E4751 V3

Government of The People's Republic of Bangladesh

Ministry of Water Resources

Bangladesh Water Development Board

Environmental Management Framework (EMF)
(Draft Final)

River Bank Improvement Program (RBIP)

February 2015

List of Acronyms

AD	Alluvion-Diluvion
ADB	Asian Development Bank
amsl	Above mean sea level
BBS	Bangladesh Bureau of Statistics
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BMD	Bangladesh Meteorological Department
BNBC	Bangladesh National Building Code
BP	(World) Bank Procedure
BRE	Brahmaputra Right-bank Embankment
BWDB	Bangladesh Water Development Board
CARINAM	Centre for Advanced Research In Natural Resource and Management
CC	Cement concrete
CEGIS	Center for Environmental and Geographic Information Services
CHT	Chittagong Hill Tracts
CLSC	Central land allocation committee
CPUE	Catch per unit effort
CSC	Construction supervision consultants
DC	Deputy Commissioner
DEM	Digital elevation model
DFID	Department of International Development
DG	Director General
DoArch	Department of Archeology
DoE	Department of Environment
DoF	Department of Forest
DPP	Development Project Proforma
EA	Environmental assessment
ECA	Environment Conservation Act
ECC	Environmental Clearance Certificate
ECoP	Environmental Code of Practice
ECR	Environment Conservation Rules
EHS	Environment, Health, and Safety

EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMIS	Environmental Management Information System
EMP	Environmental Management Plan
ERP	Emergency Response Plan
ESC	Environmental and social cell
ESU	Environmental and social unit
EQS	Environmental Quality Standards
FAP	Flood Action Plan
FGD	Focus group discussion
FHRC	Environmental Management Information System
FI	Financial intermediary
GHGs	Green House Gases
GIS	Geographical information system
GoB	Government of Bangladesh
GPP	Guidelines for People's Participation
GRM	Grievance redress mechanism
GSB	Geological Survey of Bangladesh
HH	household
HIV/AIDS	Human immuno-deficiency virus / Acquired Immune Deficiency Syndrome
HL	High land
HSE	Health, safety, and environment
IBWTA	International Boundary Waters Treaty Act
ICZM	Integrated Coastal Zone Management
IDA	International Development Association
IEC	Important environmental component
IEC	Information, Education and Communication
IEE	Initial Environmental Examination
IESC	Important environmental and social component
IPMP	International Development Association
IUCN	International Union of Conservation of Nature
IWFM	Institute of Water and Flood Management
JICA	Japan International Cooperation Agency

JMREMP	Jamuna Meghna River Erosion Mitigation Project
km	Kilometer
LL	Low land
m	meter
MHL	Medium high land
MLL	Medium low land
MoC	Ministry of Commerce
MoEF	Ministry of Environment and Forests
MoH	Ministry of Health
MoL	Ministry of Land
MoLG	Ministry of Local Governance
MoS	Ministry of Shipping
MoWR	Ministry of Water Resources
MPO	Master Plan Organization
MSDS	Material safety data sheet
NAPA	National Adaptation Program of Action
NEMAP	National Environment Management Action Plan
NEP	National Environment Policy
NFP	National Fisheries Policy
NGO	Non-governmental organization
NLDP	National Livestock Development Policy
NLUP	National Land Use Policy
NWMP	National Water Management Plan
NWP	National Water Policy
O&M	Operation and maintenance
OHS	occupational health and safety
OP	Operational policy
PD	Project Director
PHAP	Public Health Action Plan
PCR	Physical Cultural Resources
PPE	Personal Protective Equipment
PMU	Project management unit
PRSP	Personal Protective Equipment
PWD	Public Works Department

RAP	Resettlement Action Plan
RBIP	River Bank Improvement Program
RCC	Reinforced cement concrete
RD&C	Research Development and Collaboration
RHD	Roads and Highway Department
SDP	Social Development Plan
SIS	Small Indigenous (Fish) Species
TMP	Traffic management plan
ToR	Terms of Reference
UNFCCC	United Nations Framework Convention on Climate Change
VLL	Very low land
WARPO	Water Resources Planning Organization
WB	World Bank
WBG	World Bank Group

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1. Introduction

The Government of Bangladesh (GoB) through the Bangladesh Water Development Board (BWDB) is planning to initiate the River Bank Improvement Program (RBIP) primarily to rehabilitate and improve the existing right bank embankment of the Brahmaputra River, and also to undertake river bank protection and construction of a road over the embankment. The GoB is seeking assistance from the World Bank (WB) for this purpose.

The program will be implemented in phases and in the first phase, works will be carried out for the 50 km priority reach of the embankment; the remaining works will be implemented under subsequent phase(s). In line with the national regulatory as well as WB policy requirements, and in order to minimize the negative environmental and social impacts of the proposed interventions, the BWDB has conducted a detailed environmental impact assessment (EIA) for the priority reach of the program. An initial environmental examination (IEE) has earlier been prepared and submitted to the Department of Environment (DoE) for clearance. Both EIA and IEE are presented under separate covers.

In addition to EIA and IEE, the present Environmental Management Framework (EMF) has also been prepared to guide the detailed environmental assessments of the subsequent phases of the program to be carried out once the detailed design of the remaining works is completed.

1.1. Program Background

Bangladesh is mainly comprised of the fertile alluvial floodplains and the delta of the Ganges-Brahmaputra-Meghna river system (Brahmaputra south through Bangladesh, named as the Jamuna). These three rivers combine within the country to form the world's third largest river, the Lower Meghna, which drains into the Bay of Bengal via a constantly changing network of estuaries and tidal creeks. Bangladesh is one of the most vulnerable countries to natural disasters, mainly by upstream river floods during monsoon season and coastal cyclones from the Bay of Bengal. Floods are of recurring phenomena in Bangladesh, and in each year about 22 percent of the country is inundated. Major floods occur when upland flood flows of the three rivers converging to Bangladesh coincide and combine with the heavy monsoon rainfall. It is also difficult to regulate these flood flows as over 90 percent of their river catchments areas are outside the Bangladesh.

Brahmaputra is the Country’s largest of the three rivers with highest erosion and bank movements. Prior to the construction of Brahmaputra Right-bank Embankment (BRE), over bank spills along the 220 km stretch of the right bank of the Brahmaputra River used to cause flooding on an area of about 240,000 ha. In early 1960s, the BRE was built to protect from this flooding problem and to foster agricultural growth in the protected area (see **Figure 1.1**).

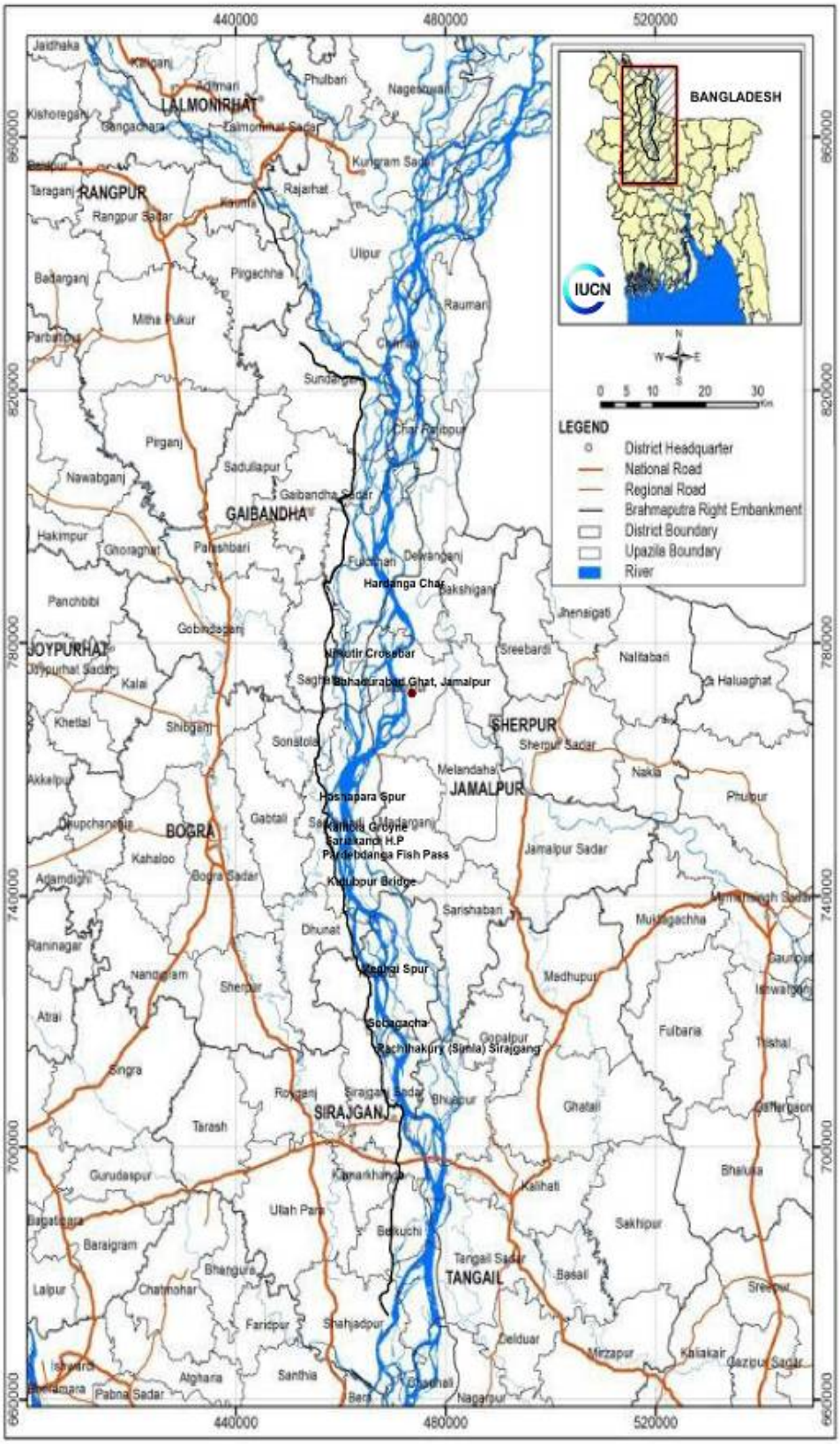


Figure 1.1: Jamuna River and Location of Brahmaputra Right-bank Embankment

The original BRE had a setback of about 1.5 km from the Brahmaputra's right bank and it was allowed to have bank erosion life of 25-30 year span. In the 1970s the embankment started to fall under sporadic erosion attacks. During 1980s, the frequency of the BRE breaches by erosion increased rapidly as longer sections came within the range of rapidly eroding river bends which could cause bank-line erosion rates of several hundred meters per year in early stages of bend formation. To prevent flooding, these breaches were typically closed by local BRE retirements at about 200 meter set-backs. As a result of this minimal set-back distance the BRE has been retired several times in many places and at present perhaps only 50 km of the original BRE has remained in place. Currently, many long stretches of the BRE are very close to the river-bank line. Hence when embankment is breached at many places it is often left open as closing of such breaching is becoming impossible. Consequently, security of area protected by the BRE has been seriously threatened and large areas of land and cities with large population like Sirajganj are exposed to flooding.

1.2. Overview of Proposed Program

The main focus of the BRE rehabilitation work under RBIP is on its length alongside the Brahmaputra/ Jamuna River from Bangabandhu (Jamuna) Bridge to the Teesta River (**Figure 1.1**). The priority works will cover the approximately 50-km long priority reach from Sailabari to Hasnapara (see **Figure 1.2**).

The program's physical works will include:

- River bank protection on portions of the western(right) bank;
- Embankment upgrading, reconstruction and realignment, including adding drainage/control;
- structures (regulators); and
- A new road on the embankment. The program may also include the option of a toll road (highway) associated with the flood embankment.

The program will also provide livelihood and resettlement support to the displaced people. Based on the field reconnaissance and the preliminary morphological assessment, the program works has been divided into three phases as shown in **Table 1.1** below.

Table 1.1: Program Phases

Description	Length (km)	Phase	Tentative Implementation Year
Embankment and riverbank protection from Jamuna Bridge to Sailabari	19	Phase II	2017 to 2022
Embankment and riverbank protection from Sailabari to Hasnapara	50	Phase I	2015 to 2020
Embankment and riverbank protection from Hasnapara to Belka	77	Phase II	2017 to 2022
Road on embankment	146	Phase III	2018 to 2023

The proposed program will be financed by WB with GoB contribution and the program has to comply with the policies and legislative requirement of the World Bank and the GoB.

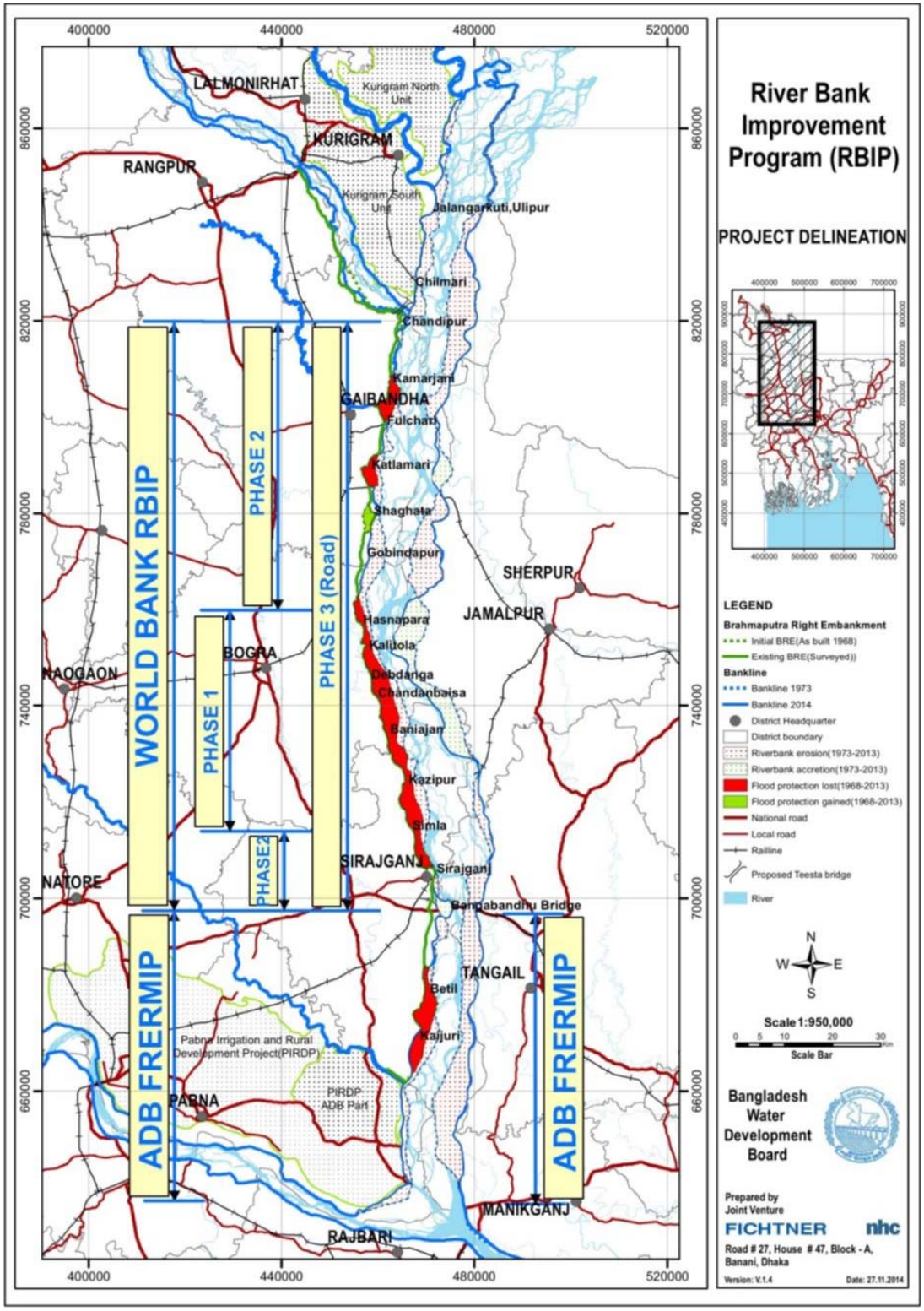


Figure 1.2: Location of Priority and Remaining Works under RBIP

1.3. Rationale of the Environmental Management Framework (EMF)

The proposed interventions of RBIP can potentially have significant impacts on the natural environment and the people living in that area. Conducting a proper environmental assessment and preparing an environmental management plan is essential to address the potentially negative impacts of the program. While the EIA that has been prepared addresses the potentially negative impacts of the Phase I of RBIP, the present EMF has been developed to:

(i) ensure all relevant environmental and social issues are mainstreamed into the design and implementation of the remaining works in subsequent phases of the RBIP,

(ii) consider in an integrated manner the potential environmental and social risks, benefits and impacts of the Program and identify measures to avoid, minimize and manage risks and impacts while enhancing benefits,

(iii) ensure compliance with national and World Bank requirements. The EMF presents potential impacts of the RBIP, mitigation, enhancement, contingency and compensation measures, environmental management and monitoring plan, and institutional framework including inter-agency cooperation for implementing EMP. The EMF will facilitate compliance with the Government of Bangladesh's policies, acts and rules as well as with the World Bank's environmental safeguard policies, and

(iv) guide conducting the detailed EIAs of the later phases of the RBIP.

1.4. Study Methodology

The present EMF has been prepared following the standard methodology consisting of the steps listed below.

- Review of the program details and meeting/discussions with the design team
- Review of the policy and regulatory requirements
- Reconnaissance field visit and initial scoping and screening to determine the key environmental parameters and aspects that are likely to be impacted by the program activities
- Collecting and analysis of baseline environmental and social data with the help of secondary literature review and field data collection
- Consultations with the stakeholders including beneficiary/affected communities and developing the consultation process
- An initial assessment of the potential and likely impacts of the program activities
- Prepare an outline environmental management plan
- Compilation of the present EMF.

The methodology for the preparation of the EMF is presented in **Figure 1.3**.

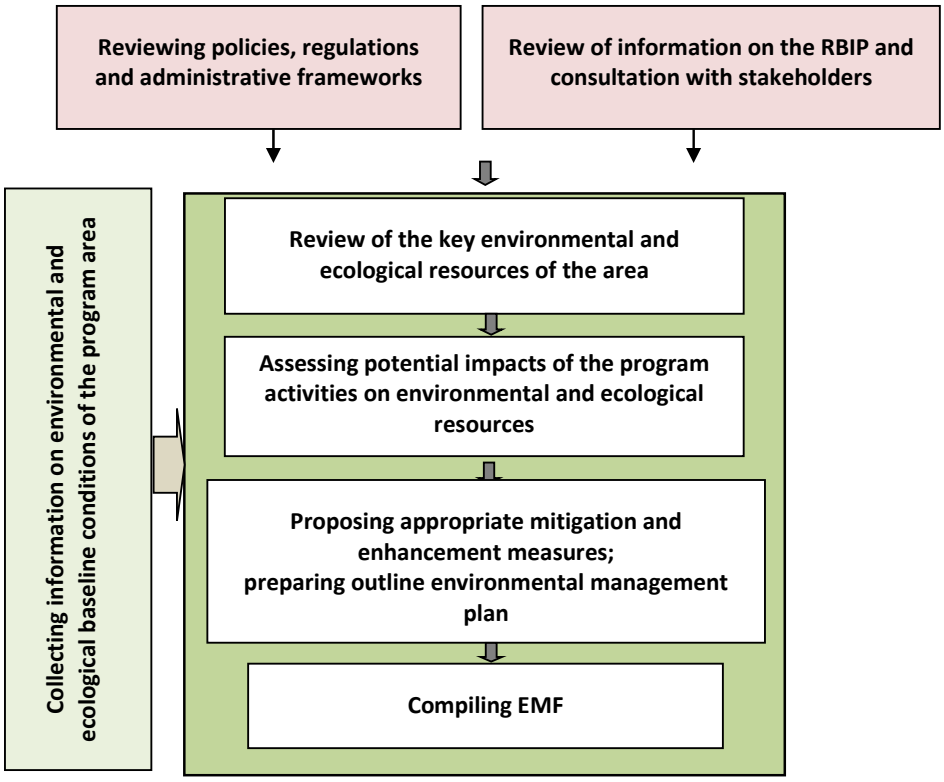


Figure 1.3: EMF Mehodology

1.5. Document Structure

Chapter 2 reviews the prevailing WB policies and national regulatory requirements relevant to environmental assessment. **Chapter 3** presents a simplified description of the program, its various components and other salient information relevant for environmental assessment. Analysis of alternatives is covered under **Chapter 4**. Screening and assessment of potentially negative environmental and social impacts as well as the appropriate mitigation measures to address these negative impacts have been discussed in **Chapter 6**. **Chapter 7** presents the outline of the environmental management plan (EMP). Finally, **Chapter 8** describes the consultations that have been carried out with the stakeholders and also the requirements of similar consultations to be carried out while conducting the EIAs of the later RBIP phases.

Annex A presents the terms of reference of the environmental impact assessment (EIA) to be conducted for the remaining reaches of the RBIP (a similar EIA is being carried out for the priority reach as described earlier). **Annex B** presents environmental codes of practice.

2. Policy and Regulatory Review

This Chapter presents a review of the national policy, legal, and regulatory framework relevant to the environmental and social aspects of the Program. Also reviewed in the Chapter are the WB environmental and social safeguard policies.

2.1. National Environmental Laws

The key national policies, strategies, and plans relevant to environmental management are briefly discussed below.

2.1.1. Bangladesh Environment Conservation Act (ECA), 1995

The Environmental Conservation Act (ECA) of 1995 is the main legislative framework relating to environmental protection in Bangladesh. This umbrella Act includes laws for conservation of the environment, improvement of environmental standards, and control and mitigation of environmental pollution. This Act has established the Department of Environment (DoE), and empowers its Director General to take measures as he considers necessary which includes conducting inquiries, preventing probable accidents, advising the Government, coordinating with other authorities or agencies, and collecting and publishing information about environmental pollution. According to this act (Section 12), no industrial unit or project shall be established or undertaken without obtaining, in a manner prescribed by the accompanying Rules, an Environmental Clearance Certificate (ECC) from the Director General of DoE.

In accordance with this Act, the RBIP will need to be cleared by DoE before commencing the project following procedures given in the Environment Conservation Rules (ECR) 1997 (discussed below). Also the Ecologically Critical Areas, defined by DoE under this act, will be considered while planning and designing of the RBIP interventions.

2.1.2. Bangladesh Environment Conservation Act (ECA), (Amendments) 2010

The ECA 1995 was amended in 2010, which provided clarification of defining wetlands as well as Ecologically Critical Areas and included many important environmental concerns such as conservation of wetlands, hill cutting, ship breaking, and hazardous waste disposal. This amendment empowered the government to enforce more penalties than before. Moreover, affected persons were given provision for putting objections or taking legal actions against the polluters or any entity creating nuisance to affected person.

2.1.3. Bangladesh Environment Conservation Rules (ECR), 1997

The Environment Conservation Rules, 1997 were issued by the Government of Bangladesh in exercise of the power conferred under the Environment Conservation Act (Section 20), 1995. Under these Rules, the following aspects, among others, are covered:

- Declaration of ecologically critical areas
- Classification of industries and projects into four categories
- Procedures for issuing the Environmental Clearance Certificate
- Determination of environmental standards.

The Rule 3 defines the factors to be considered in declaring an area 'ecologically critical area' (ECA) as per Section 5 of ECA95. It empowers the Government to declare an area 'ECA', if it is satisfied that the ecosystem of the area has reached or is threatened to reach a critical state or condition due to environmental degradation. The Government is also empowered to specify which of the operations or processes shall not be carried out or shall not be initiated in the ecologically critical area.

The Rule 7 classifies industrial units and projects into four categories depending on environmental impact and location for the purpose of issuance of ECC. These categories are: Green, Orange A, Orange B, and Red.

All existing industrial units and projects and proposed industrial units and projects, that are considered to be low polluting are categorized under "Green" and shall be granted Environmental Clearance. For proposed industrial units and projects falling in the Orange-A, Orange-B and Red Categories, firstly a site clearance certificate and thereafter an environmental clearance certificate will be required. A detailed description of these four categories of industries has been given in Schedule-1 of ECR'97. Apart from general requirement, for every Red category proposed industrial unit or project, the application must be accompanied with feasibility report, Initial Environmental Examination (IEE), Environmental Impact Assessment (EIA) based on approved ToR by DoE, Environmental Management Plan (EMP). As per ECR'97, water resources development projects fall under 'Red' category project. Therefore RBIP is a 'Red' category project which requires IEE, EIA and EMP for environmental clearance from DoE.

The ECR'97 describes the procedures for obtaining Environmental Clearance Certificates (ECC) from the Department of Environment for different types of proposed units or projects. Any person or organization wishing to establish an industrial unit or project must obtain ECC from the Director General. The application for such certificate must be in the prescribed form together with the prescribed fees laid down in Schedule 13, through the deposit of a Treasury Challan in favor of the Director General. The fees for clearance certificates have been revised in 2010. Rule 8 prescribes the duration of validity of such certificate (three years for green category and one year for other categories) and compulsory requirement for renewal of certificate at least 30 days before expiry of its validity.

2.1.4. Bangladesh Environment Court Act, 2010

Bangladesh Environment Court Act, 2010 has been enacted to resolve the disputes and establishing justice over environmental and social damage raised due to any development activities. This act allows government to take necessary legal action against any parties who creates environmental hazards/ damage to environmentally sensitive areas as well as human society. According to this act, government can take legal actions if any environmental problem occurs due to RBIP interventions.

2.2. Relevant National Policies, Strategies and Plans

2.2.1. National Environment Policy, 1992

The National Environment Policy (NEP) is one of the key policy documents of the Government. The policy addresses 15 sectors in all, in addition to providing directives on the legal framework and institutional arrangements. Marine environment is one of the key

sectors covered in this policy. Regarding water resource development, flood control and irrigation sector, the policy seeks to:

- ensure environmentally-sound utilization of all water resources;
- ensure that water development activities and irrigation networks do not create adverse environmental impact;
- ensure that all steps are taken for flood control, including construction of embankments, dredging of rivers, digging of canals, etc, be environmentally sound at local, zonal and national levels;
- ensure mitigation measures of adverse environmental impact of completed water resources development and flood control projects;
- keep the rivers, canals, ponds, lakes, *haors*, *baors* and all other water bodies and water resources free from pollution;
- ensure sustainable, long-term, environmentally sound and scientific exploitation and management of the underground and surface water resources; and
- conduct environmental impact assessment before undertaking projects for water resources development and management.

The Policy is applicable to the RBIP and the proposed interventions are required to comply with all the policy directives emphasizing particularly on reducing adverse environmental impacts. The EIA studies of the proposed RBIP are required to clearly address the potential impacts and propose mitigation measures.

2.2.2. National Environment Management Action Plan, 1995

The National Environment Management Action Plan (NEMAP, 1995) identifies the main national environmental issues, including those related to the water sector. The main water related national concerns include flood damage, riverbank erosion, environmental degradation of water bodies, increased water pollution, shortage of irrigation water and drainage congestion; various specific regional concerns are also identified.

2.2.3. NationalWater Policy, 1999

Endorsed by the GoB in 1999, the National Water Policy (NWP) aims to provide guidance to the major players in water sector for ensuring optimal development and management of water. According to the policy, all agencies and departments entrusted with water resource management responsibilities (regulation, planning, construction, operation, and maintenance) are required to enhance environmental amenities and ensure that environmental resources are protected and restored in executing their tasks.

The policy has several clauses related to water resource development projects for ensuring environmental protection. Some of the relevant clauses are:

- Clause 4.5b: Planning and feasibility studies of all projects will follow the Guidelines for Project Assessment, the Guidelines for People's Participation (GPP), the Guidelines for Environmental Impact Assessment, and all other instructions that may be issued from time to time by the Government.
- Clause 4.9b: Measures will be taken to minimize disruption to the natural aquatic environment in streams and water channels.

- Clause 4.9e: Water development plans will not interrupt fish movement and will make adequate provisions in control structures for allowing fish migration and breeding.
- Clause 4.10a: Water development projects should cause minimal disruption to navigation and, where necessary, adequate mitigation measures should be taken.
- Clause 4.12a: Give full consideration to environmental protection, restoration and enhancement measures consistent with National Environmental Management Action Plan (NEMAP) and the National Water Management Plan (NWMP).
- Clause 4.12b: Adhere to a formal environment impact assessment (EIA) process, as set out in EIA guidelines and manuals for water sector projects, in each water resources development project or rehabilitation program of size and scope specified by the Government from time to time.
- Clause 4.13b: Only those water related projects will be taken up for execution that will not interfere with aquatic characteristics of those water bodies.

Most of the above clauses will be applicable to the RBIP.

2.2.4. National Water Management Plan, 2001 (Approved in 2004)

The National Water Management Plan (NWMP) 2001, approved by the National Water Resources Council in 2004, envisions to establish an integrated development, management and use of water resources in Bangladesh over a period of 25 years. Water Resources Planning Organization (WARPO) has been assigned to monitor the national water management plan. The major programs in the Plan have been organized under eight sub-sectoral clusters: i) Institutional Development, ii) Enabling Environment, iii) Main River, iv) Towns and Rural Areas, v) Major Cities; vi) Disaster Management; vii) Agriculture and Water Management, and viii) Environment and Aquatic Resources. Each cluster comprises of a number of individual programs, and a total of 84 sub-sectoral programs have been identified and presented in the investment portfolio.

2.2.5. National Land Use Policy (MoL, 2001)

The National Land Use Policy (NLUP), enacted in 2001, aims at managing land use effectively to support trends in accelerated urbanization, industrialization and diversification of development activities. The NLUP urges that increasing the land area of the country may be not possible through artificial land reclamation process, which is cost-effective only in the long run. Therefore, land use planning should be based on the existing and available land resources. The policy suggests establishing land data banks where, among others, information on accreted riverine and coastal chars will be maintained. Among the 28 policy statements of NLUP, the following are relevant to RBIP:

- forests declared by the Ministry of Environment and Forests will remain as forest lands;
- reclassification of forest lands will be prevented.

The RBIP will be designed in accordance with this Strategy and will comply with the above listed requirements.

2.2.6. National Agriculture Policy, 1999

The overall objective of the National Agriculture Policy is to make the nation self-sufficient in food through increasing production of all crops including cereals and ensure

a dependable food security system for all. The policy particularly stresses on research on the development of improved varieties and technologies for cultivation in water-logged and salinity affected areas. The policy also recognizes that adequate measures should be taken to reduce water-logging, salinity and provide irrigation facilities for crop production.

The proposed RBIP is expected to contribute to achieve the objectives of the agriculture policy.

2.2.7. National Fisheries Policy, 1996

The National Fisheries Policy (NFP), 1996 recognizes that fish production has declined due to environmental imbalances, adverse environmental impact and improper implementation of fish culture and management programs. The policy particularly focuses on aquaculture and marine fisheries development.

The policy suggests following actions:

- Biodiversity will be maintained in all natural water bodies and in marine environment
- Chemicals harmful to the environment will not be used in fish shrimp farms
- Environment friendly fish shrimp culture technology will be used
- Expand fisheries areas and integrate rice, fish and shrimp cultivation
- Control measures will be taken against activities that have a negative impact on fisheries resources and vice-versa
- Laws will be formulated to ban the disposal of any untreated industrial effluents into the water bodies.

2.2.8. National Livestock Development Policy, 2007

The National Livestock Development Policy (NLDP) has been prepared to address the key challenges and opportunity for a comprehensive sustainable development of the livestock sub-sector by creating an enabling policy framework. As livestock is one of the key assets in livelihoods of the program area, and protection of livestock from floods should be emphasized along with security of human life. The proposed RBIP interventions will contribute to the safety of livestock and thus increase livestock productivity in the program area.

2.2.9. Private Forest Policy 1994

The policy suggested for extended effort to bring about 20% of the country's land under the afforestation programs of the government and private sector by year 2015 by accelerating the pace of the program through the coordinated efforts of the government and NGOs and active participation of the people in order to achieve self-reliance in forest products and maintenance of ecological balance. The policy viewed equitable distribution of benefits among the people, especially those whose livelihood depend on trees and forests; and people's participation in afforestation programs and incorporation of people's opinions and suggestions in the planning and decision-making process. The people-centered objectives of the policy are: creation of rural employment opportunities and expansion of forest-based rural development sectors; and prevention of illegal occupation of forest lands and other forest offences through people's participation. The policy statements envisage: massive afforestation on marginal public lands through partnerships with local people and NGOs; afforestation of denuded/encroached reserved forests with

an agro forestry model through participation of people and NGOs; giving ownership of a certain amount of land to the tribal people through forest settlement processes; strengthening of the Forest Department; strengthening of educational, training and research facilities; and amendment of laws, rules and regulations relating to the forestry sector and if necessary, promulgation of new laws and rules. Thus, over time the policy has shifted somewhat from total state control to a management regime involving local communities in specific categories of forests.

Because of limited amount of forestland, the policy underscores for effective measures for afforestation in rural areas, in the newly accreted chars, and in the denuded Unclassed State Forest areas of Chittagong Hill Tract and northern zone of the country including the Barind tract. The policy also encourages the private sector participation in afforestation.

2.2.10. National Policy for Safe Water Supply and Sanitation (1998)

The National Drinking Water Supply and Sanitation Policy (1998) goal is accessibility to all of water and sanitation services within the shortest possible time at a price that is affordable to all. The Policy will be achieved through strategies formulated at various levels in consultation with the Ministry of Planning. Policy objectives are (i) to improve the standard of public health and (ii) to ensure an improved environment. Policies for rural and urban areas are presented separately as they differ in institutional aspects, content, and magnitude.

2.2.11. National Policy for Arsenic Mitigation (2004)

The National Policy for Arsenic Mitigation (2004) provides a guideline for mitigating the effect of arsenic on people and environment in a realistic and sustainable way. It supplements the National Water Policy (1998) and the National Policy for Safe Water Supply and Sanitation (1998) in fulfilling national goals related to poverty alleviation, public health, and food security.

The Policy states that access to safe water for drinking and cooking shall be ensured through implementation of alternative water supply options in all arsenic-affected areas. Arsenic mitigation activities under the Policy will focus on public awareness, alternative arsenic safe water supply, diagnoses and management of patients and capacity building. The national arsenic program is to encourage and promote research and development on the impact of arsenic on water supplies, health, food, and agriculture.12

2.2.12. National Adaptation Programme of Action (NAPA)

In 2005, the Ministry of Environment and Forest (MoEF), Government of the People's Republic of Bangladesh has prepared the National Adaptation Program of Action (NAPA) for Bangladesh, as a response to the decision of the Seventh Session of the Conference of the Parties (COP7) of the United Nations Framework Convention on Climate Change (UNFCCC). The basic approach to NAPA preparation was along with the sustainable development goals and objectives of the country where it has recognized the necessity of addressing climate change and environmental issue and natural resource management. The NAPA is the beginning of a long journey to address adverse impacts of climate change including variability and extreme events and to promote sustainable development of the country. There are 15 adaptation strategies suggested to address adverse effects of climate change. Among the 15 adaptation strategies the following strategies are relevant for reducing climate change induced vulnerability:

- Construction of flood shelters, and information and assistance center to cope with enhanced recurrent floods in major floodplains
- Promotion of research on drought, flood and saline tolerant varieties of crops to facilitate adaptation in future.

The RBIP broadly contributes toward achieving g the aims and objectives of the climate change adaptation strategies.

2.2.13. Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2009

The Government of Bangladesh has prepared the Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009. The BCCSAP is built on six pillars:

i. **Food security, social protection and health** to ensure that the poorest and most vulnerable in society, including women and children, are protected from climate change and that all programs focus on the needs of this group for food security, safe housing, employment and access to basic services, including health.

ii. **Comprehensive disaster management** to further strengthen the country's already proven disaster management systems to deal with increasingly frequent and severe natural calamities.

iii. **Infrastructure** to ensure that existing assets (e.g., coastal and river embankments) are well maintained and fit for purpose and that urgently needed infrastructures (cyclone shelters and urban drainage) is put in place to deal with the likely impacts of climate change.

iv. **Research and Knowledge management** to predict that the likely scale and timing of climate change impacts on different sectors of economy and socioeconomic groups; to underpin future investment strategies; and to ensure that Bangladesh is networked into the latest global thinking on climate change.

v. **Mitigation and low carbon development** to evolve low carbon development options and implement these as the country's economy grows over the coming decades.

vi. **Capacity building and Institutional strengthening** to enhance the capacity government ministries, civil society and private sector to meet the challenge of climate change.

RBIP will contribute towards achieving the objective of pillars such as (i), (ii), (iii), (iv), and (vi).

2.3. Other Relevant Acts, Laws and Rules

2.3.1. Bangladesh Wildlife (Protection and Safety) Act 2012

The Act protects 1,307 species of plants and animals, including 32 species of amphibian, 154 species of reptile, 113 species of mammal, 52 species of fish, 32 species of coral, 137 species of mollusk, 22 species of crustacean, 24 species of insect, six species of rodent, 41 species of plant and 13 species of orchid. Of these, eight amphibian, 58 reptile, 41 bird, and 40 mammal species are listed as endangered in the IUCN Red Data Book (2000). The Act mandates:

- one to three years imprisonment, a fine of BDT 50,000 to 200,000, or both, for wildlife poaching, capturing, trapping, and trading, and for the purchase of wild animals, parts of wild animals, trophies, meat or other products without license.

The Act mandates two to seven years imprisonment and BDT 100,000 to 1 million fine or both, for killing an elephant or tiger; and 12 years plus BDT 1.5 million for repeat offenders.

- five years imprisonment and BDT 200,000 fine for killing a cheetah, clouded cheetah, gibbon, sambar deer, crocodile, gavial, whale, and dolphin.
- two years imprisonment and BDT 200,000 fine for killing a wild bird or migratory bird.
- empowers the Government to create an eco-park, safari park, botanical garden, or breeding ground on any state-owned forest land, land or water-body.
- two years imprisonment for farming, woodcutting, burning, and construction on such reserves.

2.3.2. Bangladesh Wildlife (Preservation) Order (1973) and Act (1974)

The Bangladesh Wildlife Preservation (Amendment) Act 1974 regulates the hunting, killing, capture, trade and export of wild life and wild life products. It designates a list of protected species and game animals. It empowers the Government to declare areas as game reserves, wildlife sanctuaries, and national parks to protect the country's wildlife and provides the following legal definitions:

- Game reserve is defined as an area declared by Government wherein the capture of wild animals is unlawful, to protect wildlife and increase the population of important species;
- National park is defined as an area declared by Government comprising a comparatively large area of outstanding scenic and natural beauty with the primary objective of protection and preservation of scenery, flora, and fauna in their natural state, to which access for public recreation and education, and for scientific research, may be allowed;
- Wildlife sanctuary is defined as an area declared by Government that is closed to hunting, shooting, or trapping of wild animals as an undisturbed breeding ground, primarily for the purpose of protecting all natural resources, including wildlife vegetation, soil, and water.

The Act allows Government to relax any or all specified prohibitions for scientific purposes, for aesthetic enjoyment, or betterment of scenery.

2.3.3. Protection and Conservation of Fish Act (1950)

This Act provides power to the government to: make and apply rules to protect fisheries; prohibit or regulate erection and use of fixed engines; and construction of temporary or permanent weirs, dams, bunds, embankments and other structures. The Act prohibits: destruction of fish by explosives, guns, and bows in inland or coastal areas; destruction of fish by poisoning, pollution, or effluents. The Act prescribes the seasons during which fishing is allowed, prohibits fishing during spawning periods, and specifies officials having authority to detect breaches of this Act.

2.3.4. East-Bengal Protection and Fish Conservation Act (1950) and Amendments

The East-Bengal Protection and Fish Conservation Act (1950), as amended by the Protection and Conservation of Fish (Amendment) Ordinance (1982) and the Protection

and Conservation of Fish (Amendment) Act (1995), provides for the protection and conservation of fish in inland waters of Bangladesh. These instruments define a relatively non-specific framework that simply provides a means for Government to introduce rules to protect inland waters not in private ownership. Among other things, they sanction rule-making regarding destruction of, or any attempt to destroy, fish by poisoning of water or depletion of fisheries by pollution, industrial effluent, or otherwise.

2.3.5. Protection and Conservation of Fish Rules (1985)

These Rules are in line with the overall objectives of the Fisheries Act and its amendments. Section 5 of the Rules states that, “No person shall destroy or make any attempt to destroy any fish by explosives, gun, bow and arrow in inland waters or within coastal waters”. Section 6 states, “No person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents or otherwise in inland waters.”

2.3.6. Forestry Acts

Systematic management of forests started in the 1860s after the establishment of a Forest Department in the Province of Bengal. To regulate activities within forests, rules and regulations have been formulated, amended, modified and improved upon over the years. These rules and regulations are formulated on the basis of long-existing acts and policies.

Forest legislation in Bangladesh dates back to 1865, when the first Indian Forest Act was enacted. It provided for protection of tree, prevention of fires, prohibition of cultivation, and grazing in forest areas. Until a comprehensive Indian Forest Act was formulated in 1927, several acts and amendments covering forest administration in British India were enacted and were as follows: (a) Government Forest Act, 1865; (b) Forest Act, 1890; (c) Amending Act, 1891; (d) Indian Forest (Amendment) Act, 1901; (e) Indian Forest (Amendment) Act, 1911; (f) Repealing and Amending Act, 1914; (g) Indian Forest Amendment Act, 1918; and (h) Devolution Act, 1920.

The Forest Act of 1927, as amended with its related rules and regulations, is still the basic law governing forests in Bangladesh. The emphasis of the Act is on the protection of reserved forest. Some important features of the Act are: (i) Under the purview of the Forest Act, all rights or claims over forestlands have been settled at the time of the reservation. The Act prohibits the grant of any new rights of any kind to individuals or communities; (ii) Any activity within the forest reserves is prohibited, unless permitted by the Forest Department; (iii) Most of the violations may result in court cases where the minimum fine is Taka 2,000 and/or two month's rigorous imprisonment; and (iv) The Act empowers the Forest Department to regulate the use of water-courses within Reserve Forests.

2.3.7. Forest Act 1927 (Amendment 2000)

The Forest Act of 1927 as amended in 1989 has its roots in Indian Forest Act, 1878. The Forest Act grants the government several basic powers, largely for conservation and protection of government forests, and limited powers for private forests. The 1927 version of the act was amended in 1989 for extending authority over "any [Government-owned] land suitable for afforestation".

Forest department is the main agency to implement the provisions of the Forest Act. The Act, however, does not specify any sort of institutional structure for the forest or other

land holding agencies. It also does not set out any specific policy direction for managing the forests.

Most of the forest lands under the management of forest department are areas declared to be reserved and protected forests under this act. The act empowers the government to regulate the felling, extraction, and transport of forest produce in the country.

2.3.8. Private Forest Act (PFA), 1959

The Private Forest Act of 1959 allows the Government to take over management of improperly managed private forest lands, any private lands that can be afforested, and any land lying fallow for more than three years. The Private Forest Ordinance was originally enacted in 1945, as the Bengal Private Forest Act, and was re-enacted by the Bangladesh (then East Pakistan) in 1949 before being issued as an Act in 1959. These government managed lands under this act are called "vested forests". The Forest Department manages approximately 8,500 hectares in the country as "vested forests". This area is relatively small, but the area historically affected by this law is much larger.

PFA, 1959 empowers the government to require management plans for private forests and to assume control of private forests as vested forests. Government has broad powers to write rules regarding use and protection of vested forests, and apply rules to "controlled forests," which include all private forests subject to any requirement of the Act.

