaceae	Fruit	Pineapple
Areca catechu	Arecaceae	Plantation Crop	Tambul
Artocarpus hetrophyllus	Moraceae	Vegetable	Kathal
Brassica spp.	Brassicaceae	Oilseed	Sarson
Capsicum annuum	Solanaceae	Vegetable	Mirch
Carica papaya	Caricaceae	Fruit	Papita
Cier aeriatinum	Fabaceae	Pulse	Chana
Citrus media	Rutaceae	Fruit	Nimbu
Cocos nucifera	Arecaceae	Fruit	Narikol
Colocasia antiquoram	Aracea	Vegetable	Kachchu
Corchorus capsularis	Malvaceae	Fibre	Jute
Coriandrum sativum	Apiaceae	Condiment & Spice	Dhania
Cucumis sativa	Cucurbitaceae	Fruit	Kheera
Cucurbita pepo	Cucurbitaceae	Vegetable	Kaddu
Daucus carrota	Apiaceae	Vegetable	Gajar
Hevia brasiliensis	Euphorbiaceae	Plantation Crop	Ruber
Lens esculenta	Fabaceae	Pulse	Masur
Luffa spp.	Cucurbitaceae	Vegetable	Lauki
Lycopersicon esculentum	Solanaceae	Vegetable	Tamatar
Momordica charantia	Cucurbitaceae	Vegetable	Karela
Musa indica	Musaceae	Fruit	Kela
Oryza sativa	Poaceae	Cereal	Dhan
Phaseolus mungo	Fabaceae	Pulse	Urd
Psidum guajava	Myrtaceae	Fruit	Amrud
Raphanus sativa	Brassicaceae	Vegetable	Muli
Sesamum indicum	Pedaliaceae	Oilseed	Til
Solanum melongena	Solanaceae	Vegetable	Began
Solanum tuberosum	Solanaceae	Vegetable	Aalu
Spinach oleracea	Amaranthaceae	Vegetable	Palak
Trigonella foenium graecum	Fabaceae	Vegetable	Methi
Triticum aestivum	Poaceae	Cereal	Gehu

Zea mays	Poaceae	Cereal	Makka
Zingiber officinalis	Zingiberaceae	Rhizome	Adrakh

Source: JICA Study Team

The diversity of flora (macrophytes) of terrestrial and aquatic ecosystems, in the wild, is listed in Table 7-38. A total of 75 plant species were recorded, including herbs (34 species), shrubs (06 species), trees (21 species) and climbers (04 species). The area included 27 plant species as invasive alien species, comprising of herbs (22), shrubs (03), small trees (01) and climbers (01) (Table 7-39). The flood plain areas are occupied by native Saccharum spontaneum grass, which was well established in the riparian ecosystem on account of the availability of a suitable habitat.

Table 6-7: Plant Biodiversity in the Study Area

Scientific Name	**Family**	**Habit**	**Local Availability**	**IUCN * Status**
(A) ANGIOSPERMS				
Acacia pennata	Mimosaceae	Herb	Common	LC
Ageratum conyzoides	Asteraceae	Herb	Very Common	NA
Albizzia procera	Mimosaceae	Tree	Rare	NA
Anthocephalus chinensis	Rubiaceae	Tree	Common	NA
Artocarpus integrifolia	Moraceae	Small Tree	Common	NA
Arundinella nepalensis	Poaceae	Herb	Common	NA
Arundo donax	Poaceae	Herb	Common	LC
Asparagus racemosus	Liliaceae	Trailing Herb	Rare	NA
Bauhinia acuminata	Caesalpiniaceae	Small Tree	Common	LC
Bombax ceiba	Bambacaceae	Tree	Very Common	NA
Cardamine impatiens	Brassicaceae	Herb	Common	NA
Cassia fistula	Caesalpiniaceae	Small Tree	Common	NA
Cassia tora	Caesalpiniaceae	Shrub	Common	NA
Chrysopogon fulvus	Poaceae	Herb	Common	NA
Cissampelos pariera	Manispermaceae	Herb	Rare	NANIC
Commelina bengalensis	Commelinaceae	Herb	Very Common	NANIC
Cyperus rotundus	Cyperaceae	Herb	Abundant	NANIC
Dendrocalamus hamiltonii	Poaceae	Herb	Common	NA
Dioscorea bulbifera	Dioscoreaceae	Climber	Common	NA
Erythrina variegata	Papilionaceae	Small Tree	Rare	NA
*Eucalyptus tereticornis***	Myrtaceae	Tree	Rare	NA
Euphorbia emodi	Euphorbiaceae	Herb	Common	LC
E. hirta	Euphorbiaceae	Herb	Common	NA
Ficus hispida	Moraceae	Tree	Common	NA
Galium sp.	Rubiaceae	Herb	Common	NA
Gmelina arborea	Verbenaceae	Tree	Common	NA
Imperata cylindrica	Poaceae	Herb	Common	LC
Ipomoea aquatica	Convolvulaceae	Herb	Common	NA
I. cairica	Convolvulaceae	Creeper	Very common	NA
Justicia adhatoda	Acanthaceae	Shrub	Common	NA
*Lagerstroemia parviflora***	Lytharaceae	Tree	Rare	NA

Scientific Name	Family	Habit	Local Availability	IUCN * Status
Lathyrus aphaca	Fabaceae	Herb	Common	NA
Lemna minor	Lemnaceae	Herb	Common	LC
Lepidium virginicum	Brassicaceae	Herb	Common	NA
Litsea glutinosa	Lauraceae	Tree	Rare	NA
Mallotus philippensis	Euphorbiaceae	Small Tree	Common	NA
Mimosa pudica	Mimosaceae	Herb	Rare	NA
Phragmites karka	Poaceae	Herb	Common	LC
Phyllanthus emblica	Euphorbiaceae	Tree	Common	NA
Poa annua	Poaceae	Herb	Common	LC
Potamogeton pectinatus	Potomogetonaceae	Herb	Common	LC
Pycrius spp.	Cyperaceae	Herb	Abundant	NA
Ranunculus arvensis	Ranunculaceae	Herb	Common	NA
Saccharum spontaneum	Poaceae	Herb	Abundant	LC
Sapium baccatum	Euphorbiaceae	Tree	Common	NA
Scripus spp.	Cyperaceae	Herb	Common	NA
Shorea robusta	Dipterocarpaceae	tree	Rare	NA
Smilex zylanica	Smilaceae	Climber	Rare	LR
Solanum erianthum	Solanaceae	Herb	Common	NANIC
Sonchus spp.	Asteraceae	Herb	Common	NA
Stellaria media	Caryophylaceae	Herb	Common	NA
Syzygium cumini	Myrtaceae	Tree	Common	NA
*Tectona grandis***	Verbenaceae	Tree	Common	NA
Thysanolaena maxima	Poaceae	Herb	Common	NA
Tinospora cordifolia	Manispermaceae	Climber	Rare	NA
Toona ciliata	Meliaceae	Tree	Common	NA
Trewia nudiflora	Euphorbiaceae	Tree	Rare	LR
Vitex peduncularis	Verbenaceae	Tree	Rare	NA
Zizyphus mauritiana	Rhamnaceae	Tall Shrub	Abundant	NANIC
(B) FERNS AND FERN ALLIES				
Adiantum caudatum	Adiantaceae	Herb	Common	NA
Equisetum diffusum	Equisetaceae	Herb	Common	NA
Marselia minuta	Marseliaceae	Herb	Common	NANIC
Pteris biaurita	Pterideae	Herb	Rare	NA
Seleginella helferi	Selaginellaceae	Herb	Common	NANIC

*Based on the IUCN Red List of the Species Version 2016-3, downloaded on Dec. 28, 2016.
** Planted / Cultivated
Abbreviations: VU = Vulnerable, NA = Not assessed but present in the catalogue of Life, NANIC = Not assessed and not present in the catalogue of Life, LC = Least concern, LR = Low risk
Source: JICA Study Team

Table 6-8: Invasive Alien Plants in the Study Area

Species	Family	Habit	Nativity
Aerva javanica	Amaranthaceae	Herb	Tropical America
Ageratum conyzoides	Asteraceae	Herb	Brazil
Amaranthus spinosus	Amaranthaceae	Herb	Tropical America
Anagallis arvensis	Primulaceae	Herb	Europe
Argemone mexicana	Papaveraceae	Herb	Tropical South America
Calotropis procera	Asclapiadaceae	Shrub	Tropical America
Cannabis sativa	Cannabaceae	Herb	Tropical America
Chenopodium album	Chenopodiaceae	Herb	Tropical America

Species	Family	Habit	Nativity
Cleome viscosa	Capparaceae	Herb	Tropical America
Cuscuta reflexa	Cuscutaceae	Climber	Mediterranean region
Datura metal	Solanaceae	Shrub	Tropical America
Eichhornia crassipes	Pontederiaceae	Herb	Tropical America
Euphobia hirta	Euphorbiaceae	Herb	Tropical America
E. thymifolia	Euphorbiaceae	Hurb	Tropical America
Galinsoga paviflora	Asteraceae	Herb	Tropical America
Lantana camara	Verbenaceae	Shrub	Tropical America
Oxalis corniculata	Oxalidaceae	Herb	Europe
Parthenium hysterophorus	Asteraceae	Herb	Tropical America
Physalis minima	Solanaceae	Herb	Tropical America
Portulaca oleracea	Portulacaceae	Herb	Tropical South America
Prosopis juliflora	Mimosaceae	Small Tree	Mexico
Saccharum spontaneum	Poaceae	Herb	Tropical America
Side acuta	Malvaceae	Herb	Tropical America
Solanum nigrum	Solanaceae	Herb	Tropical America
Tridex procumbens	Asteraceae	Herb	Tropical America
Typha angustifolia	Typhaceae	Herb	Tropical America
Xanthium strumarium	Asteraceae	Herb	Tropical America

Source: JICA Study Team

The faunal diversity as recorded for the bridge influenced area is listed in Table below. Evidently, 177 animal species belonging to mammals (10), avifauna (68), reptiles (15) amphibians (04), fish (70), and invertebrates (10) are recorded for the study site. The status of occurrence of these speciesased on the field study and following the Wildlife Act (amended in 2013) as well as the IUCN status are also in the Tables. The diversity of fish fauna as recorded for the area along with the IUCN status and local availability is enlisted in Table below. Some migratory species were found in the study area and indicated in bold letter in the table below. Ganges river dolphins are known to have local migration pattern due to water level change between wet and dry season, but they are seen in Dhubri area all year around, All of the other migratory species were birds, and no seasonal variation was found in reptiles, amphibians, fish and invertebrate according to interview and literature surveys.

Table 6-9: Animal biodiversity in the Study Area

Scientific Name	Local /English Name	Status* WLA	IUCN** Status
Mammals			
Canis aureus	Jackal		LC
Cnnomys badius	Bay Bamboo rat		NANIC
Lepus nigricollis	Hare	Sch.III	LC
Macaca mulatta	Monkey		LC
Mus musculus	House mouse		LC
Platanista gangetica ssp. gangetica	Dolphin	Sch. I	EN
Pteropus giganteus	Flying fox	Sch. I	LC
Trachypithecus pileatus	Capped Langur	Sch. I	VU
Sus scrofa	Wild Boar		LC
Vulpes bengalensis	Fox	Sch. III	LC
Birds			
Actitis hypoleucos	Common Sandpiper		LC

Scientific Name	Local /English Name	Status* WLA	IUCN** Status
Alcedo atthis	Common Kingfisher		LC
Anas crecca	Common Teal		LC
A. acuta	Northern Pintail		LC
A. strepera	Gadwall		LC
A. platyrhynechos	Mallard		LC
Alcedo atthis	Common Kingfisher		LC
Anastomus oscitans	Asian Openbill		LC
Ardea alba	Great Egret		LC
A. cinerea	Grey Heron		LC
A. intermedia	Intermediate Egret		LC
Ardea cinerea	Grey Heron		LC
Ardeola grayii	Indian Pond Heron		LC
Aythya baeri	Baer's Pochard		CR
A. ferina	Common Pochard		LC
A. fuligula	Tufted Duck		LC
A. nyroca	Ferruginous Duck		NT
A. platyrhynchos	Mallard		LC
Bubulcus ibis	Bagula, Cattle Egret		LC
Calidris minuta	Little Stint		LC
Ceryle rudis	Pied Kingfisher		LC
Charadrius dubius	Little Ringed Plover		LC
Chlidonias hybrida	Whiskered Tern		LC
Chroicocephalus ridibundus	Black-headed Gull		LC
Circus melanoleucos	Pied Harrier		LC
Corvus splendens	House Crow		LC
Cuculus micropeterus	Indian Cuckoo		NANIC
Dendrocygna javanica	Lesser Whistling Duck		LC
Dendrocopus mahrattensis	Woodpecker		NANIC
Egretta garzetta	Little Egret		LC
Falco tinnunculus	Common Kestrel		LC
Fulica atra	Common Coot		LC
Gallinago gallinago	Common Snipe		LC
Gracula religiosa	Hill Myna	Sch. II	LC
Gyps indicus	Vulture	Sch. I	CR
Halcyon smyrnensis	White-throated Kingfisher		LC
Hirundo rustica	Barn Swallow		LC
Hydrophasianus chirurgus	Pheasant-tailed Jacana		LC
Leptoptilos javanicus	Lesser Adjutant		VU
L. dubius	Greater Adjutant		VU
Mareca strepera	Gadwall		LC
M.penelope	Eurasian Wigeon		LC
Metopidius indicus	Bronze-winged Jacana		LC
Microcarbo niger	Little Cormorant		LC
Motacilla flava	Western Yellow Wagtail		LC
M. alba	White Wagtail		LC
M. citreola	Citrine Wagtail		LC
M. cinerea	Grey Wagtail		LC
Otus spilocephalus	Mountain Scoops Owl	Sch. I	LC
Rostratula benghalensis	Greater Painted-snipe		LC
Passer domesticus	House Sparrow		LC
Perdicula asiatica	Jungle Bush Quail		LC

Scientific Name	Local /English Name	Status* WLA	IUCN** Status
Ploceus philippinus	Baya		LC
Pluvialis fulva	Pacific Golden Plover		LC
Podicep nigricollis	Blacknecked grebe		LC
Porphyrio porphyrio	Purple Swamphen		LC
Psittacula krameri manillensis	Parrot	Sch. I	NA
Spatula clypeata	Red-crested Pochard		LC
S. querquedula	Garganey		LC
Sturnus contra	Grey-headed Myna	Sch.I	NA
Tachybaptus ruficollis	Little Grebe		LC
Tringa stagnatilis	Marsh Sandpiper		LC
T. glareola	Wood Sandpiper		LC
T. nebularia	Common Green Shank		LC
T. ochropus	Green Sandpiper		LC
Vanellus vanellus	Northern Lapwing		LC
V. cinereus	Grey-headed Lapwing		LC
V. indicus	Red-wattled Lapwing		LC
Reptiles			
Aspideretes gangaticus	Gangetic softshell turtle	Sch. I	VU
Aspideretes hurum	Indian peacock softshell turtle	Sch. I	VU
Bungarus fasciatus	Common Indian Krait	Sch. II	LC
Chitra indica	Narrow-headed softshell turtle		EN
Crotalus sp.	Viper		LC
Cyclemys sp.	Asian leaf turtle		NT
Hemidactylus flaviviridis	House Geeko		NA
Lissemys punctata	Indial flap-shelled turtle		LC
Melanochelys tricarinata	Tricarinate turtle	Sch. I	VU
Morenia petersi	Indian eyed turtle		VU
Naja naja	Cobra	Sch. II	DD
Pangshura smithii	Brown roofed turtle		NT
Pangshura sylhetensis	Assam roofed turtle		EN
P. tentoria	Indian tent turtle		LC
Varanus bengalensis	Common Indian Monitor	Sch. I	LC
Amphibians			
Bufo melanostictus	Common Asian Toad		LC
Hoplobatrachus tigerinus	Indian Bull Frog	Sch. I	LC
Polypedates sp.	Frog		LC
Spaerotheca brericeps	Burrowing Frog		NANIC
Fish			
Ailia coila	Gangetic ailia		NT
Amphipnous cuchia	Cuchia		NA
Anabas testudineus	Climbing perch		DD
Aorichthys seenghala	Giant river-catfish		NA
A. aor	Long-whiskered catfish		LC
Apistogramma borelli	Bareli		NA
Aspidoparia moror	Boreala		NANIC
Badis badis	Blue perch		LC
Bagarius bagarius	Devil catfish		NT
Barillus bendalisis	Barilius		NANIC
B.barna	Barilius		NANIC
Batasio sp.	Tengra		NA
Catla catla	Catla		NA

Scientific Name	Local /English Name	Status* WLA	IUCN** Status
C.striatus	Sal		NANIC
Chaca chaca	Angler catfish		LC
Chanda nama	Elongate glassy perchlet		LC
C.ranga	Indian Glassy Fish		LC
C.baculis	Chanda		NA
Channa marulius	Sal		LC
C. orientalis	Chengeli		NA
C.punctatus	Spotted snakehead		NA
C.striatus	Striped snakehead		NA
Cirrhinus mrigala	Mrigal		LC
C. reba	Mrigal		LC
Clarias butrachus	Magur		NANIC
C.gariepinus	African sharptooth catfish		LC
Clupisoma garua			LC
Colisa chuna	Honey Gourami		NA
C.fasciata	Banded gourami		NA
C.lalia	Dwarf gourami		NA
Ctenopharyngodon idella	Grass carp		NA
*Cyprinus carpio**	Common carp/Chinese carp		VU
C. nudus	Common carp/Chinese carp		NA
Eutropiichthys vacha			LC
E. murius	Kangong		LC
Gudusia chapra	Indian river shad		LC
Heteropneustes fossilis	Asian stinging catfish		LC
Hypopththalmicthys molotrix	Silver carp		NA
Labeo rohita	Rohu/Rau		NANIC
L. calbasu	Orangefin labeo		LC
L. gonius	Kuria labeo		LC
L. dero	Kalabans		LC
L. boga	Bogabata		LC
L. pangusia	Bholung		NT
Macrognathus pancalus	Indian spiny eel		LC
M aculeatus	Lesser spiny eel		NA
Mastacembelus armatus	Common Spiny Eal		LC
Monopterus cuchia	Cuchia		LC
Mystus bleekeri	Day's mystus		LC
M. cavasius	Dwarf Tengra		LC
M. gulio	Long Whiskers Catfish		LC
M. tengara	Tingorah		LC
M. vittatus	Striped dwarf catfish		LC
Nanuas nandus			NANIC
Neolissocheilus hexagonolepis	Mahseer		NA
Noemachilus beavani	Botia		NANIC
N. botia	Striped Louch		NANIC
Notopteru notoputerus	Bronze featherback		NANIC
N chitala			NANIC
Ompok bimaculatus	butter catfish		NT
O. pabo	Pabo catfish		NT
O. pabda	Pabdah catfish		NT
Pangasius pangasius	Pangas catfish		LC
Punctius chola	Puthi/Punti		NANIC

Scientific Name	Local /English Name	Status* WLA	IUCN** Status
P. javanicus			NANIC
P. sarana	Fire fin barb		NANIC
P. ticto			NANIC
Rita rita	Rita		LC
Tenualosa ilisha (Hilsa ilisha)	Ilis/Ilisha		LC
Wallago attu	Wallago		NT
Invertebrates			
Macrobrachium choprai	Prawn		NA
M. rosenbergii	Prawn		NA
Macrognathus aral	Toru		LC
Chilades Laius	Lime blue		NA
Graphium sarpedon sarpedon	Common Bluebottle		NA
Mycalensis perseus blasius	Common Bushbown		NANIC
Anopheles stepnensi	Anepheles Mosquito		NANIC
Culex quingquefaeciatus	Culex Mosquito		NANIC
Hippasa lycosina	Grassland spider		NA
Pholcus phalangiodes	House Spider		NANIC

*According to Wildlife Act, 1972 amended in 2013.
**Based on the IUCN Red List of the Species Version 2016-3, downloaded on Dec. 29, 2016.
Bold: Migratory species
Abbreviations: VU = Vulnerable, NA = Not assessed but present in the catalogue of Life, NANIC = Not assessed and not present in the catalogue of Life, LC = Least concern, LR = Low risk, NT = Near Threatened, EN = Endangered, CR = Critically Endangered, DD = Data Deficient
Source: JICA Study Team

Dr. Abdul Wakid, a Project Scientist at the Wildlife Institute of India and Head (honorary) of the Gangetic Dolphin Research and Conservation Division (GDRCD) of Aaranyak, an Assam based leading environmental NGO, has 17 years of experience in the scientific study and conservation activities of the Ganges River Dolphins in Assam State. He conducted a series of dolphin surveys in the Brahmaputra river system, starting from 2005. In the last census conducted in 2012, Dr. Wakid and his team estimated dolphin population in Brahmaputra river system as follows.

Brahmaputra river system (including 2 tributaries): 635 dolphins
Brahmaputra River (not including tributaries): 583 dolphins
Brahmaputra River between the Golpara Bridge and Bangradesh border: 92-96 dolphins

During the 2012 survey, Dr. Wakid recorded the highest density of the dolphin population in the section between the Goalpara Bridge and the Bangladesh border, including the river stretches within the proposed bridge construction site of the Dhubri District. Highest density of dolphin population was recorded in the dolphin survey conducted in 2005. The breeding season for the Gangetic dolphins of Brahmaputra River is recorded as February to June. Dolphins are found in and around Dhubri area throughout the year but aggregate in the deep section of the river in the winter and more spread to the side channels during the summer. The population has had an upward trend since 2008 because of the lot of community engagement and awareness activities conducted since 2008.

2) Hydrology/geology/geography

A riverbed topographic map of the Brahmaputra River was created for the area of the 20km width including the Bridge crossing section by the riverbed configuration survey. The survey included the Gandadhar River on the north bank and the Jinjiram River on the south bank, and tributaries of the Brahmaptra River, to consider any influence from those rivers.
Existing data and materials were collected from all available resources including the observation data from the Brahmaputra and Barak Basin organization (B&BBO), Shillong of the Central Water

Commission (CWC), available literature to assess the catchment areas and hydraulic parameters, interviews of local people, DPR of Naranarayan Bridge, and physical model studies conducted by NEHARI (North Eastern Hydraulic and Allied Research Institute) on behalf of the Brahmaputra Board. These data and materials were studied and analyzed to determine the HFL (High Flood Level), LWL (Low Water Level), Maximum discharge, and other necessary parameters. Various simulations were carried out using the US Army Corps of Engineers (USACE) Hydraulic Engineering Centre's River Analysis System (HEC-RAS).

Source: DPR

Figure 6-9: Riverbed Topography around the Dhubri Bridge

Building structures in a river may cause erosion of the bank and riverbed. There are two kinds of erosions: contraction scour and local sour. The contraction scour occurs due to a reduction in the flow area of the river when it approaches a bridge. Reduction in flow area is followed by an increase in flow velocity which results in the removal of sediments and rocks. The local scour is caused by increased velocity of water around a bridge pier and abutment and due to the formation of vortices and wakes. The contraction scour and the local scour together constitute the total scour around piers. Hydraulic parameters used for the analysis are shown in the table below.

Table 6-10: Hydraulic Parameters

Parameters	Values
High Flood Level（HFL）	30.36 m
Low Water Level（LWL）	23.00 m
Average Riverbed Slope	1/14,700
Maximum discharge for 100 years return period	100,306 m3/s
Maximum discharge for 10 years return period	71,225 m3/s
Maximum water velocity at HFL	4.5 m/s

Source: DPR

The analysis of the impact of the contrition was conducted. The interval of the substructures of the Project Bridge is 125m and there will be no impact due to the contraction of the river width.

6.2.2 Anticipated Impacts and Mitigation Measures

1) Ecology

Impacts

The main impact on flora involves the removal of trees and the grubbing of vegetative cover for construction and a clear zone within the Right of Way (ROW) and for spoil bank. The types of impacts on ecosystem and biodiversity can be as follows:

- Loss of trees;
- Compaction of vegetation, and
- Pollution and dust accumulation on vegetation.
- The construction phase of the bridge will lead to the release of some amount of debris which needs be managed judiciously in order to maintain ecology of the area and aquatic life.
- During the construction of the proposed dam, there is a high possibility of dolphins and their habitats impacts due to high underwater noise, water quality change, habitat geomorphology changes, prey-base depletion etc.
- The existing Gangas river dolphin population suffers from habitat fragmentation by the development activities such as the construction of dam. It is estimated to be one of the causes of population decrease. In the case of this project, the dolphins and other aquatic species can pass under the bridge and no habitat fragmentation will be caused.
- Several endangered chelonian species are found in Dhubri area. These species can potentially suffer from habitat change by the construction activities, but the main cause of decline of the turtles is illegal hunting by humans for their meat. Therefore, in order to minimize the negative impacts on the turtle species, habitat change should be kept at minimum and hunting activities must be completely prohibited amongst the contractors. Noise from different equipment, vehicles, and human traffic has the potential to disturb migratory birds, which may cause them to leave or change their flight route until the activities are over.
- No direct negative impact is anticipated on other species, but care should be taken to prevent indirect negative impact such as the deterioration of habitat. There will be some temporary physical disturbance to the aquatic environment during construction, but no chemical pollution will be caused and therefore no irreversible damage will be caused for the aquatic species.

Mitigation Measures

The following mitigation measures are recommended.

<Pre-Construction phase>

- No detailed survey has been done on the population of the dolphins in the Dhubri area, so it is suggested that a scientific study is done before the construction begins as a baseline for monitoring.

<Construction phase>

- Land clearing activities at the construction site should be kept at an absolute minimum. Construction vehicles, machinery and equipment will be moved or stationed in the (ROW) to prevent compaction of vegetation. While operating on temporarily acquired land for traffic detours, storage, material handling or any other construction related or incidental activities, it will be ensured that the trampling of soil is avoided.
- Anti-poaching measures during the construction phase should be strengthened to check for any violation of existing regulations. Awareness campaign to be made among the workers to aware them on the endangered and other important species. The species at higher risk of being hunted are the softshell turtles as it is known to be a delicacy. No hunting of any kind will be permitted and vigilant monitoring will be carried out amongst construction workers.

- Regular monitoring of the impacts of construction activities on the Gangetic dolphins and other important species should be done by dedicated wildlife experts and forest officials, so that immediate prevention activities can be undertaken.
- Channels will be kept free at all times for free movement of dolphins.
- To minimize impacts, noisy operations should be avoided during winter (Nov-Feb; when dolphin congregates into the deeper channel and pre-monsoon season (Mar-Jun; dolphin breeding time), thus from November to June, which are also the breeding season for the turtles. Migratory birds also stay around Dhubri area during the winter months, so avoiding noisy operations during these months also reduce the impacts on them.
- Construction activities should be carried out in close supervision of the dolphin ecologist.
- Measures such as the creation and monitoring of an exclusion zone of a 500m radius for at least 30 minutes before the start of construction activities shall be followed. If dolphins are observed in the exclusion zone, construction works should be delayed until they have left the area. If dolphins enter the exclusion zone after construction has commenced, construction works should cease until they have left. The contractors are recommended to adopt these mitigation measures during construction works inside the river. Acoustic deterrents can be tested to keep the dolphin away during from construction zone under the supervision of dolphin ecologist.
- Relevant information (e.g. encounter with vulnerable species during engineering work) shall be shared with the State Environment and Forest Department and concerned regional environmental experts with which the project authority will discuss potential measures to promote conservation and monitoring of the ecosystem.
- If trees are cut down for the labor camps and materials storage sites, the trees shall be re-planted after construction. Also, when trees in the ROW are cut down, alternative tree planting should be considered using local native tree species.
- Before construction of piers the construction site must be checked for the presence of threatened turtles, migratory birds, and other threatened species and their nests. If the turtles and/or their nest are found inside or near the construction area the animals and/or the eggs must be physically moved to safer habitat areas under the guidance of the local wildlife experts.
- All boats or ferries transporting construction material and workers will have propeller guards installed to prevent injury and death of dolphins, turtles and other aquatic fauna.
- One of the threats to bird and turtle habitat is conversion of the river edges from natural soft embankments into hard concrete embankments. Therefore the natural bank slope is preserved and location of the bridge piers will avoid such areas. No construction camp, borrow areas or disposal sites will be established within 100m of the shorelines at the highest water level period.
- All avoidance, mitigation and enhancement measures and monitoring plans proposed to address impacts on flora, fauna and the threatened species should be updated during the detailed design stage by conducting detailed studies such as identification of the migrating routes of dolphins and birds, exact locations of turtle nesting grounds, etc.