2.3.9. Embankment and Drainage Act, 1952

The *East Bengal Act No. 1,* 1953 has been adapted by the People Republic of Bangladesh, by the Bangladesh Order (adaptation of Existing Laws), 1972 (President's Order No. 48 of 1972). The Act consolidates the laws relating to embankments and drainage providing provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion or other damage by water. The specific Sections and Articles relevant to the RBIP are mentioned below.

- Section 4 (1) of the Act states that the embankment, water-course, and tow-path, earth, pathways, gates, berms and hedges of the embankments shall vest in the Government of the Authority (BWDB).
- Section 56 (1) states that, person will be subject to penalty (500 taka or imprisonment… if he erects, or causes of willfully permits to be erected, any new embankment, or any existing embankment, or obstructs of diverts, or causes or willfully permits to be obstructed or diverted, any water course.
- Section 15 allows for the engineer (engineer in charge of Divisional level BWDB) for constructing new embankment or enlarging, lengthening or repairing existing embankments.
- The other sections of the Act give powers and access to the Government or Authority or Engineers to commence necessary Project activities, for land acquisition (through the Deputy Commissioner), and site clearing activities including removal of trees or houses (if necessary).

2.3.10. Bangladesh Water Act, 2013

The recently published Water Act 2013 is based on the National Water Policy, and designed for integrated development, management, extraction, distribution, usage, protection and conservation of water resources in Bangladesh. In general, if one takes a

critical look at the Act, the new law has provided the right framework for better management of water resources in the country.

As per this Act, all forms of water (e.g., surface water, ground water, sea water, rain water and atmospheric water) within the territory of Bangladesh belong to the government on behalf of the people. The private landowners will be able to use the surface water inside their property for all purposes in accordance with the Act. A worthwhile initiative is the requirement for permits/licenses for large scale water withdrawal by individuals and organizations beyond domestic use. Without prior permission issued by the Executive Committee, no individuals or organizations will be allowed to extract, distribute, use, develop, protect, and conserve water resources, nor they will be allowed to build any structure that impede the natural flow of rivers and creeks. However, the maximum amount of surface water or groundwater that can be withdrawn by individuals or organizations is not mentioned in the Act. Setting up a priority order for water usage in an area where the water resources is in critical condition is also a significant step.

2.3.11. Bangladesh Labor Act, 2006

The Bangladesh Labor Act, 2006 provides the guidance of employer's extent of responsibility and workmen's extent of right to get compensation in case of injury by accident while working. Some of the relevant Sections are:

- ***Section 150. Employer's Liability for Compensation:*** (1) If personal injury is caused to a workman by accident arising out of and in the course of his employment, his employer shall be liable to pay compensation in accordance with the provisions of this Act; and (2) Provided that the employer shall not be so liable - (a) in respect of any injury which does not result in the total or partial disablement of the workman for a period exceeding three days; (b) in respect of any injury, not resulting in death or permanent total disablement, caused by an accident which is directly attributable to - (i) the workman having been at the time thereof under the influence of drink or drugs, or (ii) the willful disobedience of the workman to an order expressly given, or to a rule expressly framed, for the purpose of securing the safety of workmen, or (iii) the willful removal or disregard by the workman of any safety guard or other device which he knew to have been provided for the purpose of securing the safety of workmen.
- ***Section 151.*** (1) *Amount of Compensation**:*** Subject to the provisions of this Act, the amount of compensation shall be as follows, namely :- (a) where death results from the injury, an amount equal to fifty cent of the monthly wages of the deceased workman multiplied by the relevant factor; or an amount of fifty thousand taka, whichever is more; (b) where permanent disablement results from the injury an amount equal to sixty per cent of the monthly wages of the injured workman multiplied by the relevant factor.

2.3.12. Bangladesh National Building Code, 2006

The Bangladesh National Building Code (BNBC) clearly sets out the constructional responsibilities according to which the relevant authority of a particular construction site shall adopt some precautionary measures to ensure the safety of the workmen. According to Section 1.2.1 of Chapter 1 of Part 7, "In a construction or demolition work, the terms of contract between the owner and the contractor and between a consultant and the owner shall be clearly defined and put in writing". These however will not absolve the owner

from any of his responsibilities under the various provisions of this Code and other applicable regulations and bye-laws. The terms of contract between the owner and the contractor will determine the responsibilities and liabilities of either party in the concerned matters, within the provisions of the relevant Acts and Codes (e.g.) the Employers' Liability Act, 1938, the Factories Act 1965, the Fatal Accident Act, 1955 and Workmen's Compensation Act 1923". (After the introduction of the Bangladesh Labor Act, 2006, these Acts have been repealed.)

The BNBC also stipulates the general duties of the employer to the public as well as workers. According to this section, "All equipment and safeguards required for the construction work such as temporary stair, ladder, ramp, scaffold, hoist, run way, barricade, chute, lift shall be substantially constructed and erected so as not to create any unsafe situation for the workmen using them or the workmen and general public passing under, on or near them".

The Code also clarifies the issue of safety of workmen during construction and with relation to this, set out the details about the different safety tools of specified standard. In relation with the health hazards of the workers during construction, this chapter describes the nature of the different health hazards that normally occur in the site during construction and at the same time specifies the specific measures to be taken to prevent such health hazards. According to this chapter, exhaust ventilation, use of protective devices, medical checkups etc. are the measures to be taken by the particular employer to ensure a healthy workplace for the workers.

To prevent workers falling from heights, the Code sets out the detailed requirements on the formation and use of scaffolding. According to Section 3.9.2 of the same chapter, "every temporary floor openings shall either have railing of at least 900 mm height or shall be constantly attended". Every floor hole shall be guarded by either a railing with toe board or a hinged cover. Alternatively, the hole may be constantly attended or protected by a removable railing. Every stairway floor opening shall be guarded by railing at least 900 mm high on the exposed sides except at entrance to stairway. Every ladder way floor opening or platform shall be guarded by a guard railing with toe board except at entrance to opening. Every open sided floor or platform 1.2 meters or more above adjacent ground level shall be guarded by a railing on all open sides except where there is entrance to ramp, stairway or fixed ladder, the above precautions shall also be taken near the open edges of the floors and the roofs".

2.3.13. Other Laws

There are a number of other laws and regulations applicable which are relevant for the RBIP. These are presented in the **Table 2.1** below.

Table 2.1: Laws and Acts

Act/Law/Ordinance	Brief description	Responsible Agency
The Vehicle Act (1927) and the Motor Vehicles Ordinance (1983)	Provides rules for exhaust emission, air and noise pollution and road and traffic safety	Road Authority
Rules for Removal of Wrecks and Obstructions in inland Navigable Water Ways (1973)	Rules for removal of wrecks and obstructions	IBWTA

Act/Law/Ordinance	Brief description	Responsible Agency
The Water Supply and Sanitation Act (1996)	Regulates the management and control of water supply and sanitation in urban areas.	MoLG, RD&C
The Ground Water Management Ordinance (1985)	Describes the management of ground water resources and licensing of tube wells	Upazila Parishad
The Private Forests Ordinance (1959)	Deals with the conservation of private forests and afforestation of wastelands.	MoEF
The Antiquities Act (1968)	Describes the preservation of cultural heritage, historic monuments and protected sites	DoArch

2.4. International Treaties Signed by GoB

Bangladesh has signed most international treaties, conventions and protocols on environment, pollution control, bio-diversity conservation and climate change, including the Ramsar Convention, the Bonn Convention on migratory birds, the Rio de Janeiro Convention on biodiversity conservation, and the Kyoto protocol on climate change. An overview of the relevant international treaties signed by GoB is shown in **Table 2.2**.

Table 2.2: Treaty or Convention and Responsible Agency

Treaty	Year	Brief Description	Relevant Department
Protection of birds (Paris)	1950	Protection of birds in wild state	DoE/DoF
Ramsar Convention	1971	Protection of wetlands	DoE/DoF
Protocol Waterfowl Habitat	1982	Amendment of Ramsar Convention to protect specific habitats for waterfowl	DoE/DoF
World Cultural and Natural Heritage (Paris)	1972	Protection of major cultural and natural monuments	DoArch
CITES convention	1973	Ban and restrictions on international trade in endangered species of wild fauna and flora	DoE/DoF
Bonn Convention	1979	Conservation of migratory species of wild animals	DoE/DoF
Prevention and Control of Occupational hazards	1974	Protect workers against occupational exposure to carcinogenic substances and agents	MoH
Occupational hazards due to air pollution, noise & vibration (Geneva)	1977	Protect workers against occupational hazards in the working environment	MoH
Occupational safety and health in working environment	1981	Prevent accidents and injury to health by minimizing hazards in the working	MoH

Treaty	Year	Brief Description	Relevant Department
(Geneva)		environment	
Occupational Health services	1985	To promote a safe and healthy working environment	MoH
Convention on oil pollution damage (Brussels)	1969	Civil liability on oil pollution damage from ships	DoE/MoS
Civil liability on transport of dangerous goods (Geneva)	1989	Safe methods for transport of dangerous goods by road, railway and inland vessels	MoC
Safety in use of chemicals during work	1990	Occupational safety of use of chemicals in the work place	DoE
Convention on oil pollution	1990	Legal framework and preparedness for control of oil pollution	DoE/MoS
Vienna convention	1985	Protection of ozone layer	DoE
London Protocol	1990	Control of global emissions that deplete ozone layer	DoE
UN framework convention on climate change (Rio de Janeiro)	1992	Regulation of greenhouse gases emissions	DoE
Convention on Biological Diversity (Rio de Janeiro)	1992	Conservation of bio-diversity, sustainable use of its components and access to genetic resources	DoE
International Convention on Climate Changes (Kyoto Protocol)	1997	International treaty on climate change and emission of greenhouse gases	DoE
Protocol on biological safety (Cartagena protocol)	2000	Biological safety in transport and use of genetically modified organisms	DoE

2.5. Implication of GoB Polices, Acts and Rules on RBIP and their Classification

The legislations relevant for environmental assessment for RBIP are the Environmental Conservation Act 1995 (ECA'95) and the Environmental Conservation Rules 1997 (ECR'97). Department of Environment (DoE), under the Ministry of Environment and Forest (MoEF), is the regulatory body responsible for enforcing the ECA'95 and ECR'97. According to the Rule 7 (1) of the Environmental Conservation Rules 1997; for the purpose of issuance of Environmental Clearance Certificate (ECC), every industrial units or projects, in consideration of their site and impact on the environment, will be classified into the four categories and they are: Category I (green), Category II (Orange-A), Category III (Orange B) and Category IV (Red). According to the categorization, all construction/reconstruction/expansion of flood control embankment/polder/dykes falls under Red Category. Therefore RBIP falls under the '**Red**' category.

It is the responsibility of the proponent to conduct an EIA of development proposal, the responsibility to review EIAs for the purpose of issuing Environmental Clearance Certificate rests on DoE. The procedures for "Red" Category include submission of:

- An Initial Environmental Examination (IEE)
- An Environmental Impact Assessment (EIA)
- An Environmental Management Plan (EMP)

Environment clearance has to be obtained by the respective implementing agency or project proponent (private sector) from Department of Environment (DoE). The environmental clearance procedure for Red Category projects can be summarized as follows:

Application to DoE→Obtaining Site Clearance →Applying for Environmental Clearance →Obtaining Environmental Clearance→Clearance Subject to annual renewal.

The Department of Environment (DoE), the technical arm of the Ministry of Environment and Forest (MoEF) is the regulatory body and the enforcement agency of all environmental related activities. Like all other projects, this project also needs to meet the requirement of the DOE. An environmental assessment (EA) study needs to be undertaken for obtaining the environmental clearance. As per ECR 1997, the proposed RBIP falls under the Red Category and hence, necessitates a full-scale EIA. Steps to be followed for obtaining Environmental Clearance Certificate (ECC) in connection with the construction/ reconstruction / extension of bridges over 100 meter in length (under Red Category) from DOE are outlined in **Figure 2.1**.

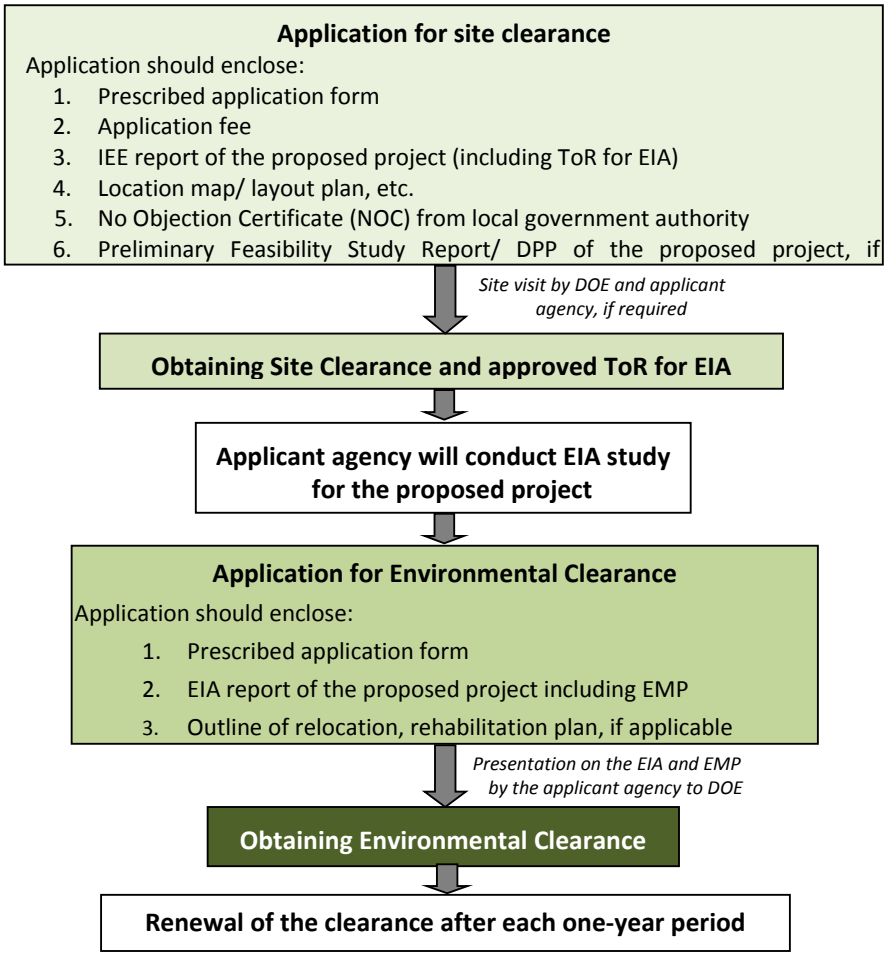


Figure 2.1: Process of obtaining Clearance certificate from DoE

Public participation or consultation is not a condition in the ECR 1997 and or EIA Guidelines, however, DOE prefers the proponent to engage in public participation and put conditions while providing site clearance or during the approval of the EIA TOR.

2.6. World Bank's Environmental Safeguard Policies

The World Bank has developed a number of Safeguard Policies to ensure that all possible impacts are considered and mitigation measures are spelled out prior to the implementation of any proposed project. These policies ensure that the quality of operations is uniform across different settings worldwide. If the decision is taken that a Safeguard Policy should be applied, mitigation measures and plans must be developed and in place before the implementation of a proposed project.

The Bank requires environmental screening and classification for all investment projects[2] (including ones financed by Trust Funds, Project Preparation Facilities and Guarantees) proposed for Bank financing, to help ensure that they are environmentally and socially sound and sustainable. Screening and classification take into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, Indigenous Peoples); cultural property; and trans-boundary and global environmental aspects.

The objectives of environmental screening and classification are: to evaluate the environmental risks associated with a proposed operation; to determine the depth and breadth of Environmental Assessment (EA); and to recommend an appropriate choice of EA instrument(s) suitable for a given project. The Bank recognizes that environmental screening and classification is not absolute and involves professional judgment on a case by case basis. When screening, careful consideration needs to be given to potential environmental impacts and risks associated with the proposed project. Judgment is exercised with reference to the policy expectations and guidance; real impacts on the ground; and established regional and Bank-wide precedence and good practice.

2.6.1. Environmental Assessment (OP/BP 4.01)

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

The present EMF has been prepared in compliance with this OP/BP.

EA classification. The World Bank classifies the proposed project into one of the four categories, depending on the type, location, sensitivity, and scale of the project and the

nature and magnitude of its potential environmental impacts. These categories are defined below.

Category A: A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works.

Category B: A proposed project is classified as Category B if its potential adverse environmental impacts on human populations or environmentally important areas--including wetlands, forests, grasslands, and other natural habitats--are less adverse than those of Category A projects.

Category C: A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required for a Category C project.

Category FI: A proposed project is classified as Category FI if it involves investment of Bank funds through a financial intermediary (FI), in subprojects that may result in adverse environmental impacts.

The proposed RBIP has been classified as Category A, since some of the potential impacts are likely to be significant and diverse.

2.6.2. Natural Habitats (OP 4.04)

The Policy describes the conservation of natural habitats, like other measures that protect and enhance the environment, to be essential for long-term sustainable development. The Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats and their functions in its economic and sector work, project financing, and policy dialogue. The Bank also supports, and expects borrowers to apply a precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development. The Bank- promotes and supports natural habitat conservation and improved land use by financing projects designed to integrate into national and regional development the conservation of natural habitats and the maintenance of ecological functions. Furthermore, the Bank promotes the rehabilitation of degraded natural habitats. The Bank does not support projects that involve the significant conversion or degradation of critical natural habitats.

The activities under the proposed program could potentially alter the natural habitat hence this policy is triggered. Habitat restoration and enhancement measures will be included in the program design to mitigate and or compensate any adverse impacts on the natural habitat.

2.6.3. Physical Cultural Resources (OP 4.11)

The World Bank's general policy regarding cultural properties is to assist in their preservation, and to seek to avoid their elimination. The specific aspects of the Policy are given below. [1]

- The Bank normally declines to finance projects that will significantly damage non-replicable cultural property, and will assist only those projects that are sited or designed so as to prevent such damage.

[1] Excerpts from the OPN 11.03.WB Operational Manual. September 1986.

- The Bank will assist in the protection and enhancement of cultural properties encountered in Bank-financed projects, rather than leaving that protection to chance. In some cases, the project is best relocated in order that sites and structures can be preserved, studied, and restored intact in situ. In other cases, structures can be relocated, preserved, studied, and restored on alternate sites. Often, scientific study, selective salvage, and museum preservation before destruction is all that is necessary. Most such projects should include the training and strengthening of institutions entrusted with safeguarding a nation's cultural patrimony. Such activities should be directly included in the scope of the project, rather than being postponed for some possible future action, and the costs are to be internalized in computing overall project costs.
- Deviations from this policy may be justified only where expected project benefits are great, and the loss of or damage to cultural property is judged by competent authorities to be unavoidable, minor, or otherwise acceptable. Specific details of the justification should be discussed in project documents.
- This policy pertains to any project in which the Bank is involved, irrespective of whether the Bank is itself financing the part of the project that may affect cultural property.

This OP is not triggered by Phase 1 (i.e. priority reach) since no cultural or archaeological resources are known to exist in the vicinity of the Program area nor have any such resources been identified during field investigations. However, the EIAs to be carried out for subsequent phases of the program will include full assessments of any cultural heritage that may be affected, and appropriate mitigation measures will be identified in the detailed EMPs as required. In addition, 'chance find' procedures will be included in the EMPs for all program phases.

2.6.4. Forests (OP/BP 4.36)

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

This OP is not triggered since the proposed program is not located in any forested area and will therefore not have any direct impact on forests.

2.6.5. Projects on International Waterways (OP 7.50)

Projects on international waterways may affect the relations between the World Bank and its borrowers, and between riparian states. Therefore, the Bank attaches great importance to the riparian making appropriate agreements or arrangements for the entire waterway, or parts thereof, and stands ready to assist in this regard. A borrower must notify other riparian of planned projects that could affect water quality or quantity, sufficiently far in advance to allow them to review the plans and raise any concerns or objections.

This Policy is triggered since Brahmaputra/Jamuna is an international waterway. However, as Bangladesh is the most downstream country of the Brahmaputra/ Jamuna River and the proposed program is not expected to adversely change the quality or quantity of water flow to the other riparians, the notification requirement is waived.

2.6.6. Pest Management (OP/BP 4.09)

Through this OP, the WB supports a strategy that promotes use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides. Rural development and health sector projects have to avoid using harmful pesticides. Other pesticides can be used, but only as an element of an Integrated Pest Management Plan (IPMP) that emphasizes environmental and biological controls.

Though increase in agriculture production hence an increased usage of chemical pesticides and fertilizers is not included in the program objectives, such a consequence of the program cannot be ruled out. Hence this policy is triggered.

2.6.7. Indigenous Peoples (OP 4.10)

For purposes of this Policy, the term 'Indigenous Peoples' is used in a generic sense to refer to a distinct, vulnerable, social and cultural group possessing the following characteristics in varying degrees:[2]

- self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;
- collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories;
- customary cultural, economic, social, or political institutions that are separate from those of the dominant society and culture; and
- an indigenous language, often different from the official language of the country or region.

The OP defines the process to be followed if the project affects the indigenous people.

The social impact assessment of the RBIP indicates that there are no indigenous communities residing in the program area and therefore, no impacts on them are expected under the program. This has been confirmed in the priority reach where investments will be carried out under the proposed program. Therefore this OP is not triggered for the proiority reach.This finding will be further reviewed through the detailed assessments to be carried out during program implementation for the subsequent phases.

2.6.8. Involuntary Resettlement (OP/BP 4.12)

The WB's experience indicates that involuntary resettlement under development projects, if unmitigated, often gives rise to severe economic, social, and environmental risks: production systems are dismantled; people face impoverishment when their productive assets or income sources are lost; people are relocated to environments where their productive skills may be less applicable and the competition for resources greater; community institutions and social networks are weakened; kin groups are dispersed; and

[2] Excerpts from the OP 4.10.WB Operational Manual. July 2005.

cultural identity, traditional authority, and the potential for mutual help are diminished or lost. This policy includes safeguards to address and mitigate these impoverishment risks.[3]

The overall objectives of the Policy are given below.

- Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs.
- Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits. Displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs.
- Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

Since the proposed program will involve land acquisition as well as displacement of houses and other assets, a Resettlement Action Plan (RAP) has been prepared, under a separate cover, in accordance with this Policy.

2.6.9. Projects in Disputed Areas (OP 7.60)

Projects in disputed areas may raise a number of delicate problems affecting relations not only between the Bank and its member countries, but also between the borrower and one or more neighboring countries. In order not to prejudice the position of either the Bank or the countries concerned, any dispute over an area in which a proposed project is located is dealt with at the earliest possible stage.

The Bank may proceed with a project in a disputed area if the governments concerned agree that, pending the settlement of the dispute, the project proposed for country A should go forward without prejudice to the claims of country B. [4]

This OP is not triggered since no part of the program area is located in any disputed territory.

2.6.10. Safety of Dams (OP 4.37)

The Policy seeks to ensure that appropriate measures are taken and sufficient resources provided for the safety of dams the WB finances. However this OP is not relevant since the proposed program does not involve construction of dams. Nonetheless, while the embankments do not qualify as ‘dams’, many of the same risks and concerns associated with potential dam failure are also relevant in the context of the embankments. The program has therefore convened an international Panel of Experts to provide guidance on diverse aspects including technical, environmental and social. The technical reviews to be provided by the panel will look at embankment safety aspects and provide guidance to BWDB on design aspects to minimize structural risks of breaching or failure of the embankments. Safety monitoring and emergency management plans will also be developed and implemented through the RBIP.

[3] Excerpts from WB OP 4.12.WB Operational Manual. December 2001.

[4] Excerpts from the OP 7.60.WB Operational Manual. November 1994.

2.6.11. World Bank Policy on Access to Information

This BP deals with the World Bank policy on disclosure of information. It is a mandatory procedure to be followed by the borrower and Bank and supports public access to information on environmental and social aspects of projects.

Once finalized, the EMF and Bengali translation of its executive summary will be disclosed to the public and will also be available on the official website of the BWDB. EMF will also be sent to the WB InfoShop.

2.6.12. Environment, Health and Safety Guidelines

The Environment, Health, and Safety (EHS) Guidelines[5]contain the performance levels and measures that are generally considered to be achievable in new facilities or project by existing technology at reasonable costs. These Guidelines will be applicable to the RBIP.

2.6.13. Applicable World Bank Policies

The RBIP is classified as a Category A project, due to the complexity of environmental issues associated with program activities involving major civil works by reconstruction and rehabilitation of the embankment to protect against inundation. Since the area is of high economic value and ecological sensitivity, certain negative environmental impacts may occur during the implementation and operational phase of the RBIP. There may be localized impacts on the natural habitats especially on the fish spawning areas during the implementation of the civil works.

The environment assessment (OP/BP 4.01), natural habitats (OP/BP 4.04), pest management (OP/BP 4.09), involuntary resettlement (OP/BP 4.12) and international waterways (OP/BP 7.5) have been triggered for the proposed operation. Although no direct impacts on physical cultural resources are expected, screening mechanism incorporated into the EA process will identify places and or objects of archeological, paleontological, historical, religious, or unique natural values. Physical cultural resources (OP/BP 4.11) are considered in the environmental framework preparation. The status of the environmental and social safeguard policies of the World Bank is provided below in **Table 2.3**.

Table 2.3: Triggering the World Bank Policies

Directive	Policy	Triggered	Comments
Environmental Assessment	OP/BP 4.01	Yes	The Program falls into Category A, Full EIAs will be carried out for subsequent reaches or phases (a full EIA of the priority reach of the RBIP is being carried out) in accordance with the EMF document.
Natural Habitats	OP/BP 4.04	Yes	The RBIP has potential to cause conversion of habitat and impair associated ecological functions by: altering aquatic habitat through placing geo-bags and concrete blocks along the river bank; disturbing aquatic habitat during sand extraction from river banks; changing/interrupting ecological connectivity

[5] EHS Guidelines available at: http://www.gcgf.org/wps/wcm/connect/554e8d80488658e4b76af76a6515bb18/Final%2B-%2BGeneral%2BEHS%2BGuidelines.pdf?MOD=AJPERES

Directive	Policy	Triggered	Comments
			between main Jamuna river and inland smaller rivers, water ponds (beels), and water channels (khals). Appropriate mitigation and control measures have been included in the RBIP design and EIA to address these potential impacts.
Physical Cultural Resources (PCR)	OP 4.11	No	Not triggered since no PCR are known to exist in the RBIP corridor. Chance find procedures will nonetheless be included in the environmental management plan (EMP).
Forests	OP/BP 4.36	No	Not triggered since the program activities will not impact any forests or associated resources.
Pest Management	OP 4.09	Yes	Triggered. Although no agro-chemicals will be used in any of the program activities, the program may induce changes in cropping pattern (if not further intensification of cropping) in the area because of increased protection against riverbank erosion and flooding. This change in cropping pattern can in turn potentially increase usage of agro-chemicals. To address this eventuality, linkages will be developed with the already on-going IPM initiatives in the region.
Safety of Dams	OP/BP 4.37	No	Not triggered since no dams are involved under the program.
Projects in International Waterways	OP/BP/ GP 7.50	Yes	The Program is located on an international waterway and will require a riparian notification consistent with World Bank.
Projects in Disputed Areas	OP/BP 7.60	No	Not triggered since no disputed areas exist in or around the program area.
Access to Information			World Bank has developed a new approach to the disclosure of information, transparency and sharing of knowledge. The public will have access to a broad range of information about project in preparation and implementation. The EMF, EIA report, and RAP will be disclosed on BWDB website and also sent to WB InfoShop. Consultations have been held while conducting EIA and preparing EMF as well as RAP. A consultation and disclosure workshop was held in Dhaka on 25 January 2015. Similar workshops will be held in entire program area to disclose the present EMF. The EMF will be placed on BWDB website and also in relevant offices in the program area. The EMF will also be sent to WB InfoShop.

Public consultation and disclosure requirements by World Bank

The Bank reaffirms its recognition and endorsement of the fundamental importance of transparency and accountability to the development process. Accordingly, it is Bank's policy to be open about its activities and to welcome and seek out opportunities to explain its work to the widest possible audience. According to 'OP 4.01: Environmental Assessment' of World Bank, the following conditions applies to the RBIP.

Consultations. For all Category A (e.g. RBIP) and B projects the borrower should consult the project-affected groups and local nongovernmental organizations (NGOs) about the project's environmental aspects and takes their views into account. The borrower should initiate such consultations as early as possible. For Category A projects, the borrower should consult these groups at least twice: (a) shortly after environmental screening and before the terms of reference for the EA are finalized; and (b) once a draft EA report is prepared. In addition, the borrower should consult with such groups throughout project implementation as necessary to address EA-related issues that affect them.

Disclosure. For a Category A project, the borrower should provide relevant information on project interventions in a timely manner prior to consultation and in a form and language that are understandable and accessible to the groups being consulted. The borrower should provide a summary of the proposed project's objectives, description, and potential impacts for the initial consultation. For consultation after the draft EA report is prepared, the borrower should provide a summary of the EA's conclusions. In addition, for a Category A project, the borrower makes the draft EA report available at a public place accessible to project-affected groups and local NGOs. The borrower also ensures that EA reports for Category A subprojects are made available in a public place accessible to affected groups and local NGOs. The document needs to be translated into Bengali. Public availability of the EA report for Category A project in the borrowing country and official receipt by the Bank are prerequisites to Bank appraisal of these projects.

3. Program Description

This Chapter provides an overview of the proposed program activities; detailed description will be included in the EIA reports of the priority reach and subsequent RBIP phases when detailed engineering designs are available.

3.1. Background

The Jamuna is one of the most important rivers of Bangladesh and dominates the hydrology and inundation cycles of the flood plains of Bangladesh. The river originates in the northern Himalayas in Tibet, flows through China as the Yarlung Tsangpo and India as the Brahmaputra and enters Bangladesh as the Jamuna. The Brahmaputra-Jamuna river system displays characteristics of a braided river and is highly susceptible to migration and avulsion. In plan form, the river typically shows two to three main channels per cross-section and has an average width of 12 km in Bangladesh.

In the 1960s, the 220 km Brahmaputra Right-bank Embankment (BRE) was constructed from Kaunia in Rangpur district to Bera in the Pabna district, to protect the surrounding area from flooding of the Jamuna (Brahmaputra) river and to improve agricultural production in the area **(Figure 1.1)**. Around 180km of the embankment follow the Brahmaputra/Jamuna right bank, while 40km of embankment was built along the Teesta right bank. The Teesta is the main tributary of the Jamuna river in Bangladesh with its flow controlled by barrages in Bangladesh and India.

Prior to the BRE construction, overbank spills regularly caused flooding to some 240,000 ha of fertile floodplain land. Originally the BRE had a setback distance of about 1.50 km from the Jamuna river bankline. Over the years the embankment has been increasingly under attack from westward shifting of the river and consequent bank erosion, causing the embankment to breach at several locations. After such breaches, the embankment had to be retired from its original alignment and reconstructed. The retired embankments were typically constructed with around a 200 meter setback distance to prevent flooding. In many places, the embankment has been retired several times.

Under the Flood Action Plan (FAP 1), a Master Plan was prepared in 1994 to protect the BRE against ongoing riverbank erosion (Halcrow, 1994). The study included an assessment of river processes and physical and hydraulic modeling of various river training structures. The study proposed constructing a series of hard point structures along the existing bankline to limit future erosion. The structures were typically about 800 meters long and it was proposed that they be spaced 2.5 km apart along the right bank. It was recognized that erosion might continue between the structures, albeit at a slower rate, and where this occurred, the embankment could still need to be retired.

Recent History

After completion of the Master Plan hard points were constructed at Sirajganj, Sariakandi, and Mathurapara, and a groyne was installed at Kalitola from 1995 to 1998. The structures were heavily damaged, first in 1998 and 1999 and repeatedly later, and have required ongoing maintenance and re-construction. Due to the high cost of the “hard points”, the BWDB developed alternatives since the mid-1990s. While protruding spurs did not work satisfactorily, the BWDB has turned to guiding revetments since the mid-2000s, which have demonstrated a lower failure rate and protect the embankment better against steadily reducing overall setback distances to the river.

Bank erosion has continued to attack the BRE, causing it to breach frequently and at different locations. Presently, only 41 kilometers of the original BRE remains intact upstream of Jamuna Bridge, and the overall setback distance is steadily reducing with more and more embankment length being within the reach of annual average erosion rates. Consequently, the integrity of the BRE is threatened and large areas of rural and urban areas are increasingly being exposed to the risk of flooding.

3.2. Proposed Interventions

3.2.1. Program Rationale

Bangladesh, as the lowest riparian country of the Brahmaputra-Ganges river basin, lacks control over the basin and has to adapt to externally imposed basin changes. Natural processes associated with the continuing mountain-building process of the Himalaya and the annual monsoon rainfall on their southern mountain slopes, have built and continue building the delta that constitutes the major part of Bangladesh. This process is driven by some of the highest river flows and sediment loads in the world, mostly transported through Bangladesh into the Bay of Bengal during the four-month monsoon period from June through September. Besides being unable to control the physical environment, Bangladesh also lacks political influence over basin developments, including land-use changes and the construction of dams in India and China. Given the very high and growing population density, climate change poses additional future threats through projected increases in river flows, sediment loads, and sea levels.

Feeding the rapidly growing population of Bangladesh over the last half-century called for systematic reduction of flood risks to agricultural land, but until now this was constrained by large-scale river instability. Nevertheless, a quest for food self-sufficiency has resulted in some control and regulation to achieve multiple and increasingly high-yield crops. The key elements are: (i) flood risk reduction through the construction of embankments to control water levels during the monsoon season; and (ii) upgrading of irrigation infrastructure to enable a major second crop during the dry season. River instability and widening, however, has caused increasing destruction of flood embankments since the later 1970s and has also affected the irrigation schemes. At first, the reasons for this increased instability were not understood, but the Government also did not have sufficient resources or appropriate technologies to arrest large-scale riverbank erosion. A better understanding of river processes, together with low-cost technologies for riverbank protection, was developed only after 1990.

As of 2014, Bangladesh was in a transition from “fire-fighting” local riverbank erosion to developing a more comprehensive program for riverbank protection and river stabilization. The BWDB developed a promising bank protection technology from the early 1990s until 2010, based on experimentation with a number of technologies, often donor-supported. The method recommended in the Board’s Guideline for Riverbank Protection (2010), involves long guiding revetments along similar lines of those in high-energy reaches of the lower Mississippi River, USA. In support of larger-scale river stabilization, the BWDB experimented with capital dredging within the scope of a feasibility study,[6] and the two main funders of water projects - the World Bank and the

[6] Feasibility Study of Capital Dredging and Sustainable River Management in Bangladesh, draft final report, April 2014. This study estimates that 311 km of long guiding revetments could protect both riverbanks along the 220-km long Brahmaputra/Jamuna course from the Indian border to the confluence with the Ganges. The riverbank protection would be supplemented by an annual dredging volume of

Asian Development Bank - have launched major initiatives[7]. Given that the annual average cost of capital dredging amounts to 30 times the annual BWDB budget, the need is recognized for a phased river stabilization program and for riverbank protection and land reclamation to be viewed as a joint process.

One critical length is the 150-km BRE north of Jamuna Bridge, which protects around 200,000 ha of the grain-growing Northwestern Region against flooding. Riverbank erosion in this area has continuously displaced the floodplain population since 1973, so that by 2014 around 100,000 squatters were living on the embankment, of which about 40,000 were located in a 50-km priority reach. These people have lost their land and livelihood, some having had to relocate up to seven times. The fear of riverbank erosion and major flooding has a strong negative impact on riparian residents, who generally have high poverty levels, low health, and crowded low-quality dwellings with restricted access to civic amenities and roads. Their overwhelming demand is to stop riverbank erosion and forced retirement of embankments, which cuts ever more deeply into long-established communities.

3.2.2. Program Objectives

The overall objectives of the RBIP are to reconstruct the BRE and secure it against erosion. Arresting erosion is the primary interest of the local population living alongside the riverbank. Secondary objectives are to: (i) develop the local area to catch up with the rest of the country and reduce poverty; and (ii) strengthen BWDB's capacity as a competent agency for mitigation of flooding and bank erosion within an overall strategy for Integrated Flood Risk Management.

While reduction of riverbank erosion and flooding risks will have positive impacts on development of the area in general, the rehabilitation of erosion victims presently squatting on more than 90 percent of the embankment length will directly benefit a large population that is neglected by current disaster response mechanisms.

The specific objectives of the Riverbank Improvement Program (RBIP) are: (i) to reduce riverbank erosion along 150 km of the right (western) bank of the Brahmaputra/Jamuna River from the Teesta River to the Jamuna Bridge; (ii) provide a reliable flood embankment with roadway; (iii) rehabilitate the population squatting on existing embankments; and (iv) initiate institutional change within BWDB to provide long-reach stabilization work and maintain it jointly with local communities. The performance indicators associated with these objectives and the associated timeframe are given below.

Table 3.1: Performance Indicators and Timeframes

Indicator	Level	Timeframe
Impact	Overarching or higher order goals: Millennium Development Goals, 6th Five-Year Plan,	Five years after program end

146 million cubic meters - which amounts to roughly one third of the annual sediment load of the Brahmaputra River.

7 ADB: Flood and Riverbank Erosion Risk Management Investment Program (FRERMIP) covering the central Brahmaputra System from Jamuna Bridge to Chandpur, study from 2012 to 13, loan effective since mid-2014; and the World Bank's current River Bank Improvement Program (RBIP), covering the northern part of the Brahmaputra system in Bangladesh between Jamuna Bridge and Indian border, study from 2012 until 2015, loan expected at the end of 2015.

Indicator	Level	Timeframe
	"a world free of poverty"	
Outcome	Dominant goals of water sector and people's livelihoods, such as erosion and flood protection, irrigation expansion etc.	At program end
Output	Detailed results from individual program components or activities, such as embankment construction, training, formation of stakeholder groups	During program implementation

3.2.3. Program Boundaries

The BRE protects central parts of Bangladesh's north-western zone from Brahmaputra/Jamuna River flooding. It is delineated to the north by the Kurigram Irrigation Project, North and South Units, which provide around 36km of embankments along the Brahmaputra/Jamuna towards the Indian border, and in the south by the Pabna Irrigation and Rural Development Project (PIRDP), which provides around 30km of embankment line to the confluence with the Ganges. The BRE starts at the Teesta Bridge at Kaunia and follows the right bank of the Teesta River for 40km to its confluence with the Brahmaputra/Jamuna. The Teesta River forms the southern boundary of the Kurigram Irrigation Project. From the Teesta confluence the BRE follows the Jamuna River for around 180km to the south until it reaches the Hurasagar/Baral River, where it ends. The Hurasagar/Baral forms the northern boundary of the PIRDP. **Figure 3.1** shows the BRE as the central part of the Brahmaputra/Jamuna right bank flood protection. The BRE influences around 297,000 ha of land. Since its establishment at the end of the 1960s, around 21,000 ha of flood-protected land were eroded along the BRE, and only 50km of the originally 178-km embankment along the Brahmaputra/Jamuna was still in place in 2014.

The RBIP covers the central and northern part of the BRE in the Sirajganj, Bogra, and Gaibandha Districts, and can be extended to the Kurigram Irrigation Project's North and South Units over a new bridge across the Teesta River in future (**Figure 3.2**). The 40-km BRE section along the Teesta River has been omitted due to its low risk of flooding since construction of the Teesta Barrage in 1990. A 50-km priority reach (Phase I works) extends from Simla, about 8km upstream of Sirajganj, to Hasnapara approximately 10km upstream of Sariakandi, covering the central part of the BRE. The remaining 97km will be addressed in Phase II, while the embankment along the whole length will be provided with a highway standard road in Phase III. The short 20-km long southern reach between Simla and Jamuna Bridge was left out of Phase I, as the BWDB has undertaken some minor interventions there to reclaim a small piece of the lost floodplain land. It is planned to align the new embankment over the reclaimed land under Phase II.