During the construction, the following endangered species may be encountered in the following locations.

Table 6-11: Distribution of vulnerable and other important species in the project area

Scientific Name	Local /English Name	Local Availability	Location
MAMMALS			
Trachpithecus pileatus	Capped Langur	Common	Forest, agricultural field, residential area
Platanista gangetica ssp. gangetica	Dolphin	Common	Whole section of Brahmaputra River
Pteropus giganteus	Flying fox	Common	Forest, agricultural field, residential area

Semnopithecus entellus.	Langoor	Rare	Forest, agricultural field, residential area
Vulpes bengalensis	Fox	Common	Grassland
BIRDS(AVIFAUNA)			
Aythya baeri	Baer's pochard	Rare	Lakes, ponds, rivers
Gracula religiosa	Hill Myna	Abundant	Forest
Gyps indicus	Vulture	Rare	Agricultural field
Leptoptilos javanicus	Lesser Adjutant	Rare	River bank, grassland, agricultural field
L. dubius	Greater Adjutant	Rare	River bank, grassland, agricultural field
Otus spilocephalus	Mountain Scops Owl	Rare	Forest
Sturnus contra	Grey-headed Myna	Abundant	Grassland, agricultural field, residential area
REPTILES			
Aspideretes gangaticus	Gangetic softshell turtle	Rare	Deep rivers, lakes and ponds with sandy or muddy bottom.
Aspideretes hurum	Indian peacock softshell turtle	Rare	Rivers, lakes and ponds
Bungarus fasciatus	Common Indian Krait	Common	River bank, grassland, agricultural field
Chitra indica	Narrow-headed softshell turtle	Rare	Large rivers with clear water and sandy bottom
Melanochelys tricarinata	Tricarinate turtle	Rare	Grassland, river bank
Morenia petersi	Indian eyed turtle	Rare	Rivers, wetland
Naja naja	Cobra	Common	River bank, grassland, agricultural field
Pangshura sylhetensis	Assam roofed turtle	Rare	rivers and floodplains with muddy bottom and aquatic plants
P. smithii	Brown roofed turtle	Rare	Shallow rivers, canals, lakes with maddy bottom
Varanus bengalensis	Common Indian Monitor	Common	River bank, grassland, agricultural field
AMPHIBIANS			
Hoplobatrachus tigerinus	Indian Bull Frog	Common	Wetland

Source: JICA Study Team

<Operation phase>

- It is suggested that regular monitoring by the forest department and relevant environment and wildlife experts should be done. In keeping view of a likely increase in vehicular emissions in the future, the monitoring should include the assessment of impact due to increased air pollution;
- A suitable landscaping plan for the project road shall be prepared to enhance the ecological status of the area. It was noticed, that the project road did not have tree cover at a few locations. Tree plantation at these locations will enhance the aesthetics as well as reduce the pollution level of the area.
- It is recommended that the lost trees be compensated at a 1:3 ratio.
- Awareness programmes as training, workshops, seminars, brainstorming, etc., need to be organized to promote responsible consumerism, sustainable economic practices and the protection of endangered species for all the stakeholders. Research on Ganges River Dolphins

needs be conducted to study in details the abundance, distribution, ecology and threats of the Ganges River Dolphin in and around the construction sites. Community engagement and awareness activities regarding the conservation of Gangetic dolphin also need to be done.

2) Hydrology

Impacts

Potential impact on hydrology will be minor, as the project does not involve the diversion or re-routing of existing watercourses. However, the river flows in Brahmatupta and its tributary Jhinjer will be slightly obstructed during the construction of piers of bridge, but for a limited period. There is no other pond/canal that will be affected by the Project. Hence, a change in natural drainage pattern will be very insignificant to the present state of the project.
During the operation stage, no impact is envisaged.

Mitigation Measures

The new bridge design is based on hydrological calculation results. Based on the obtained location of water crossings and water discharge, the dimension and locations for drainage system are determined. For cross drainage structure, the appropriate culvert type is selected by taking into account the economy, construction workability, and maintenance ability.

3) Topography and Geology

Impacts

Change in topography (that of the existing) is envisaged to some extent at various places along the entire length of the bridge and approach road while developing a 4-lane standard. The riverbed will be excavated for the construction of substructures. The impact is temporary because the excavation will be filled in after the construction of substructures. The change in topography will also happen due to the operation of borrow areas. The construction of material handling yards and labor camps will also alter the existing topography temporarily.

Mitigation Measures

During construction phase, the existing vegetation including shrubs and grasses along the route (except within the strip directly under embankment or cutting) will be properly maintained. The borrow areas shall be operated and closed as per the specifications for road and bridge construction manual of MORTH. The borrow areas shall be filled with the rejected waste/material, spoil and then finally a layer of topsoil shall be spread over it before carrying out plantation and turfing. For turfing, plant species that are native to the area will be used. Temporary structures such as borrow areas, material handling yards, and labor camps should be returned to their original states after construction finishes. During the operation phase, maintenance of the embankment will be carried out to avoid soil erosion. The slope protection/ retaining wall, if damaged due to land slide, will be repaired promptly. The slope protection will also be established / strengthened regularly through the plantation of shrubs and vegetation.

6.3 Major Impacts on Social Environment

(1) Involuntary Resettlement

As per the ROW design, the project will affect 761 households and 3,043 people. Out of which, 633 households (2,538 people) will be affected by their land only, and 127 households (500 people) will be affected by the structure, meaning physically displaced households. One commercial shop will be affected and one public structure (the government office) will be affected. No schools or religious facilities will be affected.

Table 6-12: Summary of Households Affected

Item	PAHs	PAPs

Item	PAHs	PAPs
Total project-affected household	761	3,043
Household whose residential land will be affected (physically displaced)	127	500
Household whose agricultural land will be affected	633	2,538
Household whose commercial land will be affected	1	5

Source: JICA Study Team

Mitigation Measures

Affected households will be provided with adequate compensation and assistance. Based on the census survey, the majority of affected households requested cash compensation and self-relocation. However, if they request land compensation, the respective DCs in consultation with local communities shall secure the land in the vicinity of the original place of residence to the extent possible.

(2) The Poor

It should be noted that the poor are less exposed to big development projects and hence may feel intimidated and unable to voice concerns, grievances and suggestions. The baseline survey has identified the gap between official poverty level and poverty level as reported by the people. Their income level is low and illiteracy rate is high, especially in Char land. Therefore, impact mitigation measures and assistances shall be well considered recognizing the local situation.

Mitigation Measures

During the course of land acquisition and resettlement activities, adequate information sharing is a must to include the poor in the process and it should be ensured that their grievances are heard and redressed. A resettlement and restoration plan should be prepared considering their limited coping capacity, as well as develop measures that lead to sustainable income generation for the affected people rather than a one-off payment of compensation and assistance. Skill development shall be also planned and implemented in a livelihood restoration program.

(3) Local Economy and Livelihood

Economic activities and livelihoods in the project area are mainly agriculture, animal rearing, fishing and boat operation. People whose livelihoods that are likely to be affected by the project are as follows.

1) Agriculture labours

In the project area, major crops are paddy and pulses and vegetables are the second crop. In Char land, jute is also a common crop along with paddy and pulses. The land acquisition will not only affect land owners but also agriculture laborers who are hired by the land owners on a temporary basis during cultivation and harvest season. Those labourers are either relatives of the land owners or villagers in the same or neighboring villages. Due to the land acquisition, loss of livelihood associated with those agricultural lands is expected.

2) Boat operators

Based on the information provided by the boat operators association, a total of 2,000 boat operators are registered in the Dhubri District and out of which around 250-300 operators are directly serving between Dhubri and Phulbari. Others are operating to and from others parts of the district and islands (Char lands) in the Brahmaputra River. According to Inland Waterway Transportation (IWT), daily operations of direct boat services between Dhubri to Phulbari are 20 passenger boats and 30-50 goods transportation boats.

Boat operators who are providing the service between Dhubri and Phulbari may experience loss of business opportunities by the project. Considering that the continued demand is expected for the passengers and goods transportation to and between the Char lands, boat operators servicing those

routes will not have a negative impact from the project. The impact on the loss of assets was also pointed out by the boat owners. The project will consider compensation for those boats.

3) Fishermen

According to the meeting with fishermen in the project area, normally households engaging in fishery also have agricultural land and their primary income source is agriculture. On the other hand, there are around 100 fishermen along the alighnment whose livelihood depends primarily on fishery activities. Fishing activities usually take place at night and they sell them to licensed traders in the area. Fishermen are having their own boats without engines and their fishing ranges are normally 4-5km radius upstream, downstream and across the Brahamputra River, and thus fishing locations are not fixed. Most fishermen are from the villages along the Brahamputra River and Char land and only during the rainy season when the river becomes wider, will the people from other villages also come for fishing.

Since there is no particular fishing ground mentioned along the alignment, permanent impact will not be anticipated. During the construction stage, based on the fact that the fishermen move freely in the Brahamputra River and that their activities take place at night when the construction work is finished, the impact may not be significant. However, during the construction stage, considering there will be vibration around pier construction areas and that the construction section will be restricted during the construction period, travel distance may increase for fishermen and they may face difficulty compared to during the pre-construction stage.

Mitigation Measures

In R&R, a combination of compensation and assistance will be prepared for those likely affected. Since the project entails large scale construction, significant job opportunities will be generated. Especially for the affected people in the project area, necessary trainings will be provided to meet the eligibility of employment criteria. Moreover, the improvement of the transportation network is expected to enhance accessibility to market, goods, increase employment opportunities and bring a positive impact to the local economy. Necessary training will be also included in R&R to take advantage of those opportunities.

(4) Land Use

Change of the land use will be expected along the alignment, most of which is agricultural land. Although most of PAPs requested cash compensation over land compensation, if requested, DC shall be responsible for identifying land for relocation. In this case, the development of a resettlement site is required, which causes changes in land use pattern. In the case of the construction of workers' camp, land use will change in the short term.

Mitigation Measures

If land compensation were requested as a resettlement option, a resettlement site should be identified by the DC as close to the existing village area as possible, and should ensure a proper supply of basic utilities. As for the workers' camp, the contractor should make lease agreements with the land owners in consultation with the local community assisted by the DC. Prior to the development of such sites, EIA should be carried out.

(5) Utilization of Local Resources

Excessive use of local resources especially the construction materials is expected. Assam and Meghalaya State produces large amount of construction materials including crushed stones. In this project, those materials will be procured from the existing public and private quarries. Aggregate and landfill sand are also available from the surrounding areas of the project site. Local resources should be procured in consultation and in agreement with the owners.

Mitigation Measures

If the excessive use of construction materials causes a price hike for local usage, although the impact will be short-term, the source of construction materials should be coordinated accordingly.

(6) Social Infrastructure and Service / Sensitive Facilities

With the change of the starting point in the Dhubri District, there will be no impact on schools that were initially a subject for relocation.

(7) Unequal Distribution of Benefits and Damages

Land acquisition and involuntary resettlement may lead unequal distribution of benefits between those who are directly affected by the project and those who are not. Due to the nature of the bridge, there is a possibility of an uneven distribution of benefits between the bridge connection site and Char lands. However, people in Char lands will also benefit from the improved logistics network in terms of easy access to materials, daily necessities and improved access to a market for their produce.

Mitigation Measures

R&R will be designed and implemented to mitigate unequal distribution of benefits by providing preferential opportunities to those who are directly affected. The project will pay special attention to the people in Char lands to ensure that they will get benefits from the project. For this purpose, an income restoration program will be prepared by taking into consideration their socio-economic condition assisted by the external expert.

(8) Gender

There are a number of women headed households identified in the project site. Considering that the target areas are Muslim communities, women may not be able to articulate their issues and demands in the same way that the men can. It is also possible that participation in economic activities and travelling distances may be limited for women.

Mitigation Measures

In order to reflect women's needs, which may be different from those of men, the involvement of women should be ensured in various stages of the project. Therefore, during RAP implementation, a women representative should be invited and consulted with necessary assistance from village chiefs and NGOs. If required, assistance would be provided to open accounts and receiving compensation under their names. During the construction period, equal employment opportunities should be sought for women and also preference should be given to women in choosing light loaded work and day time work, if necessary.

(9) Children's Rights

Although child labor is unlawful according to Article 24 of the Indian Constitution, it should be ensured that child labor will be strictly prohibited.

Mitigation Measures

In order to ensure that only adults are eligible for potential employment opportunities created by the project, the contract agreement with contractor should include the condition in its clause.

(10) Public Health and Occupational Health and Safety (OHS)

The health and safety measures at the design, construction, and operation phases are outlined in Table below.

Table 6-13: Health and Safety Measures

Stage	Health and Safety Measures
Construction Stage	

Stage	Health and Safety Measures
Health hazards at workplace	• Good and sufficient potable water (as per Indian Standard (IS) codes) shall be provided to avoid water-borne diseases and to ensure the health of workers. • Adequate provision for drainage, sanitation and waste disposal shall be provided. • Preventive medical care shall be provided to workers.
Hygiene at construction camps	• The contractor will provide and maintain temporary accommodation and ancillary facilities for workers that meet standards and scales approved by the resident engineer. • Drinking water, latrines and urinals shall be provided within the precincts of accommodation, as per standards set by the Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act. • Garbage bins must be provided, regularly emptied and disposed of at landfill sites.
Health/social hazards	• Provide training on transmitted diseases to workers and villagers. • Segregation of male and female areas in the construction camp.
Risk from operations	• The contractor is required to comply with all the precautions as required for the safety of the workmen as far as those applicable to this project. • The contractor shall supply all necessary safety appliances such as safety goggles, gloves, helmets, masks, etc., to the workers and staff. • The contractor must comply with all regulations regarding safe scaffolding, ladders, working platforms, gangways, stairwells, excavations, trenches and safe means of entry and egress. • Fences are recommended between the road and quarry places.
Malaria risks	• The contractor shall, at their own expense, conform to all anti-malarial instructions given to them by the engineer including filling up any borrow pits that may have been dug.
Operation Phase	
Traffic accidents	• Establish traffic signs and enforce traffic control measures including speed limits in the vicinity of schools and residential area. • A traffic management plan shall be developed especially along congested locations. • Sidewalks and shoulders will be constructed at the congested locations to ensure safety of pedestrians • Conduct traffic safety education by giving guidance to neighbors and schools for the safe way of walking along the roads, crossing the roads and consider safe route to school.To ensure the above, the physical facilities will be installed by contractors. Safety education shall be continued in coordination with the schools and the police in the neighborhood. These conditions will be included in the TOR of contractors.

Source: JICA Study Team

(11) Accidents

During the construction stage, traffic volume of heavy equipment and construction vehicles will increase. During the operation stage, increase of traffic volume and speed might increase the risk of accidents.

Mitigation Measures

During the construction stage, the construction section should be properly demarcated and signages should be placed. Notice and necessary information shall be shared amongst surrounding villagers prior to the construction activities. During the operation stage, traffic signs shall be installed, especially in the built-up areas as well as at the junction of the existing road and approach road to avoid traffic accidents. Sidewalks and pedestrian crossings will be equipped to ensure the safety and movement of pedestrians.

6.4 Impact Analysis

Comparison between the scoping and survey results is shown below.

Table 6-14: Scoping and Survey Result

Item	Impact Assessments of Scoping			Impact Assessments of Study Result			Rational of the Impact Assessment
	Pre-construction	Construction Stage	Operation Stage	Pre-construction	Construction Stage	Operation Stage	
Pollution							
Air Pollution	D	B-	B-	D	B-	B-	P: No impact is expected. C: Some negative impacts are expected due to the operation of construction equipment and vehicles. One example is dust incidental to earthwork especially during the dry season. O: Air pollution is expected to increase due to increase in traffic volume on the road.
Water Pollution	D	B-	D	D	B-	D	P: No impact is expected. C: Turbid water due to the earthworks, bridge pier construction work and wastewater effluents from construction workers' camps / yards are expected to pollute the Brahmaputra river to some extent. O: No impact is expected.
Wastes / Hazardous Materials	D	B-	D	D	B-	D	P: No impact is expected. C: Waste will be generated from construction workers' camps. Waste generated from construction and demolition work may include hazardous materials that must be treated before final disposal. O: No impact is expected.
Soil Contamination	D	B-	D	D	B-	D	P: No impact is expected. C: Impacts on soil from deposition of pollutants from construction materials in the construction site are expected to be small. Since there is no major industrial activity along the road, it is unlikely that soil along the road is already polluted. O: No impact is expected.
Noise and Vibration	D	B-	B-	D	B-	B-	P: No impact is expected. C: Noise and vibration are expected to be generated by the operation of construction equipment and vehicles, although temporary. Construction schedule should take into account the location of schools, hospitals and religious facilities that require silence during parts of the day. O: Noise and vibration levels are likely to increase due to greater traffic volume along the road. Specific measures may be required to minimize impacts on schools, hospitals and religious facilities.
Bottom sediment	D	C	C	D	D	D	P: No impact is expected. C/O: The piers may cause slight changes in the hydrodynamics and cause erosion of the bottom sediment.
Natural Environment							
Eco-system/Bio-diversity	D	A-	B-	D	B-	B-	P: No impact is expected. C: During the construction period, ecosystems in

Item	Impact Assessments of Scoping			Impact Assessments of Study Result			Rational of the Impact Assessment
	Pre-construction	Construction Stage	Operation Stage	Pre-construction	Construction Stage	Operation Stage	
							the project area, including local flora and fauna, are damaged to some extent.
							O: No impact is expected.
Topography/ Geology	D	B-	D	D	B-	D	P: No impact is expected.
							C: Changes in topographic conditions over the project area takes place due to the need for cutting and filling work.
							O: No impact is expected.
Hydrology	D	B-	B-	D	D	D	P: No impact is expected.
							C: Construction work may cause minor and temporary impacts on hydrology because of pier construction, or the local use of water.
							O: No impact is expected.
Social Environment							
Involuntary Resettlement	A-	D	D	A-	D	D	P: The project requires approximately 94ha land and a Total of 761 PAHs will be affected by the project, out of which 30% need to be resettled.
							C/O: Resettlement will be completed before construction begins and thus no resettlement is expected during construction and operation.
Land Use	B-	B-	D	B-	B-	D	P: Land acquisition and involuntary resettlement are likely to cause changes in the existing land use patterns along the alignment.
							C: Construction yards and workers' camps will have an impact on the land use, however the impact will be short term.
							O: Land usage of the approach road section will be permanently changed, however no significant negative impact is expected. Construction yard will be restored to its original condition by the contractors.
Utilization of Local Resources	D	B-	D	D	B-	D	P: No impact is expected.
							C: Procurement of large quantities of local resources for the construction materials may have impact on the price hike.
							O: No impact is expected as use of local resources is not expected during operation.
General, Regional / City Plans	D	D	B+	D	D	B+	P/C: No impact is expected.
							O: Better infrastructure network may trigger an influx of outsiders and economic development in the region.
Social Infrastructure and Services	B-	B-	B+/ B-	D	D	B+	P/C: Due to the change of the alignment, there will be no impact on school which was assumed in the beginning
							O: Improved connectivity contributes to better accessibility to social infrastructure and services.
Local Economy and	A-	B+ /B-	B+ /B-	A-	B+/B -	B+/ B-	P: Loss of income source and livelihood due to involuntary resettlement and change in land usage

Item	Impact Assessments of Scoping			Impact Assessments of Study Result			Rational of the Impact Assessment
	Pre-construction	Construction Stage	Operation Stage	Pre-construction	Construction Stage	Operation Stage	
Livelihood							are expected to negatively affect the local economy and livelihood.
							C: Construction work may have a negative impact on the fishery activities to some extent. On the other hand, construction work will have a positive impact on local economy by creating employment and business opportunities in the project area. Due to the increase of construction workers, business opportunities such as small shops are expected to increase in the area.
							O: The bridge will have impacts on the boat operators who operate directly between Dhubri and Phulbari. On the other hand, improvement of logistic network will increase accessibility to market, goods and generate employment opportunities and bring positive effect on regional economy. Although the Char area will not be directly connected by the bridge, accessibility to the markets and other necessities is expected to be improved.
Unequal Distribution of Benefit and Damage	B-	B-	B-	B-	B+/B-	B+/ B-	P: Land acquisition and involuntary resettlement will lead to an unequal distribution of benefits and damage between those who are directly affected by the project and those who are not.
							C: Those who are affected by Land acquisition and resettlement should have preference in access to employment opportunities in the construction work.
							O: There is a possibility of uneven distribution of benefits between the bridge connection site and Char land. In the long term, the whole area is expected to have economic benefits from improved logistics networks including access to markets as well as employment opportunities.
Local Conflict of Interest	B-	B-	B-	B-	B-	B-	P/C/O: There is a possibility that unequal distribution of benefits and loss will cause local conflict of interests
Water Usage, Water Rights and Communal Rights	D	B-	D	D	B-	D	P: No impact is expected.
							C: There is a possibility that the residents who use rivers as living water may be affected in the short term
							O: No impact is expected.
Sensitive Facilities (e.g. hospital, school)	B-	D	B-	D	D	D	P/C/O: Due to the change of the alignment, there will be no impact on school which was assumed in the beginning
Poor People	A-	B+	B+/ B-	A-	B+/B-	B+/ B-	P: The ratio of illiterates and the poor is high in the Char area. Given the limited coping capacity of the poor, appropriate mitigation measures will be considered in the RAP.

Item	Impact Assessments of Scoping			Impact Assessments of Study Result			Rational of the Impact Assessment
	Pre-construction	Construction Stage	Operation Stage	Pre-construction	Construction Stage	Operation Stage	
							C: The poor may bear a higher burden due to their limited capacity to cope. However, they can benefit from employment opportunities during construction work.
							P: The poor may fail to benefit from the project due to lack of skills and coping capacity, therefore assistance to improve their skills and capacity will be considered in the RAP. With that assistance, the poor can also gain benefit from improved market access and business opportunities in the long run.
Ethnic Minorities/ Indigenous People	C	C	C	D	D	D	P/C/O: Ethnic minority and Scheduled Tribes were not identified in PAH/PAPs.
Gender	B-	B-	D	B-	B+/B-	D	P: Numbers of women-headed households were identified. Involvement of women should be ensured during the course of the land acquisition and resettlement process.
							C: Equal opportunity in construction work should be sought for women and job training should be provided as necessary.
							O: No impact is expected
Children's Rights	B-	D	D	D	D	D	P: Due to the change of the alignment, there will be no impact on school which was assumed in the beginning
							C: Child labor is unlawful according to Article 24 of the Indian Constitution. Only adults are eligible for potential employment opportunities created by the project. As for the precaution, the contract with the contractors should include the clause to prohibit hiring children for the construction works.
							O: No impact is expected
Public Health (sanitation and infectious diseases)	D	B-	D	D	B-	D	P: No impact is expected.
							C: Influx of construction workers is likely to increase the health risk, particularly that of STD / STI and HIV / AIDS.
							O: No impact is expected
Occupational Health and Safety (OHS)	D	B-	B-	D	B-	B-	P: No impact is expected.
							C: Occupational health and safety of construction work should be properly managed through adequate EMP.
							O: Hygiene and safety of workers should be considered for those in charge of maintenance and repair work.
Others							
Accidents	D	B-	B-	D	B-	B-	P: No impact is expected.
							C: An increased risk of accidents associated with construction activities is expected due to the operation of heavy equipment and vehicles.

Item	Impact Assessments of Scoping			Impact Assessments of Study Result			Rational of the Impact Assessment
	Pre-construction	Construction Stage	Operation Stage	Pre-construction	Construction Stage	Operation Stage	
							O: Risks of accidents is expected to increase due to greater traffic volume and speed. Traffic measures shall be taken especially in the village area.

Source: JICA Study Team

CHAPTER 7 Environmental Management Plan and Monitoring Plan

7.1 Environmental Management Plan

Descriptions of the environment management measures during different stages of the project are provided in the tables below. Regarding measures to mitigate impacts on aquatic organisms such as Ganges dolphins, reference was made to experts on the ecology of Ganges dolphin and other similar projects.

Table 7-1: Environmental Management Plan for Pre-Construction Stage

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
P1	Bottom sediment	• Mobilization of bottom sediments will require Contractor to install turbidity curtains.	Brahmaputra River	During boring survey	Contrcator	Project Implementation Unit (PIU)
P2	Resettlement of Project Affected Persons (PAP) / Local Economy and livelihood	• All requirements of the RAP as applicable shall be complete before start of construction stage.	All areas	Before construction begins	Government of Assam / Meghalaya, District Revenue authorities and District Authorities, NGO/Consultant	PIU, SC
P3	Land use / Identify and prepare relocation sites	• The identification and selection of land use, land acquisition and/or lease during construction work shall be carried out with the assistance from respective DCs and in consultation with local residents. • In case of preparing relocation sites, necessary utilities such as water and electricity shall be provided.	Near the original villages	Before construction stage	District Authorities/ Contractor	PIU
P4	Unequal distribution of benefit and damage	• Support measures shall be implemented based on RAP including the preferential provision of employment opportunities to those directly affected. • Support measures for the char people will be planned with the assistance from NGO and other experts so that they can receive maximum benefit from the project.	Within ROW	Before construction stage	District Authorities, NHIDCL, NGO	PIU
P5	Local conflicts of interest	• Carry out close monitoring of RAP process to detect and resolve the local conflicts at earlier stage.	All areas	Before construction stage	District Authorities, NHIDCL, NGO	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
P6	Poor people / Gender	• Ensure the participation of the poor and women in the process of land acquisition and resettlement. • Livelihood restoration plan will be considered taking in to account the limited skills of the poor people including illiterate population and different needs of women. • Information shall be shared to women and representatives of women with the assistance from the village heads and NGOs.	Within ROW	Before construction stage	District Authorities, NHIDCL, NGO	PIU

Source: JICA Study Team

Table 7-2: Environmental Management Plan for Construction Stage

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
Soil						
C1	Soil Erosion in Borrow Pits (Impact on topography/ geology)	• The depth of borrow pits shall be Restricted so that sides of the excavation shall have a slope not steeper than 1:4, from the edge of the final section of the bank. After construction, excavated land shall be filled back to the original condition.	On approved locations of borrow pits.	Construction Stage	Contractor a Supervision Consultant	Project Implementation Unit (PIU)
C2	Loss of top soil in Borrow pits (Impact on topography/ geology)	• Agricultural fields or productive land shall be avoided for borrowing earth. • Top soil shall be preserved as instructed by the state government and used for tree plantation.	On approved locations of borrow pits.	Construction Stage	Contractor a Supervision Consultant	PIU
C3	Compaction of Soil (Impact on topography/geology)	• Construction equipment and vehicles shall be restricted to move only within designated area to avoid compaction of productive soil.	Throughout corridor.	Construction Stage	Contractor a Supervision Consultant	PIU
C4	Soil erosion in embankments (Impact on topography/geology)	• Pitching shall be done for slope stabilization as per the IRC guidelines	At the embankments	Construction Stage	Contractor a Supervision Consultant	PIU

C5	Soil Pollution	• Construction vehicles and equipment shall be operated and maintained in such a manner so that soil contamination due to its spillage shall be at a minimum. • Fuel storage shall only be done on wasteland and will be kept away from drainage channels and natural water bodies. • All spills and discharged petroleum products shall be disposed of in accordance to the Hazardous Waste Management and Handling Rules.	Near Labor camp and Sites of installation of Construction machineries.	Construction Stage	Contractor a Supervision Consultant	PIU
C6	Soil Pollution from construction waste	• Debris generated due to unused / waste material shall be suitably reusedin the proposed construction, suchas for filling materials for embankments. . All spoils shall be disposed of as desired and the site shall be fully cleaned before handing over. • Construction waste including non-bituminous and bituminous waste shall be dumped in an approved landfill site identified byStatePollution Control Board (SPCB) or competent authority. All spoils shall be disposed of as desired and the site shall be fully cleaned before handing over.	Solid waste dump Site identified and approved by SPCB or competent authority.	Construction Stage	Contractor a Supervision Consultant	PIU
C7	Loss of top soil	• Topsoil shall be stripped, stored and laid on ground for landscaping purposes.	Throughout the area	Construction Stage	Contractor and Supervision Consultant	PIU
Water						
C8	Water pollution	• Construction vehicles / equipment shall be operated and maintained in such a manner to avoid contamination of water bodies due to oil spillage. • Fuel storage shall only be done on wasteland and will be kept away from drainage channels and natural water bodies. • Oil and grease traps will be provided at fueling locations	Near labor camp and sites of the installation of Construction machineries.	Construction Stage	Contractor and Supervision Consultant	PIU
C9	Water pollution from labor camp.	• Labor camp shall not be allowed near any of the water bodies. • The proper sanitation facilities shall be provided.	Preapproved locations away from the water bodies.	Construction Stage	Contractor and Supervision Consultant	PIU
C10	Deposition of dust in open wells near construction site	• The mouth/opening of the well shall be covered with suitable material during any of the construction activity so as to prevent dust from entering in the well.	All the wells along the project corridor.	Construction Stage	Contractor and Supervision Consultant	PIU