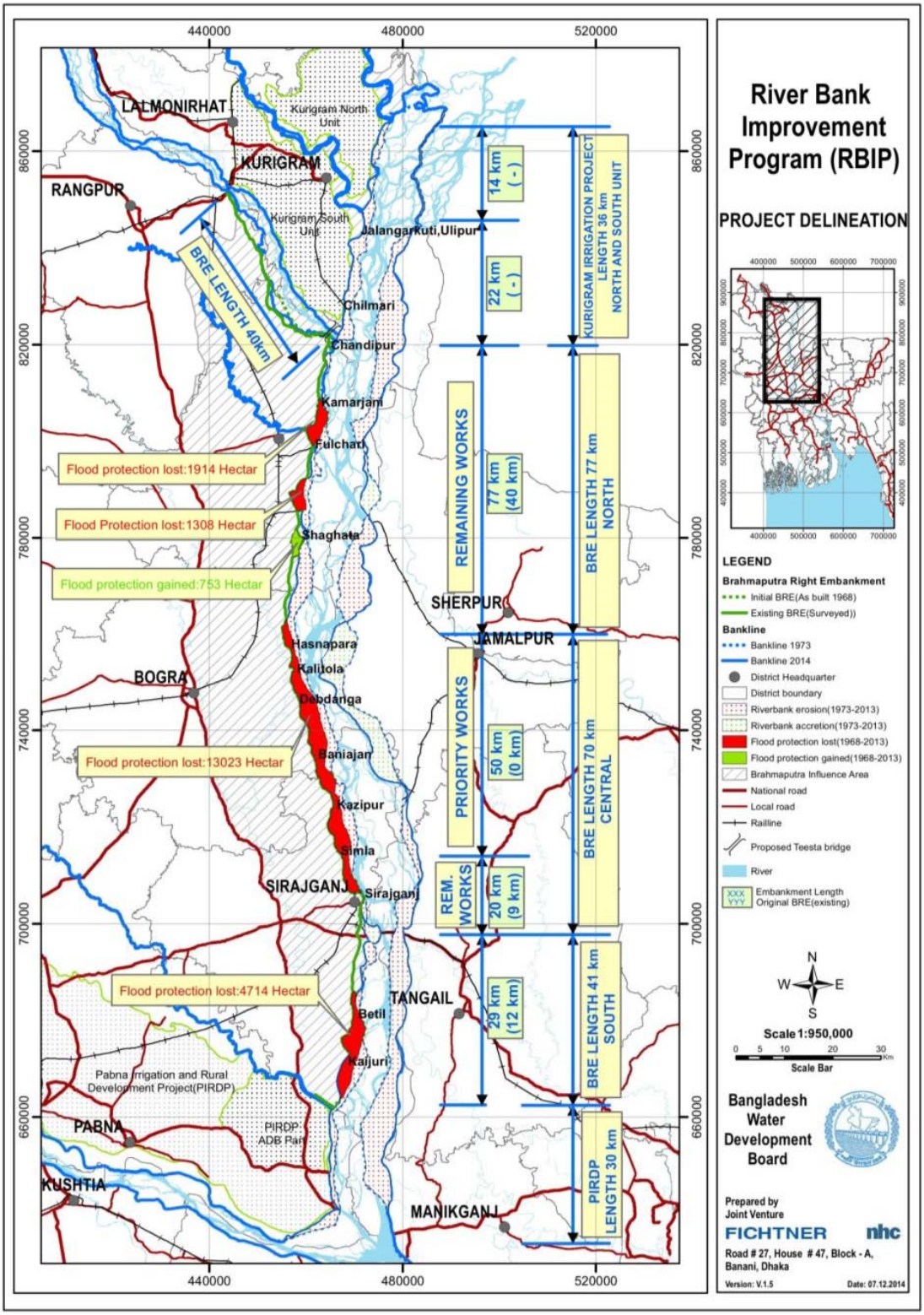


Figure 3.1: BRE and Adjacent Areas

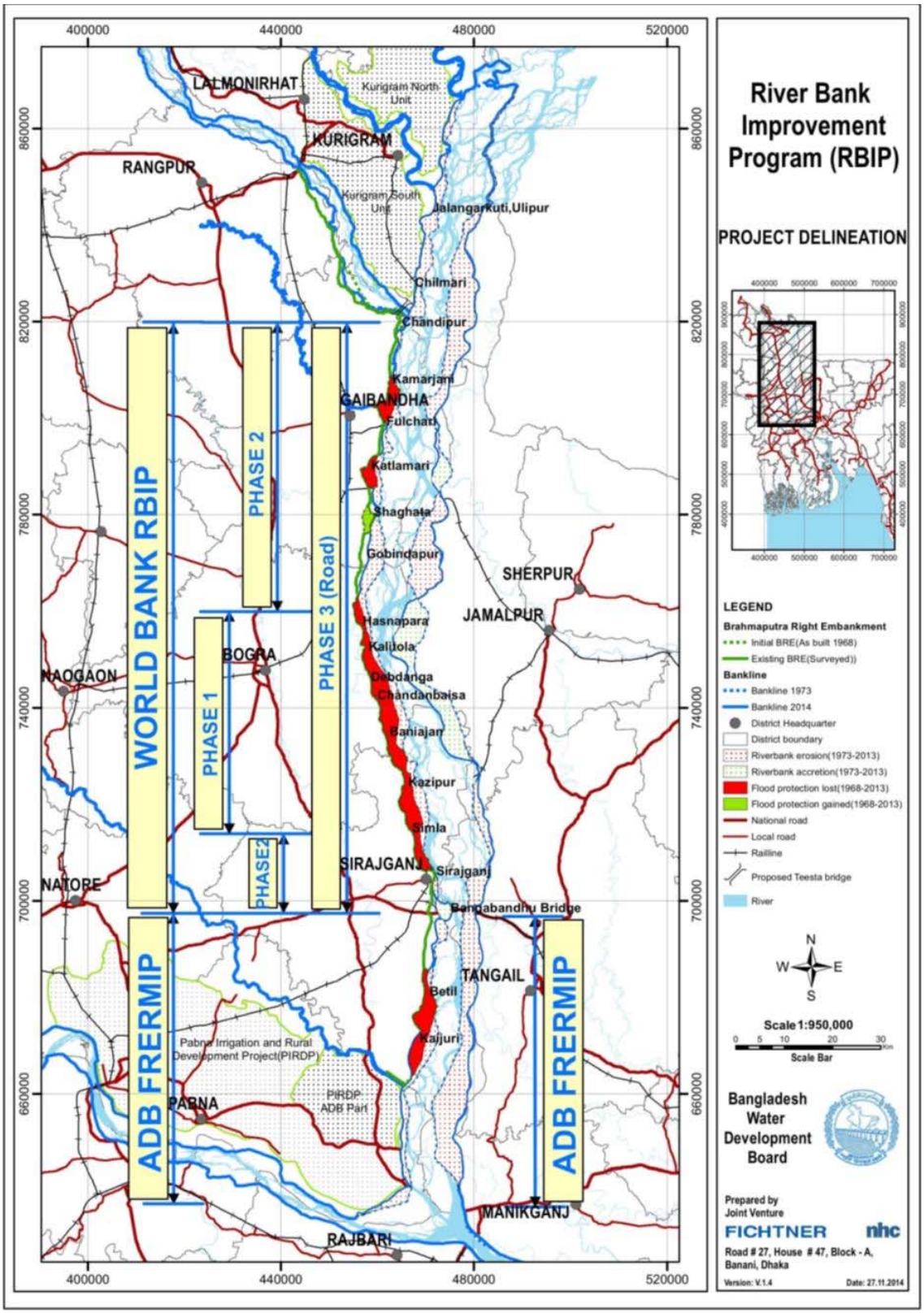


Figure 3.2: Program Delineation

3.3. Program Area, Work Sequencing, and Key Components

3.3.1. RBIP Area and Selection of Priority Reach

The RBIP starts with the rehabilitation of the existing around 150km long Brahmaputra Right Embankment (BRE) from the Teesta River to the Jamuna Bridge while the future ADB support under FRERMIP will cover the 140km length from Jamuna Bridge to Chandpur. The 70km BRE reach from Jamuna Bridge to Hasnapara is under heavy erosional attack with frequent embankment breaching and retirements. Out of this, the 50-km length between Hasnapara and Simla is designated as a priority reach for the following reasons:

- Erosion rate: Over the 42-year period 1973 to 2014 the Brahmaputra/Jamuna eroded an average 3.3km wide strip into the floodplain with peak erosion exceeding 5 km. In comparison the average erosion rate along the whole BRE was 1.9km from 1973 to 2014.
- Embankment breaching: The embankment setback distance has reduced from typically 1.5 km in 1973 to 390m in 2014. About 33 percent of the existing BRE in the priority reach is situated within 200m from the riverbank. With annual erosion rate of 150m in one year and 250m in two years in 10 percent of the cases the embankment is at a high risk of erosion. About 86 percent of the embankment retirements between 1995 and 2013 occurred in this reach, and the annual risk of a breach is 67 percent. The embankment has been retired typically five times and as much as nine times up to 3.5km to the west of the historic embankment line.
- Risk of inundation: The floodplain slopes to the west towards a network of smaller streams draining the terrain behind a natural levee built by the river. A sequence of several breaches of the BRE would inundate substantial parts of the floodplain to levels not experienced since its completion. Numerical modeling indicates that the flooded area due to breaches within the 50 km priority reach would average nearly 50,000 ha annually, as opposed to 15,000 ha in the remaining (Phase II) areas upstream.
- Risk of avulsion: The Bangali River flows closely to the Brahmaputra riverbank in the Sariakandi area. Over a length of some 15 km it is located as close as 350 m to the Brahmaputra bankline, a distance that could be eroded in one year. Avulsion of the Brahmaputra into the Bangali during a higher flood could cause widespread destruction.
- Limited bank protection: The riverbank is insufficiently protected against embankment breaching with currently only 12km provided with riverbank protection work. Over the last four decades some 20,000 ha of the priority reach land has been lost due to erosion and breaches - corresponding in area to a large irrigation project.

Table 3.2 summarizes key project interventions in the priority and remaining reaches. Interventions in the priority reach will be designed in detail, whereas those in the remaining reaches will be tentative as based on the existing river morphology - their final design will depend on the amount of river change between the present feasibility study and the detailed design phase and the desired level of reclamation and river training identified during the first year of Phase I.

Table 3.2: Summary of Physical Interventions

Intervention	Phase I (Priority Reach)	Later Phases (Remaining Reaches)
Reconstructed BRE	12.00 km (upgrade) 38.00 km (new)	87 km
New Riverbank Protection	18.01 km	25km
Upgraded Revetment	18.55 km	5.4 km
Upgraded Spur	6	-
Upgraded hard point	-	1
Upgraded Groyne	1	-
Upgraded cross bar	-	4
Regulators	2	14
Fish Passes	4	To be decided
Culverts	2	-
Bridges	0	1
Road	-	137 km

3.3.2. The Phased Program

The complex task of attempting to stabilize the largest braided sand-bed river in the world within one of the densest populated countries of the world demands a phased approach. The proposed program consists of three phases of typically 5 years each, with on average 2 years of overlap, as follows:

- **Phase I – Priority Reach:** In this reach, all of the original BRE has been eroded due to widening and westward shift of the Brahmaputra. Phase I involves complete reconstruction of the flood embankment, while securing the riverbank against erosion through long guiding revetments that will incorporate current emergency works being built by BWDB. Approximately 18km of new riverbank protection will be provided in addition to about 19km existing, the remaining areas being shielded by upstream protection.
- **Phase II – Remaining Reaches:** The remaining reaches include 20 km of the BRE extending upstream from Jamuna Bridge to the priority reach, and 77 km extending upstream from the priority reach to the Teesta River. The two areas are distinctly different as indicated below.
  - In the southern 20 km, upstream and downstream of the exposed Sirajganj Town Protection, BWDB has undertaken interventions to reclaim a small piece of lost floodplain land where the river has outflanked Sirajganj Town and the western guide bund of Jamuna Bridge. The Phase II activities will support the existing riverbank protection where required and construct a new embankment parallel to the new bankline, to secure the reclaimed land against flooding.
  - In the northern 77 km the BRE is heavily populated and its crest level is too low for the future design flood. The embankment is subject to riverbank erosion in several places, although not at the scale of the priority reach. The river's main channel runs alongside the left bank, with mostly flood channels and attached chars alongside the right bank. Some reclamation of lost floodplain land can be considered as part of Phase II.

- The Phase II also focuses on reconstruction of the BRE and securing it against riverbank erosion. While this preparatory study is based on riverbank protection along the present bankline, we recognize the need for a concept of comprehensive river stabilization, in line with the recommendation from the IPoE. The extent and type of riverbank erosion protection will be decided on the basis of a river training and reclamation study component encompassing the whole Brahmaputra River from the Indian border to the Jamuna Bridge. This river training study will precede the updated feasibility study component and detailed design of the remaining works and allow considering the option of reclaiming lost floodplain land and realigning the BRE over the reclaimed land.
- Efforts should be made to understand flooding processes on the floodplain. The BRE provides flood protection to around 6 percent (220,000 ha) of the Northwestern Region (3,433,500 ha), a region that produces 34 percent of the country's food grains. Growing road connections interfere with natural flooding and drainage paths and have led to noticeable changes since the time of BRE construction. Future sustainable development depends on a better understanding of residual flood risks, which requires two-dimensional flood modeling. In combination with depth-duration-damage curves, such modeling will enable the production of flood risk maps that identify areas and assets at risk during events of various frequencies, so providing input for land-use zoning and development of a Master Plan.
- **Phase III – Road:** The new embankment will incorporate an emergency and maintenance road. Existing service or feeder roads on embankments often consist merely of crest pavement. For better market access by the local population, a higher category of road construction is warranted that would allow for future widening to four lanes. Also, subsoil conditions indicate that a wide embankment is needed to avoid geotechnical failure from seepage. The alignment of the reconstructed BRE will therefore allow for future road upgrading according to the Asian highway standard adopted in Bangladesh. Three development stages are envisaged as base case as described below, with alternative construction and operation models to be studied at the beginning of Phase I to identify the best way forward:
  - The 50-km length of embankment constructed in Phase I will be provided with a "service road" on the country-side berm.
  - After completion of the reconstructed embankment, a two-lane highway on the country side will provide local connectivity and also establish an interregional link from the Jamuna Bridge to the new Teesta Bridge near Chilmari, connecting the northern districts of Kurigram and Lalmonirhat. An initial traffic count indicates that this road would be economically feasible as it would shorten the travel distance between Jamuna Bridge and the northwestern districts[8] from about 187 to 150 km. The new road would also cater to diverted traffic from Chilmari port. An origin and destination survey indicates that about 50 percent of the traffic on the existing route is through traffic that would be diverted. Non-through traffic will continue to use the existing route.
  - The highway would start construction shortly after completing the reconstruction of the priority reach and will be opened one year after completion of the Phase II BRE. Various toll road options will be considered, to cover both road and

[8] Gaibandha, Lamonirhat, Thakargaon, Dinajpur, Panchagarh, Nilmaphar.

embankment maintenance - but not the investment cost for the embankment, as indicated by initial estimates.

- Traffic forecasts indicate that after 20 years the increased traffic could justify a four-lane highway for interregional traffic. This highway could be separated from the existing road network and accessible to it at a few locations, but otherwise bridged for uninterrupted interregional communication. Local communication would be provided through an extended network of feeder or service roads, established at that time through the continuous road program of the local government. However, the four-lane highway is not included in the RBIP.

Figure 3.3 shows the preliminary schedule of the detailed planning, design and construction tasks to be carried out under the three phases of the RBIP. The environmental assessment work is not shown, because it will be contracted separately to ensure its independence from the detailed engineering design; however, it will run in parallel to the indicated timeframes for the engineering design and resettlement planning tasks indicated. The environmental management tasks will similarly be carried out in advance of, or in parallel to, the construction work activities indicated.

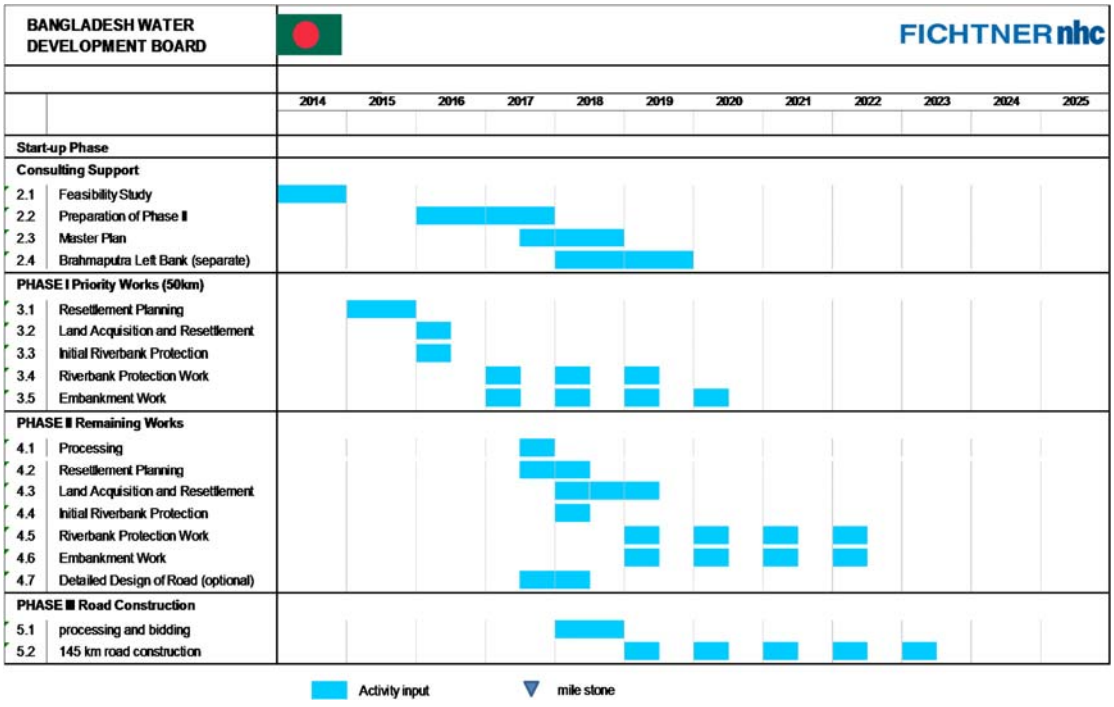


Figure 3.3: Outline of Overall Preliminary RBIP Schedule for Detailed Design, Planning and Construction Tasks

3.3.3. Flood Embankments

The Alignment Planning

The planned change from repeated retirements to a permanent, drivable embankment along stable riverbanks demands higher design standards for the reconstructed BRE. Modern flood embankments that both keep out flood water and provide emergency road access normally have two parts: (i) a higher, riverside part for flood resistance, including an impermeable cover layer, wave protection, and freeboard, and (ii) a lower country-side part incorporating a road and designed to reduce seepage through the embankment body or the underlying subsoil. In Bangladesh, both original BRE and reconstructed sections

have similar profiles, with the country-side berm having been used as a bullock-cart trail until the mid-1980s. As of 2014 this berm was mostly occupied by squatters.

The proposed reconstructed BRE alignment has been selected on the basis of a multi-criteria assessment of alternative solutions, following a seven-step process that covers both technical and non-technical aspects (Figure 4-1 of the Feasibility report). Technical criteria came first: a safe setback distance and a cross-section suitable for all expected loads, followed by design speed and environmental requirements and optimizing protection to the local population while minimizing land acquisition and resettlement impacts. The high number of squatters on the existing embankment required additional land for resettlement villages and in many cases led to an alignment parallel to the existing embankment and bypassing dense settlements, which gained widespread approval from the local population. Final adjustments were made in the field, bypassing locally important sites.

The final alignment of the embankment has been setback from the riverbank at a safe distance of minimum 100m to account for local bank failure but aligned as closely as possible to the riverbank to provide maximum protection. The length and land acquisition requirements are provided in **Table 3.3**.

Table 3.3: Key Parameters of the BRE

	Phase II Jamuna Bridge to Simla	Phase I Simla to Hasnapara	Phase II Hasnapara to Teesta	Total Jamuna Bridge to Teesta
Length				
Existing BRE	20	53	74	147
New BRE	17	50	70	137
Footprint				
New BRE	110ha	340ha	435ha	885ha
Already acquired	10ha	50ha	100ha	160ha

Figure 3.4 explains a number of alignment issues on one example of the detailed program maps, with the explanations given in **Table 3.4** below.

Table 3.4: Explanations of Map in Figure 3.4

Number	Description
1	New embankment alignment with widening in places for road intersections
2	Existing embankment (green line) situated close to the eroding riverbank.
3	Eroded land between 2013 (date of satellite picture) and early 2014 (orange bankline)
4	Predicted erosion line based on CEGIS 2014 erosion prediction (dashed black line)
5	Minimal alternative (yellow line) following the existing embankment and being widened to the river side.
6	New embankment aligned over an attached char (to protect a small piece of land that has recently been reclaimed under BWDB intervention described earlier in **Section 3.3.2**)
7	The planned riverbank protection in light blue to protect the recently reclaimed land mentioned above.
8	Hard point proposed by FAP 1 in the early 1990s following the then bankline.
9	Destroyed riverbank protection built in the early 2000s (dashed yellow line)
10	Homesteads on the floodplain

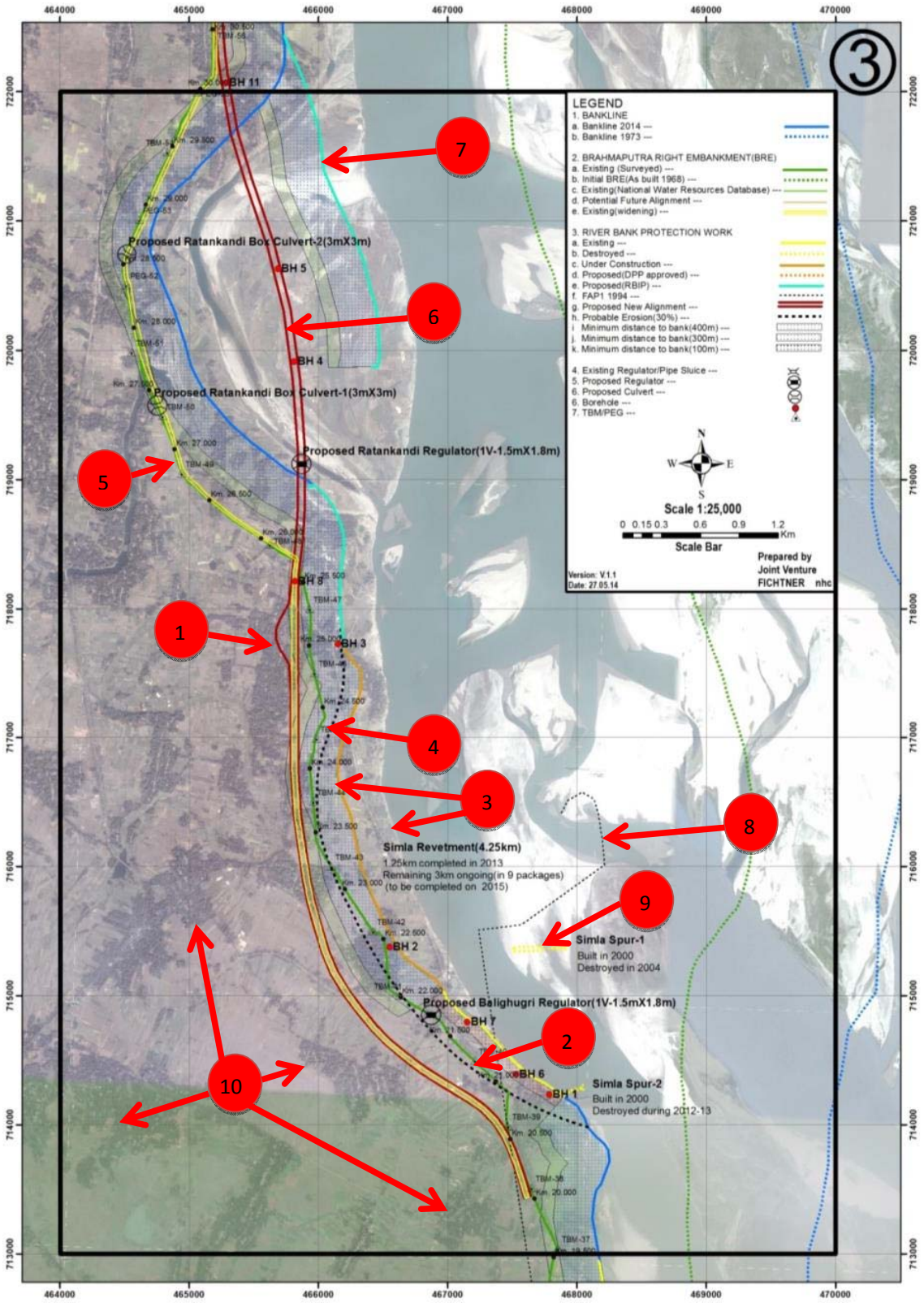


Figure 3.4: Detailed Map (see Explanations in Table 3.4)

Embankment Design

The proposed new embankment incorporates the following design features (more details are provided in the Feasibility report):

- The crest level will be raised to the 100-year flood level including climate change addition for 30 years plus 1.5 m freeboard.
- Along around 40 percent of the length of the reconstructed BRE in the priority reach, an impermeable membrane will be placed to separate subsoil and embankment body (as the cohesive topsoil layer is insufficiently thick).
- The new embankment is designed for load combinations including earthquake, rapid drawdown, and seepage. Seepage control requires a wide embankment body and two separate drainage systems to drain seepage and rainwater. The drainage system and outlet structure are designed to prevent entry of rodents and facilitate regular flushing.
- The core of the embankment will consist of dredged sand, to avoid additional borrow pits on the densely populated floodplain. Surficial cladding will use selected cohesive soil from the toe excavation and the existing embankment line, which will be cut along about 40 percent of the length of the new alignment.
- Both toe lines will be protected from encroachment by placing open cell pavers along the river side and planting trees on the country side, so that farmers cannot plough into the protective clay layer.
- The crest of the embankment will be covered with open cell pavers to allow vegetation growth, fix the crest level, and discourage through traffic.
- A countryside berm will initially accommodate a two-lane service road for emergency and local access, connected in eight places to the local road network. In other places crossings will allow the local population to access the river. The unoccupied part of the berm will have suitable vegetation coverage to discourage unauthorized settlement.

The standard design water level for the main rivers in Bangladesh has a 100-year return period. Climate change predictions indicate a slight increase in water levels such that 30 years into the future, the 100-year level will correspond to the present 200-year level. Morphological modeling, used to evaluate the water levels associated with a future 100-year discharge, indicate that water levels higher than indicated by statistical analysis should be used - specifically to account for a future protected riverbank. A comparison of water levels for key locations is provided in **Table 3.5**. Finally, a freeboard of 1.5 m will be added to the new design water level to account uncertainty in flood statistics, wave run-up, morphological changes, local settlements or subsidence etc. In terms of statistics, the 500-year flood level is estimated to be 0.5 m above the design flood level (DFL), which would still be below the crest of the embankment. The safety of the embankment against failure from overtopping, either from waves or extreme peak flows, is further increased by the wide paved road on the country side, which protects against retrogressive failure and sudden breach.

Table 3.5: Comparison of Design Water Levels and Embankment Crest Levels

Location	Existing 100-year DFL [m+PWD]	Existing crest level [m+PWD]	RBIP 100-yearDFL [m+PWD]	RBIP crest level [m+PWD]
Jamuna Bridge, West Guide Bund Northing: 699500	15.00	16.50	15.27	16.77
Sirajganj Town Protection Northing: southern end 704500 Northing: northern end 707000	15.75	16.75	15.79	17.29
Sariakandi (Kalitola) Northing: 752800	19.77	20.85	20.25	21.75
Kamarjani Northing:804000	22.90	23.50	NA	NA

The constructed embankment will also have the following features:

- The height in the priority will range from 2.6 to 9 m.
- The footprint will range from 40 to 90 m, mostly from 60 to 70m;
- The setback distance from the river will range from 100 to 700m, with 50 percent of the length less than 400 m. The minimum distance of 100 m has been selected for geotechnical reasons: in case the riverbank fails locally, the failure boundary needs to be far enough from the embankment to avoid compromising the flood protection and road.
- The cross-section will be uniform. Old embankments will be cut off and any suitable material will be used as cladding.
- The country-side slope allows for future super-elevation of a four-lane highway.

The alignment of the new road has been fixed for the priority reach, with construction expected to start at the end of 2015. The alignment along the remaining lengths, while fixed tentatively for budgeting purposes, is subject to uncertainties over the future course of action – whether to follow the existing bank or to reclaim lost floodplain land.

3.3.4. Service Road

The reconstructed BRE will be provided with a road (under Phase III) for four main purposes: (i) reliable road access facilitates emergency response; (ii) regional connectivity of the local population provides additional development impetus and helps fighting poverty, (iii) the northern districts of Kurigram including border posts to Assam, India profit from enhanced interregional connectivity to and from Dhaka, and (iv) potentially an alternate route for connectivity of the South Asian Sub-regional Economic Cooperation (SASEC).

Based on future traffic forecasts and the geotechnical need for a wider embankment, the proposed embankment cross-section along the 50km priority reach allows for a future four-lane highway, reducing the need for future land acquisition. The typical cross section is between 60 and 70m wide including a 2.5m wide strip between land acquisition boundary and embankment toe line as buffer. The countryside toe has been established

based on a four-lane highway layout with super-elevation, in order to avoid later additional land acquisition. About 90 percent of the land for the reconstructed embankment in the priority reach needs to be acquired, as the existing embankment is mostly within an unsafe distance to the riverbank.

The priority reach will be provided with a service road to facilitate the movement of construction vehicles, BWDB inspection teams, slow moving traffic, and maintain largely non-motorized connectivity to the local population. The sand for the embankment construction requires stockpiling at dedicated areas. During construction the sand is transported, spread and compacted along the long linear alignment. The service road facilitates this transport, accelerates construction progress, and reduces the need for a large number of intermediate stockpiles. The service road will consist of a two-lane, 6.2m wide road of 200mm crushed bricks (water-bound macadam) on 300mm sub-base with uniform side slope towards the countryside for improved drainage. The alignment follows the centerline of a future 7.3m wide two-lane highway with 2m wide shoulders. The unused part between service road and toe drain alongside the embankment crest will be planted with shrubs and trees to discourage settlement. **Figure 3.5** shows the cross section of the service road and the potential two-lane highway.

Twenty crossings of different types will connect the service road with the local road network and permit the local population to cross the embankment. Eight large crossings connect the embankment to the network of paved roads. Four T-junctions connect roads from the countryside and four elevated intersections pass over the embankment. Twelve small crossings with limited works, also termed "community infrastructure", connect local roads, parts of the existing embankment, but also individual settlements to the new embankment wherever required to maintain and improve the connectivity. These crossings do not allow large motorized vehicle access.

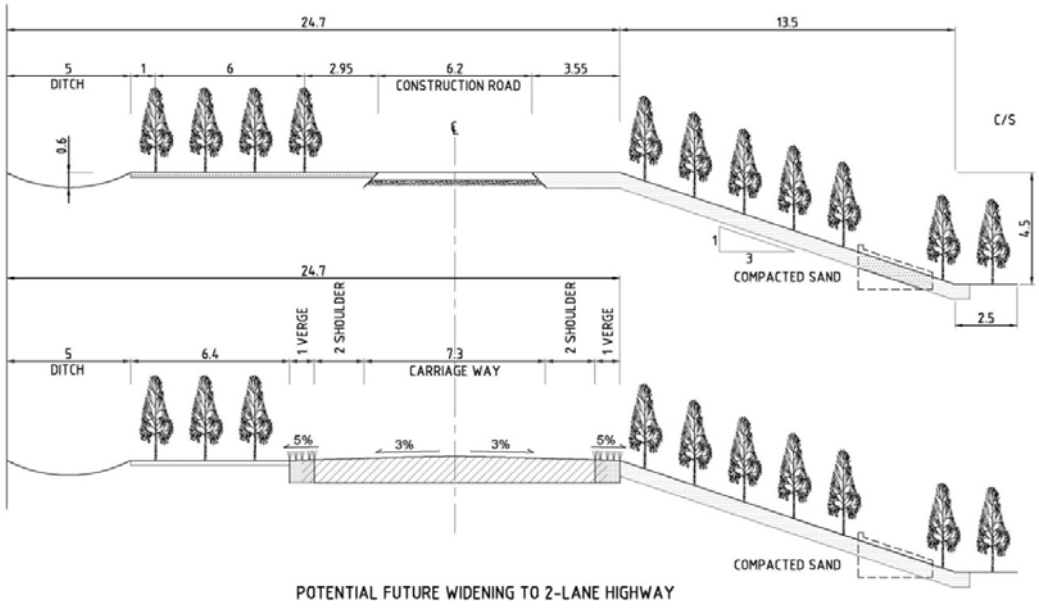


Figure 3.5: Two Lane Service Road following Alignment of Future Two-lane Highway

3.3.5. Regulators and Fish Passes

The reconstructed embankment will enhance the environment through a number of regulators and fish passes. The existing embankment, especially in the priority reach hermetically seals the floodplain from the flood flows carrying fertile sediment and fish. Water passage is important for a number of reasons:

- Recharging the groundwater: the passage of floodwater through dedicated khals contributes largely to groundwater recharge. As opposed to the impermeable floodplain, small rivulets, locally called khals contribute largely to the ground water recharge, as they penetrate through the surficial clay layer into the porous underlying sand strata. Closing passage ways through embankments leads to the degradation of the khals and reduced infiltration. This does not only negatively impact on wetlands but also the groundwater table used for local irrigation.
- Supplementary irrigation: Regulators or fish passes allow substitution of low rainfall through flood flows and therefore provide supplementary irrigation. Regulators are commonly opened during normal flood seasons to provide additional water to the rice cultivation but also to entrain some of the fertile silt and clay. Regulators are effective for water levels above flood level in order to inundate the rice fields.
- Fish migration: It is widely recognized that further enhanced agriculture and fish productivity depends on a mix of rice and fish culture. Fish also provides an important part of the protein intake of poor people. Increased fish production requires the passage of fish eggs, fingerlings, and fry from river to the floodplain during the period April to June and the return of adult fish after the monsoon in October. It is important to recognize that eggs and fingerlings drift with the flowing water and cannot swim, while fish fry can move on its own. Fish passes are designed to be effective for water levels typically 2m below flood plain level to allow fish migration through khals starting from May.

Figure 3.6 presents an engineering drawing of the fish pass that has been designed for the Phase I of the RBIP in line with requirements briefly described above.

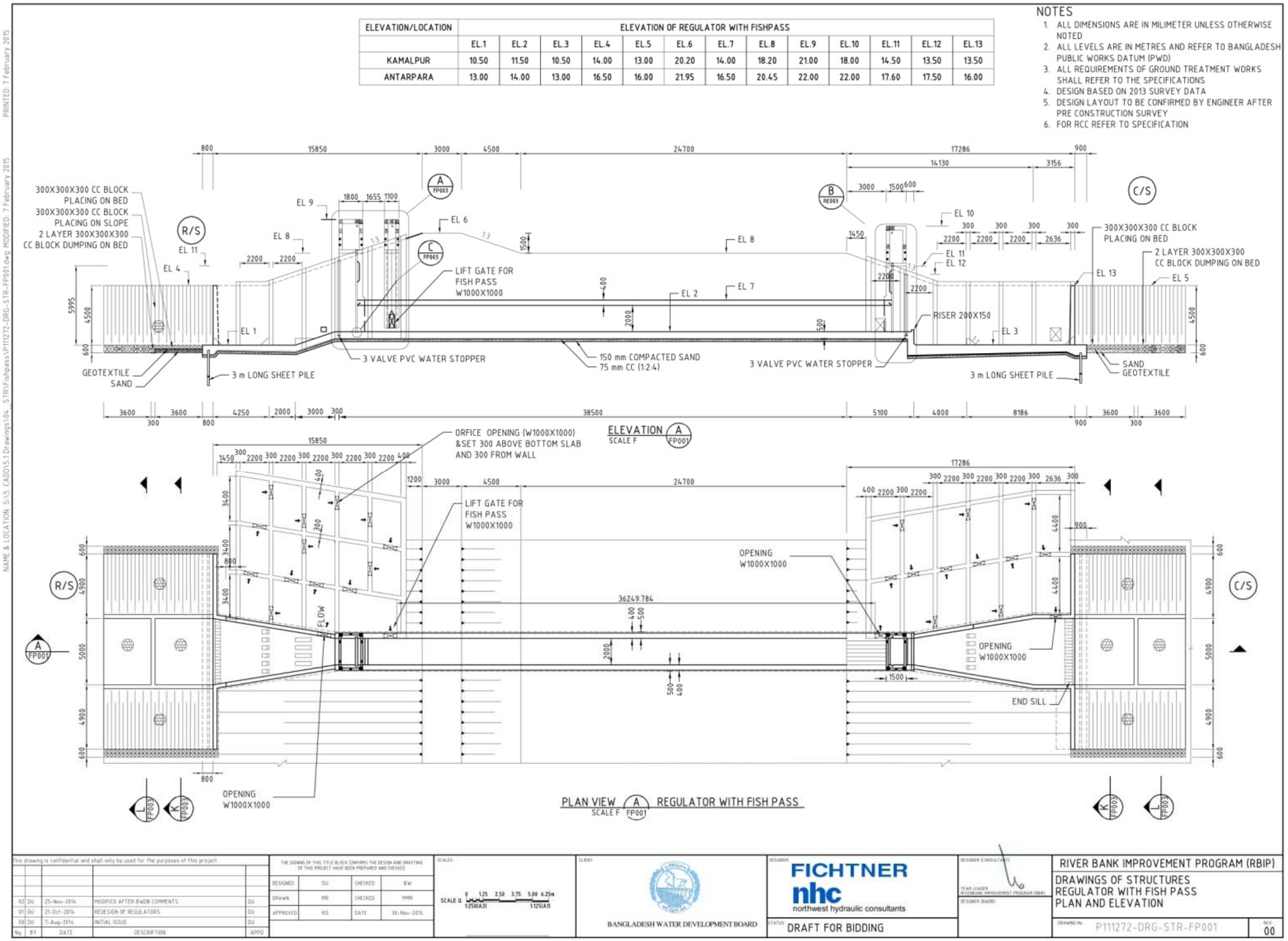


Figure 3.6: Regulator with Fish Pass

3.3.6. Riverbank Protection

Of a range of options for protecting the riverbank, guiding revetments incorporating sand-filled geo-textile bags (geo-bags) are the preferred solution for the high-energy main channel that is presently eroding the right bank in the priority reach and the downstream area to the Jamuna Bridge. The selection process, including designs for alternative solutions and cost estimates, is summarized in Annex A of the Feasibility report, River Engineering Feasibility Designs. The selection of revetments is based on three key considerations:

- Protection of Infrastructure alongside the riverbank: A main purpose of riverbank protection is to assure the integrity of the BRE and other infrastructure alongside the riverbank. Consistent protection is best provided by continuous revetments. To provide equivalent protection, intermittent works such as "hard points" or spurs require greater embankment setback distances with additional riverbank erosion and more displacement of the local population.
- Avoidance of erosion caused by the protection works themselves: Numerical modeling indicates that a frequent cause of failure is outflanking by the river at the curved upstream end of protection works. Short works such as hard points or spurs tend to cause rapid, deep scouring during initial river attack, which worsens over time due to increasing protrusion into the flow as outflanking proceeds. Long guiding revetments produce less severe flow disturbances and typically only about half the total scoured depth resulting from short protrusions.
- Stability of Cover Layers: It is difficult to protect the upstream curvature of hard points or the head of spurs from failure under the high shear stresses of accelerating flow in these locations. Computational fluid dynamics with turbulence modeling of cover layers, in combination with recent turbulence theory, demonstrates that the common apron system of relying on single-layer rock or concrete block aprons must fail, and that in the absence of filters, many layers of rock are required to prevent wash-out of the underlying fine soil. Flexible geo-bags incorporate filter properties perform better as they leave much less gaps through which the subsoil can be eroded.

Guiding revetments have proven sustainable since their first use in 1998 at Sirajganj, especially after the upstream termination was strengthened with a wide apron of geo-textile bags. Subsequently the BWDB placed nearly 30 km of geo-textile bag revetments systematically on underwater slopes between 2004 and 2011. Another 40 km or so were placed using a simpler construction method. In the design of the river training works for Padma Bridge from 2009 to 2011, geo-bag revetment design was developed further: in the immediate vicinity of the bridge the geo-bags were to be covered with a multiple rock layer to increase longevity and robustness, while in upstream areas thicker geo-bag revetments without rock cover were proposed. In the present RBIP case, however, the largely agricultural areas to be protected do not warrant the high cost of rock cover, which would require rock to be imported and paid for in foreign currency. Therefore, as in the upstream areas of Sirajganj Town Protection and Padma Bridge, multiple layers of heavy, filter-tight geo-bags are proposed.

Along the 145 km length of the BRE approximately 55 km of riverbank protection will be required, of which approximately 25 km will be in the priority reach – the remaining part of the riverbank either does not need protection or has already been protected through earlier works. This includes rehabilitation of approximately 15 km of existing protection,

of which 10 km is in the priority reach. **Figure 3.7** shows the proposed locations of riverbank protection.

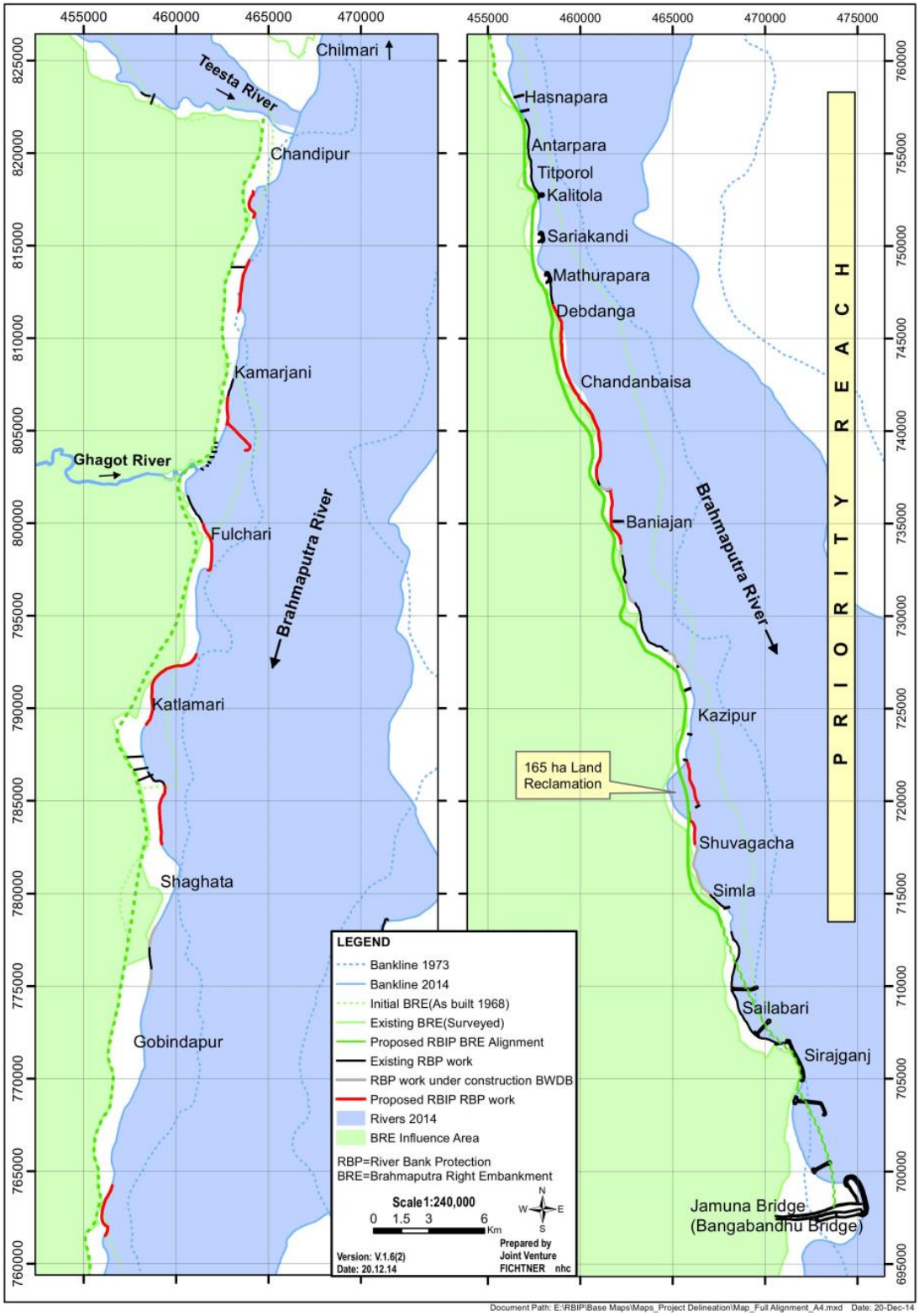


Figure 3.7: Estimated Riverbank Protection in Program Influence Area

Given the uncertainties associated with future river plan forms, the priority works have a higher level of confidence, as construction is expected to start during the dry season 2015/16. The remaining works, estimated to start three or four years after commencement of Phase I, will be subject to changes associated with (i) river channel shifts, and (ii) consideration of an approach more oriented to river training.

Besides having the best performance record, long guiding geo-bag revetments also reduce impacts on channel and char patterns, since they do not protrude into the flow or deflect the channel into char areas, but rather have a stabilizing influence on the near-bank channel. Unprotected riverbanks tend to show an alternating pattern of erosion and deposition, leading to a meandering planform where the near-bank channel is sometimes deflected into the central part of the river. Long guiding revetments prevent this and result in a channel flowing parallel to the riverbank, with indirect stabilization of the adjacent river islands. Also, the low water channel alongside long revetments tends to be slightly deeper than the natural channel, which assists inland navigation[9].

Construction of riverbank protection involves the following three components, from floodplain level to deepest bed level (**Figure 3.8**):

- Wave protection built above low water level, consisting of concrete blocks placed on a geo-textile filter layer.
- Underwater slope protection consisting of three layers of sand-filled geo-bags large enough to be stable under design flow velocities, and providing a tight cover layer including filter properties.
- Toe aprons consisting of multiple layers of geo-bags for self-launching in case of scour.

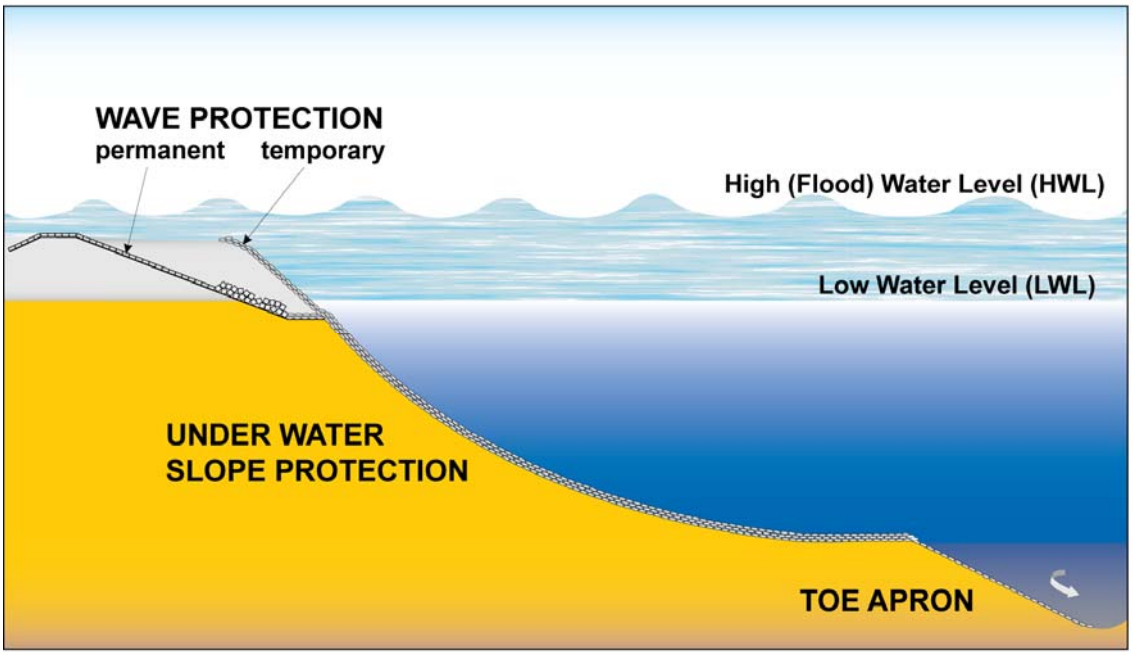


Figure 3.8: The three elements of riverbank protection

[9] After constructing the 10 km long revetment upstream of the Hurasagar, the dredging volume in the downstream channel to the Baghabari port dropped to around 30,000 m³ annually from 100,000 earlier.

The following sections provide details about the work above and below water.

Above water protection

Above-water wave protection covers the zone from 2m below low water and floodplain level and allows access to the water. Concrete blocks with a 40 x 40 cm base over a geo-textile filter are generally used in this zone (**Figure 3.9**). The block thickness is selected to resist maximum flood velocities and lifting forces from wave action and is generally around 20 to 30 cm. Near the floodplain level, alternating rows of thicker and thinner blocks are used to reduce wave run-up. Below low water level, 30 cm concrete cubes are dumped in multiple layers over a geo-textile filter ending on a bench that marks the transition to the underwater slope protection.

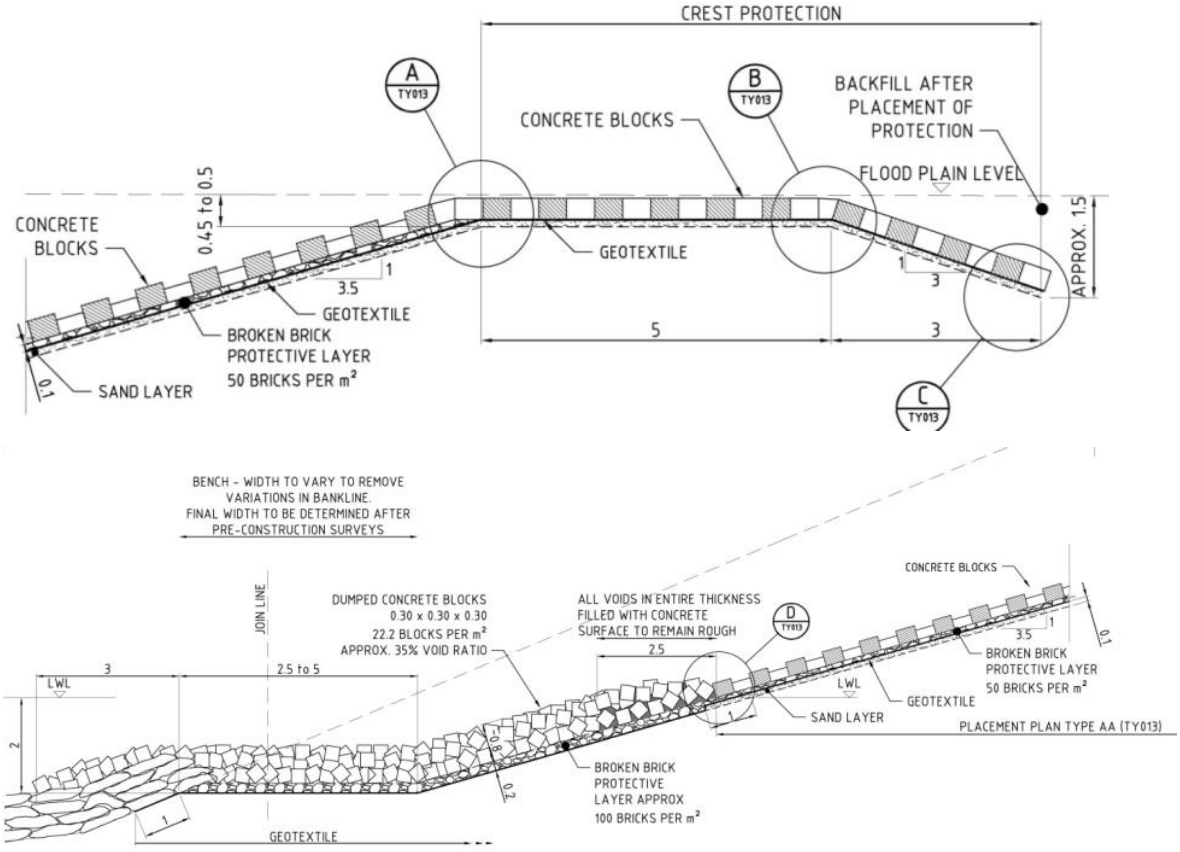


Figure 3.9: Typical cross section of the upper slope treatment

The amount of concrete in the wave protection layer can be reduced if interconnected elements are used. Grout-filled mattresses are a viable alternative, as the grout consists of cement and sand that is available on site. Such mattresses have been built at the Meghna Bridge and downstream of the Hurasagar River. They have the added advantage of reducing construction time, as the grout hardens within hours - in one season many kilometers of revetment can be built, even under water, whereas several seasons are required for concrete blocks. **Table 3.6** compares the two alternatives. The design for the priority works incorporates 3 km of grout-filled mattresses, to verify their applicability to RBIP and to prepare for future larger-scale implementation as proposed for the remaining works.

Table 3.6: Comparison of cover layer alternatives above low water level

	Concrete blocks	Grout filled mattress
Construction	➢ Large casting yards on the floodplain, ➢ added traffic for supplying the materials from far distance, ➢ preparation one year ahead of placement, ➢ sensitive to water level rises ➢ depending on manual labor for transport and placement	➢ Very fast in one season and one construction sequence starting under water and moving up the slope, ➢ Reduced transport of materials as mostly dependent on river sand ➢ Batching plant and transport mixers reduce local labor force
Performance	➢ Robust, proven all over Bangladesh, ➢ Low value and low risk of theft ➢ Risk of damages from anchors	➢ Experience at two locations since the end of the 1990s and 2006 without major issues, ➢ low value and low risk of theft ➢ some types are sensitive to localized damages from anchors

Underwater Slope Protection

Two problems with riverbank protection in Bangladesh are difficult to overcome:

- The highly dynamic river morphology can result in large river changes between the low-flow dry season when construction is feasible and the flood season when it is inhibited by high discharges, velocities, and sediment transport rates.
- Bangladesh has no rock quarries, except for one granite mine that can provide only limited quantities of smaller crushed rock largely unsuitable for riverbank protection.

Given the lack of rock and the good experience with initial geo-bag placements, the selected underwater slope protection design for RBIP consists of four layers of systematically dumped sand-filled geo-bags. Geo-bags of 250 kg weight will be used for standard revetment sections, with greater weights for strengthening of existing protruding structures such as spurs. The bags are placed by systematic dumping from barges precisely positioned in the river, to cover the underwater slope from the inner edge of the apron to the riverbank.

Underwater Toe Protection with Aprons

Riverbank protection in these highly mobile rivers depends on self-launching toe aprons that can respond flexibly to river-bed deepening by scour. The method was developed in the subcontinent in the late 19th century and was first applied to protect the piers of railway bridges against local scour. Due to lack of underwater observations, aprons were wrongly believed to produce multiple-layer coverage after launching, but when they were investigated in physical models after failure of a guide bund at Harding Bridge in the 1930s, it was found that only single-layer coverage resulted. This was confirmed after 2000 by diving observations and physical model tests in The Netherlands, Canada, and Bangladesh associated with the Jamuna Bridge, JMREMP, and Padma Bridge projects.

Recent experience demonstrates that flexible geo-bags incorporating filter properties perform better than hard materials for underwater bank protection in Bangladesh river conditions. Four main milestones in their development were as follows:

- After the 1988 flood, the World Bank-supported Flood Damage Restoration Project placed sand-filled geo-bags of around 900 kg weight as filter material under large concrete blocks for Chandpur Town Projection Works. This installation has performed well to date.
- In 1996, the Flood Action Plan, Component 21, built a revetment test section incorporating sand-filled geo-bags as apron material. This protection still performs well.
- After an upstream failure in 1998, the World Bank-financed Sirajganj Town Protection was repaired with a wide apron consisting of three sizes of sand-filled geo-bags, termed cushions (20 kg), pillows (250 kg), and mattresses (900 kg). Although Sirajganj Town Protection continues to fail along downstream areas protected solely by concrete block or rock aprons, the areas with geo-bag aprons have remained stable. This is one of the most turbulent areas in the Bangladesh rivers, due to prominent protrusion of the upstream corner of the Town Protection.
- In the JMREMP project, falling aprons consisting of multiple layers of geo-bags were placed along 17 km of riverbanks in the lower Jamuna. The observed underwater slopes have inclinations of 1V:2H and are geo-technically stable.

Over the last decade, it has been found that three levels of safety can be achieved with increasingly larger footprints:

- Emergency protection dumped from the riverbank: This is widely applied to provide protection for one flood season. After the first flood it is usually upgraded to the next level.
- Above- and underwater slope protection: The methodology was developed under JMREMP in 2004 and later expanded under the Secondary Town Protection Project. Systematic coverage of the slope, secured by an apron, keeps deep toe scour far enough from the bankline and does not destabilize the slope. More recent studies for Padma Bridge showed that to cope with rare earthquake loading and associated flow slides, the apron needs to be widened to ensure that flat slopes following flow slides do not penetrate into the upper slope.
- Dredged slopes to levels near design scour levels: The highest level of safety can be achieved through flat dredged slopes that are stable when subjected to design earthquakes. However, this expensive work has limited stability because the fine non-cohesive soils of Bangladesh liquefy easily at earthquake intensities corresponding to a 50- to 100-year return period. Nevertheless, these flat man-made slopes provide a higher level of safety than the usual natural slopes of the riverbanks. There seem to be no practical ways to improve the stability of riverbanks subject to increased earthquake loads.

Riverbank protection designs for the RBIP are made with a wide apron to account for larger earthquake and potential flow slides during the lifetime.

3.4. Resources Requirements

3.4.1. Material Requirements and their Sources

The construction materials required for embankment, road, river bank revetment, and other program components will include earth, geo-bags, hard rock, sand, geo-textile, stone-chips, brick chips, asphalt, cement, steel for concrete reinforcement, road furniture,

and other accessories. Some of these materials will be obtained from within the program influence area: sand from the river bank and earth from the existing embankment. Other materials such as cement, steel, and brick chips will be procured from local/national markets, whereas some of the materials such as hard rock and asphalt may have to be imported. See **Table 3.7** for the key construction materials needed for the RBIP. Quantities of these materials will be estimated during the detailed design of the later phases of the Program.

Table 3.7: Construction Materials

	Description	Possible Source
Embankment		
1	Sand	River
2	Clay	Existing land of proposed alignment, old embankment
3	Brick chips	Local supply
4	Concrete blocks	Constructed at site
5	Stone Chips	Local Supply
6	Geo-textile (3mm thick)	Imported/Local Supply
New River bank Protection		
1	CC blocks (Slope protection)	Constructed at site
2	CC blocks (underwater)	Constructed at site
3	Geo-bags (250kg and 800 kg)	Imported/Local Supply
4	Geo-textile	Imported/Local Supply
5	Sand	River
Up grading existing protective work		
1	CC block	Constructed at site
2	Geo-textile (3mm thick)	Imported/Local Supply
3	Sand	Local Supply
Structures		
1	Cement	Local supply
2	Sand	River
3	Stone chips	Local supply
	Steel	Local supply
Road		
1	Sand	River
3	Brick chips	Local supply
4	Stone Chips	Local Supply
5	Cement	Local Supply
6	Asphalt	Imported/Local Supply

3.4.2. Manpower Requirements

During the construction phase, technical and non-technical man power will be required in sizeable numbers. These will include engineers, technicians, supervisors, surveyors, mechanics, foremen, machinery operators, drivers and skilled and unskilled labor**.** Local community will be able to avail some employment opportunities during this phase.

During the O&M phase, the regular staff of the BWDB will carry out the monitoring, repair, and maintenance works.

3.4.3. Construction Machinery

A sizeable number of construction machinery and equipment would be needed for the construction activities of RBIP. A tentative list of these machinery and equipment is presented below **(Table 3.8).**

Table 3.8: List of Construction Equipment and Machinery

1	Bulldozers
2	Dump-trucks
3	Pay loaders
4	Excavators
5	Barges
6	Engine Boats
7	Vibrators
8	Compactors
9	Mixture Machines
10	Mixing Plants
11	Trucks
12	Tractors
13	Generators
14	Total stations
15	De-watering systems
16	Water-pumps including suction pumps

3.4.4. Construction Camps

Construction camps for each construction site are to be established by the contractor. The contractor will select the location of the camp through consultation with the local union

parishad chairman and the local community. Moreover, they will have to obtain permission from the authorized BWDB representative. Tube wells may be installed in the labor camps premises for obtaining water for drinking and other purposes. For sanitation, latrines will be constructed along with septic tanks for safe disposal of sewage.

Location of these camps is not known at this stage however the key criteria to be used while selecting the sites are listed below.

- Community consultations will be carried out to select the camp sites
- Cultivation fields will be avoided as far as possible
- Government-owned lands will be given priority while selecting the camp sites
- If private land is used for camp sites, a fair rent will be paid to the land owner.
- Camps will not be establishes near sensitive receptors such as schools
- Camps will not be established near any sensitive habitat
- Camps will not be established that could affect any *khal*, *beel* or river.
- Camp sites will be approved by construction supervision consultants.

3.5. Operational and Maintenance Requirements

The BWDB receives fund from the government under the annual development program (ADP) for operation and maintenance of its infrastructure under different projects. Records indicate that the BWDB has been receiving on average about 17 percent of the total requirement for O&M, which reveals that the BWDB could not respond to all maintenance needs. For attaining sustainable maintenance of multipurpose project like proposed RBIP, the allocation for O&M in the ADP to be adequate as per actual need or there need to find a way to involve the beneficiaries directly in contributing to O&M. In RBIP, provision for toll collection from the highway can recover a good part of the maintenance cost of the program. It may be noted here that funds available for maintenance are often less than optimal, so it is important to make the best use of available funds and estimates of O&M components should be well supported by appropriate justification.

O&M works of proposed RBIP can be divided into three categories described below.

(a) Routine Maintenance: Routine maintenance includes preventative activities such as repair of small holes and rain cuts in embankments, removal of weeds and sediments from approach canal of regulators, repair of displaced blocks if any in the slope of the bank revetment work, petty repair of the pavement and a forestation of highway. The objective of routine maintenance is to keep overall flood protection system including all its elements in good functional order thereby reducing the need of periodic maintenance eventually avoiding high rehabilitation costs. The works are simple, generally inexpensive and cost effective and may need to be carried out round the year, almost continuously or as and when required.

(b) Periodic Maintenance: This is less frequent than routine maintenance and is likely to include re-sectioning of embankment, re-excavation of approach canal of regulators, rehabilitation of gates and gate lifting devices of regulators, repair of sliding of bank protection work, and maintenance of highway pavement after rainy season. BWDB engineering personnel will identify periodic maintenance works during surveys and inspections or on information from its field staffs.

(c) Emergency Maintenance: This type of maintenance is similar to periodic maintenance, but involves a potentially catastrophic situation that would likely cause significant damage to the infrastructure if not repaired immediately. Emergency maintenance may include breach closure in embankment, repair of major sliding of bank revetment work which if not taken care on emergency basis may cause further damage of the adjacent bank revetment work, arresting of unintentional erosion upstream and downstream of the existing bank revetment work, and repair of loose apron of the regulators. A component of the BWDB O&M budget should be set aside for natural or human caused calamities. Necessary funding and authorization to execute emergency maintenance should be readily available whenever required.

3.5.1. O&M Requirement of Bank protection structures

Bank revetment work is a major component of the program. The life and security of the program largely depend on the performance of the erosion protection works. It has been observed that inadequate monitoring of the completed work and lack of proper O&M activities due to limited funding provisions cause greater damage to the bank protection. Hence regular monitoring and proper O&M activities of bank protection work must be ensured to keep the project functional. O&M of new river bank protection as well as upgrading existing protection will be required to keep the work sustainable. Based on the Flood Plan Coordination Organization (FPCO) guidelines of May 1992, annual O&M cost for the proposed river bank protection should be around ten percent of the capital cost.

3.5.2. O&M Requirements of Embankment cum Road

Maintenance of embankment cum road is another most important item of activities of the program. It is necessary and cannot be avoided because it helps preserving the infrastructure in good and functional condition, protects investments and prevents high rehabilitation costs. BWDB O&M staffs will regularly visit the embankment cum road and detect the weak sections, gullies, slips, sign of squatter settlements, cultivation of perennial cash crops, cuts in the embankments to accommodate homesteads, embankment subsidence and erosion and requirement of repair maintenance work in the road pavement etc. Based on the above observations O&M estimate will be prepared for execution. As per FPCO guidelines the annual O&M cost of this component is five to six percent of the capital cost.

3.5.3. O&M Requirements of Regulators

The proposed regulators would be subjected to variable flows, the most severe of which are likely to occur during high Jamuna stages. Therefore, it is essential that regular inspections take place, so that any damage or any irregularities will be noticed within reasonable time. Measures for rectification can then be taken, so that the damage will be contained. FPCO guidelines suggest to keep three percent of the capital cost as annual O&M cost for this component.

3.6. Program Costs

Initial cost estimates of the RBIP, Phase I are presented in **Tables 3.9**. Cost estimates for the later phases will be estimated during the detailed design.

Table 3.9: Initial Cost Estimates of RBIP Phase I (in USD)

Program Cost by Component and Subcomponent			Total (US$ m)
Component A: Rehabilitation and Improvement of Brahmaputra River Embankment Scheme			375
	(1)	Embankment Rehabilitation and Improvement	105
	(2)	Bank Protection and Revetment	270
Component B: Implementation of Social and Environmental Management Plans			135
	(1)	Social and Resettlement Management Plan	120
	(2)	Environmental Management Plan	15
Component C: Institutional , Capacity Building of BWDB, Technical Assistance and Training and Future Project Preparation and Strategic Studies			20
	(1)	Strengthening of BWDB, Independent Panel of Experts and Technical Assistance	15
	(3)	Future Project Preparation and Strategic Studies	5
Component D: Construction Supervision, Monitoring and Evaluation of the Program Impacts and Social and Environmental Management Plan			50
	(1)	Construction Supervision and Implementation Support	25
	(2)	Third Party Monitoring and Evaluation of Program, and Supervision of EMP, SAP, RAP	5
	(3)	Program Management Support and Audit	20
Total Program Cost			**580**

4. Analysis of Alternatives

Various alternatives have been considered in siting and design of the program components. All these alternatives are evaluated considering social and environmental aspects as well as technical and financial aspects. The criteria considered for comparative evaluation of various alternatives is given in **Table 4.1**.

Table 4.1: Criteria for evaluation of alternatives

Main Criteria	Sub Criteria
Technical Aspects	• Robustness, • constructability, • geology, • degree of protection, • scour, • maintenance requirements, • history of performance, etc.
Financial Aspects	• Construction cost and • maintenance cost
Environmental Aspects	• Program footprints, • material requirements, • impact on river flows and channels, • impact on flood plains and erosion, • impact on chars, • impact on left bank, • impact on aquatic and terrestrial habitats, • impact on fish and fish migration • safety, etc.
Social Aspects	• Land acquisition, • Resettlement • Impacts on navigation • Impacts on char people • Socioeconomic impacts

In addition to the 'no project' alternative, the following alternatives are evaluated for RBIP using the criteria presented in **Table 4.1**:

- River Bank Protection Alternatives
- Embankment and Road Alternatives
- Regulator Alternatives
- Resettlement Sites Alternatives

4.1. No Project Alternative

The 'no-project' alternative is likely to result in continuation of the losses summarized in the sections below. Based upon these projected losses, it can be concluded that the 'no-project' alternative is not a preferable option.

4.1.1. Damages from Jamuna Right Bank Erosion

Annual damages from Jamuna right bank erosion and cost of these damages are summarized as follows:

- About 200 ha of land, including about 104 ha of agriculture land, will be lost annually to the river and total value of these land lost is estimated to be about BDT 1.18 billion (US$ 15.1 million). The affected land also includes about 22 ha of water bodies that provide habitat for floodplain aquatic species and spawning grounds for migratory fish species.
- About 1,105 residential structures (93.5 percent structures are adobe/mud walled) will be lost annually to the river and total value of these structures is estimated to be about BDT 0.15 billion (US$ 1.9 million). The relocation cost of the households is estimated to be about BDT 16.6 million (US$0.20 million).
- About 5.7 non-residential structures such as schools and shops will be lost annually to the river and total value of these structures is estimated to be about BDT 9.8 million (US$ 0.13 million).

4.1.2. Damages from Breach of BRE

Breaches of the embankment cause flooding of the floodplains damaging the standing Aman paddy, livestock, houses, and other social and physical infrastructure, and livelihood of the local communities. Historical data on annual flood damages of last 27 years was collected from local government offices and a summary of extent of these damages are presented below. It can be expected that without the project scenario, the extent of damages will be similar in future.

- About 7,000 ha of Aman paddy (main crop in flood season) is completely damaged and about 4,900 ha are partially damaged annually. Total average annual value of damaged crop is estimated to about BDT 669 million, (US$8.6 million).
- About 396 animals are lost each year and value of these animals estimated to be about BDT 4 million (US$ $50,000).
- About 51,735 houses are damaged each year. About 80 percent of these houses are semi-permanent structures that are partially damaged and remaining 20 percent are temporary structures that are fully damaged. Value of these damages on structures is estimated to be about BDT 7.2 billion (US $113 million). In addition the values of moveable assets (furniture, appliances, food, etc.) that are damaged with the houses are estimated to be about BDT 1.47 billion (US $18 million).
- About 130 km of paved road, and 148 km of unpaved road would be damaged each year if there is no project. Similarly, on an average each year about 9.3 bridges and culverts will be fully damaged, while 6.3 bridges and culverts will be partially damaged. Without the project the anticipated average annual loss will be about BDT 1.5 billion (US$19.5 million).

4.2. Alternatives for River Bank Protection

The concept of providing systematic protection started with the development of “hard points” in the early 1990s as part of the Flood Action Plan, Component 1 (FAP1). With the exception of construction at two locations, the technically demanding and expensive FAP1 strategy was not implemented by BWDB and alternative strategies were developed.

As an alternative, the BWDB developed and implemented lower cost "groynes**"** from the end of the 1990s until the mid-2000s. While these were initially successful, eventually most of these groynes failed due to increasing protrusion and river attack. After repeated failures, BWDB gradually abandoned these groynes. From the early 2000s BWDB pilot-tested and implemented low-cost "revetment" based on earlier FAP1 and FAP21 technologies. The technology was incorporated into the Guidelines for Riverbank Protection 2010, and is the most inexpensive and sustainable one. It has proven stable along 17km of riverbanks in the Brahmaputra/Jamuna. These long-guiding revetments are systematically replacing the other options when those fail. These three options are considered for analysis of alternatives. In addition, one more alternative of building revetments in to the river is also considered. The guideline of the comparative analysis is proposed in **Table 4.2**.

Table 4.2: Analysis of River Bank Protection Alternatives

	Option 1 **Hard Points**	**Option 2** **Revetment at Riverbank**	**Option 3** **Revetment in the River**	**Option 4** **Groynes**
Technical Aspects				
Degree of protection	Limited protection Partial protection with erosion between hard points, specifically under angular attack	Consistent protection Revetments will not cover all of the riverbank leaving some areas in natural conditions, downstream of convex curvatures, which are naturally protected	Full protection Complete coverage of the sensitive fill built into the main channel	Limited protection Similar to Option 1
Constructability	Medium complexity Dredging requirement for termination points, cross bar located on floodplain	Low complexity Simple construction along the existing riverbank, making use of proven technologies	High complexity Massive dredging and fill operation followed by challenging compaction under water and dredging of flat riverbanks for slope protection. Revetment construction similar to Option 3	Medium complexity Same as option 1
Robustness	Low Deep scouring and high turbulence are the main reasons for failure of riverbank protection	High Long guiding revetments are associated with minor scouring and smooth parallel flow	High Long guiding revetments are associated with minor scouring and smooth parallel flow	Low
Scour	High	Low	Low	High
Loading	High	Low	Low	Medium

	Option 1 Hard Points	Option 2 Revetment at Riverbank	Option 3 Revetment in the River	Option 4 Groynes
	High localized increase in flow velocities and turbulence, deep, fast scouring	Small increase in flow velocities, scour depth half of the scour of hard points	Small increase in flow velocities, scour depth half of the scour of hard points	
Maintenance requirements	High The design and function and hard points inherently create severe hydraulic conditions that the structure must accommodate. On this basis, hard points are subject to more risk, which is reflected by higher maintenance and emergency repair costs.	Low	Low	High Similar to hard points. In some cases, maintenance costs of groynes and hard points can equal or exceeded the original construction costs
History of performance along Jamuna	Repeated failures The hard point structures experienced considerable damage due to repeated undermining by scour. The main problems were associated with the deep scour at the upstream end due to outflanking and geotechnical stability problems associated with the dependency on launching aprons on curved slopes.	No failures	No experience	Repeated failures Problems are similar to hard points
Financial Aspects				
Construction cost (without cost of land acquisition)	Medium	Low	High	Medium
Maintenance cost	High 2 to 10% of construction cost	Low 0.4% of construction cost	High 2 to 10% of construction cost	High 2 to 10% of construction cost

	Option 1 Hard Points	Option 2 Revetment at Riverbank	Option 3 Revetment in the River	Option 4 Groynes
Environmental Aspects during Construction				
Program Footprints	High Footprints are higher compared to other options due to higher crest elevations	Low Lower footprints compared to other options. Crest level of revetment is equal to floodplain level	High Higher footprints due to new construction	Higher Footprints are similar to hard rock due to similar crest level and apron size.
Impact on Chars during construction	Medium While the initial construction along the riverbank does not impact on the river, later erosion between the hard points leads to a marginal increase in chars and shoals	Low The continuous revetment does not add or reduce the space for the river. However, the revetment attracts flow and leads to a stable channel along the riverbank and stabilizes the char and shoal pattern opposite to the bank.	High The construction into the river reduces the overall area for chars. After construction the effects are similar to Option 2.	High The construction into the river reduces the overall area for chars.
Material requirements	High The crest of the hard point is about 5 m higher than the guiding revetment, which adds considerably to the material requirements compared to the guiding revetment	Low Low material requirements compared to other options. Material from the existing embankment can be used for construction of new embankment	High Higher material requirements due to new construction of entire embankment and also requirement of huge dredging (42 million cubic meters) for filling of associated new embankment	High Similar to hard points
Impact on aquatic habitat	Limited impacts Some benthic fauna may be impacted during construction	Limited impacts Some benthic fauna may be impacted during revetment installation.	Significant impacts on aquatic fauna are likely because of works inside the river	Medium impacts on aquatic fauna are likely because of works inside the river
Environmental Aspects during O&M				
Impact on right bank	High Huge area on right bank would be eroded, at locations where there is no existing protection due to embayment between the hard points.	Low No impact on the right bank	Low No further erosion of river bank. Some additional land will in fact become available because of the riverbed reclamation	High Huge area of right bank land will be eroded where there is no protection works due to erosion between groynes
Changes in char patterns	Low The hard points do	Medium The char pattern	High The char area is	Low

	Option 1 Hard Points	Option 2 Revetment at Riverbank	Option 3 Revetment in the River	Option 4 Groynes
	not impact on the char pattern	gets more stabilized which might lead to higher land use and reduced area for wildlife	reduced due to the increase in land along the riverbank and based on the need to dredge sand from the chars for filling the area alongside the riverbank	
Changes to river channels	Low The increasing protrusion of the hard points leads to a more pronounced "meandering" channel pattern	Low The continuous protection straightens the channels along the riverbanks	Medium After pushing the main channel into the river the result is similar to Option 2	Low
Changes to river flow patterns	High Turbulence and flow velocities increase with increasing protrusion	Low A slight increase due to the smoother protected bank is compensated by a reduction due to a more stable larger channel	Low Same as Option 2	High Same as hard points
Changes in river depth	Low Apart from localized scour holes no fundamental change	Medium The channel along the bankline will be deeper overall than unprotected channels.	Medium Similar to Option 2	Low Similar to hard points
Changes in flow velocities	High 5.8 m/s Turbulence and flow velocities increase with increasing protrusion	Low 3.7 m/s No significant change	Low Same to Option 2	High 5.8m/s Similar to Option 1
Impact on aquatic habitat	High Changes in flow patterns, velocities and scouring will have an impact on the aquatic habitat along the hard point	Low Revetment works may provide good habitat conditions for fish due to regulation of channel flows. Geo-bags and concrete blocks may also provide suitable habitat conditions for benthic fauna	Low Similar to Option 2	High Similar to Option 1
Social Aspects				

	Option 1 **Hard Points**	**Option 2** **Revetment at Riverbank**	**Option 3** **Revetment in the River**	**Option 4** **Groynes**
Land acquisition	Medium Land acquisition on floodplains is required in addition to land along the bankline. While the land for revetments is low value and located along the low water line, hard points make use of higher value land on the floodplain for the connection with the existing embankment line.	High While no land required on the floodplain longer reaches along the riverbank where land has little economic value	Low No floodplain land required	Medium Similar option 1
Resettlement	Medium On floodplain and to be considered for known erosion between hard points	Medium The high risk area along the existing bankline is sparsely populated, often mainly by squatters	Low No resettlement	Low
River access	Medium Not good at eroding banks between hard points but easy at the hard points	High The river is easily accessible over the mildly sloping revetment	High Same as Option 2	
Protection from future erosion	Medium The limited protection and known outflanking lead to additional erosion of land between the hard points.	High Consistent protection along the riverbank	High Same as Option 2	Medium Same as Option 1
Protection of the embankment	Medium The limited protection entails the risk of outflanking and erosion of the embankment	High Safety margin to the embankment on consolidated floodplain reduces the risk of embankment erosion	Medium The new fill is susceptible to liquefaction under earthquake which leads to an increased risk of embankment failure	Medium Same as Option 1
Changes to navigation	Low The turbulent flow around increasingly exposed protrusions does not improve	High The smooth parallel flow along a pronounced channel encouraged by the revetment	High Same as Option 2	

	Option 1 Hard Points	Option 2 Revetment at Riverbank	Option 3 Revetment in the River	Option 4 Groynes
	navigation conditions	improves navigation.		
Displacement of char people	Low Construction along the riverbank and future outflanking lead to potentially slightly increased char area	Low The revetment does not impact on the char area	Medium The reclamation of riverbank goes at the cost of char area.	
Conclusion	Not recommended Not a preferred option because of technical difficulties, high environmental impacts and also high initial as well as recurring costs compared to other options.	**Recommended** Preferred option because of lower costs, limited environmental impacts, and substantial social benefits.	Not recommended Not a preferred option because of high costs, technical difficulties, and significant environmental impacts.	Not recommended Same as Option 1.

4.3. Embankment and Road Options

BWDB is mandated to build roads on flood embankments. It is common, world-wide practice to provide emergency access alongside flood embankments in order to provide better access to the area during emergencies. The embankment built under this program will have provision of a higher standard than the emergency roads alongside flood embankments due to its use for regional and inter-regional connectivity. Currently, annual repair maintenance allocation of the BRE is insufficient even to attend regular maintenance work. If the proposed road would be a toll road, then there will be a scope for revenue generation, which can be used for future maintenance of the program.

Table 4.3: Analysis of Embankment and Road Alternatives

	Option 1 Widening existing embankment	Option 2 Reconstructed embankment, 2-lane road	Option 3 Reconstructed embankment, 4-lane road	Option 4 Reconstructed embankment, 4 lane road in river
Technical Aspects				
Degree of protection	Low Does not provide full seepage safety and is not stable for typical loading combinations	High Fully complies with stability requirements	High Same as Option 2	Medium construction on recent fill is associated with higher seepage and liquefaction risk than old consolidated floodplain
Mobility within the local area	Medium Local connection over the	High Good local connection	Medium Dedicated road with limited	Medium Similar to Option 3

	Option 1 Widening existing embankment	Option 2 Reconstructed embankment, 2-lane road	Option 3 Reconstructed embankment, 4-lane road	Option 4 Reconstructed embankment, 4 lane road in river
	embankment crest		number of overpasses	
Regional mobility	Low Slow connection over winding embankment	High Fast connection over straight road	Medium Connection through feeder roads to toll entry points	Medium Same as Option 3
Interregional connectivity	Low Not attractive for through traffic	Medium Direct interregional link	High Direct dedicated link	High Same as Option 3
Constructability	Low complexity Simple construction	Low complexity Simple construction making use of proven technologies	Low complexity Same as Option 2	High complexity Massive dredging and fill operations
Maintenance requirements	Low	Medium Road and sluice gates require higher maintenance	Medium Same as Option 2	High Work on fill requires locally higher maintenance
Financial Aspects				
Construction cost	Low	Medium	High High road coast	High
Cost recovery for O&M of embankment	Nil No option to collect toll.	High Dedicated toll stations can recover a good part of the maintenance cost	Medium Lower than Option 2 as the road maintenance is higher	Low Lower than Option 3 as the road maintenance is higher
Environmental Aspects				
Program Footprints	Low Width of embankment is about 25m	Medium Width of embankment is 51.5 m	High Width of embankment is 62m	High Width of embankment is 62m
Material requirements for construction	Low Only fill is required for widening	Medium	High Higher embankment and fill compared to Option 2 due for four lane road, fencing, and local road connections	High Similar to Option 3 but additional efforts, such as stone columns for compaction of the unconsolidated fill under the embankment

	Option 1 Widening existing embankment	Option 2 Reconstructed embankment, 2-lane road	Option 3 Reconstructed embankment, 4-lane road	Option 4 Reconstructed embankment, 4 lane road in river
			with dedicate overpasses	
Impact on aquatic habitat	Medium	Low Low impacts due to construction of regulators to maintain ecological connectivity between river and floodplains	Low Same as Option 2	High
Additional flood protected land	None	Medium 165 ha of reclaimed char land	Medium Same as Option 2	High 1980ha of reclaimed land along the riverbank
Segregation of landscape	Low The standard embankment does not pose a major dividing element at all places	Medium A two lane highway is more difficult to cross but allows easy river access at all places	High A fenced four lane highway	Medium Same as Option 3
Social Aspects				
Amount of land required	Low Maximum use of existing land	Medium Partial use of existing land	High Wider than Option 2 and therefore more land required	High Same acquisition as for Option 3.
Number of people displaced	Medium Displacement of squatters and some new acquisition	Medium Higher than Option 1 due to the overall wider footprint	High Wider footprint than Option 2 due to the wider road	Low No displacement as built on newly filled land on river
Access to the river	High No major obstacle	Medium Crossing the highway could locally reduce the access	Low Access is limited to the locations of overpasses	Low Same as Option 3
Impact of traffic on community	Low Low traffic volume and speed	High Faster and mixed traffic with increased noise, accidents etc.	Medium Segregated traffic with reduced accident risk but higher noise levels	Medium Same as Option 3
Conclusion	Not recommended	Not Recommended Though this option has less environmental footprints and less	Recommended	Not recommended

	Option 1 Widening existing embankment	Option 2 Reconstructed embankment, 2-lane road	Option 3 Reconstructed embankment, 4-lane road	Option 4 Reconstructed embankment, 4 lane road in river
		cost compared to Option 3, recognizing the future development needs in the fast growing communication sector – this option is not recommended		

4.4. Alternatives for Embankment Materials

Construction of embankment and road requires huge amounts of earth fill. The following sources are considered as the sources of borrow material for earth fill:

- Alternative 1: Entire embankment is constructed with soil excavated from the floodplains and agriculture land.
- Alternative 2: Embankment to be constructed with dredged sand from the river bank and soil cladding.

Constructing the embankment with soil (Alternative 1) is a technically viable and perhaps the least cost option. However the soil will have to be either transported from long distances or obtained from the local areas thus significantly affecting the already scarce cultivation lands. Hence this option is not being considered for embankment construction.

The cost of Alternative 2 could be slightly higher than the other option discussed above. However the biggest advantage of this option is that it will avoid any adverse impacts on the cultivation lands of the area. There could be some localized and temporary impact on the aquatic habitat/fauna during the sand extraction from river bank and these impacts can be minimized with the improved sand extraction methodology and locating the extraction points away from the sensitive aquatic habitats. Alternative 2 is recommended for as source of earth fill primarily to avoid any impacts on the floodplain agriculture lands.

The source of cladding material of the embankment is usually extracted from the floodplain agriculture lands. In the RBIP, the material from the unused embankments will be used as cladding material.

4.5. Alternatives for Regulators

During Construction of BRE a good numbers of regulators were built on the embankment to provide lateral fish migration between the river and floodplains and also to provide drainage and supplementary Irrigation facilities. But most of them were engulfed into the Jamuna river due to erosion. During retirement or re-construction of BRE those engulfed regulators were not rebuilt and at those regulator points the natural channels were closed permanently. As a result the natural connectivity has been lost and there have been some problems with the natural drainage and supplementary irrigation. Following three alternatives were considered to address the problems:

Alternative 1: No new regulator and no rehabilitation of fish pass. This is the least cost option, avoiding any capital cost as well as any environmental and social impacts associated with the construction/rehabilitation activities. This option however is likely to have adverse impact on the ecological connectivity of the area with the main Jamuna river, resulting in reduced fish production and hence reduced livelihood for the local population

Alternative 2: rehabilitation of existing regulators and fish pass. This option will result in capital cost associated with rehabilitation works, in addition to environmental and social impacts associated with the rehabilitation works. This option will eventually result in restoration of ecological connectivity that has been lost because of the dysfunctional regulators

Alternative 3: Rehabilitation of existing regulators and fish pass, and construction of additional regulators. This option will obviously result in higher capital and O&M costs compared to the second option discussed above. The environmental and social impacts associated with the construction activities will also be higher than those associated with the second option. However this option will enhance the fish production from the floodplains and hence enhance the livelihood of local fishermen. Therefore this option has been preferred over the other alternatives. Total seven regulators and two culverts will be constructed/ rehabilitated in the priority reach. Moreover, the lost connectivity of the natural channel system will be re-established by re-excavation of the links under project condition.

4.6. Alternatives for Resettlement Sites

The program requires resettlement of about 5,732 households. Based on the recent experiences in Bangladesh on similar projects on embankment rehabilitation and Padma Bridge, the following four alternatives are considered for planning of resettlement sites:

- Alternative1: No Resettlement Site (RS). Affected households (hh) will be encouraged to relocate on their own with eligible compensation and assistance from the program and provision for additional incentives.
- Alternative 2: Large RS sites (for 300 to 500 hhs) to be development by the program
- Alternative 3: Small Group (10 to 20 hhs) relocation by members of extended families
- Alternative 4: Small RS Site – within the same area with access to existing civic amenities

A comparative evaluation of these alternatives is presented in **Table 4.4**. All alternatives, exception Alternative 2 on development of large resettlement sites will be followed up under RBIP.

Table 4.4: Analysis of Resettlement Site Alternatives

	No RS Site	Large RS Sites	Small Group	Small RS Site
Technical	Reduce further acquisition of land for resettlement sites; people	Involve massive acquisition of land affecting new set of households s	No land acquisition needed. People move on their own on residual land	Minimum LA for RS site development; available BWDB land may be

	No RS Site	Large RS Sites	Small Group	Small RS Site
	choice their own place of choices within the vicinity of the existing communities.	requiring resettlement	and/or buy land for resettlement	used in some instances
Financial	Cost of building construction sites will be avoided	Expensive; about $1 million per sites (4 to 5 sites) would be required	No additional costs to the program except for provision of support of amenities such as tube-well and access roads	Low costs in RS site development; on site minimum amenities
Environmental	Minimal environmental issues in such relocation, because there is no major concentration or cluster in one site.	Many environmental issues related to large sites – water, sewerage, sanitation, health etc.	No or very limited environmental impacts	Minimum environmental impacts
Social	People with residual land and/or support from kin/relatives will have easier time to resettle; those without land will have hard time finding a place to relocate.	Cyclical impacts and displacement; fragmentation of social and community ties; host village issues	Well integrated new community in the resettled villages/settlement; no potential conflict; due monitoring of relocation for eligible social programs	Limited or no disruption due to relocation; access to already existing amenities – no host area issues
Conclusion	This is a preferred option expressed by many affected households on the ROW, including those to be relocated from the embankment.	To be avoided as much as feasible due to linear program over 50 km	Encouraged with incentive such as additional cash - to take own decision on resettlement	Encouraged, because many affected households expressed their desire to remain within their own community

5. Description of Environment

5.1. Program Area of Influence

The influence area of the overall program has been derived considering areas that are likely to be directly or indirectly affected by the RBIP construction and operation activities, including but not limited to the extent the project would have impacts on the floodplain areas, lateral fish migration, hydrological, road network, and the project footprints. The following criteria have been considered to define the influence area:

- Project footprints: areas that directly fall under foot prints of the projects, ancillary facilities, temporary construction areas and worker camp sites, borrow areas, and access roads to the project facilities for transport of material; areas that will be affected by the emissions from construction and by operation of traffic.
- Floodplain area: The extent of flood plain area that will be protected from the floods by the flood embankments (BRE) has primarily been considered as the program influence area. This area has been derived based on the latest satellite maps and GoB topographic maps through digital elevation model (DEM).
- Flood Inundation: The extent of flood inundation caused by breaches of BRE. Satellite maps were analyzed for August-September, 2014 (i.e., the high flow season) to understand the extent of flooding from breaches and internal rivers like the Dharla, Dudhkumar, Teesta, Karotoya, Bangali, Ichamati, and Hurasagar.
- Connectivity: The area is crisscrossed with a network of *khals* (water channels) which carry flood waters from Jamuna to the internal rivers on the western part of the project influence area. All these rivers are interconnected by numerous khals, tributaries and distributaries forming a hydrological network in the entire northwest region of the Country. For example, Mahananda and Punorbhaba that are major rivers of the northwest region, are connected to the Atrai-Karatoya-Bangali river system which drains to the lower Jamuna through the Hurasagar/Baral in the south east corner of the region.
- Lateral Fish Migration: Some fish species of Jamuna, such as major carps, undergo lateral migration from Jamuna to floodplains for spawning. The migratory routes have historically been affected by the BRE and the proposed interventions also have a potential to affect these lateral migratory routes (if appropriate features are not included in the proposed program to address it)[10]. Therefore the extent of lateral migration from Jamuna to floodplains, based on the known present-day fish migration and spawning behavior, has been included in the program influence area.
- Longitudinal fish migration. The other type of fish migration in Jamuna is longitudinal migration between upstream and downstream (e.g. hilsa migration from sea to Jamuna). The RBIP will not have any impacts on the longitudinal migratory routes because: i) the proposed interventions in the river are limited to works either along the riverbank itself (revetment) or very close to it within the first channel of the

[10] The blockage of fish migration was caused by the original BRE. However the frequent breaches in the embankment have restored to some extent this lost connectivity. The proposed interventions will however reduce the frequency of / eliminate the breaches hence the RBIP has a potential to affect the fish migration/connectivity if appropriate features such as regulators and fish passes are not included in the program design.

river in shallow waters (sand extraction); ii) the river is sufficiently wide and has multiple channels thus providing suitable conditions for fish migration; and iii) the longitudinal fish migration takes place in deep channels that are far away from the location of the proposed interventions mentioned above. Hence the entire width of Jamuna river and river reaches downstream of the project area are not included in the program influence area (only the first active channel is included).