C11	Impact on Surface water quality due to eroded soils	• Construction work close to the watercourses or other water bodies will be avoided, especially during the monsoon period. • Increase coverage of open surface area by planting grass and creepers so that the washing away of materials from sloped surfaces would be reduced by a significant extent. • Silt curtain should be used for all underwater works.	All the respective locations	Construction Stage	Contractor and Supervision Consultant	PIU
Air						
C12	Emission from construction vehicles and machinery.	• All vehicles, equipment and machinery shall be selected to meet recognized international and national standards for emissions and shall be maintained and operated in a manner that ensures relevant air, noise and discharge rules. • Only unleaded petrol and low sulphur diesel or sulphur-free diesel shall be used as fuel for vehicles, equipment and machinery. • Air quality monitoring shall be conducted.	Wherever the hot mix plant and batching plant is setup.	Construction Stage	Contractor and Supervision Consultant	PIU
C13	Air pollution from various plants	• The asphalt plants, crushers and batching plants shall not be sited within at least 500m in leeward direction from the nearest human settlement. • Particulate Filters shall be installed.	Locations near Settlement	Construction Stage	Contractor and Supervision Consultant	PIU
C14	Dust	• The dust generated by vehicles on site shall be arrested using a water tanker fitted with a sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding. • Trucks shall be covered by the sheet.	Wherever the plants are Set up and s locations as suggested in the monitoring plan.	Construction Stage	Contractor and Supervision Consultant	PIU
Waste						
C15	Waste disposal	• Debris generated due to unused / waste material shall be suitably reused in the proposed construction, such as for filling materials for embankments. • Construction waste including non-bituminous and bituminous waste shall be dumped in an approved landfill site identified by State Pollution Control Board (SPCB) or competent authority. All spoils shall be disposed of as desired and the site shall be fully cleaned before handing over.	Solid waste dump identified and ap by SPCB or competent authority. Throughout the area	Construction Stage	Contractor a Supervision Consultant	PIU
Noise						

C16	Noise levels from vehicles. Asphalt plants and equipment	• The plants and equipment used for construction will strictly conform to Central Pollution Control Board (CPCB) noise standards. Vehicles, equipment and construction machinery shall be monitored regularly with particular attention to silencers and mufflers to maintain noise levels to a minimum; • Workers in the vicinity of high noise levels must wear ear plugs and helmets and should be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90 dB(A); • In construction sites within 150 m of human settlements, noisy construction will be stopped between 10 PM and 6 AM. • Hot mix plants, batching or aggregate plants shall not be located within 500m of sensitive land use for schools and hospitals; • For places close to the sensitive receptors such as hospitals and schools, noise barriers such as earth, concrete, wood, metal or double-glazing of windows for façade insulation shall be used; • Phase demolition, earthmoving, and ground-impacting operations are not to occur in the same time period. Unlike noise, the total vibration level produced could be significantly less when each vibration source operates separately; • Construction machinery will be located away from the settlements; • Careful planning of machinery operation and scheduling of operations can reduce the noise levels. • Noise monitoring shall be conducted to check if the noise level is within the environmental standards.	Throughout the project area	Construction Stage	Contractor and Supervision Consultant	PIU
Bottom Sediment						
C17		• Slit curtain shall be installed to prevent move of the sediment. • Construction works shall be suspended when flood warning is issued.				

Ecology						
C18	Tree cutting in ROW	• Land clearing activities at the construction site should be kept at an absolute minimum. • Construction vehicles, machinery and equipment will be moved or stationed in the (ROW) to prevent compaction of vegetation.	Throughout the project area	Construction Stage	Contractor and Supervision Consultant Forest Dept.	PIU
C19	Endangered species	• Relevant information (e.g. encounter with vulnerable species during engineering work) shall be shared with the State Environment and Forest Department and concerned regional environmental experts. • Anti-poaching measures during the construction phase should be strengthened to check for any violation of existing regulations. Awareness campaign to be made among the workers to aware them on the endangered and other important species. • Construction vehicles must be operated at safe speed to avoid collision with wildlife. Training should be provided for the vehicle operators and warning signs should be installed. • Change of geology and topography should be kept minimum. Avoid constructing labor camps and construction yards near the river banks. • To minimize impacts, noisy operations should be avoided during breeding season of the dolphins (February-July). • River flow should not be blocked at all times for free movement of dolphins. • Measures such as the creation and monitoring of an exclusion zone of a 500m radius for at least 30 minutes before the start of construction activities shall be followed. If dolphins are observed in the exclusion zone, construction works should be delayed until they have left the area. If dolphins enter the exclusion zone after construction has commenced, construction works should cease until they have left.	Throughout the project area	Construction Stage	Contractor and Supervision Consultant	PIU

C19	Endangered species (continued)	• All activities that increase soil erosion or contribute to nutrients and pollutants to water need be minimized both on • -site and off-site by using measures such as silt curtain. • Construction activities should be carried out in close supervision of the dolphin ecologist. • Construction works should be avoided or kept minimum in vicinity of the dolphins' favorable microhabitats (downstream of shallow areas/sandbars, tributary junctions) • Dolphins are likely to prefer water depth range between 4.1 to 6 m. Therefore, movement of sediment and influx of soil/silt etc. should be avoided to keep the favorable depth range. • In case rare birds of prey are observed near the construction area, the construction work will be avoided during their breeding season. • Before construction of piers the construction site must b checked for the presence of threatened turtles, migratory birds and other threatened species and their nests. If the turtle and/or their nest are found inside or near the construction are the animals and/or the eggs must be physically moved to safe habitat areas under the guidance of the local wildlife experts. • All boats or ferries transporting construction material an workers will have propeller guards installed to prevent injur and death of dolphins, turtles and other aquatic fauna. • One of the threats to bird and turtle habitat is conversion of th river edges from natural soft embankments into hard concret embankments. Therefore the natural bank slope is preserve and location of the bridge piers will avoid such areas. N construction camp, borrow areas or disposal sites will b established within 100m of the shorelines at the highest wate level period. • All avoidance, mitigation and enhancement measures an monitoring plans proposed to address impacts on flora, faun and the threatened species should be updated during th detailed design stage by conducting detailed studies such a identification of the migrating routes of dolphins and birds exact locations of turtle nesting grounds, etc.	Throughout the project area	Construction Stage	Contractor and Supervision Consultant	PIU

C20	Underwater noise impacts on aquatic species.	• Use vibratory hammer. Under conditions where impact hammers are required for reasons of seismic stability or substrate type, it is recommended that the pile be driven as deep as possible with a vibratory hammer prior to the use of the impact hammer. • Monitor sound levels during pile driving to ensure that they do not exceed the NOAA (National Oceanic and Atmospheric Administration, USA) or any other international recognized criteria. • Implement measures to attenuate the sound when sound pressure levels exceed the NOAA or any other international recognized criteria. Methods to reduce the sound pressure levels include but are not limited to: Installation of underwater enclosures to minimize sound Surrounding the pile with an air bubble curtain system or air-filled coffer dam. Using a smaller hammer to reduce the sound pressure. The sound produced in pile driving has a direct relationship to the force used to drive the pile. A smaller hammer will have less force on the pile therefore producing less sound. • Construction works should be ceased when the dolphins are observed near the work area.				
Social Environment						
C21	Land Use	• When the workers' camp was to be developed, the contractor should make lease agreements with the land owners in consultation with the local community assisted by the DC. Prior to the development of such sites, EIA should be carried out.	At respective planned construction sites	Construction Stage	Contractor and Supervision Consultant	PIU
C22	Utilization of Local Resources	• If the excessive use of construction materials causes a price hike for local usage, the source of construction materials should be coordinated accordingly.	At respective planned construction sites	Construction Stage	Contractor and Supervision Consultant	PIU

C23	Local Economy and Livelihood / Unequal Distribution of Benefit and Damage / Local Conflict of Interest	• PAP (including women and the poor) will be given priority to be employed in the construction work. Information will be widely shared to local residents for them to understand and take advantages of the employment opportunities. • Provide vocational training that allows local residents to satisfy the conditions to become workers.	Throughout the project area	Construction Stage	Contractor and Supervision Consultant, NHIDCL, NGO	PIU
C24	Water use	• To minimize the river pollution during construction, mitigation measures will be applied such as installing a silt fence in places close to the residential area.	At respective planned construction sites	Construction Stage	Contractor and Supervision Consultant	PIU
C25	Gender	• Equal employment opportunities should be sought for women and also preference should be given to women in choosing light loaded work and day time work, if necessary.	Throughout the project area	Construction Stage	Contractor and Supervision Consultant	PIU
Health and Hygiene						
C26	Health hazard at Construction work sites	• At every workplace, good and sufficient potable water (as per IS 10500) supply shall be ensured to avoid water-borne diseases and to secure the health of workers. • Adequate drainage, sanitation and waste disposal shall be provided at workplaces. • Preventive Medical care shall be provided to workers.	Wherever labor camp is set up	Construction Stage	Contractor and Supervision Consultant	PIU
C27	Health hazard during construction work	• Personal protective equipment shall be provided to workers as per the Factories Act.	Construction work	Construction Stage	Contractor and Supervision Consultant	PIU

C28	Hygiene at Construction Camps	• The Contractor during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labor to appropriate standards and scale approved by the resident engineer • These shall be provided within the precincts of every workplace, latrines and urinals in an accessible place, and the accommodation, separately for each for these, as per standards setby the Building and other Construction Workers (regulation of Employment and Conditions of Service) Act, 1996. There shall be adequate supply of water, close to latrines and urinals. • All temporary accommodation shall be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. The sewage systemfor the camp must be properly designed, built and operated. • Compliance withthe relevant legislation must be strictly adhered to. Garbage bins shall be provided in the camp and regularly emptied and the garbage disposed of in a lined landfill sites.	Wherever labor camp is set up	Construction Stage	Contractor a Supervision Consultant	PIU
C29	Health/ social hazard, sexual harassment to female workers	• Segregation of male and female areas in labor camp shall be executed.	Wherever labor camp is set up	Construction Stage	Contractor and Supervision Consultant	PIU
C30	Construction Camps	• Upon completion of the works, the entirety of such temporary structures shall be cleared away, all rubbish burnt, excreta or other disposal pits or trenches filled in and effectively sealed off and the entirety of the site left clean and tidy, a the Contractor's expense, to the entire satisfaction of the Engineer.	Wherever labor camp is set up	Construction Stage	Contractor and Supervision Consultant	PIU
C31	Quarry site will accumulate water and act as a breeding ground for disease vectors.	• Reclamation measures shall be adopted with a garland of trees around the periphery. The quarry dust and waste shall be used for refilling. The remaining portion should be covered with trees.	All quarry locations	Construction Stage	Contractor and Supervision Consultant	PIU
Safety						

C32	Workers' safety	• The contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, etc. to the workers and staff. Especially all workers employed in mixing Asphaltic material, welding works, stone breakers, and paint should be provided with appropriate personal protected equipment. • The contractor has to comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and a safe means of entry and egress. • All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian Standards' (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the Engineer.	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU
C33	Unexpected disasters and accidents	• All reasonable precautions will be taken to prevent danger for the workers and the public such as fire, flood, drowning, etc. All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work. • At every workplace, a readily available first aid unit including an adequate supply ofsterilized dressing material and appliances will be provided.	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU
C34	Workers' health	• The Contractor shall, at his own expense, conform to all anti-malarial instructions given to him by the Engineer, including filling up any borrow pits which may have been dug by him	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU
C35	Accidents	• The construction section should be properly demarcated and signage should be placed. • Notice and necessary information shall be shared amongst surrounding villagers prior to the construction activities. • Carry out traffic safety awareness program for road side communities. • Check and approve the Contractor's method of work, including site organization, program of performance, quality assurance system, safety plan, method statements of safety and environmental monitoring plan.	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU

Source:

Table 7-3 Environmental Management Plan for Operation Stage

	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
O1	Water Pollution	• Silt fencing, oil & grease traps, etc. shall be provided at sensitive water bodies to ensure that the water quality is not impaired due to contaminants from road run-off Monitoring shall be carried out as specified in the monitoring plan • Contingency plans to be in place for cleaning up of spills of oil, fuel and toxic chemicals	As specified in the Monitoring plan	As per monitoring plan	PIU, SPCB	Project Implementation Unit (PIU)
O2	Soil contamination	• Contingency plans to be in place for cleaning up of spills of oil, fuel and toxic chemicals • Monitoring shall be carried out as specified in the Monitoring Plan	All area and as specified in the monitoring plan	Plan to be developed at state/district level By early operation stage	PIU, SPCB, Local Government Bodies	PIU
O3	Air quality degradation due to increases in traffic volume	• Monitoring shall be carried out as specified in the Monitoring plan • Share air quality data with SPBC and relevant agencies and discuss options for mitigate air quality degradation associated with greater traffic volume.	As specified in the monitoring plan	As per monitoring plan	PIU, SPCB	PIU
O4	Increases in noise and vibration due to greater traffic volume	• Monitoring shall be carried out as specified in the Monitoring plan • Install noise barrier (wall etc.) in sensitive areas, if necessary • Carry out proper road maintainance to reduce noise and vibration.	As specified in the monitoring plan	As per monitoring plan	PIU, SPCB	PIU
O5	Ecology	• Monitor the poplutaion of endangered species. • Enhance research and conservation of Gangatic river dolphins. • Littering from the bridge into the river must be prohibited. • Roadside greenbelt should be mainteained to enhance ecological landscape, using native local tree species.	As specified in the monitoring plan	As per monitoring plan	PIU, NGO	PIU
O6	Local economy and livelihoods/ Poor people	• Change of income source and income of PAPs shall be monitored and modify the assistance measures as necessary.	Within ROW	As per monitoring plan	PIU, NGO	PIU

O7	Unequal Distribution of Benefit and Damage / Local Conflict of Interest	• Conduct interviews to DCs and village heads about dissatisfaction or conflict of residents of the target area and explain and take measures as necessary.	All area	When issues are identified	District Authorities, PIU, NGO	PIU
O8	Public Health / Occupational Health and Safety (OHS)	• Ensure the safety of the workers by providing safety guidance to the maintenance and repair workers.	Area of maintenance / repair work	At the time of maintenance / repair work	PIU	PIU
O9	Accidents	• Ensure the safety through traffic rules such as speed limit. • Traffic signs shall be installed, especially in the built-up areas as well as at the junction of the existing road and approach road to avoid traffic accidents. • Sidewalks and pedestrian crossings will be equipped to ensure the safety and movement of pedestrians.	All area	As per monitoring plan	PIU	PIU

Source: JICA Study Team

7.2 Environment Monitoring Program

(1) Ambient Air Quality

Ambient air quality parameters recommended for monitoring road transportation developments are PM10, PM2.5, Carbon Monoxide (CO), Oxides of Nitrogen (NOX), and Sulphur Dioxide (SO2). These will be monitored at designated locations starting from the commencement of construction activity. Data should be generated at all identified locations in accordance with the National Ambient Air Quality Standards, 2009. The location, duration and the pollution parameters will be monitored and the responsible institutional arrangements are detailed in the Monitoring Plan.