- Significant Habitats (eco-dynamic area). There are many significant ecological habitats in the area especially in the chars. The proposed interventions under RBIP are not expected to have any impact on the *chars*, except one small char that is very close to the riverbank (shown on a map later in the document). Therefore the nearest chars have also been included in the program influence area.
- River morphology. Jamuna is a braded river with water flowing through multiple channels. However at the Jamuna bridge at a short distance downstream of the project area the river morphology transforms dramatically from multi-braided to mostly single-braided river.

On the basis of the above criteria, the boundaries of program influence area have been determined as follows (see **Figure 5.1**):

- On the northern side of the area, the Teesta river provides a natural boundary for the hydrological connectivity. However, some area north of this river experiences inundation because of floods in the Jamuna river hence the extent of this inundation just north of the Teesta river has been taken as the northern boundary of the program influence area.
- On the western side of the area, the Dhaka-Bogra-Rangpur highway acts as a barrier for the hydrological connectivity (and also flood inundation) hence this highway has been taken as the western boundary of the program influence area.
- The Jamuna bridge - since at this point the river morphology changes significantly – and the road (and its corridor on the southern side) leading from this bridge to the above-mentioned highway have been taken as the southern boundary of the program influence area.
- Finally, Jamuna river forms the eastern boundary of the hydrological connectivity and has therefore been taken as the eastern boundary of the program influence area. However because of the braided nature of the river, its entire width has not been included in the program area of influence; broadly the first active channel and associated chares are included in it.

Area of influence for each subsequent phase will be determined in respective EIA consistent with the above criteria and will cover the areas that will be directly or indirectly affected by the program.

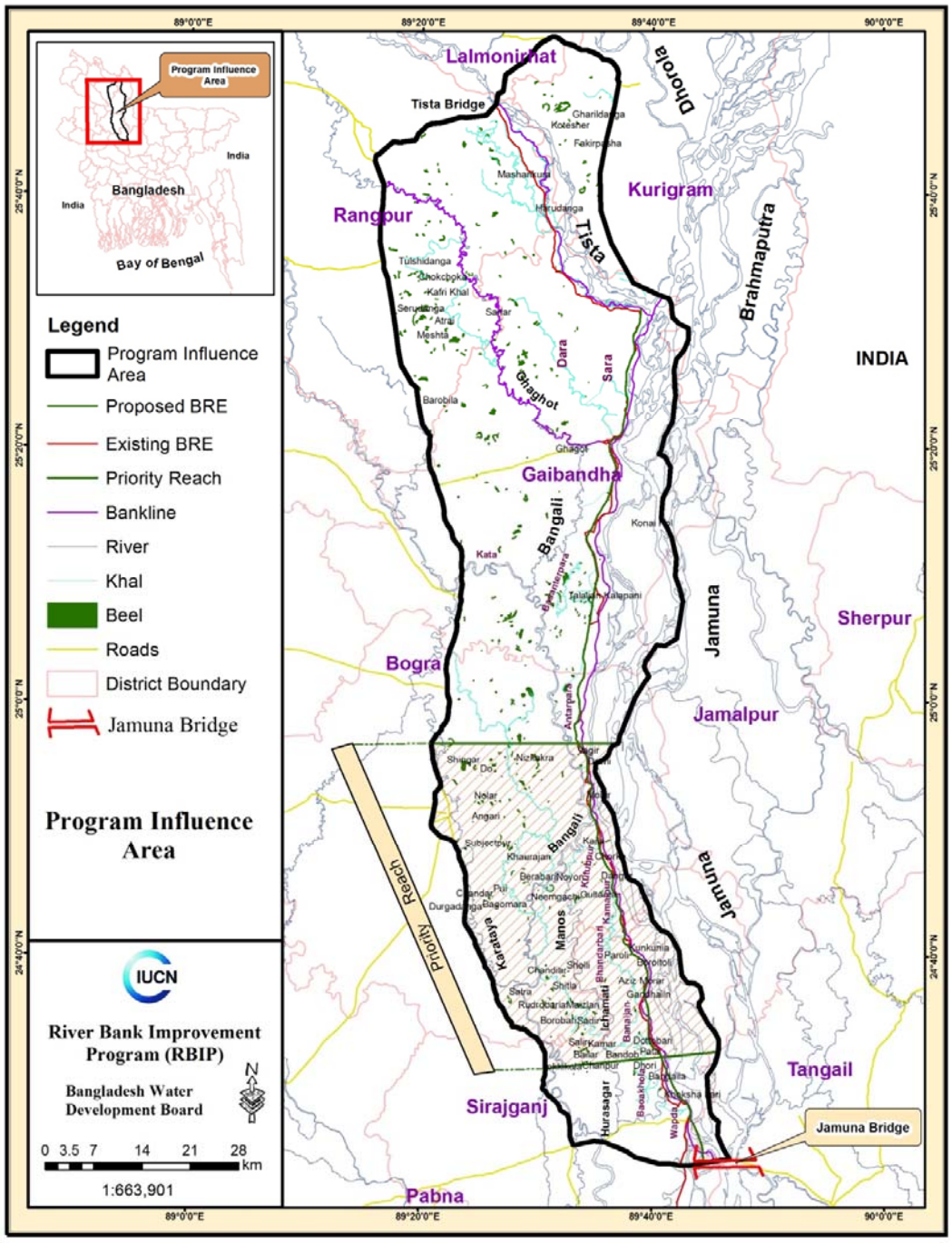


Figure 5.1: Program Influence Area

5.2. Baseline - An Overview

For proper environmental assessment (as a part of IEE and EIA), it is very important to adequately assess the baseline condition before the project takes place, so as to understand which phenomena existed before project implementation and which could be impacts from project activities. The baseline assessment allows to provide timely input to project designs to reduce potentially adverse environmental impacts. It can also be used to

reassure the public and decision makers that key environmental issues have been identified and will be monitored during project implementation. The characteristics of environmental baseline would depend on:

- Nature of the project location,
- Nature/ extent of a project and its likely impact,
- Influence area of the project.

For systematic recording of data, baseline environment is usually classified into physicochemical environment, biological environment, and socio-economic environment; and important features/parameters under each category are identified and measured/ recorded during baseline survey. Each phase or subproject-specific EIA should provide an updated overview of baseline conditions for the whole program area (reflecting any changes on the ground since this preliminary baseline for the full program area was established at the time of preparation of this document), as well as a detailed analysis specific to the influence area of that phase.

The lands of the program influence area are part of the Karotoya-Bangali and the Active Brahmaputra-Jamuna flood plain. The eastern part of the area has broad floodplain ridges and almost level basins. While the land adjacent to Jamuna river and the *chars* (shoals or river islands) comprises of a belt of unstable alluvial land constantly being formed and eroded by shifting river channels. It has an irregular relief of broad and narrow ridges and depressions. About 41 percent of the total 459,159 ha is available for agriculture. The rest of the land is occupied by settlement (37 percent), homestead forestry, bamboo plantations (11 percent) and; chars and water bodies (12 percent).

Bangladesh is a highly populated country and its reflection is present in the four program districts, viz. Kurigram, Gaibandha, Sirajganj and Bogra. The population of Kurigram was 1.79 million in 2001. The population density was 780 per sq-km. Among nine Upazilas of Kurigram, the Raumari Upazila had the highest population while the Char Razibpur Upazila had the lowest.[11] On the other hand, Gaibandha had a population of 2.48 million in 2001. The density of population was 981 per sq-km. Among seven, the Gobindaganj Upazila had the highest and Fulchari had the lowest population[12]. The population of Sirajganj in the census of 2011 was 3 million. Among the four districts the scale of urbanization is higher in Bogra district, and it has 12 municipalities. Urban population is 0.59 million. Sirajganj has six municipalities and 0.32 million urban population. Gaibandha has three municipalities and 0.19 million people. Kurigram has three municipalities and 0.27 million urban population.

The overall base line of the program area is presented in a separate volume of EA documents.

[11] BBS (2011), *Census of Agriculture 2008, Kurigram Series*, Ministry of Planning, GOB.

[12] BBS (2011),*Census of Agriculture 2008, Gaibandha Series*, Ministry of Planning, GOB; BBS(2007), *Census of Agriculture and Economic Census of 2001 & 2003, Zila Series Gaibandha*, Ministry of Planning, GOB.

6. Assessment and Prediction of Impacts

This Chapter discusses the guideline to predict the potential and mostly typical impacts of the RBIP on the key environmental parameters. Impacts are anticipated on overall baseline, primary assessment of the nature and scale of the remaining phases and the detailed impact assessment carried out for the Phase I (Priority Reach).

6.1. Overview of Potential Impacts

After its completion, the program is expected to have a multiple of very positive and beneficial effects on the people and economy of the area. First of all, the river bank protection will discontinue the recurring bank erosion and the associated loss of homesteads and cultivated land. Then, the improved embankment will also significantly reduce the flooding events and associated economic losses. Finally, the road constructed on the embankment will facilitate local mobility as well as long-distance transportation. All of these factors are likely to have very profound positive impacts on the local people and their economic condition. In addition, increased safety against river bank erosion and flooding as well as improved mobility and connectivity will bring in further development and investment in the area that is currently not possible because of the area vulnerability.

Most of the proposed interventions pertain to rehabilitation and improvement of the existing embankment and hence the potentially negative environmental impacts will primarily be limited to the construction activities.

The key potentially negative impacts and issues associated with the construction phase of the proposed program include changes in aquatic habitat because of riverbank protection works as well as from sand extraction from the river bank; changes in land form and land use because of rehabilitation of existing and construction of new embankment; land acquisition for construction of new embankment and resulting displacement of people; use of natural resources particularly river sand; health and safety risks associated with handling of hazardous materials and operation of construction machinery; air quality deterioration because of operation of construction vehicles and machinery as well as excavation activities; noise generation caused by the operation of construction machinery and vehicles; contamination of land and water caused by wastes generated from construction activities and camp operation; loss of trees that need to be removed for construction of embankment; risk of accidents associated with movement of construction vehicles and machinery; blockage of local routes caused by construction activities; and impacts on sensitive receptors such as schools along the embankment.

The potentially negative impacts associated with the O&M phase of the program include changes in river morphology caused by riverbank protection; changes in aquatic habitat caused by riverbank revetment; blockage of local routes caused by the embankment and road, effects on water bodies and associated habitats caused by disruption of hydrological and ecological connectivity between main river and internal rivers, beels and khals; noise generation and air quality deterioration caused by the vehicular traffic on the embankment road; risks of accidents associated with vehicular traffic on the embankment road; and increased usage of agro-chemicals caused by agricultural intensification due to enhanced protection against riverbank erosion and flooding.

6.2. Assessment Methodology

The assessment of effects and identification of residual impacts takes account of any incorporated mitigation measures adopted due to any potential impact of Program

activities, and will be largely dependent on the extent and duration of change, the number of people or size of the resource affected and their sensitivity to the change. Potential impacts can be both negative and positive (beneficial), and the methodology defined below will be applied to define both beneficial and adverse potential impacts.

The criteria for determining significance are generally specific for each environmental and social aspect but generally the magnitude of each potential impact is defined along with the sensitivity of the receptor. Generic criteria for defining magnitude and sensitivity used for the Program are summarized below.

6.2.1. Magnitude

The assessment of magnitude shall be undertaken in two steps. Firstly the key issues associated with the Program are categorized as beneficial or adverse. Secondly, potential impacts shall be categorized as major, medium, minor or negligible based on consideration of the parameters such as:

- Duration of the potential impact;
- Spatial extent of the potential impact;
- Reversibility;
- Likelihood; and
- Legal standards and established professional criteria.

The magnitude of potential impacts of the Program shall be identified according to the categories outlined in **Table 6.1**.

Table 6.1: Parameters for Determining Magnitude

Parameter	Major	Medium	Minor	Negligible/Nil
Duration of potential impact	Long term (more than 35 years)	Medium Term Lifespan of the program (5 to 15 years)	Less than program lifespan	Temporary with no detectable potential impact
Spatial extent of the potential impact	Widespread far beyond program boundaries	Beyond immediate program components, site boundaries or local area	Within program boundary	Specific location within program component or site boundaries with no detectable potential impact
Reversibility of potential impacts	Potential impact is effectively permanent, requiring considerable intervention to return to baseline	Baseline requires a year or so with some interventions to return to baseline	Baseline returns naturally or with limited intervention within a few months	Baseline remains constant
Legal standards and established professional criteria	Breaches national standards and or international guidelines/oblig	Complies with limits given in national standards but breaches international lender	Meets minimum national standard limits or	Not applicable

Parameter	Major	Medium	Minor	Negligible/Nil
	ations	guidelines in one or more parameters	international guidelines	
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur

6.2.2. Sensitivity

The sensitivity of a receptor shall be determined based on review of the population (including proximity / numbers / vulnerability) and presence of features on the site or the surrounding area. Criteria for determining receptor sensitivity of the Program's potential impacts are outlined in **Table 6.2**.

Table 6.2: Criteria for Determining Sensitivity

Sensitivity Determination	Definition
Very Severe	Vulnerable receptor with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.
Severe	Vulnerable receptor with little or no capacity to absorb proposed changes or limited opportunities for mitigation.
Mild	Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation
Low / Negligible	Vulnerable receptor with good capacity to absorb proposed changes or/and good opportunities for mitigation

6.2.3. Assigning Significance

Following the assessment of magnitude, the quality and sensitivity of the receiving environment receptor shall be determined and the significance of each potential impact established using the potential impact significance matrix shown in **Table 6.3**.

Table 6.3: Assessment of Potential Impact Significance

Magnitude of Potential impact	Sensitivity of Receptors			
	Very Severe	Severe	Mild	Low / Negligible
Major	Critical	High	Moderate	Negligible
Medium	High	High	Moderate	Negligible
Minor	Moderate	Moderate	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

6.3. Summary of key Impacts

The potential impacts of the program on the key environmental parameters that have been identified as part of the EIA of the Phase I (priority reach) but broadly valid for the

remaining phases are listed in **Table 6.4**. Also given in the table is the significance of each impact based upon the criteria defined in **Section 6.2** and **Tables 6.1** to **6.3**. In the subsequent sections, these impacts are discussed and guidelines included for the EIAs of the later phases of the RBIP.

Subsequent EIAs for additional program phases should modify and further detail out this high level analysis as applicable to each phase, starting with a review of what the relevant IESCs are for that phase, based on professional judgment and public consultations.

The additional phase EIAs should also incorporate into their impact assessment a review of monitoring results from the priority reach phase, and adjust this preliminary impact identification as appropriate based on the findings.

Table 6.4: Summary of Potential Impacts and their Significance

Potential Impacts on IESCs	Duration of Impact	Spatial Extent	Reversible or not	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance after Mitigation
Control of Riverbank Erosion	Long term	Local	Yes	Certain	Major	-	High positive	High positive
Improved flood protection	Long term	Local	Yes	Certain	Major	-	High positive	High positive
Impacts related to Program siting								
Land cover and land use changes	Long term	Local	No	Certain	Major	Mild	Moderate negative	Low negative
Loss of natural vegetation and trees	Long term	Local	Yes	Certain	Major	Mild	Moderate negative	Low negative
Loss of riverbank/aquatic habitat	Long term	Local	No	Likely	Medium	Mild	Moderate negative	Low negative
Loss of flood plain habitat	Long term	Local but beyond program foot print	No	Certain	Major	Severe	High negative	Low negative
Drainage congestion and water logging	Long term	Local but beyond program foot print	No	Likely	Medium	Mild	Moderate negative	Low negative
Land acquisition and resettlement	Long term	Local	No	Certain	Major	Severe	High negative	Low to moderate negative
Loss of agriculture	Long term	Local	No	Certain	Major	Severe	High negative	Low to moderate negative
Impacts on Community Facilities and Places of Religious Significance	Long term	Local	No	Certain	Major	Severe	High negative	Low to moderate negative
Blocked access because of road and embankment	Long term	Local but beyond	No	Certain	Major	Mild	Moderate negative	Low negative

Potential Impacts on IESCs	Duration of Impact	Spatial Extent	Reversible or not	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance after Mitigation
		program foot print						
Improved road connectivity	Long term	Local	No	Certain	Major	-	High positive	High positive
Environment impacts during construction phase								
Impacts of borrowing of material	Short term	Local	Yes	Certain	Major	Severe	High negative	Low negative
Air pollution	Short term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative
Noise	Short term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative
Water pollution	Short term	Local	Yes	Certain	Major	Severe	High negative	Low negative
Soil contamination	Short term	Local	Yes	Certain	Major	Severe	High negative	Low negative
Solid wastes and hazardous wastes	Short term	Local	Yes	Certain	Major	Severe	High negative	Low negative
Impacts on aquatic habitat	Short term	Local	Yes	Certain	Major	Severe	High negative	Low to moderate negative
Impacts on floodplain habitat	Short term	Local	Yes	Certain	Major	Severe	High negative	Low negative
Impacts on *charland* habitat	Short term	Local	Yes	Unlikely	Minor	Low	Minimal	Minimal
Site clearance and restoration	Short term	Local	Yes	Likely	Medium	Severe	Moderate negative	Low negative
Social impacts during construction phase								
Impacts on cultural heritage	Short term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative
Impacts on community facilities	Short term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative
Occupational health and safety	Short term	Local	Yes	Certain	Major	Severe	High negative	Low to moderate negative

Potential Impacts on IESCs	Duration of Impact	Spatial Extent	Reversible or not	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance after Mitigation
Community health and safety	Short term	Local	Yes	Certain	Major	Severe	High negative	Low to moderate negative
Environmental impacts during O&M								
Changes in river morphology	Long term	Local	No	Likely	Nominal	Severe	Minimal Negative	Minimal negative
Loss of ecological connectivity	Long term	Local	No	Certain	Major	Severe	High negative	Low negative
Drainage congestion and water logging	Long term	Local	No	Likely	Medium	Mild	Moderate negative	Low negative
Generation of solid waste	Long term	Local	Yes	Certain	Major	Severe	High negative	Low negative
Air pollution	Long term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative
Noise generation	Long term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative
Water pollution	Long term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative
Risk of embankment breaches	Long term	Local but beyond program foot print	Yes	Likely	Major	Very Severe	Critical	Low to moderate negative
Social impacts during O&M								
Changes in agricultural pattern	Long term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative
Community health and safety	Long term	Local	Yes	Certain	Major	Severe	High negative	Low to moderate

6.4. Significant Environmental Impacts from Program Siting

6.4.1. Control of River Bank Erosion

During the last four to five decades, Jamuna river has been undergoing strong metamorphosis in width, bank erosion, braiding intensities. Recent researches suggest that sediment slugs generated by 1950 Assam earthquake was the main driver for those rapid changes. In particular, the riverbank erosion has been resulting in loss of valuable land along both of the river banks.

The riverbank erosion not only causes loss of land, but also attacks the already dilapidated BRE, causing frequent beaches that in turn result in flooding of the BRE-protected floodplain causing substantial losses to private and public assets as well as crops and cultivation fields.

As detailed in the Phase I EIA, the revetment works envisaged under the proposed RBIP (Phase I) will help avoid the above-mentioned losses and will result in saving of about US $ 17.33 million per year – the annual losses that are likely to take place caused by the riverbank erosion if no protective measures are undertaken under the Priority Reach works.

The EIAs of the later phases of RBIP will include detailed analysis of the riverbank erosion along the remaining reaches and the associated monetary loss - the amount that would be saved once the riverbank protection works under the later phases of RBIP are implemented.

6.4.2. Improved Flood Protection

As already described in **Section 1.1**, prior to the BRE construction, overbank spills regularly caused flooding to a 240,000 ha area along the right bank of Jamuna. Originally, the BRE had a setback distance of about 1.5 km from the Jamuna river bankline. Over the years the embankment has been increasingly under attack from bank erosion causing the embankment to breach at several locations. After such breaches of the embankment, it needs to be retired back away from its original alignment and reconstructed.

As detailed in the EIA of the RBIP Phase I, the embankment rehabilitation and reconstruction works envisaged under the proposed RBIP will help avoid the losses caused by the repeated floods and will result in saving of about US $ 164 million per year – the annual losses that are likely to take place caused by the flooding if no protective measures are undertaken. *The EIAs of the later phases of RBIP will include details of the projected losses associated with the flooding of the area and the amount that would be saved once the new embankment is constructed.*

6.4.3. Land Cover and Landuse Changes

Potential impacts. As already discussed in **the baseline chapter**, the program influence area is dominated by cultivation and associated activities covering 53 percent of the area, followed by settlements that cover about 29 percent of the area.

The cropping intensity is already quite high in the program influence area (211 percent against the national average of 190 percent). Therefore there is a limited opportunity for any increased cropping intensity once the RBIP is complete providing enhanced security against floods caused by the Jamuna river. However, cropping pattern could be changed with increasing trend of high value crops.

Based upon the changed cropping pattern and increased yield as mentioned above, there will be an increase in the agricultural income from the program influence area. While the increased agricultural income will positively impact the livelihood of the local farmers, the increased cropping intensity and changed cropping pattern discussed above will potentially cause an increased use of agro-chemicals.

The EIAs for the later phases of RBIP, the above mentioned economic benefit and increased usage of agro-chemicals will be quantified.

The increased use of agro-chemical can potentially cause an enhanced level of soil and water contamination and pose health hazards for the farm workers and also for the communities in the program influence area. Significance of these impacts has been determined as **Moderate** based upon the criteria described in **Section 6.2**.*This assessment will be revisited during the EIAs of the later phases of the RBIP*.

Mitigation and Management. The integrated pest management programs (IPM) are already under implementation in Bangladesh. Linkage with these programs will be facilitated to address any increase usage of agro-chemicals in the area.

In addition to the above, an integrated pest management plan (IPMP) will be prepared by the RBIP during the program implementation but before its completion. The key objectives of the IPMP will include: i) to increase the productivity of agricultural crops through IPM and Integrated Plant and Soil Nutrient Management (IPSNM) practices, that includes the rational use of chemical pesticides and nutrients; ii) to raise awareness of all stakeholders about the IPM approach to crop management, and train extension agents and farmers to become practitioners of IPM; and iii) to determine the level of pesticide residue on agricultural crops in normally-treated and IPM-treated areas and disseminate information to stakeholders on the usefulness of undertaking IPM practices. The key elements of the IPMP will include: i) awareness/ dissemination of Information; ii) training of facilitators (ToF) and establishing of Farmer Field Schools (FFS); iii) implementing Integrated Plant and Soil Nutrient Management (IPSNM) techniques (including organic fertilizers, composting and worm culture); iv) determining pesticide residue on crops; and v) strengthening institutional capacity on IPSNM.

Furthermore, the Information, Education, and Communication (IEC) component of the Social Development Plan (SDP) of RBIP will include capacity building of farmers and awareness raising of communities. For this purpose, linkage will be developed with the Agriculture Extension Department and local farmers will be provided IPM trainings; in addition, potential candidates will be identified among the local farmers to be trained as IPM trainers. This will ensure sustainability of capacity building initiative even after the completion of five-year SDP under RBIP.

In the EIAs of later phases of RBIP, the above-described mitigation measures will be reviewed and revised if needed in light of the experience of their implementation during the Phase I.

Residual impacts. With the implementation the above measures, the impacts associated with intensification of cultivation will be adequately addressed and the significance of the residual impacts is likely to be **Low**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

6.4.4. Loss of natural vegetation and trees

Potential impacts. Program area harbors different sorts of floral species though along the proposed embankment the number of species richness and individual quantity is not so much high relative to the other part of country. The floral composition of the program site comprises tree, shrubs and herbs. The survey during the baseline data collection has indicated that there are 114 mature trees per ha and 21 mature shrubs in per ha while the number of bamboo species in program site is 34 per ha. Most of the tree species comprises timber (e.g. eucalyptus and acacia) and horticultural species (e.g. mango, jackfruit). Ecologically, these species are not very important; moreover they have negative impact on human health also. Except for the economic value of eucalyptus and acacia, these species have no significant benefit for the ecosystem. On the other hand, the horticultural species like mango and jackfruit support the poor people of this area by providing various products such as fuel wood, food and timber. Some horticultural species such as jackfruit is used as fodder as well. These species are used by birds for their habitat and food. Due to the proposed interventions during the Phase I, the program influence area in the priority will lose about170,000 trees, as detailed in the EIA of Phase I (priority reach). *The EIAs of subsequent phases will provide details of the trees that would need to be felled in the remaining reaches.*

The revetment proposed under the RBIP can potentially affect the aquatic vegetation along the riverbank. Some parts of the riverbank are covered with dense reeds that provide nursing ground of birds and small fishes. However, the revetment is being proposed for the riverbank stretches that undergo severe erosion during every high-flow season resulting in loss of any vegetation that exists there. Hence the revetment works are unlikely to cause any significant loss of the aquatic vegetation; in fact these protection works will discontinue the loss of vegetation caused by the riverbank erosion. Furthermore, the aquatic vegetation naturally grows along slow moving streams at different places of Jamuna river hence it is expected that it will gradually re-grow along the protected riverbank as well. *While conducting the EIA of the later phases of the RBIP, the above aspect will be reconfirmed and actual state of the riverbank along which revetment will be constructed will be described.*

The significance of the above impacts is likely to be **Moderate**, based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

Mitigation and Management. For the trees to be removed for the proposed interventions, compensatory tree plantation will be carried out along the embankment. About 140 ha of land is available for this purpose. A plantation plan has been prepared for the priority reach. In addition to providing ecological service, embankment stabilization, and enhanced aesthetic value, this plantation will also prevent any encroachment over the embankment. A monitoring program will be initiated for the re-growth of the aquatic vegetation along the riverbank revetment.

For the later phases of the RBIP, a similar plantation plan will be prepared and implemented; details will be included in the EIAs of those phases. The experience of plantation carried out in the priority reach and results of the earlier described monitoring program (if available) will also be included in the respective EIAs.

Residual impacts. With the help of the above-mentioned mitigation measures, the potential impacts associated with clearing of riparian as well as terrestrial vegetation/trees will be adequately addressed and hence the significance of the residual impacts in likely

to be **Low**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

6.4.5. Loss of riverbank/aquatic habitat

Potential impacts. Total length of the revetment to be constructed during the Phase I of RBIP will be about 17 km divided into four major sites at Balighuri, Ratankandi, Baniajan and Chandanbaissa. Average width of the revetment will be 100 meter of which the under-water portion will be 60 meter. Hence the estimated total potentially impacted aquatic area will be about 102 ha. However, this part of the aquatic habitat is regularly eroded because of the frequent riverbank erosion. Hence the revetment will not result in any additional loss of aquatic habitat. *Similar estimates will be included in the later EIAs for the revetment to be constructed during the later phases of the RBIP.*

The river bottom material like clay, silt, sand, cobbles, and boulders has different physical and chemical gesture and may support aquatic life differently. Geo-bags are helpful to stun sediment which will help to improve water transparency. On the other hand, geo-bag will cover part of the riverbed that may potentially have negative impacts on benthos. The benthic fauna at the substrates and phytoplankton at the water column will potentially be affected negatively at the revetment sites, which will in turn have effect on the food chain and may result in food shortage for faunal species such as fish, crab, and turtle. The covering of river bed with geo-bags in limnetic zone may potentially affect some fishes, such as Ayre (Aorichthysaor), boal (Wallagoattu), Pangas (Pangasiuspangasius), different types of balm, gutum (Lepidocephalusguntea), bala (Glossogobiusgiuris) and some small fish species by limiting their feeding opportunity. The associated fish production loss has been estimated at about 9tonnesannually during the construction phase (considering that the annual fish production rate of the Jamuna river is 90kg/ha/year); however this loss will be more than compensated through increased fish production in the flood plains (discussed later in the Chapter).*Similar estimates will be included in the later EIAs for the revetment to be constructed during the later phases of the RBIP.*

Furthermore, it is now established that the geo-bags revetment creates fish habitat, as phytoplankton grow on their surface. Previous studies[13][14] on impacts of geo-bags on the aquatic species have shown positive results. In general, there were more number of species and more population of fish and non fish aquatic organisms in areas protected with geo-bags. The overall accumulation of species in number was better in geo-bag protected area than in the areas protected by cement concrete blocks. The quantity of fish availability was also better with geo-bags in many locations. In addition, the CC blocks used in the upper portion of the revetment are likely to provide habitat for certain fish species such as eels. The revetment is not likely to affect the dolphin or wintering bird habitats since the river protection works will not be carried out at or in the vicinity of those areas.

The above assessment will be revisited with the help of results (if available) of the habitat monitoring that will be carried out during the implementation of Phase I works (monitoring is described under the mitigation measures given below).

[13] Geotextile Bags for River Erosion Control in Bangladesh, Under water behavior and environmental aspects. Hannes Zellweger; 2007.

[14] Bank Protection and Fisheriesat JMREMP; Jamuna-Meghna River Erosion Mitigation Project, Special Report; 2007.

The aquatic habitat can also be potentially affected if sediments and pollutants from the construction sites and camp sites are released in the water bodies.

Based upon the above discussion, the potential impacts of the program on aquatic habitat have been characterized as **Moderate**, using the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

Mitigation and Management. Since most of the potentially negative impacts of riverbank revetment on the aquatic habitat are expected to be temporary in nature, and since the revetment is likely to provide habitat for some aquatic species, as stated earlier, no mitigation measures are needed for this activity. Habitat monitoring will however be carried out during the construction phase and will be continued thereafter to fully understand the impact of revetment on the aquatic habitat. Appropriate mitigation measures may need to be designed and implemented on the basis of monitoring results. Similarly, long-term monitoring of river morphology will also be initiated to fully understand the changes in river morphology.

The monitoring program will be based on the assumption that different riverine fish species prefer different bankline conditions. The program will include year-round data collection on fish and non-fish organisms in control sites (i.e., areas without geo-bag revetment) as well as revetment sites. For each location, depth series data will be collected on fish habitat, availability of food, and abundance of key species. The monitoring will primarily focus on adult or sub adult fish that will be available along bankline, however additional information will also be collected on breeding, nursing, and migration of the key species. The monitoring program will also cover potential impacts on other key aquatic species such as dolphins and turtles.

To protect the aquatic habitat from the sediments and pollutants from the construction sites and cam sites, contractors will be required to prepare and implement pollution prevention plan and waste management plan. Through these plans, it will be ensured that no untreated effluents or solid waste is released in the water bodies.

Residual impacts. With the help of the above-mentioned mitigation measures, the potential impacts associated with aquatic habitat will be adequately addressed and hence the significance of the residual impacts in likely to be **Low**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

6.4.6. Loss of floodplain habitat

Potential impacts. The embankment works will affect about 340 ha of terrestrial habitat in the priority reach however most parts of this area is completely modified and is currently either under cultivation or included in built-up area (homesteads, other physical infrastructure). Hence the program interventions are unlikely to cause any significant negative impacts on the natural habitat under its immediate footprint (loss of natural vegetation is already covered earlier in the Chapter). This potential impact is assessed as **Low**, based upon the criteria described in **Section 6.2** and hence no mitigation is required for this. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

In addition to the above impacts, the embankment construction can potentially disrupt the hydrological and ecological connectivity between the Jamuna River and smaller inland rivers, *khals* and *beels* – negatively affecting the floodplain habitat and potentially reducing the fish production in the area. This potential impact is characterized as **High**, based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

It is estimated that total annual fish production will decline by about two tonnes in *khals* (water channels) and internal rivers, about 261 tonnes in *beels* (water ponds), and about 311 tonnes in floodplains of the priority reach as detailed in the EIA of the Phase I. The associated annual economic loss has been estimated to be BDT 616,275 from *khals* and internal rivers, BDT 78,306,750 from *beels* and BDT 93,355,500 from floodplain – a total of about BDT 255 million on a yearly basis. *Similar estimates will be included in the EIAs of the later phases of the RBIP.*

Mitigation and Enhancement. To restore the ecological and hydrological connectivity, appropriate number of regulators and fish passes will be constructed at appropriate locations as part of the RBIP. During the EIA of the priority reach (Phase I) four potential areas within the priority reach have been identified where re-establishing of ecological connectivity will greatly help in restoring the biodiversity of the area particularly facilitating the fish migration, which in turn will enhance the fish production in the beels, khals, and other water bodies of the floodplain. *During the EIAs of the later phases of RBIP as well, regulators and fish passes will be proposed at appropriate location.*

Operation and maintenance committees will be established for each regulator to appropriately operate and maintain these structures. These committees will be responsible for scheduled opening and closing of regulator gates, and removal of silt deposits in the khals. These committees will be provided with adequate training in O&M of the regulators. Furthermore, to achieve maximum benefit and also to ensure functionality of the fish passes, it is also necessary to undertake enhancement measures in the connecting *khals*, *beels* and other water bodies.

Construction of fish passes will facilitate fish migration that will ultimately enhance fish production of the area. It is estimated that the restoration of ecological connectivity achieved through fish pass structures and regulators will enhance the fish production from the floodplain of the priority reach by about 1,880 tonnes per year, resulting in a net economic benefit of about BDT 564 million annually in the priority reach, as detailed in the EIA of Phase I of RBIP. *Similar estimates will be included in the EIAs of the later phases of the RBIP*. Since the productivity enhancement is a gradual process, it is estimated that the above enhancements will be achieved after five years of program completion.

Residual impacts. With the help of the above-described mitigation measures, the potential impacts on the floodplain habitat are likely to be adequately addressed and hence the residual impacts will be **Low** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP*. On the other hand, the program will result in net economic benefit of BDT 564 million on an annual basis in the priority reach, as described above.

6.4.7. Drainage Congestion and Water Logging

Potential impacts. As stated in above section, construction and or rehabilitation of the embankment may potentially block some water channels (*khals*), which provide ecological connectivity in addition to facilitating irrigation/drainage. Some regulators were constructed across the original embankment constructed as part of the BRE however many of them have either been blocked or not functioning properly. As a result some cultivated lands particularly near Baliaghuri in Sirajganj are facing drainage congestion and water logging problems. Significance of these impacts has been determined as

Moderate based upon the criteria described in **Section 6.2**.*This assessment will be revisited during the EIAs of the later phases of the RBIP.*

Mitigation and Management. Water regulators have been included in the program design of Phase I; *similarly, regulator will be included in the later phases of RBIP at appropriate locations*, as stated earlier. Appropriate operating procedures will be implemented to operate these structures to address the drainage congestion and water logging problems in the area.

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with water logging and drainage congestion are likely to be adequately addressed and hence the residual impact is likely to be **Low** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

6.5. Significant Social Impacts from Program Siting

6.5.1. Land acquisition and Resettlement

Potential impacts. Rehabilitation of existing and construction of new embankment will cause changes in land form and land use. For the priority reach, the total land requirement is about 370 ha. According to the full census of the priority reach carried out by the social safeguard team, a total of 5,751 households will be affected by the construction / rehabilitation of the embankment, in which 3,639 households need to be relocated. *Similar estimates will be included in the EIAs of the later phases of RBIP*. In addition, there will be some temporary land take during construction phase for establishing contractors' facilities such as camps and offices.

Significance of the above-described impacts has been determined as **High** based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

Mitigation and Management. To address the land take and resettlement impacts, detailed resettlement planning is underway following the national as well as World Bank policies and guidelines. A Resettlement Acton Plan (RAP) has been prepared for the Priority Reach; *similar plans will be prepared for the later phases of the Program and summarized in the EIAs of those phases*. The RAP includes entitlement matrix for each kind of resettlement impact, compensation payment procedure, monitoring requirements, and a comprehensive grievance redress mechanism (GRM).

Residual impacts. With the implementation RAP, the displacement-related impacts will be greatly addressed and the significance of the residual impacts is likely to be **Low to Moderate**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

6.5.2. Loss of Agriculture and Other Sources of Income

Potential impacts. The program interventions particularly the embankment works can potentially affect agricultural and other income generating activities under the program footprint and its immediate vicinity. The embankment works in the priority reach are likely to affect 276 ha of agricultural land and a total of 232 business structures. *Similar estimates will be included in the EIAs of the later phases of RBIP.*

Significance of the above impacts has been determined as **High** based upon the criteria described in **Section 6.2**.*This assessment will be revisited during the EIAs of the later phases of the RBIP.*

Mitigation and Management. The RAP will address all losses to agriculture and other income-generating activities caused by the program.

Residual impacts. With the implementation RAP, impacts associated with loss of agriculture and other incomes will be greatly addressed and the significance of the residual impacts is likely to be **Low to Moderate**. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

6.5.3. Impacts on Community Facilities and Places of Religious Significance

The program interventions particularly the embankment can potentially affect community facilities, common property resources, and religious places such as mosques, temples, and graveyards. The embankment in the priority reach is likely to affect a total of 74 such places. *Similar estimates will be included in the EIAs of the later phases of RBIP*. Most of these facilities are likely to be displaced because of the land acquisition for the program. Significance of these impacts has been determined as **High** based upon the criteria described in **Section 6.2**.*This assessment will be revisited during the EIAs of the later phases of the RBIP*.

Mitigation and Management. The relocation of the above listed community facilities and places will be covered under the RAP that is being prepared for the RBIP priority reach as mentioned in **Section 6.6.1** earlier; *similar RAPs will be prepared for the later phases of the RBIP as well*. The RAP describes the procedure to be adopted to relocate these facilities and will also include cost estimates for the relocation. The entire process of relocation will be carried out in complete coordination and participation of the relevant community and in a culturally- and socially-acceptable manner.

Residual impacts. With the implementation RAP, the displacement-related impacts will be greatly addressed and the significance of the residual impacts is likely to be **Low to Moderate**. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

6.5.4. Barrier/Severance Effect

Potential impacts. Riverbank revetment may potentially block access of the people to the river since slope of the concrete blocks can potentially make it difficult for the people and livestock to cross it. Similarly linear nature of embankment may block communities' access to and from the river. The embankment slope will also pose a hurdle for the people and livestock to cross it. Finally, when the road is constructed and becomes operational, it may potentially act like a barrier between the settlements and river. However, the road once operational will greatly facilitate local and long-distance transportation. The EIA of the Phase I lists the key bazaars and jetties that could potentially be affected by the program works; *a similar list will be included in each of the EIAs of the later phases as well*.

Significance of the above impacts has been determined as **Moderate** based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

Mitigation and Management. Stairs and ramps will be built at appropriate places of the river bank protected by revetment, in consultations with the local community. Similarly, stairs and or ramps will be built across the embankment at appropriate places in consultation with the local community. For vehicular traffic, road crossings will be

included in the road design; for pedestrian crossing appropriate arrangements such as zebra crossings and foot bridges will be included in the road design.

The EIA of the Phase I lists locations of the possible intersections along the road; *a similar list will be included in each of the EIAs of the later phases of the RBIP*.

During detailed design of road component, the location of the intersections and crossings along the road will be finalized using the following criteria:

- Selection of four arm junction:
  - Bank erosion line is more than 400m away
  - Earthen shank is directly connected to proposed embankment.
  - Big bazaar or growth center is on the river side.
  - Regular all weather crossing route exists
  - Big char area on the river side with habitation.
  - Road crossing the embankment.
  - Proposed alignment is straight and side road from river is perpendicular.
- Selection of T junction:
  - A connection to local road in country side
  - Big bazaar or growth center exists.
  - Regular all weather crossing route exists.
  - Road exists close to alignment
  - To connect nearby upazilas
  - To facilitate traffic for connecting other rural roads.

Residual impacts. With the help of above-specified mitigation measures, potential impacts associated with blocked access will be adequately addressed and hence the residual impacts will be **Low** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

6.6. Significant Environmental Impacts during Construction

6.6.1. Impacts from Borrow Areas

Potential impacts. During the construction phase, RBIP will need sand for construction of embankment and filling of geo-bags for riverbank protection. A limited quantity of earth will also be needed for embankment cladding. Sand will be extracted from the river banks with the help of small pumps.

Although, the sand extraction locations are not known at this stage, but it can be assumed that the contractors will prefer to collect sand from the nearest shallow semi-permanent sand bars. It is estimated that for the priority reach works, about 500 ha of riverbed would be affected by the sand extraction during each dry season (basis: about 23 million m^3 sand needed; about 10 million m^3 sand to be extracted each year along about 50 km river stretch with depth of about 2 m). *Similar estimates will be included in the EIAs of the later phases of RBIP*. Sand extraction may potentially decrease the quality of river habitat by increasing the water turbidity which may potentially affect the aquatic fauna including fish and dolphin. If this activity takes place during the breeding season (July to

August) of fish and dolphin then it may negatively affect their population dynamics as well. The sand extraction if carried out during nighttime may potentially affect the wintering birds that are mostly found on chars.

Several carp spawn collection area, some *koles* (embayment), and important *charlands* having waterfowl habitats were identified during the baseline survey. The sand extraction may potentially temporarily impact these areas by reducing feeding ground, creating noise, illumination, and increasing water turbidity. In addition, benthic fauna, phytoplankton and zooplankton may potentially be affected at the sand extraction sites ultimately disrupting the food chain, and as a result, tertiary level animals such as fish, birds, and dolphins that feed on these primary and secondary level fauna are likely to temporarily leave the area. The loss of fish production from the affected river area due to sand extraction for the RBIP Phase I (ie, priority reach) is estimated to be about 45 tonnes during each year of sand extraction (considering that the annual fish production rate of the Jamuna river is 90kg/ha/year). *Similar estimates will be included in the EIAs of the later phases of RBIP*. The disturbed river productivity will be restored by next flooding season due to natural sedimentation process of the river. Furthermore, this temporary loss will be more than compensated with the expected increase in the fish production on a permanent basis

Significance of the above impacts has been determined as **High** based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

Mitigation and Management. The contractor will be required to prepare the Borrow Area Management Plan and obtain approval from the construction supervision consultants (CSC). Sand extraction from river bank will be carried out in an environmentally and ecologically safe manner. Only small quantities of sand will be collected from any single location and stretches of riverbank will be left undisturbed between the locations from where the sand is extracted – in order not to disturb long, unbroken stretches of river bank thus allowing the aquatic fauna to rejuvenate at the sand extraction locations. Sand extraction will not be carried out at or in the vicinity of sensitive habitats.

The contractor will obtain clearance from the CSC before sand extraction can be carried out at any particular location. The CSC will issue this clearance after surveying the area and ensuring that no critical habitat exists at such location.

Monitoring will be initiated during the construction phase of the Phase I and continued thereafter to determine any long lasting impacts of sand extraction and to identify any mitigation measures if so needed (ToR of this monitoring is included in the EIA of Phase I). *The EIAs of the later phases will include the results of this monitoring if available by that time*.

No earth will be obtained from any cultivation fields; the existing embankments will be excavated to obtain the earth required for the embankment cladding.

Water will be obtained from the existing sources after reaching agreements with the relevant community and after paying the appropriate cost. Otherwise new tube-wells will be installed but maintaining safe distances from the existing ones thus ensuring no draw down of water in them. The GRM will also be put in place to address community complaints.

Residual impacts. With the help of the mitigation measures described above, the potential impacts associated with and extraction and water procurement will be

adequately addressed and hence the significance of the residual impacts is likely to be **Low**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

6.6.2. Air Pollution and Greenhouse Gases Emissions from Construction Works

Potential impacts. Construction of bank revetment, embankment and road works will generate emissions from excavation equipment, other machinery and construction traffic. The emissions will also include greenhouse gases (GHGs) from engine fuel combustion (exhaust emissions) and evaporation and leaks from vehicles (fugitive emissions) and emissions from asphalt works. The EIA of the Phase I of RBIP includes estimates for the total emissions of Reactive Organic Gases (ROG), carbon monoxide (CO), nitrogen oxides (NOx), sulfur oxides (SOx), particulate matter (PM), carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) generated by construction of embankment and revetment (from 2015 to 2019) and road works (from 2019 to 2020). *Similar estimates will be included in the EIAs of the later phases of RBIP*. Total GHG emissions in terms of CO_2 equivalent are provided in the EIA of the Phase I. It is estimated that about 0.019 million tonnes of CO_2 will be emitted during the six years of construction period from all the construction activities during the RBIP Phase I. *Similar estimates will be included in the EIAs of the later phases of RBIP*. The emissions from construction activities will deteriorate the ambient air quality and affect the public health. The dense populated areas and crowded market places (bazaars) are particularly vulnerable to these impacts. In addition, dust generated from the above activities will also have impacts on crops and livestock. These impacts have been assessed as Moderate Adverse. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

Mitigation and management. To mitigate deterioration of air quality and generation of dust, following measures will be taken:

- The equipment and vehicles used during the construction process will comply with the national standards on emission exhausts.
- Concrete batching and asphalt plants will be located minimum 500 m away from residential areas and will have appropriate dust/emission suppression mechanisms such as wet scrubbers.
- Contractor will implement dust prevention measures such as watering of roads near the residential areas and spraying of water on loose material where required and appropriate.
- Continuous air monitoring will be carried out near the sensitive receptors (already identified for the priority reach and listed in the EIA of the Phase I; *similar receptors will be identified in the EIAs of later phases of the RBIP*) to ensure ambient air quality remains within the EQS limits.
- Construction materials will be stored away from the residential areas and will be properly covered.
- Measures will be taken to protect the workers from excessive dust.
- A grievance redress mechanism (GRM) (discussed later in the document) will be put in place to receive complaints from public on various aspects of environmental issues, including air pollution. These grievances will be addressed by the contractor by adopting necessary pollution control measures. Continued consultations with the affected communities will be carried out during construction phase.

- To reduce the greenhouse gases emissions, a series of vehicle exhaust emission controls will be implemented. These include regular maintenance of vehicles, plant and machinery in accordance with manufacturer's specifications; monthly visual inspections on vehicle and plant exhausts to identify excessive emissions of smoke, and maintenance undertaken where required; switch off / throttle down all site vehicles and machinery when not in use; and avoid unnecessary idling of equipment.
- In addition, the measures in Environmental Codes of Practice (ECoP) on air quality management will be implemented (ECoPs are discussed later in the document).

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with air quality deterioration are likely to be adequately addressed and hence the residual impact is likely to be **Low** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

6.6.3. Noise Pollution from Construction Works

Potential impacts. Noise will be produced by vehicular movement, excavation machinery, concrete mixing, and other construction activities. The schools, religious places and crowded market areas are particularly vulnerable to the increased noise levels. Noise levels resulting from construction works during the Phase I have been estimated using US Federal Highway Administration's (FHWA) Roadway Construction Noise Model (RCNM) and presented in the associated EIA; *similar estimates will be included in each of EIAs for the later phases of the RBIP*. These impacts have been assessed as Moderate Adverse. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

Mitigation and management. To mitigate impacts associated with noise generation, following measures will be taken:

- The equipment and vehicles used during the construction process will comply with the national standards on noise.
- Continuous monitoring of noise levels will be carried out to ensure they do not exceed national standards.
- Contractors will adopt appropriate noise attenuation measures to reduce the noise generation from construction activities. The noise attenuation measures will include, (i) fitting of high efficiency mufflers to the noise generating equipment; and (ii) keeping acoustic enclosures around drilling equipment.
- The construction activities near the settlements will be stopped during night times if high noise values are observed
- A grievance redress mechanism (GRM) will be put in place to receive complaints from public on various aspects of environmental issues, including noise pollution. These grievances will be addressed by the contractor by adopting necessary pollution control measures. Continued consultations with the affected communities will be carried out during construction phase.
- In addition, the measures in ECoP on noise quality management will be implemented

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with noise generation are likely to be adequately addressed and hence the residual impact is likely to be **Low** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

6.6.4. Water Pollution

Potential impacts. During the construction phase, sand extraction and launching of geo-bags along the river bank can potentially cause some localized increase in water turbidity. However this increase in turbidity is not likely to have any significant impact on overall water quality and the aquatic fauna primarily because of its temporary and localized nature. The construction camps and other site facilities such as offices and warehouses will also generate substantial quantities of waste effluents. It is estimated that about 75,000 liters per day of waste effluents will be generated during the construction works of Phase I of the RBIP as detailed in the associated EIA; *similar estimates will be provided in each of the EIAs of later phases of the RBIP*.

Other possible causes of land or water contamination include accidental leakage or spillage of fuels, oils, and other chemicals, and waste effluents released from workshops and washing bays for vehicles.

These effluents can potentially contaminate the drinking water sources of the area and can also be harmful for the natural vegetation, cultivation fields, water bodies, and aquatic flora and fauna. The EIA of Phase I identifies the location of the water bodies (*khals* and *beels*) in the priority reach and their distance from the proposed embankment alignment; some of these water bodies are quite close to the alignment (eg, Kothir Pinjira khal, WAPDA khal, and Balia Ghugri khal); *similar estimates will be included in the EIAs of the later phases of RBIP.*.

Significance of the above-described impacts has been determined as **High** based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

Mitigation and Management. A methodology will be prepared for the river bank protection works in which the geo-bag launching will not be carried out in long stretches of the bank simultaneously. In this manner any increased water turbidity will remain limited and localized in nature hence avoiding any significant impact on overall water quality and aquatic fauna.

Similarly, sand extraction will not be carried out in long, contiguous stretches hence minimizing the extent of water pollution caused by this activity.

The contractors will be responsible to prepare and implement a waste and pollution management plan. The Plan will need to be cleared by the Construction Supervision Consultants (CSC) before it can be implemented. The Plan will include categorization and quantities, treatment mechanism (such as retention ponds and septic tanks), and final disposal of various waste streams; monitoring protocols; roles and responsibilities for the personnel assigned to implement the Plan; and documentation requirements.

For avoiding and managing any accidental leakages and spillages, standard operating procedures will be included in the HSE Plan described earlier. Monitoring of drinking water sources and other key water bodies in the area will also be carried out to ensure that these water resources are not affected by the program activities.

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with water pollution are likely to be adequately addressed and hence the residual impact is likely to be **Low** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

6.6.5. Soil Contamination

Potential impacts. Much like water pollution discussed above, soils in the construction area and nearby lands that are used for agriculture will be prone to pollution from the construction activities, construction yards, workers camps and other construction areas. Fuel and hazardous material storage sites and their handling are also the potential sources for soil and water pollution. Improper siting, storage and handling of fuels, lubricants, chemicals and hazardous materials, and potential spills from these will severely impact the soil and water quality and also cause safety and health hazards. Significance of these impacts has been determined as **High** based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

Mitigation and Management. For avoiding and managing any accidental leakages and spillages, standard operating procedures will be included in the HSE Plan. The contractors will also be responsible to prepare and implement a waste and pollution management plan. For the effluents to be released from workshops, camps, and offices, appropriate treatment arrangements such as retention ponds and septic tanks will be incorporated in the facility design.

The contractor will employ the general criteria for oil and leakage at construction sites, in accordance with the standards set forth by "Guidelines for Oil Spill Waste Minimization and Management" issued by International Petroleum Industry Environmental Conservation Associate which are as follows[15]:

- **Minor Skill / Leakage:** Soil contaminated by minor spills / leakages (defined as leaks from vehicles, machinery, equipment or storage containers such that the area and depth of soil contaminated is less than 1sqmeter and 75mm respectively) is to be scraped and burnt in a burn pit, away from population.
- **Moderate Spills** are defined as spills of volume less than or equal to 200 liters is to be contained and controlled using shovels, sands and native soil. These equipment and materials are to be made available at camp sites during the operation. The contaminated soil is to be excavated and stored in a burn area lined with an impermeable base. Depending on the volume, the contaminated soil is either disposed of by burning in the burn pit or by specialized treatment such as bioremediation.
- **Major Spills** (defined as spills of volume much greater than 200 liters) requires initiation of Emergency Response Plan. These spills are to be handled and controlled according to the Plan and require special treatment such as bioremediation.

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with soil pollution are likely to be adequately addressed and hence the residual impact is likely to be **Low** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

6.6.6. Generation of Solid Waste and Hazardous Waste

Potential impacts. Solid waste generated during the construction phase will include excess construction material such as sand and soil, faulty/damaged parts, metal scraps, cardboard boxes and containers, and cotton swaths from workshops, and domestic solid waste from construction offices and camps. It is estimated that about 150 kg of domestic

[15]Source: IPIECA/Energy Institute/Cedre 2004. IPIECA Report Series, Volume-12, "Guidelines for Oil Spill Waste Minimization and Management"

solid wastes will be generated daily from the construction camps and offices during the construction works of the RBIP Phase I. *Similar estimates will be included in the EIAs of the later phases of RBIP.*

In addition to the above, small quantities of hazardous waste will also be generated mainly from the vehicle maintenance activities (liquid fuels; lubricants, hydraulic oils; chemicals, such as anti-freeze; contaminated soil; spillage control materials used to absorb oil and chemical spillages; machine/engine filter cartridges; oily rags, spent filters, contaminated soil, and others). It is imperative that such waste is responsibly disposed to avoid adverse environmental, human health and aesthetic impacts.

Inappropriate disposal of these wastes can lead to soil and water contamination as well as health hazards for the local communities, livestock, and aquatic as well as terrestrial fauna. Significance of these impacts has been determined as **High** based upon the criteria described in **Section 6.2**.*This assessment will be revisited during the EIAs of the later phases of the RBIP.*

Mitigation and management. Contractors will be required to prepare and implement a Waste and Pollution Management Plan in accordance with the WB EHS Guidelines and ECoP. The Plan will be prepared on the 3R principle (reduce, reuse, and recycle), and will specify appropriate disposal mechanism and place for each type of waste. Particular attention will be focused on hazardous waste and it will not be released to the environment in any circumstance. Appropriate procedure such as MSDS will be used to dispose hazardous wastes. Complete record will be maintained for waste disposal. The GRM will also capture any complaints related to inappropriate solid waste disposal.

As an environmental enhancement measure, the program will prepare a waste management plan for the communities along the embankment. The Plan will be prepared under the Social Development Plan of RBIP, during the construction phase of the program.

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with solid waste generation are likely to be adequately addressed and hence the residual impact is likely to be **Low** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

6.6.7. Impact on Aquatic and Floodplain Habitats

Potential impacts. Sand extraction from the riverbank, launching of geo-bags, and placement of concrete blocks for the river revetment may potentially disturb the aquatic habitat by increasing the water turbidity (siting impacts of these activities have already been discussed earlier in the Chapter). Significance of these impacts has been determined as **Moderate** based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

Some sensitive and important habitats exist in the river chars (shoals) for wintering birds and some of the river channels for fish and dolphins. Similarly some of the beels (wetlands) in the floodplain provide important habitat for aquatic fauna. However embankment construction activities are not likely to have any direct impact on terrestrial or aquatic wildlife or their habitat since no sensitive ecological hot spots have been identified along the existing and proposed alignment in the priority reach (RBIP Phase I). A similar assessment will be carried out during the EIAs of the later phases of the RBIP. However any accidental leakage, spillage of contaminants, or dumping of solid waste/debris on land or in water bodies can potentially affect these habitats. Significance

of these impacts has been determined as **High** based upon the criteria described in **Section 6.2**.*This assessment will be revisited during the EIAs of the later phases of the RBIP*.

During the program -related boat traffic, there is a potential risk of collisions with fish and dolphins. This can cause injuries and even fatalities to these species.

Mitigation and Management. The potential impacts on the aquatic fauna can be at least partially addressed by not carrying out sand extraction and revetments along long, contiguous sections of the river bank at a time, as already described earlier. This measure is likely to keep the increased water turbidity and any other impacts on aquatic habitat localized and minimized, in addition to help rejuvenate the benthic fauna. In addition, the geo-bags and concrete blocks are likely to provide habitat for aquatic fauna such as eels. However to further understand the impact of revetment on aquatic fauna and characteristics of the new habitat provided by geo-bags and concrete blocks a long term monitoring and data collection is needed. This will be initiated during the program construction phase and continued thereafter; attempts will be made to involve national and international research and educational organization for this purpose. The ToR of this monitoring program has been included in the EIA of the Phase I.

Boat movement will be restricted to within 500 m of river bank. Motor boat speed will be limited to 15 km/h in accordance with best international practices. Pingers will be used to chase away dolphins form the construction areas thus minimizing the chances of any collision.

Any negative impacts on terrestrial or aquatic flora and fauna through land and water contamination can be adequately addressed by adopting pollution control measured implementation of which will be a binding on the contractors (see **Sections 6.6.4** to **6.6.6**).

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with aquatic habitat are likely to be somewhat addressed and hence the residual impact is likely to remain **Low to Moderate** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

6.6.8. Impact on C*harland* Habitat

Potential impacts. The construction activities are not likely to affect the wintering birds that are mainly found in the chars (shoals) since these chars are across the river channels and quite away from the construction sites. If any sand extraction activities are located near chars, noise generated from these activities has a potential to affect the migratory birds. However, due to the vast habitat range of these birds along the chars in Jamuna, the program is not expected to have any impacts on the migratory birds. If any construction activities disturb their roosting, hunting and feeding grounds, they would move to another lesser or undisturbed areas without any difficulty. Significance of these impacts has been determined as **Minimal** based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

Mitigation and Management. The contractors will be required to reduce the noise levels generated from the construction activities by providing mufflers or acoustic enclosures for high noise generating equipment. The Contractor will also raise awareness about the protection of birds among the work force to reduce impacts such as disturbance and poaching.

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with charland habitat are likely to be somewhat addressed and hence the residual impact is likely to remain **Minimal** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

6.6.9. Site clearance and Restoration

Potential impacts. After the completion of the construction activities, the left over construction material, debris, spoils, scraps and other wastes from workshops, and camp sites can potentially create hindrance and encumbrance for the local communities in addition to blocking natural drainage and or irrigation channels. Significance of these impacts has been determined as **High** based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

Mitigation and Management. The contractors will be required to remove all left over construction material, debris, spoils, and other wastes from the construction sites. The camps sites will be completely cleaned and restored in original condition to the extent possible. No waste disposal will be carried out in water channels (*khals*) or natural depressions and ponds (*beels*).

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with site clearance are likely to be adequately addressed and hence the residual impact is likely to be **Low** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

6.7. Significant Social Impacts during Construction

6.7.1. Impact on Cultural Heritage

Potential impacts. A number of sites and buildings of religious and cultural importance such as mosques, temples and graveyards in the priority reach will have to be relocated because of the reconstruction and rehabilitation of the embankment, as detailed in the EIA of Phase I. *The EIAs of the later phases will also identify any such sites that would potentially be affected by the construction activities.* Significance of these impacts has been determined as **Moderate to High** based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

Mitigation and Management. The contractors will be required to prepare code of conduct to be followed by all site personnel - to respect religious beliefs and sites, and to conduct in a culturally appropriate manner. In addition, 'chance find' procedures will be followed in case of accidental discovery of any sites or artifacts of religious, historical, or cultural importance.

Relocation of places such as mosques and temples will be covered under the RAP and the program will cover the entire cost of such relocation or reconstruction.

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with cultural resources are likely to be adequately addressed and hence the residual impact is likely to be **Low** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

6.7.2. Impact on Community Facilities

Potential impacts. A few schools and other community facilities exist along the embankment in the priority reach; a list of such facilities is included in the EIA of the RBIP Phase I. *The EIAs of the later phases will also identify any such community*

facilities that would potentially be affected by the construction activities. The potential impacts of the program on these schools could include relocation, air quality deterioration, noise, and safety hazards.

The construction activities can potentially damage the existing public and private infrastructures such as local roads, foot paths, and boat jetties. This can further aggravate the sufferings of the local communities because of river bank erosion and floods.

Significance of the above impacts has been determined as **Moderate** based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

Mitigation and Management. Any relocation needs of the schools and other community facilities will be adequately covered under the RAP that has been prepared for the Priority Reach. For noise, air quality, and safety hazard, the contractors will be required to ensure that activities in the vicinity of the sensitive receptors such as schools are carried out in a manner so as to minimize these risks (e.g., carrying out the construction activities after the school time). The construction site will be fenced near such places to minimize safety hazards. Safety signage will be placed and coordination will be maintained with the facility management as well as with the community to minimize the risks. Finally, any complaints of related to program impacts on the sensitive receptors will be addressed through the GRM described earlier.

The RAP covers the replacement and or relocation of the infrastructure that is affected by the direct land take for the program. Other damaged infrastructure affected by the construction activities will be repaired and or restored by the contractor.

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with community facilities are likely to be adequately addressed and hence the residual impact is likely to be **Low** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

6.7.3. Blockage of Local Roads/Routes/Jetties and Traffic Congestion

Potential impacts. Construction activities for riverbank protection may potentially block/hinder access to boat jetties. Similarly, construction works on the embankment may block local roads and routes and may prevent the local people to cross the construction area. Furthermore, the construction works and associated vehicular traffic may cause traffic congestion on local roads, particularly near local markets and boat jetties (list of the key boat jetties and local bazaars in the priority reach has been included in the EIA of Phase I; the EIAs of later phases will also include similar lists). Significance of these impacts has been determined as **Moderate** based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

Mitigation and Management. The contractor will prepare and implement a traffic management plan. Consultations with the local communities will be carried out on an on-going basis and the construction schedule will be discussed with them to ensure that blockage of the local routes is minimized. The construction works particularly at/near the boat jetties and local bazaars will be carefully planned to minimize hindrance to the local communities. The GRM described earlier will address any community grievances related to blocked routes as well. The contractors will be required to prepare and implement a traffic management plan that will be prepared in consultation with the local community and relevant officials.

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with blockage of local routes and roads are likely to be adequately addressed and hence the residual impact is likely to be **Low** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

6.7.4. Occupational Health and Safety

Potential impacts. Generally the construction activities will involve large scale excavation, operations of heavy construction machinery and vehicular traffic. These activities may pose health and safety hazards to the workers at site during use of hazardous substances, lifting and handling of heavy equipment, operating machinery and electrical equipment, working near water or at height and more.

The program will need fuels, oils, and asphalt during the construction phase. Inappropriate handling or accidental spillage/leakage of these substances can potentially lead to safety and health hazards for the construction workers as well as the local community.

Significance of the above impacts has been determined as **High** based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

Mitigation and Management. Standard operating procedures will be used to handle, transport, and store hazardous materials during the construction phase. Contractors will be required to prepare and implement Health, Safety, and Environment (HSE) plan at the construction sites and in construction camps. The Plan will need to comply with the WB Environment, Health, and Safety (EHS) Guidelines and Environmental Code of Practice (ECoP). The Plan will include standard operating procedures for handling with emergencies, accidents, and incidents; roles and responsibilities, training and capacity building requirements; and documentation and reporting protocols. The contractors will have qualified people at the site to implement the HSE Plan. The construction workers will use PPEs. Contractors will also prepare an Emergency Response Plan (ERP) to define procedures and actions in the event of any accidents such as fires. Contractors will also be responsible to provide HSE trainings to their staff and workers and awareness raising of nearby communities.

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with health and safety issues are likely to be addressed to a considerable extent and hence the residual impact is likely to be **Low to Moderate** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

6.7.5. Community Health and Safety

Potential impacts. During the construction phase, the population living in close proximity of the construction area and construction camps, people living in and around the potential resettlement sites, the construction workforce and individuals drawn to the area in search of income opportunities will be exposed to a number of temporary risks such as safety hazards associated with the construction activities and vehicular movement, exposure to dust, noise, pollution, infectious disease, and various hazards, including potential conflict with “outsiders” to the program influence area about employment and income. The influx and accommodation of a large work force will result in increased concerns for the health and safety of local population, including the spreading of sexually transmitted diseases such as HIV/AIDS. Significance of these

impacts has been determined as **High** based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

Mitigation and Management. To address the safety risks for the construction workers, the contractors' HSE plan will include detailed occupational health and safety (OHS) procedures and protocols. Similarly, the HSE plan will also include measures and protocols to protect the nearby community against the risk of accidents and mishaps. In addition, the ERP will also include procedures to be followed in case any accident does take place. Community awareness, warning signboards, and area fencing where possible will be some of the key elements of the safety protocols.

To address the health hazards caused by the program, the Public Health Action Plan (PHAP) has been prepared as part of the social safeguard documents. The key interventions proposed under PHAP include the following:

- **Safe drinking water**: Testing of tube well water for households along old embankment and upgrading them if required, as well as safe tube wells in resettlement sites.
- **Hygienic latrines**: water-sealed slab latrines for each household along old embankment and in new resettlement sites.
- **Clean cooking stoves**: provision of clean cooking stoves for each household along the old embankment and in new resettlements
- **Information, Education, and Communication (IEC)**: Construction-related risks (for households along embankments), HIV/AIDS, TB, hand washing, maternal health, nutrition for households along the old embankment and in new resettlement.
- **Capacity Building**: Training of upazila and zila (district) public health staff on infectious diseases, emergency care, traumatology and referral; and Training of Skilled Birth Attendant and Community Health Workers.

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with the community health and safety issues are likely to be addressed to a considerable extent and hence the residual impact is likely to be **Low to Moderate** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

6.8. Impacts Predicted For Construction of New Road and Improvements of Access Road

The main activities are as follows:

- Site clearance (removal of trees from one side, assets etc.);
- Construction yard & Labor Camp;
- Earth works (cutting & filling);
- Bridges/Culverts;
- Bituminous pavement works;
- Slope protection works for road (by grass turfing) and bridge/culvert (by blocks);
- Removal of construction waste.

Most of the Environmental impacts of the construction phase as like construction camp,

air-noise-water pollution, flora-fauna have been cited above. However, some specific impacts associated with the road are described below. This assessment will be revisited during the EIAs of the later phases of the RBIP.

6.8.1. Equipment

Impacts- Non specified equipment as well as setting up of Hot mix Plants and Crushers at improper location will make disturbance to the local people and community.

Mitigation Measures - Specifications of crushers, hot mix plants and batching plants, other road construction vehicles to be procured will comply to the relevant Standards/ norms and with the requirements of the relevant current emission control legislations. Hot mix plants, crushers and batching plants shall be located at a safe distance from the nearest habitation and dense tree area. Plant to be set up 500 m away from surface water body.

6.8.2. Bituminous Pavement Works

Impacts- Spills from Bitumen plants may contaminate surrounding area as well surface water quality. Generated emission and polluted air due to burning of asphalt.

Mitigation Measures - Careful management of any petroleum products used in the preparation of the bitumen mixture to avoid spills and contamination of the local water table. Using of hot mix plants, crushers and batching plants with adequate stack height will minimize the effect due to emission. Tree plantation on the slopes all along the approach road, construction yards, construction camps, to reduce the effect of emission of dust and pollutants on the adjacent/nearby communities

6.8.3. Topography and Soils

Impacts-The topography along the roads will change to some extent because of filling and cutting of soil, filling and improvement of program related structures. The main impacts generating activities during improvement will be clearing of right-of-way, cutting and filling, blasting, and dismantling damaged pavements and borrows pits. Also the soil may be contaminated due to the improper storage of bitumen or refuelling of equipment/vehicle.

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

Mitigation Measures-Storage of bitumen drum and refueling of Vehicle / machinery shall be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. An “oil interceptor” will be provided for storage and refueling areas.

Visual changes to the landscape will have no mitigation measures, but the road improvements should consider aesthetic concerns. Tree planting along the road improvements area should be properly planned.

In the selection of borrow areas for the subproject, productive agricultural areas have been avoided for borrowing of materials. The workers camps, storage and godowns will

not be established at agricultural land. In case productive areas are taken for storage or workers' camp, the post construction rehabilitation will be ensured.

6.8.4. Hydrology/ Drainage Congestion

Impacts-The potential risk of erosion will increase during road improvements if the culverts and bridges crossings improvements are provided with waterway width less than the regime width of the canal and river. The portion of the road that is in contact with canal and river will be provided with slope protection measures. Adequate drainage structures need to be provided at appropriate location of the road.

Mitigation Measures-Provision of adequate waterway opening of the bridges/culverts should be included in the design and implement accordingly. River bank revetment works should be done to protect the roads from river bank erosion. In the short-term, either temporary or permanent drainage works shall protect all areas susceptible to erosion, flood damage and rainfall. Drainage facilities need to be provided in the diversion road at the bridge/culvert construction sites to avoid temporary drainage congestion.

6.8.5. Road Safety and Construction Safety, Occupational Health and Safety

Impacts-Construction workers may be affected adversely due to hazardous working environments with high noise, dust, unsafe movement of machinery, bituminous work etc. The construction of a high-speed road can lead to severance issues.

Roads in good condition will reduce traffic blocks, engine idle time and damage to motor vehicles. The ensuing benefits to public health and economy though marginal will also add to the main benefit of smooth and faster traffic flow.

Mitigation Measures-Residents must be able to cross the road safely and particular attention must be given to vulnerable groups such as children, the elderly, and animals. All vehicles should observe speed limits and load restriction.

The contractor shall instruct his workers in health and safety matters, and requires the workers to use the provided safety equipment. The scope will need to include transmittable diseases establish all relevant safety measures as required by law and good engineering practices. Arranging for provision of first aid facilities, rapid availability of trained paramedical personnel, and emergency transport to nearest hospital with accident and emergency facilities. Arranging for regular safety checks of vehicles and material, and allocation of responsibility for checking. The contractor will responsible for ensuring that all construction vehicles observe speed limits on the construction sites and on public roads. All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles.

6.8.6. Socio-economic Aspects

Impacts-The number of households and small business and shop owners on either side of the road improvements sub-project area may be affected adversely during the construction. During the construction phase could also result from, construction workers developing conflicts with local community, spread of vector borne and communicable diseases from labour camps, and disruption of services and shifting of utilities as road improvement will pass several villages. However, the road improvements will bring in economic and social benefits to the people in the subproject area. The road will provide better connectivity between upazila in the different district. The program will thus contribute to(i) reduce travel time; (ii) ensure uninterrupted traffic and; (iii) increase economic activities in the region; (iv) employment opportunities for the local populations.

(v) reduce poverty (vi) increase accessibility to the markets, schools, and social and health services.

Mitigation Measures- The adverse impacts of construction phase are localized in spatial extent, temporary and short in duration and can be mitigated by good standard construction practices. To ensure that adverse impacts on the community are avoided, mitigated or compensated. Provide alternative sites for vendors/micro businesses and houses using or are in the right of way. These sites should be selected to facilitate equal or enhanced income/living conditions. Schedule the construction activities to avoid or minimize impact on road side shops, businesses and houses.

The program authorities might employ local people wherever possible, hopefully with preference to the qualified landless and jobless poor of the subproject areas ensuring socio-economic enhancement in the real terms. Women from PAPs' families could be offered the program created facilities.

6.8.7. Road Accidents

Impacts- The construction of road can lead to severance issues. Road accidents may increase due to higher number of vehicles using the roads at increased speeds. The road after completion of construction will attract settlements and undesired structures including commercial facilities particularly near the community. Growth of settlement on vacant ROWs near the community increase accident risk.

Mitigation Measures-If control measures are not adopted this could become a hazard to pedestrians, too. Residents must be able to cross the road safely and particular attention must be given to vulnerable groups such as children, the elderly, and animals. All vehicles should observe speed limits and load restriction. Traffic signs, speed breaker especially nearby the cultural/health centres should be installed. Drivers should follow BRTA rules and regulations.

6.9. Environmental Impacts during Operation and Maintenance

6.9.1. Potential Changes in River Morphology and Erosion

Potential impacts. The potential changes of the revetment on river morphology may include stabilization and deepening of the river channel. These changes are mostly positive in nature, likely to take place over a long period of time and need to be regularly monitored for better understanding of the phenomenon. Geomorphic studies (Attachment 1 of Feasibility Report) have shown that river bank protection revetments are likely to induce only minor, localized effects on the river morphology. Morpho-dynamic modeling was also carried out to assess the effects of river bank protection structures on water levels, near-bank velocity, bank erosion, and riverbed level. These model investigations confirmed the geomorphic assessment that the planned river bank protection works will only induce localized bed changes. Furthermore, the morphological changes that may be caused by the proposed revetment will not extend beyond the Jamuna bridge since at that location river morphology changes significantly and Jamuna flows mainly as a single channel river. This potential impact has also been assessed as **Moderate**, based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

Mitigation and Management. To better understand the cause and effect relationship of river bank revetment and morphological changes in the river, a long term monitoring program will be designed and initiated during the program implementation. The

monitoring program will continue after the program completion and arrangements will be made for funds allocation for this program on a sustainable basis. Possibility of engaging national and international educational and research organizations will also be explored. This will in turn help provide resources and manpower for on-going efforts for data collection, monitoring, analyses, as well as planning for future interventions in and around the river.

6.9.2. Generation of Solid Waste

Potential impacts. Solid waste will be generated from future toll plaza and also during regular operation and maintenance activities. Hazardous waste will also be generated from road maintenance from removal of asphalt. This waste if not appropriately disposed has a potential to contaminate soil and water resources, thus negatively affecting communities as well as natural habitat. Significance of these impacts has been determined as **High** based upon the criteria described in **Section 6.2.***This assessment will be revisited during the EIAs of the later phases of the RBIP*.

Mitigation and management. The BWDB will prepare an HSE Plan that will cover the appropriate disposal mechanism for various types of solid wastes.

In addition, a waste management plan will be prepared for the communities along the embankment, as stated earlier as well in **Section 6.7.6**.

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with waste generation are likely to be adequately addressed and hence the residual impact is likely to be **Low** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

6.9.3. Air Pollution from Traffic

Potential impacts. Emissions from road traffic may affect the ambient air quality along the road embankment. Air quality modeling will be taken up during detailed design of road component to predict the air quality during O&M Phase. Annual GHG emissions from road traffic along 50 km of priority reach are estimated using the EBRD guidance note on 'Methodology for Assessment of Greenhouse Gases'. Annual GHG emissions from future traffic will vary from 0.02 to 0.16 million tonnes. These impacts have been assessed as **Moderate** based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

Mitigation and Management. The following measures will be implemented to address the air quality issues:

- During design of road component, various options to reduce the traffic congestion will be considered to reduce traffic emission. These measures could include: (i) minimizing grade changes, at-grade crossings, and sharp curves which can promote congestion and (ii) design of roadway to shed water to minimize rolling resistance, as well as to enhance safety
- The road surface will be maintained regularly for smooth traffic flow and reduction of vehicular emissions
- Tree plantation will be carried out along the road embankments to reduce the impacts on air quality.

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with air quality are likely to be adequately addressed and hence the residual impact is likely to be **Low** in significance.

6.9.4. Noise Pollution from Traffic

Potential impacts. During operation, noise levels along the program roads will be increased due to the higher traffic volume. Traffic noise will be a significant nuisance to the sensitive receptors such as schools and religious places located vary close to the road. The traffic noise levels will depend on road way profile, horizontal alignment, road and receptors elevation, number of lanes, average daily traffic with type of vehicles, speeds, receiver location, nature of intervening ground, and the presence of noise shielding elements. Since most of this information will be available only after design of the road, a detailed traffic noise modeling will be carried out during detailed design phase of the road component (2016-2018). Based on the outcome of the noise modeling, noise barriers will be constructed near the sensitive receptors. However, a preliminary assessment has been carried out to predict the traffic noise levels using US Federal Highway Administrators Traffic Noise Model (FHWA TNM 2.5). Without construction of barriers or development of plantation along the road, the noise levels within 50 m of road will exceed the national standards. These impacts have been assessed as **Moderate**, based upon the criteria described in **Section 6.2**. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

Mitigation Measures. The following measures will be implemented to address the noise quality issues:

- During design of road component, a detailed traffic noise modeling will be carried to out to design noise barriers (e.g. walls, vegetation) along the embankments to reduce the noise levels near sensitive receptors such as schools.
- GRM will be established to address complaints particularly from the communities along the road.

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with noise generation are likely to be adequately addressed and hence the residual impact is likely to be **Low** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

6.9.5. Water Pollution

Potential impacts. Generally paved road increases the amount of impermeable surface area, which increases the rate of surface water runoff. Increased storm water flow rates can lead to stream erosion and flooding downstream; cause soil erosion, channel modification and siltation of streams.

During the O&M phase, some localized increase in turbidity may take place during any maintenance works on the bank revetment. Similarly, the maintenance works can also generate a limited quantity of waste effluents.

Significance of the above impacts has been determined as **Moderate** based upon the criteria described in **Section 6.2.** *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

Mitigation and Management. Appropriate storm water drainage arrangements will be included in the road design. The runoff will be released in a manner that it does not cause soil erosion. To address the potential issues associated with waste effluents generated by

O&M activities, the HSE Plan prepared by the BWDB also mentioned earlier will include disposal mechanism for waste effluents as well.

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with storm water are likely to be adequately addressed and hence the residual impact is likely to be **Low** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

6.10. Significant Social Impacts during Operation and Maintenance

6.10.1. Community Health and Safety

Similar to construction activities, significant community health and safety issues associated with the maintenance activities will include pedestrian safety, traffic safety and emergency preparedness. Pedestrians will be at greatest risk of serious injury from collisions with moving vehicles. Collisions and accidents can involve a single or multiple vehicles, pedestrians or bicyclists, and animals.

Emergency situations most commonly associated during O&M phase will include accidents involving single or multiple vehicles, pedestrians, and/or the release of oil or hazardous materials.

Toll Plaza and maintenance personnel at work will be subjected to physical and chemical hazards and noise. Maintenance personnel and landscaping workers working on right of way vegetation will be exposed to variety of physical hazards, particularly from operating machinery and moving vehicles and also working at elevations on bridges and overpasses.

Chemical hazards in operations and maintenance activities may be principally associated with exposures to dust during construction and paving activities; exhaust emissions from heavy equipment and motor vehicles during all maintenance activities; potentially hazardous dust generated during bridge paint removal; herbicide use during vegetation management; and diesel fuel used as a release and cleaning agent for paving equipment.

Significance of the above impacts has been determined as **High** based upon the criteria described in **Section 6.2.** *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

Mitigation and Management. During the O&M phase, the BWDB will be required to implement HSE procedures and prepare its own ERP. For the safety hazards associated with vehicular traffic on the embankment road, standard road signage and other safety measures such as Zebra Crossings and pedestrian walk-overs (bridges) are being included in the road design. Community awareness raising about these risks will be carried out during the construction phase and will also be included in the IEC component of the social development program.

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with safety hazards are likely to be addressed to a considerable extent and hence the residual impact is likely to be **Low to Moderate** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP.*

6.10.2. Risk of Embankment Breaches and Emergency Response Mechanism

Potential impacts. Though the RBIP aims to strengthen the embankment, breaches can still take place because of a variety of reasons such as earthquakes and riverbank erosion. Such breaches in the post RBIP completion phase can potentially cause considerably

higher losses than currently being incurred because of the intensified cultivation and increased area development that is likely to take place because of the enhanced protection against riverbank erosion and floods, as described earlier as well. Significance of these impacts has been determined as **High** based upon the criteria described in **Section 6.2.** *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

Mitigation and Management. The BWDB's O&M procedures include regular monitoring of the embankment and its structural integrity, ensuring that the breaches can be prevented (see **Section 3.5**). The BWDB will also prepare an ERP that will address among others embankment breaches.

Residual impacts. With the help of the above mitigation measures, the potential impacts associated with embankment breaches are likely to be addressed to a considerable extent and hence the residual impact is likely to be **Low to Moderate** in significance. *This assessment will be revisited during the EIAs of the later phases of the RBIP*.

7. Environmental Management Plan

This Chapter presents the outline environmental management plan (EMP) of the RBIP. A more detailed version has been included in the EIA of the RBIP Phase I; the EIAs of subsequent phases will also include a similarly detailed version of EMP.

7.1. EMP Objectives

The basic objective of the EMP is to manage adverse impacts of program interventions in a way that minimizes the adverse impact on the environment and people of the program influence area. The specific objectives of the EMP are to:

- Facilitate the implementation of the mitigation measures identified during the present EIA and discussed earlier in the document.
- Maximize potential program benefits and control negative impacts;
- Draw responsibilities for program proponent, contractors, consultants, and other members of the program team for the environmental and social management of the program;
- Define a monitoring mechanism and identify monitoring parameters in order to:
- Ensure the complete implementation of all mitigation measures,
- Ensure the effectiveness of the mitigation measures;
- Maintain essential ecological process, preserving biodiversity and where possible restoring degraded natural resources; and
- Assess environmental training requirements for different stakeholders at various levels.

The EMP will be managed through a number of tasks and activities and site specific management plans. One purpose of the EMP is to record the procedure and methodology for management of mitigation identified for each negative impacts of the program. The management will clearly delineate the responsibility of various participants and stakeholders involved in planning, implementation and operation of the program.

7.2. Inclusion of Relevant Components of EMP in Contract Documents

The specific EIA should include a section on special environmental clauses (SECs) to be incorporated in the Tender Document under General/Particular Specification. These clauses are aimed at ensuring that the Contractor carries out his responsibility of implementing the environment management plan (EMP), monitoring plan as well as other environmental and safety measures. Such clauses may specify, for example, penalties for non-compliance as well as incentives to promote strong compliance. The various contractors must be made accountable to implement the plans and mitigation measures which pertain to them through contract documents and/or other agreements of the obligations and importance of the environmental and social components of the program. In addition the specific EIA will ask to submit an Environment Management Action Plan (EMAP) to encompass all of the detailed plans, measures and management systems they are required to develop and implement, to be based on this EIA, their work methodology, work force involvement, equipment's standard, and work scheduling.

7.2.1. Payment Milestones

Payments to contractors would be linked to environmental performance, measured by completion of the prescribed environmental and social mitigation measures. Contractors would be required to join forces with the executing agency, project management unit, supervising consultants and local population for the mitigation of adverse impacts of the program. For effective implementation of the proposed mitigation and monitoring measures they would attract trained and experienced environmental management staff.

7.2.2. Guideline to Incorporate Environmental Management in Bid Document

The design consultants will be responsible to incorporate environmental management requirements in the bidding documents, with the assistance of the environmental consultants. The generic guidelines to incorporate environmental aspects in the bidding documents are listed below.

- Prepare cost estimates, to be incorporated in Bid Documents.
- Contractor version of the Environmental Management Plan along with the ECoPs to be incorporated in the bid document‘s work requirements.
- Penalty clauses for not complying with EMP requirements to be incorporated. Indicative penalty clauses are presented below (Addendum to Clause 17.2 Contractor‘s Care of the Works of FIDIC).
  - The contractor has to follow all traffic safety measures as defined in the technical specification. Damage shall be levied at the rate Tk. 3000/- per day per location for non – conformity of traffic safety measures as per the decision of the engineer.
  - The contractor has to follow all environmental mitigation measures as defined in the technical specification read along with the Environmental Management Plan for the specific RBIP activities. Damage shall be levied at the rate Tk. 3000/- per day per location for nonconformity of Environmental Management Plan measures as per the decision of the BWDB Engineer.
  - The contractor has to ensure that prior to every monsoon season, during the construction period; all the temporary and permanent cross drainage structures are free from debris as defined in the Technical Specifications read along with the Environmental Management Plan. Damage shall be levied at the rate of Tk.3000/- per day per location for non-conformity as per the decision of the Engineer.
  - The contractor has to ensure that sufficient numbers and good quality Personnel Protective Equipment (PPE), should be provide to staff and labor all time as defined in the labor codes read along with the EMP. Damage shall be levied at the rate of Tk. 1000/- per day for non-conformity as per the decision of the Engineer. In addition, for any non-compliance causing damages or material harm to the natural environment, public or private property or resources, the contractor will be required to either remediate / rectify any such damages in a timeframe specified by and agreed with the engineer, or pay BWDB for the cost (as assessed by BWDB) of contracting a third party to carry out the remediation work.
- Since many contractors do not have clear understanding the need of environmental management, some quote very low price for implementation of EMP and eventually cannot implement EMP as per design. To avoid this problem, fixed budget may be assigned for EMP implementation. The contractors may need orientation on the requirement of the EMP in the pre-bidding meeting.

7.3. Institutional Arrangements

The following institutional arrangements have been included the EIA of the RBIP Phase I. *For the later phases, these arrangements will be revisited and modified as appropriate.*

7.3.1. Construction Phase

The RBIP implementation will be led by the River Management Office (RMO) that will be established within BWDB. The RMO will be headed by the Chief Engineer River Management (CERM) acting as Project Management Unit (PMU) and Project Director (PD). The post CERM was approved in November 2014 as part of the planning wing under the Additional Director General Planning. Further details of the institutional arrangement for the overall RBIP management are available in Feasibility report under the Institutional Arrangement volume.

The overall responsibility of environmental performance including EMP implementation of the RBIP will rest with the PMU (i.e., RMO). The PMU will engage construction supervision consultants (CSC) (described as the Project Management Consultants in the feasibility report) to supervise the contractors that will carry out the construction activities. The CSC will ensure adherence to the design parameters including quality requirements.

Within the PMU, the environmental and social development unit (EDSU) will be established tasked with implementing the EMP during the program construction phase. The ESDU will have adequate numbers of environmental and social scientists/specialists and maintain coordination and liaison with CSC for effective EMP implementation. Similarly, the CSC will also have environmental and social monitors who will supervise and monitor the contractors for effective EMP implementation. The contractors in turn will also have HSE supervisors who will ensure EMP implementation during construction activities and will be tasked to implement HSE Plan. The PMU will also engage an independent organization to carry out environmental monitoring during program implementation. The roles and responsibilities of ESDU, CSC, and contractors are presented in **Table 7.1** below.

Table 7.1: Roles and Responsibilities for EMP Implementation

Organizations	Responsibilities
PMU (RMO)	• Ensure that all program activities are well-managed and coordinated. • Procurement of works and goods. • Payment of compensation to the program affectees • Recruitment and supervision of Construction Supervision Consultants (CSC) • Recruitment and supervision of external monitor and independent Panel of Experts
ESDU	• Ensuring inclusion of EMP in bidding documents • Supervising CSC for the implementation of EMP • Ensure that all the program activities are carried out in environmentally sound manner. • Closely coordinate with other concerned agencies, local governments

Organizations	Responsibilities
	and communities to support implementation of EMP • Preparation of progress reports on implementation of EMP. • Ensure effective implementation of EMP components not directly tasked to the contractor including components dealing with indirect, induced and cumulative effects, as well as operations and maintenance stage plans and measures. • Commissioning and review of consultant reports for EIAs/EMPs to be developed for subsequent phases of RBIP.
CSC (PMC)	• Supervise civil works, ensuring compliance with all design parameters including quality requirements • Supervising contractors for EMP implementation • Prepare monthly reports and submit to PMU • CSC will have dedicated environmental and social staff
Contractor	• Responsible for implementation of mitigation and monitoring measures proposed in the EMP • Each contractor will recruit an Environmental, Health, and Safety Manager (EHSM), who will be responsible for implementing the contractors' environmental responsibilities, and liaising with government agencies. S/he will have adequate number of staff to support him/her for these tasks.
External Monitor	• Independent monitoring of implementation of EMP • External Monitoring and evaluation

7.3.2. O&M Phase

For the environmental management of the program during the O&M phase, BWDB will establish the Environmental and Social Cell (ESC). ESC will have adequate numbers of the environmental and social specialists.