(2) Water Quality

The physical and chemical parameters recommended for the analysis of water quality relevant to road / bridge development projects are: pH, turbidity, total solids, total dissolved solids, total suspended solids, oil and grease, COD, chloride, lead, zinc and cadmium. The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan. The monitoring of the water quality is to be carried out at all identified locations in accordance with the Indian Standard Drinking Water Specification – IS 10500: 2012.

(3) Noise

The measurements for monitoring noise levels would be carried out at all designated locations in accordance with the Ambient Noise Standards formulated by the Central Pollution Control Board (CPCB) in 1989. Noise should be recorded at an "A" weighted frequency using a "slow time response mode" of the measuring instrument. The location, duration and the noise pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan.

(4) Biodiversity

The monitoring of ecosystem including the Ganges River Dolphins shall be carried out by subcontracting a competent environmental NGO led by a qualified expert. A detailed dolphin census survey shall be carried out before the onset of construction works, in which the estimated number of the dolphins, demography, geographical distribution, and their behavioral pattern will be studied in the project affected area. Using the data from the initial assessment as a baseline, the monitoring of the dolphin population will be carried out thrice a year following the same survey protocol. At the time of each survey, visual observation of the ecosystem will be also carried out for presence/absence of other rare/endangered species.

The monitoring plan for the various performance indicators of the project in the construction and operation stages is summarized in the table below.

Table 7-4: Environmental Monitoring Plan

Sl. No	Item	Project Stage	Parameters	Guidance	Standards	Location	Frequency	Responsibility	
								Implementation	Supervision
M1	Air	Construction	PM_{10}, SO_2,NOx, CO	• Dust sampler to be located 50m from the plan in the downwind direction. • Use method specified by CPCB for analysis	Air (P&CP) Rules, CPCB, 1994	Hot mix plant/ batching plant, Sampling locations specified in EIA report	Thrice a year For 6 years	Contractor through approved monitoring agency	PIU
M2		Operation	PM_{10}, SO_2,NOx, CO	• Use method specified by CPCB for analysis	Air (P&CP) Rules, CPCB, 1994	Sampling locations specified in EIA report	Twice a year for two years	PIU	PIU
M3	Water	Construction	pH, Turbidity, BOD, COD, TDS, TSS, DO, Oil & Grease and Pb	• Sample collected from source and analyzed as per Standard Methods for Examinationof Water and Wastewater	Water quality standards by CPCB	Sampling locations specified in EIA report	Thrice a year For 6 years	Contractor through approved monitoring agency	PIU
M4	Noise	Construction	Noise levels on dB (A) scale	• Free field 1m from the equipment whose noise levels are being determined.	Noise Standards by CPCB	At equipment yard / construction site.	Thrice a year For 6 years	Contractor through approved monitoring agency	PIU
M5		Operation	Noise levels on dB (A) scale	• Equivalent Noise levels using an integrated noise level meter kept at a distance of 15m from edge of Pavement	Noise standards by CPCB	At maximum 4 sites listed in EIA	Twice a year for 2 years	PIU	PIU
M6	Topography and geology	Construction	Conditions in embankment area	• Visual survey about stability of embankment		At equipment yard/ construction site.	Thrice a year For 6 years	Contractor	PIU
M7	Soil contamination	Construction	Presence/absence of oil spillage	• Visual inspection		At equipment yard/ construction site.	Thrice a year For 6 years	Contractor	PIU

Sl. No	Item	Project Stage	Parameters	Guidance	Standards	Location	Frequency	Responsibility	
								Implementation	Supervision
M9	Ecology	Construction and operation	Frequency of dolphin sightings, Observation of Vulnerable Species (name and location of the observed species)	• Observation from river bank (from sunrise to sunset, 10 days), visual observation, hearing to construction workers/local residents	Baseline survey will be carried out before contruction	Dhubri, Phulbari	Thrice a year for 6 years during construction and twice a yeaer for 2 years during operation	NGO, PIU	PIU
M10	Livelihood	Construction and operation	Change of livelihood	• Evaluate based on the RAP monitoring results	Census survey carried out during the RAP preparation	Within ROW	Twice a year	NGO	PIU
M11	Land Use	Construction	Change of land use	• Visual inspection	Land use before construction	At construction yard and labour camp	Twice a year	Contractor	PIU
M12	Utilization of Local Resources	Construction	Price of construction materials	• Interview with local construction company	NA	Dhubri, Phulbari	Twice a year	Contractor	PIU
M13	Unequal Distribution of Benefit and Damage	Construction and operation	Satisfactory level	• Evaluate based on the RAP monitoring results	NA	Dhubri, Phulbari	Twice a year	NGO	PIU
M14	Water use	Construction	Use of silt fence	• Site inspection	NA	At the construction site near residential area	During construction near residential area	Contractor	PIU

Sl. No	Item	Project Stage	Parameters	Guidance	Standards	Location	Frequency	Responsibility	
								Implementation	Supervision
M14	Gender	Construction	Number of women employed	• Employment record • Evaluate based on the RAP monitoring results	NA	Within ROW and surrounding villages	Twice a year	NGO, Contractor	PIU
M15	Public Health	Construction and operation	Adequate equipment and facilities Number of health issue reported	• Site inspection • Record on health	NA	At labour camp and construction site.	Twice a year	Contractor	PIU
M16	Occupational Health and Safety	Construction	Adequate equipment and facilities Number of work related accidents	• Site inspection • Accident records	Factories Act.	At labour camp and construction site.	Twice a year	Contractor	PIU
M17	Accidents	Construction and operation	Number of traffic accidents	• Accident records	NA	Within ROW	Twice a year	Contractor	PIU

Source: JICA Study Team

7.3 Institutional Arrangement

The detailed measures adopted and/or to be adopted during different stages of the project to mitigate negative impacts and enhance positive aspects are shown in Table 7-1 to 7-3. The responsibility for the implementation and supervision of EMPs are vested with three agencies, namely, Contractors, PIU, and Supervision consultants (SC). The Contractors herein mean the agency hired for the execution of the construction works for the respective contract packages. PIU would be the implementation agency with the support of PWD. Figure below indicates the implementation structure of the EMP.

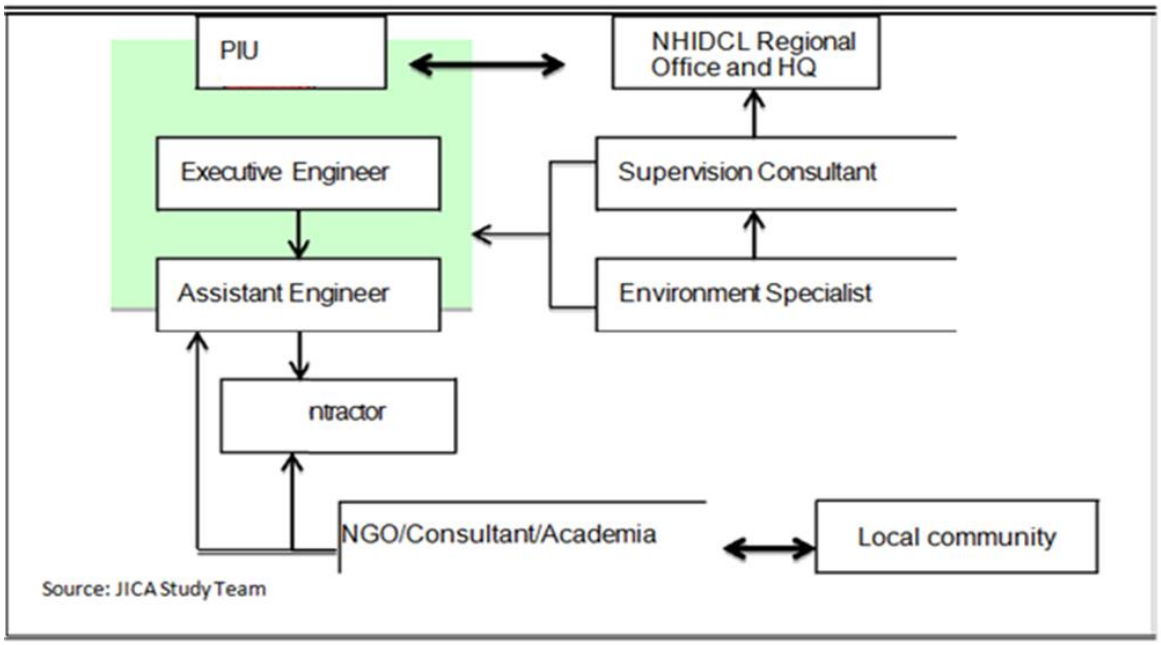

Figure 7-1: Riverbed Topography around the Dhubri Bridge

It has been proposed that the Executive Engineer (environment) based in Dhubri will be in charge of the implementation of EIA and EMP for this project. Such an engineer will be assisted by the Assistant Engineer (Environment), who will be assisted by a Junior Engineer as well as a Supervision consultant (and Environment Specialist) and contractor.

The construction supervision consultants are expected to have in-house capacity to advise on and supervise the implementation of the EMP including suggesting enhancement design options and modifications, as necessary. For this purpose, the supervision consultant will employ a full-time environmental specialist.

Compensatory plantation, maintenance and protection of vegetation will be required as part of environmental mitigation and enhancement works. Likewise, spoiled soil shall be used, where possible, to create community assets such as playgrounds, as per request of the community. In these types of works, the project may engage NGO, Consultant or experts from local universities to liaise with the local community for effective implementation of the project.

7.4 Grievance Redress Mechanism

An integrated grievance and redress mechanism (GRM) for environmental and social action plans is needed to be established for the project. The GRM provides a system for receiving,

evaluating and facilitating the resolution of affected people's concerns, complaints, and grievances about the project's social and environmental performance. Due to the scale of the project with one end of the bridge located in an urbanized section of Dhubri and adverse impacts are anticipated, issues like poor legal records, voluminous titles and sometimes conflicting holdings, intensive construction activities located near communities, traffic from construction vehicles, and conflict between migrant and host communities are to be expected.

Grievances related to the implementation of the project, will be acknowledged, evaluated, and responded to with corrective action proposed using understandable and transparent processes that are gender responsive, culturally appropriate, and readily accessible to all segments of the affected people. Records of grievances received, corrective actions taken and their outcomes will be properly maintained.

The nature and significance will be evaluated by the receiving party. Any complaint which concerns project construction activity, poses imminent serious risk to life and property, or will result to irreversible damage to wildlife (dolphin) will be immediately forwarded to the PIU- for action within 24-hours from receipt of complaint.

7.5 Monitoring Forms

The following Tables indicate JICA's standardized monitoring form. Monitoring works should be carried out every six months unless otherwise specifically noted.

Table 7-5: Environmental Clearance

During Construction

Monitoring Item	Conditions During the Reporting Period
Response to State Department's Comments/Guidance for Obtaining Environmental Clearance	

Source: JICA Study Team

Table 7-6: Air Quality

During Construction

Item (Unit)	Measured Value of Baseline Data (Max.)	Measured Value of Monitoring (Max. Value)	Indian Standard	Referred International Standard	Remarks (Location、Frequency and Method of Measurement)
SO_2	11.5 µg/m^3		80µg/m^3	20µg/m^3	Chagal chora (Latitude 26°02'0.32"N & Longitude 89°56'15.67"E) Katiaralaga (Latitude 250 57' 49.90" N & Longitude 890 58'38.26" E) Bororavatari (Latitude 250 55' 03.91" N & Longitude 900 00' 53.50" E) Phulbari (Latitude 250 53' 21.04" N & Longitude 900 02' 13.40" E) Thrice a year, Based on the National Ambient Air Quality Standard: NAAQS
NO_2	23.7 µg/m^3		80µg/m^3	200µg/m^3	
CO	780 µg/m^3		2000µg/m^3	-	
PM10	88.7		100µg/m^3	50µg/m^3	

During Operation

Item (Unit)	Measured Value of Baseline Data (Max.)	Measured Value of Monitoring (Max. Value)	Indian Standard	Referred International Standard	Remarks (Location、Frequency and Method of Measurement)

SO_2	11.5 µg/m^3	80µg/m^3	20µg/m^3	Chagal chora (Latitude 26°02'0.32"N & Longitude 89°56'15.67"E) Katiaralaga (Latitude 250 57' 49.90" N & Longitude 890 58'38.26" E) Bororavatari (Latitude 250 55' 03.91" N & Longitude 900 00' 53.50" E) Phulbari (Latitude 250 53' 21.04" N & Longitude 900 02' 13.40" E) Twice a year, Based on the National Ambient Air Quality Standard: NAAQS
NO_2	23.7 µg/m^3	80µg/m^3	200µg/m^3	
CO	780 µg/m^3	2000µg/m^3	-	
PM10	88.7	100µg/m^3	50µg/m^3	