7.3.3. Environment and Social Development Unit

BWDB has agreed to set-up an Environment and Social Development Unit/Cell with qualified staff in their regular organogram. Since the establishment of the Unit/Cell would require several administrative clearances, as an interim measure, BWDB will set-up a project specific Environment and Social Development Unit (ESDU) in the PMU (i.e., RMO) of RBIP. This ESDU under the leadership of a Superintending Engineer will assist the PMU on issues related to environmental and social management. ESDU will provide trainings to the BWDB personnel responsible for monitoring of environmental compliance during the O&M phase of the program. Thus smooth transition to BWDB will happen to ensure environmental compliance during the O&M phase.

The organogram for Environmental and Social Development Unit is shown in **Figure 7.1**.

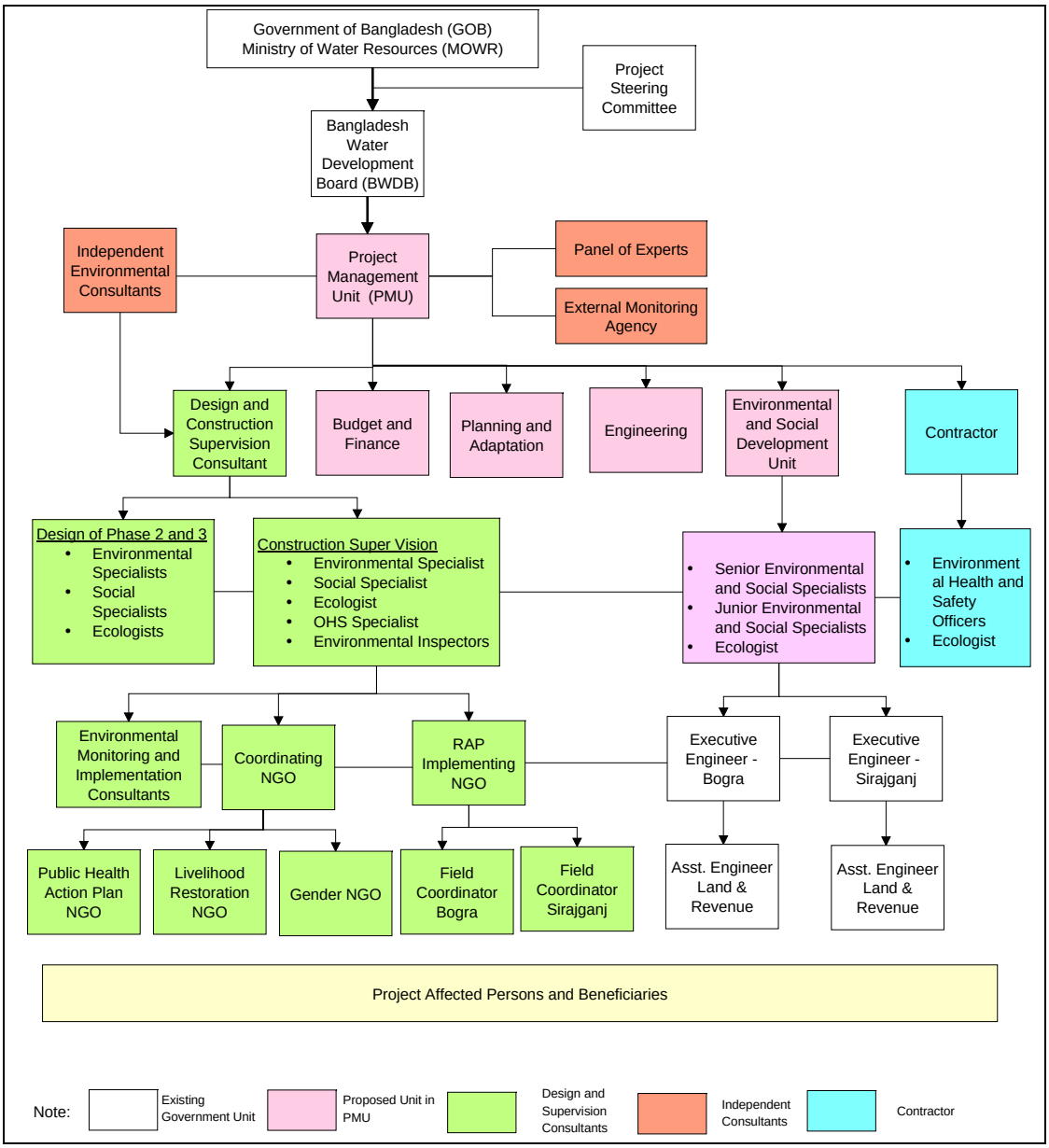


Figure 7.1**: Organogram for Environmental Management**

The ESDU to be established to implement and manage the EMP will be structured to provide co-ordination, technical support and services during the environmental screening and preparation of EA, and implementation of the environmental mitigation measures. Functions and the staffing responsibilities of ESDU are listed in **Table 7.2** below. In order to effectively manage the EA process and EMP implementation, the ESDU will be established and made operational before awarding the contract to contractor. One Senior Environment Specialist will be appointed at the head quarter. One environment specialist and one social development specialist will be posted at the field level.

Table 7.2: Functions and Responsibilities of the ESDU

Designation	Function/Responsibility
ESDU (Sr. Environment Specialist)	• Assist the PD in conducting environmental screening and categorization of each phase; • Assist the PD in implementation of the EIA and EMP during the project implementation period; • Preparation of EA and finalization of the same in close co-ordination with the design consultants and the World Bank; • Ensure integration of the EA and resulting EMP into the project redesign and implementation plans (contract documents); • Ensure compliance of the mitigation measures by the Contractors; • Ensure incorporation of appropriate environmental specifications into the respective bidding and contract documents; • Assist the BWDB Engineers at site by providing appropriate environmental advice, and developing appropriate environmental mitigation measures; • Documenting the experience in the implementation of the environmental process; • Assist consultant's and BWDB community organizer to carryout participatory consultation during planning, design and implementation; • Assist the PD in obtaining Environmental Clearances from the DOE; • Assist in development of training program for the key stakeholders (BWDB, contractors, public representatives and local government institutions/ NGOs, in collaboration with the field level junior Environmental Specialist; • Review and approve the Contractor's Implementation Plan for the environmental measures, as per the EMP; • Liaison with the Contracts, CSC for the Implementation of the EMP; • Liaison with the DOE on environmental and other regulatory matters; • Interact with the NGOs and Community based organizations to be involved in the project for EMP implementation; • Dialogue with the project affected persons (PAPs) and ensure that the environmental concerns and suggestions are incorporated and implemented in the project; • Undertaking environmental monitoring and reporting to the Project Director and follow-up activities; • Assist field level junior environment specialist to resolve any environment related issue in the project • Document the standard construction practices in the project on incorporation and integration of environmental issues into engineering design and on implementing measures reconstruction/rehabilitation and maintenance programs; • Assist the PD to arrange for the Environmental Auditing and follow up action on the Audit recommendation.

Designation	Function/Responsibility
	• Report to the PD on the environmental aspects pertaining to the project. • To guide and assist the PD and the BWDB to strengthen the environmental management practices in embankment rehabilitation, revetment and road construction. • Ensuring Update of Database for project specific environmental information • Prepare periodic progress reports on the implementation of the EMF/EMP for transmission to the World Bank throughout the project implementation period. • Update of Environmental Management Plan and Environmental Impact Assessment after receiving information from the contractors and design consultants. • Capacity Building of the responsible assistant and deputy chief responsible for environmental sustainability assurance of BWDB project • Maintaining project-specific Database for Environmental Management
Field Level Environment and Social Development Specialists	• Assist the Design Consultants in Environmental screening process • Assist the PMU in Environmental and Social Assessments for the projects; • Assist PMU in obtaining of requisite Environmental Clearances for the project; • Assist the Senior Environment Specialist and the Environmental Specialist of the Design Consultants and CSC in preparation of the training materials and in conducting training; • Review the contractor's Implementation Plan for the environmental and social mitigation measures, as per the EMP with assistance from the Environmental Specialist of the consultant; • Liaison with the contractors and CSC on the implementation of the EMP; • Carry out consultations with the NGOs and Community groups to be involved in the project; • Establish dialogue with the affected communities and ensure that the environmental concerns and suggestions are incorporated and implemented in the project; • Carry out site inspections, check and undertake periodic environmental monitoring and initiate necessary follow-up actions; • Document the good practices in the project on incorporation and integration of environmental issues into engineering design; • Report to the Executive Engineer (Environment) / PD on the environmental aspects pertaining to the project; • Assist in the preparation of periodic reports for dissemination to the PMU, and World Bank.

7.3.4. Construction Supervision Consultants (CSC)

The CSC will be responsible for supervising the contractors for the implementation of EMP. For this purpose, the CSC will appoint dedicated separate environment and social staff to ensure EMP implementation during the program. They will supervise the contractor for the EMP implementation, particularly the mitigation measures. They will also be responsible for implementing the monitoring of effects of these measures.

7.3.5. Contractors

Each contractor will be required to appoint adequate number of dedicated Environment/Social Officers at the site for the implementation of EMP in the field, particularly the mitigation measures. The contractor will also be responsible for communicating with and training of its staff in the environmental/social aspects. The contractor will develop the various plans directed towards health, safety, the environment and social issues, and get them approved by the CSC before the commencement of the physical works on site. Appropriate numbers of the following personnel are required in the contractor's environmental team:

- Environmental Specialists
- Occupational Health and Safety Specialists
- Environmental Technicians (both for lab and field investigations)

The construction contracts will have appropriate clauses to bind the contractors for the above obligations.

7.4. Environmental and Social Management

Various environmental and social management plans that need to be prepared for each phase of the RBIP. Suggestive plans are listed in **Table 7.3** and described in subsequent sections.

Table 7.3: Management Plans

	Plan
1.	Environmental Codes of Practice (ECPs)
2.	Mitigation and Compliance Monitoring Plans
3.	Material borrowing plan (river sand)
4.	Plantation Plan
5.	OHS Plan
6.	Pollution Prevention Plans (related to air, noise, soil, water resources)
7.	Waste Disposal and Effluent Management Plan

	Plan
8.	Drinking Water Supply and Sanitation Plan
9.	Traffic Management Plan
10.	Construction Camp Management Plan
11.	Fuels and hazardous substances management plan
12.	Emergency Preparedness Plan (for construction phase)
13.	Emergency Preparedness Plan (for O&M Phase)
14.	Resettlement Action Plan
15.	Gender Action Plan
16.	Public Health Action Plan

7.4.1. Environmental Codes of Practice

The environmental codes of practice (ECoPs) are generic, non site-specific guidelines. The ECoPs consist of environmental management guidelines and practices to be followed by the contractors for sustainable management of all environmental issues. The contractor will be required to follow them and also use them to prepare site-specific management plans (discussed later in the Section). The ECoPs are listed below and attached in **Annex B**.

- ECoP 1: Waste Management
- ECoP 2: Fuels and Hazardous Substances Management
- ECoP 3: Water Resources Management
- ECoP 4: Drainage Management
- ECoP 5: Soil Quality Management
- ECoP 6: Erosion and Sediment Control
- ECoP 7: Top Soil Management
- ECoP 8: Topography and Landscaping
- ECoP 9: Borrow Areas Management
- ECoP 10: Air Quality Management
- ECoP 11: Noise and Vibration Management
- ECoP 12: Protection of Flora
- ECoP 13: Protection of Fauna

- ECoP 14: Protection of Fisheries
- ECoP 15: Road Transport and Road Traffic Management
- ECoP 16: River Transport management
- ECoP 17: Construction Camp Management
- ECoP 18: Cultural and Religious Issues
- ECoP 19: Workers Health and Safety.

7.4.2. Mitigations and Compliance Monitoring Plans

The mitigation and compliance monitoring plans are the key element of EMP to be prepared on the basis of impact assessment described in **Chapter 6**. The Plans describe the potentially negative impacts of each program activity, lists mitigation and control measures to address the negative impacts, and assigns responsibilities for implementation and monitoring of these measures. The Plans for the Phase I have been prepared and included in the EIA of that phase; similar plans will be prepared for the later phases and included in the associated EIAs. **Table 7.4** presents the format of these plans.

Table 7.4: Format of Mitigation and Compliance Monitoring Plan – Construction Phase

Environmental Impact/Issue	Actions	Responsibility		Key Performance Indicator	Timing	Cost Allocation
		Execution	Monitoring			
1. Activity: Design / pre-construction considerations						
1.1 Changes in land use, loss of properties, cultivated land and grazing land, relocation of settlements and amenities	– The RAP will be implemented for permanent land acquisition and loss of assets/livelihood and other similar impacts	BWDB PMU	ESDU	– Documentary evidence of RAP implementation – Establishment of resettlement sites – Payment of compensation amounts – People resettling in new villages – Income levels of displaced households – Number of public grievances re resettlement and compensation	Before construction	Included in overall program cost
	– Contractors will lease the land for construction facilities on temporary basis. Proper documentation will be carried out for this leasing. Site selection will be carried out in consultation with the community and local officials; approval from CSC will also be required for the selected sites.	Contractor	CSC/ESDU	– Documentary evidence of land leasing for temporary facilities – CSC approval for the selected site(s) – Absence of grievances regarding temporary facilities	Before contractor mobilization	Included in contractors' costs
1.2 borrowing construction material	– A material (particularly river sand) borrowing plan will be prepared	Contractor	CSC/ESDU	– Approved plan – Plan itself will outline appropriate KPIs for its implementation.	Before construction	Included in contractors' costs

7.4.3. Site Specific Management Plans

Sand borrowing plan will be prepared and implemented by the contractors on the basis of the ECoPs and the mitigation measures given in **Chapter 6** and **Table 7.4**. The Plan will describe among others the methodology to be adopted, restrictions to be followed, prior survey to be conducted, and documentation to be maintained for the sand extraction. The Plan will be submitted to the CSC for their review and approval before initiating the sand extraction activity.

Pollution Prevention Plan will be prepared and implemented by the contractors on the basis of the ECoPs and WBG EHS Guidelines (1997) that will be part of the bidding documents. The Plan will be submitted to the CSC for their review and approval before contractor mobilization.

Waste Disposal and Effluent Management Plan will be prepared and implemented by the Contractor on the basis of the EMP, ECoP, and WBG EHS Guidelines (1997), which will be part of the bidding documents. The Plan will be submitted to the CSC for their review and approval before contractor mobilization.

Drinking Water Supply and Sanitation Plan: Separate water supply and sanitation provisions will be needed for the temporary facilities including offices, labor camps and workshops in order not to cause shortages and/or contamination of existing drinking water sources. A Plan will be prepared by the contractors on basis of the EMP and ECoPs, which are part of the bidding documents. The Plan will be submitted to the CSC for their review and approval before contractor mobilization.

Occupational Health and Safety (OHS) Plan will be prepared and implemented by each contractor on the basis of the WBG EHS Guidelines (1997), ECoPs, mitigation plan (**Table 7.4**), and other relevant standards. The Plan will be submitted to the CSC for their review and approval before contractor mobilization.

Traffic Management Plan will be prepared by each contractor after discussion with BWDB and authorities responsible for roads and traffic. The Plan will be submitted to the CSC for their review and approval before contractor mobilization. The Plan will identify the routes to be used by the contractors, procedures for the safety of the local community particularly pedestrians, and monitoring mechanism to avoid traffic congestion.

Construction Camp Management Plan will be prepared by each contractor. The Plan will include the camp layout, details of various facilities including supplies, storage, and disposal. The Plan will be submitted to the CSC for their review and approval before camp establishment.

Fuel and Hazardous Substances Management Plan will be prepared by each contractor in accordance with the standard operating procedures, relevant guidelines, and where applicable, material safety data sheets (MSDS). The Plan will include the procedures for handling the oils and chemical spills. The Plan will be submitted to the CSC for their review and approval before contractor mobilization.

An **Emergency Preparedness Plan** will be prepared by each contractor after assessing potential risks and hazards that could be encountered during construction. The Plan will be submitted to the CSC/BWDB for their review and approval before contractor mobilization.

Plantation Plan: A plantation plan has been prepared (discussed in **Chapter 6**) for the trees to be planted on the embankment of the priority reach. The Plan includes the species

to be planted, the plantation methodology, and plantation layout. *Similar plans will be prepared for the later phases of the RBIP as well.*

Resettlement Action Plan (RAP): The program will require about 340 ha of land and affect a total of 15,558 persons for the construction of embankment in the priority reach (ie, Phase I of the RBIP). The social impacts largely include loss of residential and agricultural land, residential, commercial and communal structures, as well as loss of income and livelihoods. To address and mitigate these relocation and resettlement impacts, the Resettlement Action Plan (RAP) has been prepared. The RAP is based on the findings of the inventory and census surveys as well as meetings and consultations with various program -affected persons. The RAP presents (a) type and extent of loss of assets including land, structures and trees; (b) principles and legal framework applicable for mitigation of these losses; (c) the entitlement matrix, (d) relocation strategies and plans, including provision for livelihoods; (e) resettlement and rehabilitation budget; and (f) institutional framework for the implementation of the plan, including monitoring and evaluation. It has been designed as a "development" plan, therefore the overall objective of the RAP is to restore and/or improve the living standards of the affected persons from pre- program level. *Similar RAPs will be prepared for the later phases of the RBIP as well.*

7.5. Monitoring Program

As one of the key elements of the EMP, a three-tier monitoring program has been proposed comprising compliance monitoring, effects monitoring, and external monitoring. The main purpose of this monitoring program is to ensure that the various tasks detailed in the EMP particularly the mitigation measures are implemented in an effective manner, and also to evaluate program impacts on the key environment and social parameters. Various types of EMP monitoring are discussed below.

7.5.1. Compliance Monitoring

The purpose of the compliance monitoring is to ensure that the contractor implements the mitigation measures given in the EMP are effectively and timely implemented. This monitoring will generally be carried out by the CSC with the help of checklists prepared on the basis of the Mitigation Plan (**Table 7.4**).

7.5.2. Effects Monitoring during Construction

Effects monitoring is a very important aspect of environmental management to safeguard the protection of environment. The effects monitoring plan proposed for the RBIP Phase I is presented in **Table 7.5**; for the later phases, this program will be revisited and revised. The monitoring will comprise surveillance to check whether the contractor is meeting the provisions of the contract during construction and operation of the program including the responsible agencies for implementation and supervision.

Table 7.5: Effects Monitoring Plan

Parameter / Activity	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented By	Supervised By
Sand extraction	River bank	Visual inspection to ensure the depth of excavation from the river bed is limited to 3m.	Weekly	Contractor	CSC

Parameter / Activity	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented By	Supervised By
	River bank	Visual inspection to ensure the extraction location is more than 20 m from the river bank (boats and measuring instruments would be needed)	Weekly	Contractor	CSC
	River bank	Visual inspection to ensure that sand extraction is not carried out in single, contiguous stretches	Weekly	Contractor	CSC
Pb, Cd, Cr, Cu, Zn, Mn, As, Se Hg, and oil/grease	Riverbed within the program boundary	Laboratory analysis of material for screening for metals and oil/grease	Before sand extraction	Contractor through a nationally recognized laboratory	CSC
Soil Pollution	Embankment	Visual inspection that filling is through several compartments	Beginning of earth filling works	Contractor	CSC
	Embankment	Ensure no contaminated effluent is leaving from the filling area to the nearby agricultural lands	Weekly	Contractor	CSC
	Material storage sites	Visual inspection.	Monthly	Contractor	CSC
Erosion	Side slopes	Visual inspection of erosion prevention measures and occurrence of erosion	At the end of filling activity	Contractor	CSC
Hydrocarbon and chemical storage	Construction camps	Visual Inspection of storage facilities	Monthly	Contractor	CSC
Damage to local roads	Approach Roads to the construction sites	Visual inspection to ensure local roads are not damaged	Monthly	Contractor	CSC
Traffic Safety	Haul Roads	Visual inspection to see whether proper traffic signs are placed and flag-men for traffic management are engaged	Monthly	Contractor	CSC
Air Quality (dust, smoke)	Construction sites	Visual inspection to ensure good standard equipment is in use and dust suppression measures (eg, spraying of waters) are in place.	Daily	Contractor	CSC

Parameter / Activity	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented By	Supervised By
	Asphalt Plant	Visual inspection to ensure asphalt plant is located >500 m from residential areas	Monthly	Contractor	CSC
	Material storage sites	Visual inspection to ensure dust suppression work plan is being implemented	Monthly	Contractor	CSC
	Sensitive receptors along construction corridor	Continuous monitoring with the help of appropriate instruments and analyzers	Quarterly during the constructio n phase	Contractor	CSC
Noise	Construction sites	Physical inspection to ensure good standard equipment are in use; Noise measurement using noise meter	Weekly	Contractor	CSC
	Construction sites	Visual inspection to ensure ear plugs are in use by the construction workers	Weekly	Contractor	CSC
		Ensure work restriction between 21:00-06:00 close to the sensitive locations	Weekly	Contractor	CSC
Water quality (As, Mn, Fe, and coliforms)	Locations of tube-well installation	Depth of tube well should be more than 300m. Test water for arsenic, iron and manganese before installing of casing. If the quality is found not suitable further deepening will be done.	During drilling of wells	Contractor trough a nationally recognized laboratory	CSC External Monitor
	Near camp sites and other sensitive locations along the construction corridor	Laboratory analysis	Monthly during constructio n phase	Contractor trough a nationally recognized laboratory	CSC
Plantation	Embankment/ road	Visual inspection to ensure plantations in green areas and other designated sites.	Monthly	Contractor	CSC
Waste Management	Construction camps	Visual inspection that solid waste is disposed at designated site	Monthly	Contractor	CSC

Parameter / Activity	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented By	Supervised By
Drinking water and sanitation	Camps, offices	Ensure the construction workers are provided with safe water and sanitation facilities in the site	Weekly	Contractor	CSC
Flora and Fauna	Sensitive habitats in program influence area	Survey and comparison with baseline environment	Six-monthly	Contractor through nationally recognized institute	CSC, M&E Consultant, BWDB
Fish migration	Khals, beels and river	Survey and comparison with baseline environment	Six-monthly	Contractor through nationally recognized institute	CSC, M&E Consultant, BWDB
Cultural andarcheologic al Sites	At all work sties	Visual observation for chance finds	Daily	Contractor	CSC, M&E Consultant, BWDB
Restoration of Work Sites	All Work Sites	Visual Inspection	After completion of all works	Contractor	CSC, M&E Consultant, BWDB
Safety of workers Monitoring and reporting accidents	At work sites	Usage of Personal Protective equipment	Monthly	Contractor	CSC, M&E Consultant, BWDB
During Operation and Maintenance					
Surface Water Quality (TDS, Turbidity, pH, DO, BOD, COD etc)	At the baseline monitoring sites	Sampling and analysis of surface water quality	Six-monthly	BWDB through a nationally recognized laboratory	BWDB
Pesticide residue in soil and water	Cultivation fields, khals and beels	Laboratory analysis	Six-monthly	BWDB through a nationally recognized laboratory	BWDB
Air Quality (Dust PM_{10}, $PM_{2.5}$)	At the baseline monitoring sites	24 hours Air quality monitoring	Yearly	BWDB through a nationally recognized laboratory	BWDB
Flora and Fauna specially fisheries	Sensitive habitats in program influence area	Detail species assessment and compare with baseline	Yearly	BWDB through a nationally recognized	BWDB

Parameter / Activity	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implemented By	Supervised By
	(Tables 6.7, 6.16, and 6.17 and Annex F of EIA)			institution	
Agriculture	In the program influence area	Compare the production with the baseline	Yearly	BWDB through a nationally recognized institution	BWDB
Operation of regulators and fish passes	In the program influence area	Visual inspection and public feedback	Yearly	BWDB	BWDB

7.6. Third Party Monitoring

The BWDB will engage an independent consulting firm to conduct external and independent monitoring of the EMP implementation. The main purpose of the external monitoring will be to ensure that all the key entities including EDSU, CSC, and contractors are effectively and adequately fulfilling their designated role for EMP implementation, and that all the EMP requirements are being implemented in a timely and effective manner. The ToR of the external monitoring is presented in the EIA of Phase I of the RBIP.

7.7. Performance Indicators

For evaluating the performance of the environmental management and monitoring plan, performance indicators are identified to for efficient and timely implementation of measures/actions proposed in EMP. The indicators are defined both for implementation phase and for operation phase. CSC will be responsible for compiling the information on these indicators and report to BWDB.

Separate performance indicators for each environmental issue have been specified in the mitigation plans for the Phase I and included in the associated EIA; *similar performance indicators will also be included in the mitigation plans that would be prepared and included in the EIAs of the later phases of the RBIP*. To measure the overall environmental performance of the program, an additional list of performance indicators is given below.

- Number of inspections carried out by CSC per month
- Number of non-compliances observed by CSC or ESDU.
- Availability of environmental specialists in ESDU.
- Availability of environmental specialists in CSC.
- Availability of environmental specialists with contractors.
- Timely reporting of documents (as defined in EMP and monitoring plan)
- Number of trainings imparted to stakeholders/other capacity building initiatives

- Timely disbursement of compensation/ timely resettlement of program affectees
- Timely implementation of resettlement schedule.
- Number of grievances received.
- Number of grievances resolved.
- Number of construction related accidents.

7.8. Grievance Redress Mechanism [16]

The program will establish a grievance redress mechanism (GRM) for addressing grievances and complaints received from the program -affected persons. Grievance Redress Mechanism (GRM) is a valuable tool which will allows affected people to voice concerns regarding environmental and social impacts for RBIP's activities. The fundamental objective of GRM will be to resolve any program -related grievances locally in consultation with the aggrieved party to facilitate smooth implementation of the social and environmental action plans. Another important objective is to democratize the development process at the local level and to establish accountability to the affected people. The procedures will however not pre-empt a person's right to go to the courts of law. BWDB would ensure that grievance redress procedures are in place and would monitor those procedures to ensure that grievances are handled properly. The BWDB office will establish a procedure to answer sub- program -related queries and address complaints, disputes, and grievances about any aspect of the sub- program, including disagreements regarding the assessment and mitigation of environmental and social impacts. Generally, the grievance redress committees (GRC) are of two types (i) formal courts of appeal and (ii) a locally constitutes GRC for dispute resolution. The second may not totally avoid but may reduce the problem significantly. Grievance Redress Committee (GRC) will be formed As suggested in the Social Management Framework (SMF). Additional details regarding the functioning of GRC is presented in the SMF.

7.9. Capacity Building

Capacity building for effective implementation of the environmental and social safeguard requirements is a key element of the EMP. Capacity building for environmental and social safeguard management will need to be carried out at all tiers of the program, including BWDB, ESDU, CSC, and contractors. At the construction site, CSC will take the lead in implementing the capacity building plan, though the contractors will also be responsible to conduct trainings for their own staff and workers. The various aspects that are covered under the capacity building will include general environmental and social awareness, key environmental and social sensitivities of the area, key environmental and social impacts of the program, EMP requirements, OHS aspects, and waste disposal. **Table 7.6** provides a summary of various aspects of the environmental and social trainings to be conducted at the construction site. ESDU may revise the plan during the program implementation as required.

During the O&M phase of the program, these trainings will continue to be conducted by BWDB staff for all relevant O&M personnel and community.

[16] Further details on GRM are available in RAP.

Table 7.6: Environmental and Social Trainings

Contents	Participants	Responsibility	Schedule
General environmental and socioeconomic awareness; Environmental and social sensitivity of the program influence area; Key findings of the EIA; Mitigation measures; EMP; Social and cultural values of the area.	Selected staff of BWDB, CSC, and contractors	CSC	Prior to the start of the program activities. (To be repeated as needed.)
General environmental and socioeconomic awareness; Environmental and social sensitivity of the program influence area; Mitigation measures; Community issues; Awareness of transmissible diseases Social and cultural values.	PMU; CSC; selected contractors' crew	CSC	Prior to the start of the field activities. (To be repeated as needed.)
EMP; Waste disposal; OHS	Construction crew	Contractors	Prior to the start of the construction activities. (To be repeated as needed.)
Road/waterway safety; Defensive driving/sailing; Waste disposal; Cultural values and social sensitivity.	Drivers; boat/launch crew	Contractors	Before and during the field operations. (To be repeated as needed.)
Camp operation; Waste disposal; OHS Natural resource conservation; Housekeeping.	Camp staff	Contractors	Before and during the field operations. (To be repeated as needed.)
Restoration requirements; Waste disposal.	Restoration teams	Contractors	Before the start of the restoration activities.

7.10. Documentation

The ESDU with assistance from CSC and contractors will produce the following environmental reporting documentation:

- *Environmental Monitoring Reports:* The environmental monitoring reports will include environmental mitigation measures undertaken, environmental monitoring

activities undertaken, details of monitoring data collected, analysis of monitoring results particularly the non-compliances, recommended mitigation and corrective measures, environmental training conducted, and environmental regulatory violations observed. The environmental monitoring reports will be submitted quarterly during the construction period and annually for three years after completion of construction.

- *Program Completion Environmental Monitoring Report:* One year after completion of construction, the ESDU will submit a Program Completion Environmental Monitoring Report which will summarize the overall environmental impacts from the program to all the co-financiers.

BWDB will engage External Monitors during construction period to measure the effectiveness and outcome/impact of EMP, as stated earlier. The External monitors will submit the quarterly reports throughout the contract time, impact evaluation report at the end of each year and finally a completion Report at the end of contract period.

7.11. EMP Implementation Cost

Cost estimates will need to be prepared for all the mitigation and monitoring measures to be proposed in the specific EIAs in accordance with the EMF. The cost estimates for some of the mitigation measures to be identified in the EMP will be part of civil works contract. Some of suggestive activities from EIA will be implemented by hiring NGO.

The Development Project Proposal (DPP) of GoB for the proposed program should reflect the EMP activities with budget for successful environmental management of the program.

8. Consultations and Access to Information

Field surveys, consultations with different stake holders, focus group discussions (FGDs) were carry out to develop a comprehensive Environmental Management Framework (EMF) of RBIP. Extensive field visits were conducted to the program sites to discuss the phase I –priority reaches and remaining phases to be implemented under RBIP as well as capacity and institutional arrangement for environmental management of the proposed program. Consultation meetings were held during these field visits to identify issues and problems to enable the institution to corrective measures and to identify lessons and opportunities to enhance program implementation mechanism.

8.1. Objectives of Consultations

The GoB as well as international donors (e.g. the World Bank) place great importance on involving primary and secondary stakeholders for determining the environmental and social impacts associated with project implementation. In order to gather local knowledge for baseline conditions, understand perceptions of the community regarding impact significance, and propose meaningful mitigation measures, participation of stakeholders is an integral part of the environmental assessment process. During the preparation of the present EMF, initial consultations with the key stakeholders have been carried out to obtain their views on program interventions. Additional consultations have been held on this draft EMF as well as the full draft EIA for the priority reach in January 2015.This process will be continued during the subsequent EIAs of the program for later phases.

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

- To provide key program information and create awareness among various stakeholders about program intervention;
- To share the terms of reference of the current EMF and proposed EIA for the priority reach;
- To have interaction for primary and secondary data collection with program beneficiaries, affectees, and other stakeholders;
- To identify environmental and social issues such as displacement, safety hazards, employment, and vulnerable persons;
- To begin establishing communication and an evolving mechanism for the resolution of social and environmental problems at local and program level;
- To involve program stakeholders in an inclusive manner; and
- To receive feedback from primary stakeholders on mitigation and enhancement measures to address the environmental and social impacts of the program.

8.2. Methodology and Tools for Consultation

The consultation and participation process undertaken so far has adopted a highly participatory approach fully involving all the stakeholders, both primary and secondary. The various tools used for consultations included household level interviews, participatory rural appraisal, focus group discussions (FGD), stakeholders consultation meetings, issue specific consultation meetings, open meetings, and workshops. Consultation meetings and FGDs were carried out alternatively after every kilometer of

the program area along the embankment. This ensured a comprehensive coverage of the entire program area.

8.3. Consultation Meetings and FGDs

A total of 139 consultation meetings and 227 FGDs were held in the program area. On an average a consultation meeting was conducted every two kilometers, covering the households living on the embankment. Both male and female stakeholders were consulted through these meetings. Additionally, teachers, businessmen, village leaders, and local government members, farmers, and fishermen were consulted individually. Female heads of the households were also interviewed. List of consultation meetings and FGDs carried out in different districts is given in **Table 8.1**; venue and participant details are presented in **Table 8.2**. **Figures 8.1** to **8.6** present some photographs of the consultation meetings and FGDs.

Table 8.1: List of Consultation Meetings and FGDs in Different Districts

District	Chainage	Upazila	Number of Consultation Meetings	Number of FGDs
Sirajganj	00+400 To 37+4000	Kazipur	30	50
		Sirajganj Sadar	16	30
Bogra	37+400 To 80+000	Sonatola	4	21
		Dhunut	4	18
		Sariakandi	39	42
Gaibandha	80+000 To 146+400	Fulchari	6	11
		Gaghata	10	5
		Sundorganj	3	8
		Gaibandha Sadar	4	9
Kurigram	146+400 To 181+400	Kurigram Sadar	6	8
		Chilmari	8	9
		Nagesshari	4	10
		Ulipur	5	6
	Total =		**139**	**227**

Table 8.2: Venue and Participant Details

Meeting Venues	No of Consultations or FGDs	No of Participants		
		Male	Female	Total
Kazirpur, Sariakandi and Hasnapara	Consultations: 4	129	37	166

Meeting Venues	No of Consultations or FGDs	No of Participants		
		Male	Female	Total
Sirajganj, Bogra, Kurigram, Gaibandha	Consultations: 94	2,399	1,580	3,979
Sirajganj, Bogra, Kurigram, Gaibandha	FGDs: 92	956	758	1,714
Sirajganj and Bogra	Consultations: 6	721	72	793
Sirajganj and Bogra	FGDs: 15	142	72	214
Sirajganj and Bogra	Consultations: 25	336	189	525
Sirajganj and Bogra	FGDs: 120	520	320	840
Within 50 km of priority package	Consultations: 13	810	410	1,220
Total		**6,013**	**3,438**	**9,451**

Figure 8.1: Consultation Meeting in Program Area

Figure 8.2: Consultation Meeting with Women

Figure 8.3: Informal Meeting on Embankment

Figure 8.4: Informal Meeting in the Field

Figure 8.5: FGD in the Field

Figure 8.6: FGD in the Field

8.4. Key Findings of the Consultations

Irrespective of their age, sex, occupation or economic condition, all of the consulted stakeholders strongly welcomed the program. Some of the senior respondents stated that they would willingly leave their homestead if the program guarantees to end river bank erosion. Although some were hesitating about leaving an environment that they are accustomed to and adjusting to a new location, but considering future benefits to the larger community, they are ready to be imparted from their habitation.

Although most of the respondents are very optimistic about the program, but as most of them are living on the embankment for around 15-20 years on an average, their present residence gives them a sense of comfort in the presence of their social bonding and kin members. Therefore, they are a bit hesitant to move out of their community. In addition to that, the community members help each other in day to day activities as well as during emergencies. Moving away from the neighborhood also involves losing local connections, which has a bearing on their livelihood. They are also concerned that the program activities will affect community buildings such as schools, mosques, temples, and Eid Gah. As most of the people are related to agriculture for their livelihood, they are also concerned about losing cropped land due to the program and future industrialization of the area.

Some of the expectations and needs of the people identified during the consultations include river bank protection measures, dredging of Ichamoti River, re-excavation of Ichamoti khal (water channel), and Banaijan khal for protection from flood and erosion, regulators at different locations of the proposed alignment (e.g. Bahuka) for ecological connectivity, removing drainage congestion from Pukuria Vandarbari, connectivity between Manos and Jamuna River for proper fish migration, more vents at Kutubpur

Regulator, connectivity of water flow for irrigation and fish migration through existing and proposed Antarpara Regulator, restoration of Sariakandi fish pass by de-sedimentation, khal re-excavation to maintain flow from *beels* to rivers during rainy season to remove drainage congestion and also water logging in dry season, rehabilitation of existing regulators for proper connectivity of water flow from the *beels* to river for reducing inundation, fish migration and irrigation purposes, solid waste management needed for the Gaibandha region for conservation of biodiversity, and bridge on Gaghot river.

8.5. Framework for Future Consultations

Consultations with the key stakeholders will need to be carried out throughout the program life. These will include consultations and liaison with communities and other stakeholders during the construction phase and also extensive consultations with the grass-root as well as institutional stakeholders during the EIA studies of the various RBIP phases. The framework for the future consultations is presented in **Table 8.3** below.

Table 8.3: Consultation Framework

Description	Objective/Purpose	Responsibility	Timing
Consultations with communities and other stakeholders during construction phase	Information dissemination; public-relationing; confidence building; awareness about risks and impacts; minimizing conflicts and frictions.	ESU, BWDB; Contractors; CSC	Construction phase
Consultations with communities and other stakeholders during EIA studies of various RBIP phases	Sharing EIA TOR	BWDB and EIA team	During scoping stage of EIA
	Dissemination of information on program and its key impacts and proposed mitigation measures; soliciting views, comments, concerns, and recommendations of stakeholders	BWDB and EIA team	During EIA study (once draft analysis is available for discussion and feedback)
Consultations with communities	Liaison with communities and program beneficiaries	BWDB	O&M phase

8.6. Access to Information

The draft EMF of RBIP will be disclosed to the local and national level stakeholders through different methods as described below.

- **Workshop**. A national workshop was held on January 25, 2015 at Dhaka to present the detailed design including safeguard aspects of RBIP to the key

stakeholders. In addition, four workshops have been planned in March 2015 to disclose the EIA and EMF at four districts in the program influence area. Representative of implementing authority, the study team, and the government officials from different departments, representatives from NGOs, local communities of different occupation, journalist, and local elite/civil society may attend the workshops. In the workshops, the participants will share their observations, views, and remarks with the study team. Appropriate suggestions and recommendations on different issues from the stakeholders of the meeting would be incorporated in the EMF to conduct program specific EIA. The workshops will also help to resolve conflicting issues among stakeholders.

- Publication in electronic and print media: The information on program interventions and the findings of environmental assessment would also be disclosed through newspapers and electronic media (e.g. internet, TV, radio, etc.). The report would be disclosed in Bengali language.

Availability of the Document: Summary of the EIA and EMF report along with EMP will be translated into Bengali language and disseminated locally. The full report (in English) and the summary (in Bengali) will also be uploaded in the website of BWDB and Bank. Hard copy of the EIA and EMF will also be available at BWDB Divisional offices of program area.

Annex A. Terms of Reference of EIA Study

1. Background

Bangladesh is mainly comprised of the fertile alluvial floodplains and the delta of the Ganges-Brahmaputra-Meghna river system (Brahmaputra south through Bangladesh, named as the Jamuna). These three rivers combine within the country to form the world's third largest river, the Lower Meghna, which drains into the Bay of Bengal via a constantly changing network of estuaries and tidal creeks. Bangladesh is one of the most vulnerable countries to natural disasters, mainly by upstream river floods during monsoon season and coastal cyclones from the Bay of Bengal. Floods are of recurring phenomena in Bangladesh, and in each year about 22 percent of the country is inundated. Major floods occur when upland flood flows of the three rivers converging to Bangladesh coincide and combine with the heavy monsoon rainfall. It is also difficult to regulate these flood flows as over 90 percent of their river catchments areas are outside the Bangladesh.

Brahmaputra is the largest of the three rivers with highest erosion and bank movements. Prior to the construction of Brahmaputra Right Embankment (BRE), over bank spills along the 220 km stretch of the right bank of the Brahmaputra River used to cause flooding on an area of about 240,000 ha. In early 1960s, the BRE was built to protect from this flooding problem and to foster agricultural growth in the protected area. The original BRE had a setback of about 1.5 km from the Brahmaputra's right bank and it was allowed to have bank erosion life of 25-30 year span. In the 1970s the embankment started to fall under sporadic erosion attacks. During 1980s, the frequency of the BRE breaches by erosion increased rapidly as longer sections came within the range of rapidly eroding river bends which could cause bank-line erosion rates of several hundred meters per year in early stages of bend formation. To prevent flooding, these breaches were typically closed by local BRE retirements at about 200 meter set-backs. As a result of this minimal set-back distance the BRE has been retired several times in many places and at present perhaps only 50 KM of the original BRE has remained in place. Currently, many long stretches of the BRE are very close to the river-bank line. Hence when embankment is breached at many places it is often left open as closing of such breaching is becoming impossible. Consequently, security of area protected by the BRE has been seriously threatened and large areas of land and cities with large population like Sirajganj are exposed to flooding.

Under Flood Action Program a Master Plan was prepared in 1993 (River Training Studies of the Brahmaputra River, 1993) for improving the performance of BRE that preparing a revamping program to be implemented over a period of 30 years with identified priority investments in phasing. Based on these studies several hard points were identified and river bank protection revetments were constructed at Sirajganj, Sariakandi, Mathurapar and Kalitola and the embankment sections were improved. These protection works have performed very well in keeping the BRE anchored without much ongoing maintenance. The proposed consulting services are for the Environmental Assessment for the revamping plan for BRE (220 KM) starting from Namarari to the upstream point of BRE via Sirajganj Kazipur.

The main focus of the BRE rehabilitation work is on its length alongside the Brahmaputra/ Jamuna River from Bangabandhu (Jamuna) Bridge to the Teesta River (Appendix A). The task needs to consider inclusion of the flood protection embankment of the Kurigram Irrigation Project alongside the Brahmaputra River. The priority works will cover the approximately 50-kilometre long priority reach from Sailabari to Hasnapara. This reach has the highest historic erosion rates. The project may also include the option of a toll road (highway) associated with the flood embankment. The project's physical works will include:

- River bank protection on portions of the western(right) bank;
- Embankment upgrading, reconstruction and realignment , including adding drainage/control
- structures (regulators);
- A new road on the embankment, along with a new bridge crossing of the Teesta.

The project may also provide livelihood and resettlement support to the displaced people. Based on the field reconnaissance and the preliminary morphological assessment, the project works has been divided into two phases:

Reach	**Length (km)**	**Phase**
Jamuna Bridge to Sailabari	19	Remaining
Sailabari to Hasnapara	50	Priority
Hasnapara to Belka	77	Remaining
Upstream of Teesta River	36	Remaining
Total	182	

The proposed project will be financed by IDA with GoB contribution and the project has to comply with the policies and legislative requirement of the World Bank and the GoB. Proper environmental management will require ensuring that the project would be environmentally sound and sustainable, and thus decision making will take place. It is envisaged that the detail Environment Impact Assessment (EIA) along with Environmental Management Plan (EMP) needs to be developed for priority phase. The borrower is responsible for carrying out these activities. The project is expected to be classified as Category 'A' project in accordance Bank's policy. BWDB intends to hire a consulting firm (the Consultant) to carry out these environment activities of the proposed project at the preparation stage to ensure that the proposed infrastructure takes environmental concerns into account.

2. Objective

The objective of the assignment is to carry out the tasks related to environmental aspects in light of the TOR. These include preparation of the **Environmental Impact Assessment** (including EMP) of the remaining phase (Sailabari to Hasnapara).

3. Scope of Services

Carry out an overall Environmental Assessment (EA) and prepare Environmental Management Plan (EMP) for the project area covered under the feasibility study. For the

area covered under the detailed designs conduct detail Environmental Impact Assessment and prepare full Environmental Management Plan (EMP). EIA, and EMP would be prepared according to the World Bank Guidelines and Operational Policies and the GOB procedures. The Consultant shall familiarize themselves with the project details and components as well as the Consultant shall interact with other preparation consultants (i.e, design consultant, social consultant etc) to determine best way of conduction environment activities and fits into overall project preparation/project cycle. Consultant shall appropriately plan the timing of the deliverables.