Source: JICA Study Team

Table 7-7: Water Quality

During Construction

Item (Unit)	Measured Value	Indian Standard	International Standard	Remarks (Location、Frequency and Method of Measurement)
pH	6.02-7.54	6.5-8.5	6-9	Chagal Chora (Latitude 26°02'0.58"N & Longitude 89°56'15.22"E) (Bore well) Chaitarchar (Latitude 25°55'49.65"N& Longitude 89°59'30.77"E)(Brahmaputra River) Katiaralaga (Latitude 250 57' 48.71" N & Longitude 890 58'34.52" E) (Hand pump) Bororavatari (Latitude 250 55' 00.77" N & Longitude 900 01' 45.56" E) (Jinger River) P hulbari (Latitude 250 53' 21.04" N & Longitude 900 02' 13.40" E) (Dug well) Thrice a year, Based on the Indian Standard Drinking Water Specification – IS 10500: 1991
Turbidity (NTU)	6.5	10NTU	50mg/L	
BOD/COD (mg/L)	4.2/16.0	-	30/125	
DO (% by mass)	6.0-7.2	10	-	
Heavy Metal	<0.05	-	-	
Phenol	<0.01	-	-	
Cyanide	BDL	-	-	

Source: JICA Study Team

Table 7-8: Solid Waste

During Construction

Monitoring Item	Types and amount of generated waste
Reused Debris	
Disposed Debris	

Source: JICA Study Team

Table 7-9: Noise and Vibration

During Construciton

Item (Unit)	Measured Value (Min. Value)	Measured Value (Max. Value)	Indian Standard	Referred International Standard	Remarks (Location、Frequency and Method of Measurement)
Noise Level (dB)	40.5	62.4	Noise Standard of India 2000		Chagal Chora (Latitude 26°02'0.58"N & Longitude 89°56'15.22"E) Katiaralaga (Latitude 250 57' 48.75" N & Longitude 890 58'34.64" E) Bororavatari (Latitude 250 55' 05.21 N & Longitude 900 00' 54.81" E) Phulbari (Latitude 250 53' 20.91" N & Longitude 900 02' 15.30" E),、Thrice a
Vibration Level					

	year, , Based on Noise Standard of India 2000

During Operation

Item (Unit)	Measured Value (Min. Value)	Measured Value (Max. Value)	Indian Standard	Referred International Standard	Remarks (Location、Frequency and Method of Measurement)
Noise Level (dB)	40.5	62.4	Noise Standard of India 2000		Chagal chora (Latitude 26°02'0.58"N & Longitude 89°56'15.22"E) Katiaralaga (Latitude 250 57' 48.75" N & Longitude 890 58'34.64" E) Bororavatari (Latitude 250 55' 05.21 N & Longitude 900 00' 54.81" E) Phulbari (Latitude 250 53' 20.91" N & Longitude 900 02' 15.30" E) Twice a year, Based on Noise Standard of India 2000
Vibration Level					

Source: JICA Study Team

Table 7-10: Topography and Geology

During Conctruction

Monitoring Location	Condition of embankment, presence/absence of erosion
Construction Camp	
Equipment Yard	
Construction Site	
Others	

Source: JICA Study Team

Table 7-11: Soil Contamination

During Construction

Monitoring Item	Conditions During the Reporting Period
Presence/absence of oil spillage	

Source: JICA Study Team

Table 7-12: Biodiversity

During Construciton

Monitoring Item/Parameter	Conditions During the Reporting Period	Remarks
Observation of Ganges River Dolphin (number of dolphins/hour)		At least 6 locations (2 locations in Dhubri, 2 locations in Phulbari, 2 locations on the sandbar), Thrice a year, 10 days
Observation of Vulnerable Species		Visual observation and hearing to construction workers/local residents
Name of the Species:		
Location of the Observation		

Source: Source: JICA Study Team

During Operation

Monitoring Item/Parameter	Conditions During the Reporting Period	Remarks
Observation of Ganges River Dolphin (number of dolphins/hour)		At least 6 locations (2 locations in Dhubri, 2 locations in Phulbari, 2 locations on the sandbar), Twice a year, 10 days
Observation of Vulnerable Species		Visual observation and hearing to local residents
Name of the Species:		
Location of the Observation		

Source: JICA Study Team

Table 7-13: Resettlement

Major items of action	Specific action steps (sub-items)	Progress in quantity	Progress in %	Expected Date of Completion
Recruitment, training and deployment	Deployment of consultants and resettlement workers (MM)			
	Training and mobilization (No. of trained personnel)			
Review of Resettlement Action Plan	Review of RAP (%)			
	Finalization of PAPs (%)			
	Approval of RP with corrections (%)			
Socioeconomic Survey	Field Survey and collection of data, Data analysis (%)			
	Valuation of affected property and collection of data (%)			
	Produce data for comparison/evaluation (%)			
Information campaign	Distribute information brochure (No. distributed)			
	Public consultation meetings/FGD (Times)			
Identification of PAPs	Assigning ID numbers (No. of Person)			
Payment	Opening bank account (No. of Person)			
	Assist PAPs in collecting of cash compensation (No. of Persons)			
	Confirm payment of transfer (No. of Persons)			
Resettlement	Coordination with DC on the new site (No. of Households)			
	Assist PAH for the resettlement (No. of Households)			
Income restoration program	Training program, Assistant activities (No. of cases)			
	Field Survey and collection of socio-economic data after 5 years (%)			
Grievance Redress	Formation of GRC (%)			
	Receiving complaints / claims from PAPs (No. of cases)			
	Resolved complaints / claims from PAPs (No. of cases)			
Supervision and Management	Supply of manpower (MM)			
	Number of meetings with relevant agencies (No. of meetings)			
Performance Reporting	Inception / Monthly progress / Draft final report			

Source: JICA Study Team

Table 7-14: Land Use

Monitoring Item	Land use (Before/After)	Size	Agreed with land owner (Yes/No)	Land acquired / Lease / returned
Location				

Source: JICA Study Team

Table 7-15: Utilization of Local Resources

Monitoring Item	Price hike (Yes/No)	If yes, description
Name of Construction materials		

Source: JICA Study Team

Table 7-16: Unequal Distribution of Benefit and Damage

Monitoring Item	No. of samples	No. of unsatisfied PAPs	If unsatisfied, reasons
Satisfaction level			

*Based on RAP monitoring

Source: JICA Study Team

Table 7-17: Water Use

Monitoring Item	Use of silt fence	Turbidity
Location		

Source: JICA Study Team

Table 7-18: Gender

Monitoring Item	Description
Number of women employed	

Source: JICA Study Team

Table 7-19: Public Health

Monitoring Item	Description
Equipment and facilities	Adequate/Not adequate. If no, describe.
Number and nature of health issue reported	

Source: JICA Study Team

Table 7-20: Occupational Health and Safety

Monitoring Item	Description
Equipment and facilities	Adequate/Not adequate. If no, describe.
Number and causes of work related accidents	

Source: JICA Study Team

Table 7-21: Accident

Monitoring Item	Remark
Number of Injury/Fatalities	
Location of the accident	
Type and cause of the accident	

Source: JICA Study Team

7.6 Environmental Management Budget

The Proposed Budget for implementation of EMP is estimated below.

Table 7-22: Budget for EMP Implementation

No.	Cost of Environmental / Mitigation Plan Description	Unit	Qty	Unit Rate (Rs.)	Amount (Rs.)
A.	**Cost During Construction Phase**				
1	**Environmental Monitoring**				
	Air quality monitoring at 5 locations for 3 seasons for 6 consecutive years	Nos.	90	8,000.00	720,000.00
	Surface water quality monitoring at 5 locations for 4 seasons for 6 consecutive years	Nos.	120	6,000.00	720,000.00
	Noise quality monitoring at 10 locations for 3 seasons for 6 consecutive years	Nos.	180	3,000.00	540,000.00
	Flora and Fauna Study at 2 locations for 6 consecutive years	Nos.	18	1,00,000.00	1,800,000.00
2	**Dust suppression at site (2 trips/day for 300 days/year for 6 years)**	Nos.	3600	1,500.00	5400,000.00
3	**Development of river funding near bridge area, providing toilets etc.**			10,00,000.00	1,000,000.00
	Total cost during construction phase				**10,180,000.00**
B	**Institutional Cost**				
1.	**Expert Fees**	L.S			6,00,000.00
2.	**Staff Training**	L.S			4.00,000.00
3.	**Information Disclosure**	L.S			4,00,000.00
	Total				**14,00,000.00**
C.	**Annual cost During Operation Phase**				
1	**Environmental Monitoring**				
	Air quality monitoring at 5 locations for 3 seasons for 2 years	Nos.	30	8,000.00	2,40,000.00
	Noise quality monitoring at 4 locations twice a year for 2 years	Nos.	16	3,000.00	48,000.00
	Flora and Fauna Study at 2 locations for 2 consecutive years	Nos.	4	1,00,000.00	4,00,000.00
	Monitoring and maintenance efforts for ensuring survival of planted trees for 2 years	Nos.	1000	5,00.00	5,00,000.00
Total Cost During Operation Phase					**11,88,000.00**
Total Cost (A + B + C)					99,54,000.00
Contingency (10%)					9,95,400.00
Total (Rs.)					**10,949,400.00**

Source: JICA Study Team

CHAPTER 8 Stakeholder Consultation

Public consultations were arranged at the scoping phase and draft final report phase to ensure the participation of the community in the planning process, and to gather issues, comments and suggestions from the relevant stakeholders.

Consultation with the first stakeholder was held in two locations and followed by five community meetings and three focus group discussions, in order to cover project area and to have a comprehensive view on the project. Consultation with the second stakeholder was held in four locations where a majority of the PAPs have easy access.

Information for those who remained un-surveyed due to absence during the census survey period, information of stakeholder meeting and the summary of draft report, was shared by the land acquisition officers of respective districts and assistance from the village chiefs and neighboring residents. The same method will be employed for the information dissemination during the hearing objection period.

8.1 1st Round Consultation

(1) 1st Round Consultation

The purpose of the stakeholders meeting at the scoping stage is to explain the project objective, a summary of the project and scoping results of environmental and social impact from the project in order to obtain comments and concerns from the likely affected communities. The meetings were held in two locations, at the starting point on the Dhubri and Phulbari side.

The main discussion points were as follows.

1) Outline and purpose of the Project
2) Explanation on the alignment
3) Anticipated positive and negative impacts from the project
4) Conveyed that the results of the meeting (especially comments and concerns) will be reflected in the project as necessary

The announcements of stakeholder meetings were informed by visiting land acquisition officers, publishing in a local newspaper and distributing pamphlets through village chiefs and local consultants (Enviro Infra Solutions Pvt. Ltd.: EIS). Stakeholder meetings were conducted with the approval from the NHIDCL. Participants include land acquisition officers, village chief, villagers, DPR consultant (AECOM), PWD officers etc. Assamese and Bengali were used in the meeting which are the languages used in the target area. The details are shown below.
The details of 1st Round Consultations with Communities are summarized in Table 7-97 and Table 7-98.

Table 8-1: Location and Dates of Stakeholder meetings

No.	Date	Location	Total	Male	Female	From Char	Coverage
1	24/10/2016	Irrigation IB, Dept. Of Water Resources, Phulbari	68	68	0	2	Phulbari and South Salmara-Mankachar District
2	25/10/2016	EQRA Academy School, Adabari	119	119	0	23	Dhubri District

		Chomor, Dhubri					

Source: JICA Study Team

Table 8-2: Discussion in Stakeholder Meetings

No.	Comments	Answers
1	• Compensation of land should be given on the basis of current market price and not by the price that is fixed by the government • Community meetings shall be conducted separately involving all the affected villages and affected families. • Request compensation and income generation method for boat owners and boat operators • Provide proper connectivity of the bridge to National Highway with minimal disturbance in nearby villages	• Amount of compensation will be calculated based on the current market value • Community meetings will be conducted to cover affected villages • Employment opportunities in other modes of transportation (tuktuk, truck etc.) may increase after the project. Thus, income generation method with the provision of trainings will be considered in an income restoration program. • Multiple alignments were considered and the alignment with the least disturbance in the villages was selected. Adequate compensation package will be designed for those affected by the project.
2	• Start point of bridge shall be shifted to minimize the impact on local residences. • Local people preferred compensation in terms of land for their acquired land • Community meetings shall be conducted to cover affected villages • Request separate compensation and generation of alternative employment to boat owners and boat operators as proposed bridge will have a major impact on their livelihood.	• The proposed alignment was selected considering the future connection to national roads. However, the proposed starting point is still under discussion and minimization of the impact will be considered. • DC is responsible for finding alternative land, in consultation with the target community • Community meetings will be conducted to cover affected villages • Alternative employment may be expected in other modes of transportation. Assistance for the transition of occupation will be considered in an income restoration program.

Source: JICA Study Team

(2) Community Meeting

For the purpose of gathering comments from the communities in concerned areas, five community meetings were organized. The locations of the meetings were identified based on the concentration of PAPs along the alignment. Participants in the meetings were village chiefs and villagers, including displaced persons and vulnerable groups.

The main points explained and discussed in the meetings were as follows:

1) Outline and Purpose of the Project
2) Recommended alignment
3) Anticipated positive and negative impact from the project
4) Socio-economic status of the concerned community

Summary of the results are shown in Table 7-99 and Table 7-100.

Table 8-3: Location and Dates of Community meeting

No.	Date	Location	Total	Male	Female	From Char	Coverage
1	26/10/2016 @12.00	M. E. School, Adabari, Dhubri	22	16	6	15	Starting point of Dhubri
2	26/10/2016 @16:00	Ponchu Ghat in Dhubri	17	17	0	9	Ferry point in Dhubri
3	27/10/2016 @11:00	Phulbari	20	10	10	3	Lower Phulbari
4	27/10/2016 @13:30	South Salmara	15	15	0	5	South Salmara
5	27/10/2016 @16:30	Bauskata and Bororavatari	22	22	0	20	Bauskata, Bororavatari, Phulbari

Source: JICA Study Team

Table 8-4: Discussion in Community meetings

No.	Comments	Answers
1	• Local people should be informed about compensation packages, valuation methods prior to land acquisition. • Preference shall be given to local people to be employed in the construction works. • Suggested that the location of start point of the bridge should be shifted to Chandachal Bridge, which is 500m away from the present point to minimize the impact.	• Amount of compensation will be determined by DC based on market value (details of the compensation package and the amount will be explained in separate meetings at the end of the survey). • Mechanism for employing local people will be proposed for the construction work which requires unskilled labours. • The proposed alignment was selected considering the future connection to national roads. However, the proposed starting point is still under discussion and minimization of the impact will be considered.
2	• Concern that the aquatic biodiversity will be deteriorated and whether fishing environment will be disturbed. • Concern that boat operators will become unemployed after completion of the project. • New means of livelihood shall be considered for affected people. Preference shall be given to local	• The impact on the fishery activities will be assessed and mitigation measures will be implemented if negative impact is to be expected. • Boat operation service to Char islands will continue. Regarding the loss of business opportunities, an adequate income restoration program will be considered with input from boat operator communities. • Employment in construction work and income

No.	Comments	Answers
	people for construction work.	restoration program for affected people will be considered and proposed.
3	• Suggested that end point of the bridge be shifted to Bangshidua Bridge, which is 300m north from the present point for better connection to existing road. • Will there be a possible interruption of river corridor isolating habitats with potential decrease in species numbers and local biodiversity.	• Affected people will increase as the alignment moves closer to towns. The end point of the bridge was well considered among several alternative alignments and the one with least impact on villages was selected. • Impacts on the river flow during the construction period will be well considered and specific construction method will be employed to minimize the disturbance.
4	• Do not have full information about project affected persons and would like to have clarification about the alignment. • Fair and timely compensation shall be paid to the affected people.	• Clarification about the alignment will be explained, and affected persons will be identified during census survey. • Amount of compensation will be determined based on market value. The consideration will be given to avoid the delay of payment.
5	• Concern that construction activities could damage their crops. • Compensation shall be paid for standing crops if the land will be acquired before harvesting. • Ensure that individuals and groups have opportunities to participate in the construction of the bridge.	• The land acquisition will be completed before the construction so no damage to crops are expected during construction work. • Standing crops will be subject to compensation. • Mechanism to give preference of employing affected people and local people on construction works will be considered.

Source: JICA Study Team

Starting and ending points, which were pointed out in the stakeholder meetings are as shown in the map below. As for the starting point, the suggested location is the connection point to the proposed NH-27. Final alignment was decided to connect to NH-27 without connecting existing roads which was originally planned. The point mentioned for the ending point is the location where a new bridge was recently built. However, it was explained that it is more reasonable to connect to the existing road, considering the better connectivity.

Source: JICA Study Team

Figure 8-1: Starting location mentioned in the meeting

Source: JICA Study Team

Figure 8-2: Ending location mentioned in the meeting

(3) Focus Group Discussion

In order to understand the issues from women's perspective and concerns from boat operators and fishermen, three focus group discussions were carried out. Participants in the meetings were women in surrounding villages, boat operators from boat operators association, and fishermen in the target area.

The main points explained and discussed in the meetings were as follows.

1) Outline and Purpose of the Project
2) Recommended alignment
3) Anticipated positive and negative impacts from the project
4) Socio-economic status of the concerned groups

The details are shown below.

Table 8-5: Location and Dates of Focus Group Discussions

No.	Date	Location	Total	Male	Female	From Char	Coverage
1	26/10/2016 @10.00	M.E. School, Adabari Chomor, Dhubri	9	0	9	2	Womens group
2	26/10/2016 @14.00	Panchu Ghat, Dhubri	13	13	0	7	Boat operators
3	30/06/2017 @10.00	M.E. School, Adabari Chomor, Dhubri	50	50	0	18	Fishermen

Source: JICA Study Team

Table 8-6: Topics in Focus Group Discussions

No.	Comment	Response
1	• Amount of compensation for land acquisition and resettlement shall be sufficient for the family, even during the transition period. • Payment shall be made on time. • Preference shall be given to women to be employed in the construction work.	• Amount of compensation will be calculated considering that the affected people will be able to retain their livelihood after the project. • The process will be considered to coordinate with NHIDCL, DC, etc. that payment will not be delayed. • Equal employment opportunities will be sought for women to engage in construction work taking into account their needs, competence and social situations in the area.
2	• Preference shall be given to boat operators for construction work. • Request assistance for alternative employments (road transport etc.) after completion of the bridge construction. • Request some form of livelihood programs.	• Mechanism to give preference of employing affected people on construction works will be considered. • Boat operation service to Char lands will continue and demand for the movement of goods and people may increase. Regarding the loss of business opportunities, in addition to the construction work during construction periods, an adequate income restoration program will be considered with input from boat operator communities.
3	• Whether the fishing activity will be affected by the project and the impact on the volume of catches expected during the construction stage. • If there are employment opportunities in the project, people will be very much interested.	• During the construction work, vibration may have some impact on fish at the location of pier construction. However, vibration it expected during the construction (day-time) and long-term impact is not anticipated. In case catch volume is impacted, employment options will be provided for fishermen to engage in construction works. • Mechanism to give preference of employing affected people on construction work will be considered.

Source: JICA Study Team

8.2 2nd Round Consultation

The purpose of second round stakeholder meetings was to inform the results of EIA, and explain anticipated impacts as well as mitigation measures to confirm the consent from stakeholders.

Main discussion points are as follows.

1) Outline and objective of the project

2) Reason of recommended alignment
3) Result of Environmental Assessment (anticipated positive and negative impacts)
4) Mitigation measures and monitoring plan

As for RAP, the result of the census survey and compensation policy, as well as rehabilitation and income restoration program were explained to gain concent from PAPs.
Main discussion items are as follows.

1) Scale of impact based on result of census survey
2) Compensation policy
3) Rehabilitation and income restoration program

Information disclosure for the 2nd stakeholder meeting was carried out by visiting land acquisition officers, publishing in a local newspaper, and distributing pamphlets through village chiefs and local consultants (Enviro Infra Solutions Pvt. Ltd.: EIS). The participants include NHIDCL, DPR consultant (AECOM), land acquisition officers from each DC offices, village chiefs, villagers including PAPs, boat operators, fishermen, etc. Assamese and Bengali were used in meetings which are the common languages in the target area.

Summary of the meetings is shown in the table below.

Table 8-7: Details of the Second Round Consultation Meetings

No.	Date	Location	Total	Male	Female	From Char	Coverage
1	2017/7/4 @11:00	M.E. School, Chagalchora II, Dhubri	121	113	8	47	Adabari Part-II, Airanjangla Part-I&II, Bhassanir char Part-I, Chagal chora Part-I&II&III
2	2017/7/4 @15:00	Boat operator office, Jogmaya ghat, Dhubri	56	53	3	18	Kathiar Alga, Bauskata Part-IV&VI, Basir Char, Aminerchar, Chaiter Chor Part-I
3	2017/7/5 @11:00	Phulbari Youth Club, Phulbari	100	94	6	34	Phulbari, Baladoba, Bauskata, Saboratary, Chaiter Chor Part-I, Hatsingwari
4	2017/7/5 @14:00	M.V. School, Bororawatre part-I, Dhubri	28	16	12	21	Bororawatre Part-I&II

Source: JICA Study Team

Table 8-8: Participation Details of the Second Round Consultations

No.	Comment	Answer
1	• What kind of compensation and assistance will be provided to agriculture labourers? • How will the rate for land be	• Agriculture labours will get at least minimum wage of 200 days. Employment opportunities will also be provided during construction and will be entitled to get training for business opportunity

No.	Comment	Answer
	calculated? • What will be the process of land acquisition and how to identify the land owner? • If the new owner's name is not listed, will they get compensation • Will non-title holders get compensation for land, structure and employment opportunities? • Are there employment opportunities for graduate students?	• Rate of the land will be calculated as per the latest land revenue records in the area. • First, 3A notification will be issued and field verification will be followed based on the government land record. After the 3D notification, there will be a hearing objection period before finalization. • Non-title holders will get compensation for structures and standing crops, as well as are entitled for assistance. Training will be provided and possibly issue certificates for employment opportunities. • For graduates, there are National Skill Development Programs where they can get special training. Even in the construction work, they may get employed in a position considering their capacity.
2	• What kind of assistance will be provided to the boat operators and whether boat operators will get employment opportunities? • One boat cost nearly Rs. 25-30 Lakh, after completion of this project there will be no use of these boats, will boat owners get any compensation? • Will fisherman be affected by this project? • Will fisherman get any compensation?	• Boat operators are also provided with opportunities to engage in construction work. During the period, vocational training opportunities will be offered to prepare for the transition to new occupations. • The construction period is around six years. During this period, the boat can be used for transportation of goods and workers in addition to normal services. However, considering that usage opportunities decrease after the project, the boat will also be considered for compensation. • During construction work, there will be impact on fishermen in the project area, but fishing can continue upstream and downstream of the river. • Employment opportunities will be provided to fishermen during the construction work.
3	• When and to whom will employment opportunities be offered. How should I apply? • Is there any plan to develop bridge cum railway? • When and how will compensation be provided? • What is the market rate of the land and buildings to be decided based on? • What should I do if there is a problem with land ownership? • What kind of compensation can be taken if leasing the land and holding the building on that land?	• Employment opportunities will be offered to residents of the target area when construction work will be carried out. NHIDCL will contract with contractors so the application shall be submitted to the contractors. NHIDCL is considering to state in the contract that priority should be given to local employment as a condition. • In this project, railway is not included in the plan. • First of all, DC will conduct a field survey and confirm the affected land, affected people and the price. After the compensation is paid to the affected people, land acquisition will start. • Market rate for the land will be based on the zonal valuation which is set by the land sale price. Buildings are also calculated at market prices. The amount will be decided based on a site investigation. • If there is a land ownership problem, DC office will be the window agency. The land ownership will be reviewed with documents and records. • There will be no compensation for the land, but structures and crops will be compensated and assistances will be provided. If you have been paying the lease fee of land for a long time, the amount after land acquisition will be refunded.

No.	Comment	Answer
4	• In the case the land has been submerged and became government land in the past, can the former owner with the previous land documents claim compensation? • Do residents of affected villages have access to employment opportunities for construction work?	• In principle, land that became government land will not be subject to compensation, but compensation for standing crops and financial support and support for livelihood restoration will be provided. However, during the site verification stage, the current and past land ownership will be properly reviewed. • It is assumed that employment opportunities for construction work will also be provided to residents of target villages.

Source: JICA Study Team

1st SHM in Dhubri

1st SHM in Phulbari

Meeting with boat operators

Meeitng with fishermen

2nd SHM in Dhubri

2nd SHM in Boat point in Dhubri

	
2nd SHM in Phulbari	2nd SHM in Char land

Source: JICA Study Team

Figure 8-3: Stakeholders/Community Meetings

CHAPTER 9 Conclusion and Recommendations

9.1 Key issues / Concerns Identified

Through the above exercise, the following key issues were identified:

- There is no Wildlife Sanctuary along the alignment or within 10 km from the project alignment.
- There is no archeological protected/protected monuments exists along the bridge alignment.
- The area represents flood plain or riparian area of river Brahmaputra between Dhubri and Phulbari and island with human habitations.
- Occurrence of Ganges River Dolphin has been reported in Brahmaputra river.
- Likely effect of land acquisition of approximately 65 Ha land & over the properties/owners and their financial loss.
- Air, Noise & Water pollution may increase during bridge construction and after increase in traffic volume in future.
- Project does not require Environmental Clearances from MoEFCC as per EIA notification 2006 and its amendments till date.
- During stake holder meeting and community survey, local people welcome the project and would like earlier implementation of the project, however asked proper and timely compensation, employment and suggestions regarding connectivity of the bridge with National Highway.

9.2 Summary of Key Benefits from the project

Availability of adequate and quality infrastructure is a pre-requisite for rapid development of any economy.
Improvement in the project road will result in the following benefits:

- Providing better level of service in terms of road connectivity between Dhubri and Phulbari.
- Faster transportation will ultimately lead to massive savings in the form of reduced wear and tear of vehicles, reduced vehicle operating costs (VOCs) and reduction in transportation costs etc.
- Introduction of additional safety measures like crash barrier, road illumination, retro-reflective boards, delineators etc. will result in lesser accidents.
- **Increased passenger comfort** due to proper road connectivity shall be an added benefit.
- It will increase access of the villages and other small settlements to urban areas, thus **providing connectivity** of rural produce to urban markets, thereby enhancing the reach and export of perishable cash crops, leading to better remuneration for the producer.
- The reach and export of perishable cash crops will have quite a positive impact and this will prove to be a boon for the rural agricultural sector.
- Providing connectivity to the urban infrastructure.
- **Rural industrial produce**, whether from Commercial industries, small-scale industries or medium-scale industries will have easy access to the urban markets.
- **Strengthening of rural economies:** The rural sector / economy are sure to get strengthened, though at a gradual pace.
- **Higher education**: Education is considered to be one of the most dominant indicators towards the development of a region. Though primary education facilities are present along the villages, access to high schools, higher secondary schools and colleges is not so easy at present. Provision of easy access to higher education can be directly linked to the improved educational scenario.
- **Access to medical facilities:** Villages in the project region are not yet well-equipped with all types of medical facilities and services like Public Health Centres (PHCs), dispensaries, hospitals. Due to inaccessibility, reaching even the nearest health centre sometimes becomes a colossal task. Even the doctor's reluctance will be converted into willingness to visit these areas after commissioning of bridge.
- By reducing the transportation costs, it will be more feasible to transfer construction materials which are important for many economic activities (house building, school building, etc) to hinterland. This will in turn, lead to direct as well as indirect strengthening of local economies.
- During the execution of the project, i.e. during the construction period, employment will be provided to workers from the local communities.

- The educated as well as uneducated people from villages will obtain access to new employment centers.
- The proposed bridge will reduce the travel time and also very beneficial from the safety point of view and all weather movements will take place.
- Overall improved quality of life for the lesser developed areas in the neighborhood.

Value Addition

- Aesthetic enhancement
- Over bridges, raised carriageway.
- Road connectivity between Dhubri and Phulbari.
- Reduce travel time.

9.3 Recommendations/conclusion

Keeping in view the general scope for environmental as well as socio-economical parameters and most importantly sustainable environment and economic development, the following conclusions and recommendations have been drawn:

9.3.1 Recommendations

- Proposed bridge is required for overall development of the North east region as it provide connectivity to Dhubri (Assam) and Phulbari (Meghalaya).
- Proper compensation shall be paid to the PAPs as per R&R policy 2013.
- Bridge shall be properly connected at both end through National Highway.
- Mitigation measures shall be undertaken to minimize the impact on aquatic life in Brahmaputra river during construction.
- One of the major issues that surfaced during the public consultation was to generate alternate livelihood / employment program for boat owners.

9.3.2 Conclusion

The proposed bridge shall be commissioned at the earliest with minimum acquisition of agricultural land to minimize the environmental impacts along the RoW. Mitigation Measures shall be undertaken as suggested in EMP shall be implemented in true spirit to minimize the impact on aquatic life in Brahmaputra river during construction. Proper compensation shall be paid to project affected persons.