The major activities to be carried out will include, but not limited to the following.

3.1 Environmental Impact Assessment of Priority Phase (Document owned by the Implementing Agency and Requirement of GoB and World Bank)

3.1.1 Study Area and Likely Major Impacts.

i. Specify the boundaries of the study area for the assessment (project influence area): river basin/catchments, upstream land use, the drainage area and patterns, irrigation and other development scheme(s) – current and proposed, watersheds, access to sensitive/remote areas such as parks/ reserves/forests/agriculture land, elements of transport development program in the area.

3.1.2 Describe the proposed project.

ii. Provide information on the following: location of all project-related development sites and general layout and extent of facilities at project-related development sites; flow diagrams of facilities/operations; design basis, size, capacity; pre-construction activities; construction activities (land clearing, land grading, worker camps, if any), schedule, staffing and support, facilities and services; operation and maintenance activities (water management, monitoring of flows and groundwater, etc), staffing and support, facilities and services; management of risks, including health and safety; life expectancy for major components. Components may include any or all of the following: embankment, structural control measures; river channel modifications, dikes and levees; overflow basins; floodways and drainage and nonstructural measures (eg, zoning, floodplain regulations, building and sanitary ordinances and regulation of land use in basin/watershed areas), road route(s), types, ROWs, adjustments to alignments, including earthworks; repair/replacement of bridges; widening and stabilization of embankments; improvements to drainage and service ducts; sources of materials used during proposed road works; generation of wastes and their disposal expected volume of use and traffic impacts; necessary rehabilitation activities resettlement, land acquisition and temporary re-routing of traffic, safety features; staffing and accommodation of employees, including site clearance, scheduling of project activities; road paving and road signs and markings; operation and maintenance activities (eg, clearing of ditches, prevention of erosion, especially at culverts).

iii. Provide maps at appropriate scales to illustrate the general setting of project-related development sites, as well as surrounding areas likely to be environmentally affected. These maps shall include topographic contours, as available, as well as locations of major surface waters, roads, villages/towns, parks and reserves, and political boundaries. Also provide, as available, maps to illustrate existing land uses.

3.1.3 Description of the Environment

iv. Assemble and evaluate and baseline data on the environmental characteristics of the study area, including river basin/watershed, site of embankment, inundation, floodplain and biological features (habitats and rare species, fisheries), floodplain (recession) agriculture. Include information on any changes anticipated before the project commences.

(a). Physical environment: geology, topography, soils, climate, surface and ground water hydrology, annual peak discharge, ambient air quality; recurrence intervals of various peak discharges and peak stages of various discharges), erosion and sediment loading, existing/projected pollution discharges and receiving water quality; instances of flooding, siltation/erosion;

(b) Biological environment: ecology: flora and fauna, including rare or endangered species; sensitive natural habitats, including parks and reserves; potential vectors for disease; exotics and aquatic weeds; application of pesticides and fertilizers (current and projected as agriculture production is expected to be increased);

(c) Socio-cultural environment: land use (including current crops and cropping patterns - terracing or contour planting, population in the floodplain, etc.); fisheries and farm/industrial outputs and inputs; transportation; land tenure and land titling; present water supply and water uses (including current distribution of water resources); control over allocation of resource use rights; water-related human health problems; cultural sites, present and projected population; present land use/ownership; planned development activities; community structure; present and projected employment by industrial category; distribution of income, goods and services; recreation; public health; cultural properties; indigenous peoples, customs and aspirations; significant natural, cultural or historic sites, etc. Presence of HIV/AIDS and other sexually transmitted diseases;

(d) If resettlement sites and livelihood options are considered to support, find the physical, biological and socio economic conditions of the area;

v. Provide chainage wise information along the two sides of the project intervention and identify any critical aspect which needs special consideration during design, construction and operation.

3.1.4 Determination of the Potential Impacts of and Impacts on the Proposed Project.

vi. This analysis will require in depth interpretation. In this analysis, distinguish between significant positive and negative impacts, direct and indirect impacts, and immediate and long-term impacts. Identify impacts that are unavoidable or irreversible. Wherever possible, describe impacts quantitatively, in terms of environmental costs and benefits. Assign economic values when feasible. Characterize the extent and quality of available data, explaining significant information deficiencies and any uncertainties associated with predictions of impact. Compare the impact with the baseline. Provide TORs for studies to obtain the missing information. Special attention should be given to:

(a). Effects of the flood control embankment: direct environmental impacts of the embankment construction; effects on fisheries resources (creation of a reservoir fisheries, loss of downstream fisheries); effects on water quantity and quality; effects on floodplain ecology and estuarine, river hydrology, if applicable;

(b). Effects of flood control structures, intervention of river training structure and measures (e.g., channelization measures, floodways (high flow diversions or spillways), overflow basins, disposal of dredging spoils) on: aquatic ecology, particularly fish resources; hydrology, including groundwater recharge and exclusion

of water from certain areas that may impact the hydrology and associated wildlife and agriculture; water quality; plant and animal ecology of the floodplain (habitat and species); and,

(c). Socio-economic impacts on populations in inundation area and downstream (floodplain dwellers, urban population, etc.) through: land use changes; impacts on water-related economic activities (e.g., fisheries, flood plain agriculture, transportation, etc.); health effects (e.g., increased incidence of water-borne and water related diseases). Additionally for road construction, consider loss of agricultural and residual lands; destruction of properties; loss of livelihood or other social disruption; relocation of infrastructures; unplanned settlements; noise; threat to cultural and historical sites or artifacts; demographic changes; potential for HIV/AIDS and other sexually-transmitted diseases. Also identify the impact due to resettlement and new livelihood options.

(d) Impact from road construction: Impact on air quality: air pollution from asphalt plants; dust; noise from construction, equipment and blasting; impact on land resources: crossing of rivers, streams, canals and ravines, loss of habitat; foreclosure of other land uses; landslides; erosion; roadside litter; impact on hydrology: crossing of rivers, streams, canals and ravines; foreclosure of other land uses; landslides; erosion; modifications to natural drainage patterns and groundwater elevation; flash flooding; road side litter; impact on water quality: river/stream and lake sedimentation; use of pesticides; fuel and oil spills; water pollution from spills or accumulated contaminants on road surfaces; impact on biological environment: land clearance and loss of habitat; impacts on biodiversity caused by facilitation of access to and spontaneous settlements in natural areas; impacts on wetland management; control of hunting and poaching/wood-cutting

vii. Conduct model study on the water flow, geomorphology and water quality due to project intervention and predict the impact on ecology and socio economic activities after ten years.

viii. Identify the impact of the project intervention during lean period (seasonal variation) (impact on navigability, water variability).

ix. Determine the cumulative impact of the road construction and river bank improvement for the entire project area. Identify any steps to be taken to reduce the impact of the construction of remaining tasks on the current project.

3.1.5 Analysis of Alternatives to the Proposed Project.

x. Describe alternatives that were examined in the course of developing the proposed project and identify other alternatives that would achieve the same objectives. The concept of alternatives extends to siting and design of new alignments, rehabilitation techniques, choice of hydrological structures, and phasing, and operating and maintenance procedures, resettlement sites and livelihood support. Compare alternatives in terms of potential environmental impacts, capital and operating costs (including mitigation measures and their monitoring), and institutional, training, and monitoring requirements. To the extent possible, quantify the costs and benefits of each alternative, incorporating the estimated costs of any associated mitigating measures.

xi. Based on the above analysis identify and propose the best engineering design parameters to ensure minimal environment impacts due to the project.

xii. Closely work with the design consultants that those parameters are incorporated in the design.

3.1.6 Development of an Environmental Management Plan (EMP)

xiii. Identify key mitigation and enhancement approaches and prepare the impact specific mitigation measures. Estimate the impacts and costs of the mitigation measures and of the institutional and training requirements to implement them. If appropriate, assess compensation to affected parties for impacts that cannot be mitigated. Prepare an EMP, including proposed work programs, budget estimates, schedules, staffing and training requirements, and other necessary support services to implement the mitigating measures, monitoring, etc. Include measures for emergency response to accidental events (e.g. entry of raw sewage or toxic wastes into rivers, streams, etc).

xiv. Prepare a detailed plan to monitor the implementation of mitigating measures and the impacts of the project during rehabilitation and operation (eg, emission and ambient levels of pollutants where these may be detrimental to human health, soil erosion, changes in the floodplain). Include in the plan an estimate of capital and operating costs and a description of other inputs (such as training and institutional strengthening) needed to implement the plan. Include a regular schedule of monitoring the quality of surface and ground waters to ensure that mitigation measures are effective. Provide guidance for reporting and enforcement and conducting environmental audits.

xv. Estimate the costing of EMP, ECoP and provide necessary clauses for incorporating in the bid document.

xvi. Review the responsibilities and capability of institutions at local, provincial/regional, and national levels and recommend steps to strengthen or expand them so that the EMP may be effectively implemented. The recommendations may extend to new laws and regulations, new agencies or agency functions, intersectoral arrangements, management procedures and training, staffing, operation and maintenance training, budgeting and financial support.

xvii. An outline of the contents of the EMP to be included in the project's Operational Manual should be provided along with environmental/social protection clauses for contracts and specifications**.**

3.1.7 Assist in Inter-Agency Coordination and Public/NGO Participation.

xviii. The Consultant will assist the government in coordinating the EIA with relevant agencies and the government will consult with affected groups likely to be affected by the proposed project and with local NGOs on the environmental and social aspects of the proposed project. These groups should be consulted when a draft EIA is available (a summary of the EIA will be available prior to the meeting). The draft EIA should also be available in a public place accessible to affected groups and local NGOs being consulted. The consultation workshops will be held locally, regionally and nationally.

Relevant materials will be provided to affected groups in a timely manner prior to consultation and in a form and language that is understandable and accessible to the groups being consulted. The Consultant should maintain a record of the public consultation (written and video and pictorial proof) and the records should indicate: means other than consultations) eg, surveys) used to seek the views of affected stakeholders; the date and location of the consultation meetings, a list of the attendees and their affiliation and contact address; and, summary minutes.

3.1.8 Institutional responsibility

xix. Define the roles and responsibilities of officials, staff, consultants and contractors of BWDB on environmental management;

xx. Describe in details who will (a) implement the environmental mitigation activities (b) carrying out environmental monitoring; (c) supervise environmental mitigation and monitoring; (d) design, implement and apply the environmental management information system (EMIS); and (e) prepare quarterly progress report on environmental management;

xxi. Finalize the draft EIA incorporating the comment from the consultation;

xxii. Translate and finalize the EIA in Bengali.

4. Consulting Team composition and qualifications

i. The studies outlined require interdisciplinary analysis with specialized sector knowledge (i.e., water resource and hydrology/embankment). The general skills required of the Environmental Safeguard team are: environmental management planning, civil/river /embankment engineer(s), with particular experience in dredging projects, river training and embankment construction and water-based transport; aquatic biologist depending upon the predicted impacts, land use planner, sociologist, archaeologist and communications / stakeholder engagement. The consulting team must be able to demonstrate appropriate skill mix and depth of experience to cover all areas of the proposed analysis, including incorporation of other specialized skill sets where required. The consulting team shall be led by a Team Leader with at least 10 years of experience leading EIA studies, including prior international experience on similar types of water resource projects, and prior experience as either team leader or deputy team leader on at least 3 previous major infrastructure EIAs for World Bank funded projects.

5. Schedule/Duration of the study

The study period shall be of **6 (six)** months from the date of commencement of the study.

6. Reports

After commencement of the study the submission of the reports shall be both in **hard (3 copies) and soft copy** as follows:

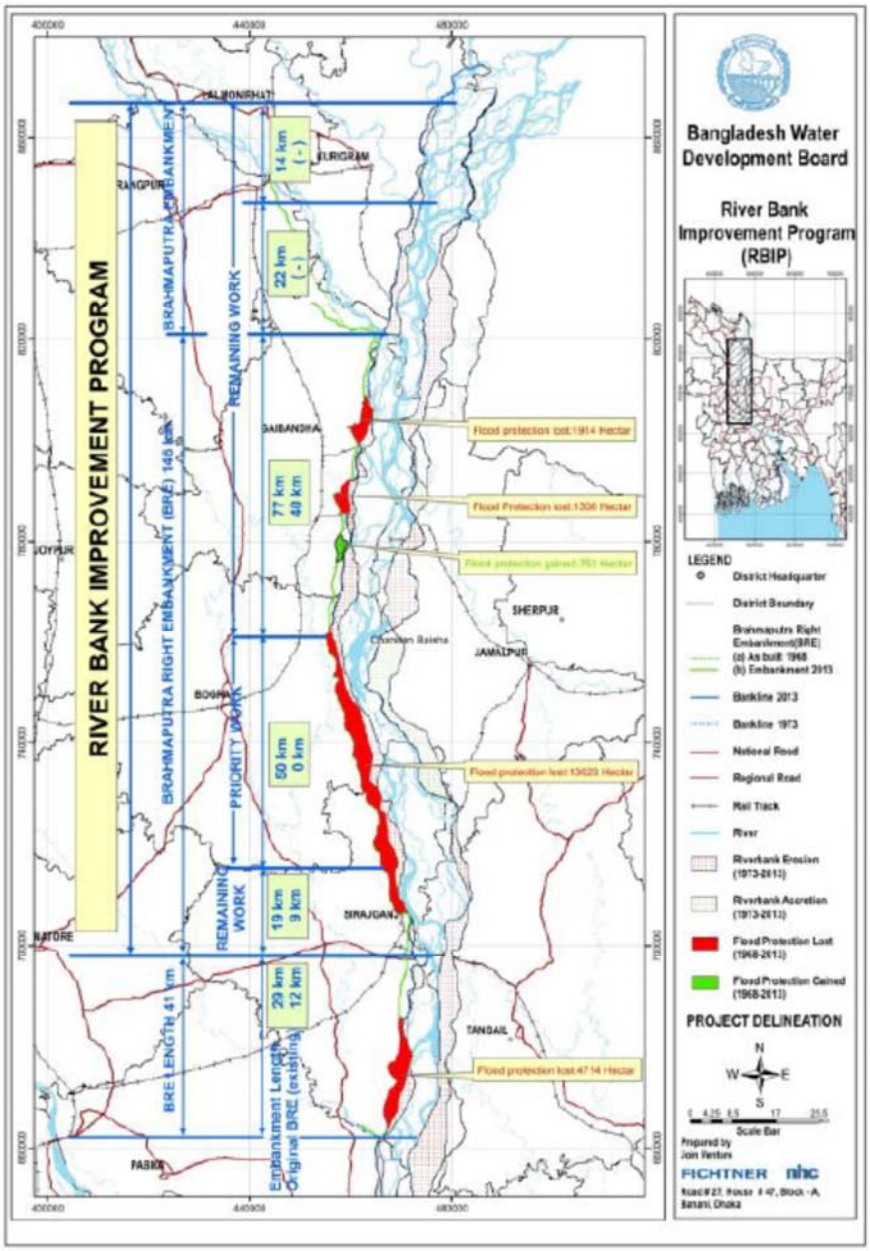
- Draft Environmental Impact Assessment---submitted at the end of 4th month of signing the contract
- Final Environmental Impact Assessment---submitted at the end of 5th month of signing the contract
- Bengali Translation of the Environmental Impact Assessment--submitted at the end of 6th month of signing the contract.

8. Reporting

The consultant will report to the Project Director, River Bank Improvement Project, Bangladesh

Water Development Board (BWDB).

Appendix A: Location of Priority (Phase I) and Remaining (Phase II) Project Location



Appendix B: Structure of EIA Report

The Consultant is required to prepare an EIA report that is concise and limited to significant environmental issues. The main text should focus on findings, conclusions and recommended actions, supported by summaries of the data collected and citations for any references used in interpreting those data. Detailed or uninterrupted data are not appropriate in the main text and should be presented in appendices or a separate volume. Unpublished documents used in the assessment may not be readily available and should also be assembled in an appendix. Organize the environmental assessment report according to the outline below.

The report should be prepared as per the following key contents:

1. Executive Summary (ES): The Executive Summary should mirror the report both in form and content and should be about 10 percent in length of the report. The significant findings and recommended actions should be clearly discussed in the ES.
2. Introduction: This section will include (i) purpose of the report and (ii) extent of the environmental study.
3. Policy, Legal and Administrative Framework: This section will describe relevant environmental policies, rules and administrative procedures that need to be followed for the proposed project. The relevant international environmental agreements to which Bangladesh is a party should also be discussed.
4. Project design and Description: This section will provide a brief but clear picture about (i) type of project; (ii) category of project; (iii) need for project; (iv) location (use maps showing general location, specific location, and project site); (v) size or magnitude of operation;(vi)Project influence area (vii) proposed schedule for implementation. The proposed project should be described with reasonable details so that the EIA report can be read as a standalone document without reference to other project documents.
5. Analysis of Alternatives: Systematic comparison for feasible alternatives to the proposed project site, technology, design, and operation--including the "without project" situation--in terms of their potential environmental impacts should be done. The feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements have to be provided. For each of the alternatives, the quantification of the environmental impacts to the extent possible, and economic values where feasible should be given. The basis for selecting the particular project design proposed and justification for recommended emission levels and approaches to pollution prevention and abatement have to be provided.
6. Environmental Baseline: *This section will provide sufficient information on the existing environmental baseline resources in the area affected by the project, including the following:*

   (i) Physical Resources: (e.g. atmosphere (e.g. air quality and climate), topography and soils, surface water & groundwater, geology/seismology)

   (ii) Water Resources: (e.g. hydrology, surface water and groundwater system, sedimentation, tidal influence, etc.)

   (iii) Land and Agriculture resources: (e.g. land type, land use, cropping pattern, crop production, etc.)

   (iv) Fisheries resources: (e.g. fisheries diversity, fish production, etc.)

   (v) Ecology:(e.g. ecosystems, wildlife, forests, rare or endangered species, protected areas, coastal resources, etc.)

   (vi) Socio-economic condition:(e.g. population and communities (e.g. numbers, locations, composition, employment), health facilities, education facilities, socio-economic conditions (e.g. community structure, family structure, social wellbeing), physical or cultural heritage, current use of lands and resources for traditional purposes by indigenous peoples, structures or sites that are of historical, archaeological, paleontological, or architectural significance, economic development (e.g. industries,

infrastructure facilities, transportation, power sources and transmission, mineral development, and tourism facilities, etc.).

To assess the dimensions of the study area, the relevant physical, biological, and socioeconomic conditions before the project commencement should be discussed. The relevant data related to the issues have to be collected and reported.

7. Climate Change issues: *Climate change aspects in global, regional and local perspectives and the likely impacts on the Project area and its surroundings should be briefly discussed in this section.*

8. Significant Environmental Impacts: This chapter will need careful interpretation. Significant environmental and social impacts due to project location, and related to project design, construction, and operations phase should be discussed in detail in this section. The prediction and assessment of the project's likely positive and negative impacts, in quantitative terms to the extent possible should be made. The mitigation measures and any residual negative impacts that cannot be mitigated should be identified. The opportunities for environmental enhancement should also be explored. Estimates should be done on the extent and quality of available data, key data gaps, and uncertainties associated with predictions; and the topics that do not require further attention should be specified. Considering the impact the project has to be classified into Categories of A, B or C as per OP 4.01.

9. Cumulative and Induced Impacts: Cumulative impacts of the proposed Project and other projects as well as induced impacts should be provided in this section.

10. Design Parameters: This section should present the parameters which should be considered in the design for minimizing the environmental impact.

11. Environmental Management Plan: The environmental management plan (EMP) will include mitigation and enhancement plan, compensation and contingency plan as well as monitoring plan including institutional arrangement for implementation of the EMP. The EMP should also include tentative cost of implementation of the plan. Guideline for preparation of EMP is included below.

12. Stakeholder Consultation and Disclosure: The proceeding of the consultations done as per OP4.01 has to be included in this section of the EIA report. It is to be noted that during the EIA process for all WB Category A and B projects, the proponents have to consults project-affected groups and local nongovernmental organizations (NGOs) about the project's environmental aspects and take their views into account. The proponents' initiates such consultations as early as possible. For Category A projects, the proponents consult these groups at least twice: (a) shortly after environmental screening and before the terms of reference for the EIA is finalized; and (b) once a draft EIA report is prepared. In addition, the proponent must consult with such groups throughout project implementation as necessary to address EIA-related issues that affect them.

13. Disclosure: For meaningful consultations between the borrower and project-affected groups and local NGOs on all Category A and B projects proposed for WB financing, the proponents must provide relevant material in a timely manner prior to consultation and in a form and language (i.e. Bangla) that are understandable and accessible to the groups being consulted. The disclosure details done as per OP 4.01 should be provided in this section.

14. Grievance Mechanism**:** A mechanism should be outlined to ensure that the project sponsor maintains appropriate external channels for communicating with and receiving feedback, questions, and complaints from local stakeholders, as well as internal procedures for following up and resolving any complaints or grievances in a timely manner. The mechanism should include more than one channel for receiving communications and grievances (for example, a hotline, a public information office, boxes to receive written complaints or queries, etc. – depending on local preferences, literacy levels, etc.), as well as indicating requirements, responsibilities and budget for documenting, processing, and resolving issues that arise, including providing feedback to complainant(s) regarding the resolution. The existence of the grievance mechanism must be fully and proactively disclosed to the public.
15. Discussions and Conclusions**:** The essential issues in the EIA report should be summarily discussed and the conclusions are to be included in this section.
16. **References:** References should be provided to written materials both published and unpublished, used in study preparation.

- Annexes:
  - ✓ List of Environmental Assessment Preparers
  - ✓ Record of interagency and consultation meetings, including consultations for obtaining the informed views of the affected people and local nongovernmental organizations (NGOs). The record specifies any means other than consultations (e.g., surveys) that were used to obtain the views of affected groups and local NGOs
  - ✓ Data and Unpublished Reference Documents

Guideline for Preparing Environment Management Plan

Environmental Management Plan (EMP)

The Consultant is required to develop an Environmental Management Plan (EMP) consisting of a set of feasible and cost-effective mitigation measures and monitoring and institutional plan to prevent or reduce significant negative impacts to acceptable levels. This will include measures for emergency response to accidental events (e.g., fires, explosions), as appropriate. The Consultant will provide an estimation of the impacts and costs of the mitigation measures, and of the institutional and training requirements to implement them. In particular this would include:

Environmental Mitigation & Enhancement Measures: Recommend feasible and cost-effective measures to prevent or reduce significant negative impacts to acceptable levels. Apart from mitigation of the potential adverse impacts on the environmental components, the EMP shall identify opportunities that exist for the enhancement of the environmental quality along the surrounding area. Residual impacts from the environmental measures shall also be clearly identified. The EMP shall include detailed specification, bill of quantities, execution drawings and contracting procedures for execution of the environmental mitigation and enhancement measures suggested, separate for pre-construction, construction and operation periods. In addition, the EMP shall include good practice guides related to construction and upkeep of plant and machinery. Responsibilities for execution and supervision of each of the mitigation and enhancement measures shall be specified in the EMP. A plan for continued consultation to be conducted during implementation stage of the project shall also be appended.

Capacity Building & Training: The EMPs shall describe the implementation arrangement needed for the project, especially the capacity building proposals including the staffing of the environment unit (as and when recommended) adequate to implement the environmental mitigation and enhancement measures. For each staff position recommended to be created,

detailed job responsibilities shall be defined. Equipment and resources required for the environment unit shall be specified, and bill of quantities prepared. A training plan and schedule shall be prepared specifying the target groups for individual training programs, the content and mode of training. Training plans shall normally be made for the client agency (including the environmental unit), the supervision consultants and the contractors.

Supervision & Monitoring: Environmental monitoring plan will be an integral part of an EMP, which outlines the specific information to be collected for ensuring the environmental quality at different stages of project implementation. The parameters and their frequency of monitoring should be provided along with cost of the monitoring plan and institutional arrangements for conducting monitoring. Reporting formats should be provided along with a clear arrangement for reporting and talk corrective action. The EMP shall list all mandatory government clearance conditions, and the status of procuring clearances. Additionally, the EMPs shall include as separate attachments, if applicable, Natural Habitat Plan and/or Cultural Properties Plan to satisfy the requirements of the World Bank safeguard policies.

Annex B. Environmental Code of Practice

ECoP 1: Waste Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
General Waste	Soil and water pollution from the improper management of wastes and excess materials from the construction sites.	The Contractor shall • Develop waste management plan for various specific waste streams (e.g., reusable waste, flammable waste, construction debris, food waste etc.) prior to commencing of construction and submit to CSC for approval. • Organize disposal of all wastes generated during construction in an environmentally acceptable manner. This will include consideration of the nature and location of disposal site, so as to cause less environmental impact. • Minimize the production of waste materials by 3R (Reduce, Recycle and Reuse) approach. • Segregate and reuse or recycle all the wastes, wherever practical. • Prohibit burning of solid waste • Collect and transport non-hazardous wastes to all the approved disposal sites. Vehicles transporting solid waste shall be covered with tarps or nets to prevent spilling waste along the route • Train and instruct all personnel in waste management practices and procedures as a component of the environmental induction process. • Provide refuse containers at each worksite. • Request suppliers to minimize packaging where practicable. • Place a high emphasis on good housekeeping practices. • Maintain all construction sites in a cleaner, tidy and safe condition and provide and maintain appropriate facilities as temporary storage of all wastes before transportation and final disposal.
Hazardous Waste	Health hazards and environmental impacts due to improper waste management practices	The Contractor shall • Collect chemical wastes in 200 liter drums (or similar sealed container), appropriately labeled for safe transport to an approved

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		chemical waste depot. • Store, transport and handle all chemicals avoiding potential environmental pollution. • Store all hazardous wastes appropriately in bunded areas away from water courses. • Make available Material Safety Data Sheets (MSDS) for hazardous materials on-site during construction. • Collect hydrocarbon wastes, including lube oils, for safe transport off-site for reuse, recycling, treatment or disposal at approved locations. • Construct concrete or other impermeable flooring to prevent seepage in case of spills

ECoP 2: Fuels and Hazardous Goods Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Fuels and hazardous goods.	Materials used in construction have a potential to be a source of contamination. Improper storage and handling of fuels, lubricants, chemicals and hazardous goods/materials on-site, and potential spills from these goods may harm the environment or health of construction workers.	The Contractor shall • Prepare spill control procedures and submit the plan for CSC approval. • Train the relevant construction personnel in handling of fuels and spill control procedures. • Store dangerous goods in bunded areas on a top of a sealed plastic sheet away from watercourses. • Refueling shall occur only within bunded areas. • Make available MSDS for chemicals and dangerous goods on-site. • Transport waste of dangerous goods, which cannot be recycled, to a designated disposal site approved by DoE. • Provide absorbent and containment material (e.g., absorbent matting) where hazardous material are used and stored and personnel trained in the correct use. • Provide protective clothing, safety boots, helmets, masks, gloves, goggles, to the construction personnel, appropriate to

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		materials in use. • Make sure all containers, drums, and tanks that are used for storage are in good condition and are labeled with expiry date. Any container, drum, or tank that is dented, cracked, or rusted might eventually leak. Check for leakage regularly to identify potential problems before they occur. • Store hazardous materials above flood plain level. • Put containers and drums in temporary storages in clearly marked areas, where they will not be run over by vehicles or heavy machinery. The area shall preferably slope or drain to a safe collection area in the event of a spill. • Put containers and drums in permanent storage areas on an impermeable floor that slopes to a safe collection area in the event of a spill or leak. • Take all precautionary measures when handling and storing fuels and lubricants, avoiding environmental pollution. • Avoid the use of material with greater potential for contamination by substituting them with more environmentally friendly materials. • Return the gas cylinders to the supplier. However, if they are not empty prior to their return, they must be labeled with the name of the material they contained or contain, information on the supplier, cylinder serial number, pressure, their last hydrostatic test date, and any additional identification marking that may be considered necessary.

ECoP 3: Water Resources Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Hazardous Material and	Water pollution from the storage, handling	The Contractor shall • Follow the management guidelines

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Waste	and disposal of hazardous materials and general construction waste, and accidental spillage	proposed in ECPs 1 and 2. • Minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes). These substances must not enter waterways, storm water systems or underground water tables
Discharge from construction sites	During construction both surface and groundwater quality may be deteriorated due to construction activities in the river, sewerages from construction sites and work camps. The construction works will modify groundcover and topography changing the surface water drainage patterns of the area including infiltration and storage of storm water. These changes in hydrological regime lead to increased rate of runoff, increase in sediment and contaminant loading, increased flooding, groundwater contamination, and effect habitat of fish and other aquatic biology.	The Contractor shall • Install temporary drainage works (channels and bunds) in areas required for sediment and erosion control and around storage areas for construction materials • Install temporary sediment basins, where appropriate, to capture sediment-laden run-off from site • Divert runoff from undisturbed areas around the construction site • Stockpile materials away from drainage lines • Prevent all solid and liquid wastes entering waterways by collecting solid waste, oils, chemicals, bitumen spray waste and wastewaters from brick, concrete and asphalt cutting where possible and transport to an approved waste disposal site or recycling depot • Wash out ready-mix concrete agitators and concrete handling equipment at washing facilities off site or into approved bunded areas on site. Ensure that tires of construction vehicles are cleaned in the washing bay (constructed at the entrance of the construction site) to remove the mud from the wheels. This shall be done in every exit of each construction vehicle to ensure the local roads are kept clean.
Soil Erosion and siltation	Soil erosion and dust from the material stockpiles will increase the sediment and contaminant loading of surface water bodies.	The Contractor shall • Stabilize the cleared areas not used for construction activities with vegetation or appropriate surface water treatments as soon as practicable following earthwork to minimize erosion • Ensure that roads used by construction vehicles are swept regularly to remove

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		sediment. • Water the material stockpiles, access roads and bare soils on an as required basis to minimize dust. Increase the watering frequency during periods of high risk (e.g. high winds)
Construction activities in water bodies	Construction works in the water bodies will increase sediment and contaminant loading, and effect habitat of fish and other aquatic biology.	The Contractor Shall • Dewater sites by pumping water to a sediment basin prior to release off site – do not pump directly off site • Monitor the water quality in the runoff from the site or areas affected by dredge plumes, and improve work practices as necessary • Protect water bodies from sediment loads by silt screen or bubble curtains or other barriers • Minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes). These substances must not enter waterways, storm water systems or underground water tables. • Use environment friendly and nontoxic slurry during construction of piles to discharge into the river. • Reduce infiltration of contaminated drainage through storm water management design • Do not discharge cement and water curing used for cement concrete directly into water courses and drainage inlets.
Drinking water	Groundwater at shallow depths is contaminated with arsenic and hence not suitable for drinking purposes.	The Contractor Shall • Pumping of groundwater shall be from deep aquifers of more than 300 m to supply arsenic free water. Safe and sustainable discharges are to be ascertained prior to selection of pumps. • Tube wells will be installed with due regard for the surface environment, protection of groundwater from surface contaminants, and protection of aquifer cross contamination

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• All tube wells, test holes, monitoring wells that are no longer in use or needed shall be properly decommissioned
	Depletion and pollution of groundwater resources	• Install monitoring wells both upstream and downstream areas near construction yards and construction camps to regularly monitor the water quality and water levels. • Protect groundwater supplies of adjacent lands

ECoP 4: Drainage Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Excavation and earth works, and construction yards	Lack of proper drainage for rainwater/liquid waste or wastewater owing to the construction activities harms environment in terms of water and soil contamination, and mosquito growth.	The Contractor shall • Prepare a program for prevent/avoid standing waters, which CSC will verify in advance and confirm during implementation • Provide alternative drainage for rainwater if the construction works/earth-fillings cut the established drainage line • Establish local drainage line with appropriate silt collector and silt screen for rainwater or wastewater connecting to the existing established drainage lines already there • Rehabilitate road drainage structures immediately if damaged by contractors' road transports. • Build new drainage lines as appropriate and required for wastewater from construction yards connecting to the available nearby recipient water bodies. Ensure wastewater quality conforms to the relevant standards provided by DoE, before it being discharged into the recipient water bodies. • Ensure the internal roads/hard surfaces in the construction yards/construction camps that generate has storm water drainage to accommodate high runoff during downpour and that there is no stagnant water in the area

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		at the end of the downpour. • Construct wide drains instead of deep drains to avoid sand deposition in the drains that require frequent cleaning. • Provide appropriate silt collector and silt screen at the inlet and manholes and periodically clean the drainage system to avoid drainage congestion • Protect natural slopes of drainage channels to ensure adequate storm water drains. • Regularly inspect and maintain all drainage channels to assess and alleviate any drainage congestion problem. • Reduce infiltration of contaminated drainage through storm water management design
Ponding of water	Health hazards due to mosquito breeding	• Do not allow ponding of water especially near the waste storage areas and construction camps • Discard all the storage containers that are capable of storing of water, after use or store them in inverted position

ECoP 5: Soil Quality Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Filling of Sites with dredge spoils	Soil contamination will occur from drainage of dredged spoils	The Contractor shall • Ensure that dredged sand used for land filling shall be free of pollutants. Prior to filling, sand quality shall be tested to confirm whether soil is pollution free. Sediments shall be properly compacted. Top layer shall be the 0.5 m thick clay on the surface and boundary slopes along with grass. Side Slope of Filled Land of 1:2 shall be constructed by suitable soils with proper compaction as per design. Slope surface shall be covered by top soils/ cladding materials (0.5m thick) and grass turfing with suitable grass. • Leaching from the sediments shall be contained to seep into the subsoil or shall be

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		discharged into settling lagoons before final disposal. • No sediment laden water in the adjacent lands near the construction sites, and/or wastewater of suspended materials excessive of 200mg/l from dredge spoil storage/use area in the adjacent agricultural lands.
Storage of hazardous and toxic chemicals	Spillage of hazardous and toxic chemicals will contaminate the soils	The Contractor shall • Strictly manage the wastes management plans proposed in ECP1 and storage of materials in ECP2 • Construct appropriate spill contaminant facilities for all fuel storage areas • Establish and maintain a hazardous materials register detailing the location and quantities of hazardous substances including the storage, use of disposals • Train personnel and implement safe work practices for minimizing the risk of spillage • Identify the cause of contamination, if it is reported, and contain the area of contamination. The impact may be contained by isolating the source or implementing controls around the affected site • Remediate the contaminated land using the most appropriate available method to achieve required commercial/industrial guideline validation results
Construction material stock piles	Erosion from construction material stockpiles may contaminate the soils	The Contractor shall • Protect the toe of all stockpiles, where erosion is likely to occur, with silt fences, straw bales or bunds

ECoP 6: Erosion and Sediment Control

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Clearing of construction sites	Cleared areas and slopes are susceptible for erosion of top soils, that affects the	• Reinstate and protect cleared areas as soon as possible. • Mulch to protect batter slopes before

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	growth of vegetation which causes ecological imbalance.	planting • Cover unused area of disturbed or exposed surfaces immediately with mulch/grass turfings/tree plantations
Construction activities and material stockpiles	The impact of soil erosion are (i) Increased run off and sedimentation causing a greater flood hazard to the downstream, (ii) destruction of aquatic environment in nearby lakes, streams, and reservoirs caused by erosion and/or deposition of sediment damaging the spawning grounds of fish, and (iii) destruction of vegetation by burying or gullying.	The Contractor shall • Locate stockpiles away from drainage lines • Protect the toe of all stockpiles, where erosion is likely to occur, with silt fences, straw bales or bunds • Remove debris from drainage paths and sediment control structures • Cover the loose sediments and water them if required • Divert natural runoff around construction areas prior to any site disturbance • Install protective measures on site prior to construction, for example, sediment traps • Control drainage through a site in protected channels or slope drains • Install 'cut off drains' on large cut/fill batter slopes to control water runoff speed and hence erosion • Observe the performance of drainage structures and erosion controls during rain and modify as required.

ECoP 7: Top Soil Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Land clearing and earth works	Earthworks will impact the fertile top soils that are enriched with nutrients required for plant growth or agricultural development.	The Contractor shall • Strip the top soil to a depth of 15 cm and store in stock piles of height not exceeding 2m. • Remove unwanted materials from top soil like grass, roots of trees and similar others. • The stockpiles will be done in slopes of 2:1 to reduce surface runoff and enhance percolation through the mass of stored soil. • Locate topsoil stockpiles in areas outside

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		drainage lines and protect from erosion. • Construct diversion channels and silt fences around the topsoil stockpiles to prevent erosion and loss of topsoil. • Spread the topsoil to maintain the physico-chemical and biological activity of the soil. The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites • Prior to the re-spreading of topsoil, the ground surface will be ripped to assist the bunding of the soil layers, water penetration and revegetation
Transport	Vehicular movement outside ROW or temporary access roads will affect the soil fertility of the agricultural lands	• Limit equipment and vehicular movements to within the approved construction zone • Construct temporary access tracks to cross concentrated water flow lines at right angles • Plan construction access to make use, if possible, of the final road alignment • Use vehicle-cleaning devices, for example, ramps or wash down areas

ECoP 8: Topography and Landscaping

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Land clearing and earth works	Flood plains of the existing Project area will be affected by the construction of various project activities. Construction activities especially earthworks will change topography and disturb the natural rainwater/flood water drainage as well as will change the local landscape.	The Contractor shall • Ensure the topography of the final surface of all raised lands (construction yards, approach roads, access roads, bridge end facilities, etc.) are conducive to enhance natural draining of rainwater/flood water; • Keep the final or finished surface of all the raised lands free from any kind of depression that insists water logging • Undertake mitigation measures for erosion control/prevention by grass-turfing and tree plantation, where there is a possibility of rain-cut that will change the shape of topography. • Cover immediately the uncovered open surface that has no use of construction activities

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		with grass-cover and tree plantation to prevent soil erosion and bring improved landscaping

ECoP 9: Sand Extraction

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Sand extraction	Sand extraction can potentially impact the aquatic habitat, water quality, and key aquatic species and their food availability.	The Contractor shall: • not extract sand from the river bed in long continuous stretches; alternate patches of river bed will be left undisturbed to minimize the potentially negative impacts on the aquatic habitat. • not collect large quantities of sand from any single location • not excavate deeper than 3 m at any single location. • not carry out sand extraction near chars that have sensitive habitats • not carry out sand extraction during the night particularly near the chars • obtain approval from CSC before starting sand extraction from any location. • carry out sand extraction from sand bars to the extent possible. • maintain record of all sand extraction (quantities, location shown on map, timing, any sighting of key species) • provide silt fences, sediment barriers or other devices around the extraction areas to prevent migration of sediment rich water in to the river channels. • refuel of barges and boats with a proper care to avoid any spills. • make available spill kits and other absorbent material at refueling points on the barges. • properly collect, treat and dispose the bilge water from of barges, and boats. • regularly service all waterborne plant as per the manufacturer's guidelines and be inspected

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		daily prior to operation. CSC will: • carry out survey of the area prior to sand extraction • identify any sensitive receptors/habitats (eg, turtle nesting area, birds colony) at or near the proposed sand extraction locations. • determine 'no-go' areas for sand extraction, based upon the above survey, • monitor the activity to ensure that the contractor complies with the conditions described earlier. • survey the area after sand extraction to identify any left over impacts.

ECoP 10: Air Quality Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Air quality can be adversely affected by vehicle exhaust emissions and combustion of fuels.	The Contractor shall • Fit vehicles with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition. • Operate the vehicles in a fuel efficient manner • Cover haul vehicles carrying dusty materials moving outside the construction site • Impose speed limits on all vehicle movement at the worksite to reduce dust emissions • Control the movement of construction traffic • Water construction materials prior to loading and transport • Service all vehicles regularly to minimize emissions • Limit the idling time of vehicles not more than 2 minutes
Construction machinery	Air quality can be adversely affected by emissions from machinery and	The Contractor shall • Fit machinery with appropriate exhaust systems and emission control devices. Maintain

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	combustion of fuels.	these devices in good working condition in accordance with the specifications defined by their manufacturers to maximize combustion efficiency and minimize the contaminant emissions. Proof or maintenance register shall be required by the equipment suppliers and contractors/subcontractors • Focus special attention on containing the emissions from generators • Machinery causing excess pollution (e.g. visible smoke) will be banned from construction sites • Service all equipment regularly to minimize emissions • Provide filtering systems, duct collectors or humidification or other techniques (as applicable) to the concrete batching and mixing plant to control the particle emissions in all its stages, including unloading, collection, aggregate handling, cement dumping, circulation of trucks and machinery inside the installations
Construction activities	Dust generation from construction sites, material stockpiles and access roads is a nuisance in the environment and can be a health hazard.	• Water the material stockpiles, access roads and bare soils on an as required basis to minimize the potential for environmental nuisance due to dust. Increase the watering frequency during periods of high risk (e.g. high winds). Stored materials such as gravel and sand shall be covered and confined to avoid their being wind-drifted • Minimize the extent and period of exposure of the bare surfaces • Reschedule earthwork activities or vegetation clearing activities, where practical, if necessary to avoid during periods of high wind and if visible dust is blowing off-site • Restore disturbed areas as soon as practicable by vegetation/grass-turfing • Store the cement in silos and minimize the emissions from silos by equipping them with filters. • Establish adequate locations for storage, mixing and loading of construction materials, in a way that dust dispersion is prevented because of such operations

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Crushing of rocky and aggregate materials shall be wet-crushed, or performed with particle emission control systems

ECoP 11: Noise and Vibration Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Noise quality will be deteriorated due to vehicular traffic	The Contractor shall • Maintain all vehicles in order to keep it in good working order in accordance with manufactures maintenance procedures • Make sure all drivers will comply with the traffic codes concerning maximum speed limit, driving hours, etc. • Organize the loading and unloading of trucks, and handling operations for the purpose of minimizing construction noise on the work site
Construction machinery	Noise and vibration may have an impact on people, property, fauna, livestock and the natural environment.	The Contractor shall • Appropriately site all noise generating activities to avoid noise pollution to local residents • Use the quietest available plant and equipment • Modify equipment to reduce noise (for example, noise control kits, lining of truck trays or pipelines) • Maintain all equipment in order to keep it in good working order in accordance with manufactures maintenance procedures. Equipment suppliers and contractors shall present proof of maintenance register of their equipment. • Install acoustic enclosures around generators to reduce noise levels. • Fit high efficiency mufflers to appropriate construction equipment • Avoid the unnecessary use of alarms, horns and sirens

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activity	Noise and vibration may have an impact on people, property, fauna, livestock and the natural environment.	The Contractor shall • Notify adjacent landholders prior any typical noise events outside of daylight hours • Educate the operators of construction equipment on potential noise problems and the techniques to minimize noise emissions • Employ best available work practices on-site to minimize occupational noise levels • Install temporary noise control barriers where appropriate • Notify affected people if major noisy activities will be undertaken, e.g. pile driving • Plan activities on site and deliveries to and from site to minimize impact • Monitor and analyze noise and vibration results and adjust construction practices as required. • Avoid undertaking the noisiest activities, where possible, when working at night near the residential areas

ECoP 12: Protection of Flora

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Vegetation clearance	Local flora are important to provide shelters for the birds, offer fruits and/or timber/fire wood, protect soil erosion and overall keep the environment very friendly to human-living. As such damage to flora has wide range of adverse environmental impacts.	The Contractor shall • Reduce disturbance to surrounding vegetation • Use appropriate type and minimum size of machine to avoid disturbance to adjacent vegetations. • Get approval from supervision consultant for clearance of vegetation. • Make selective and careful pruning of trees where possible to reduce need of tree removal. • Control noxious weeds by disposing of at designated dump site or burn on site. • Clear only the vegetation that needs to be cleared in accordance with the plans. These measures are applicable to both the construction areas as well as to any associated

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		activities such as sites for stockpiles, disposal of fill and construction of diversion roads, etc. • Do not burn off cleared vegetation – where feasible, chip or mulch and reuse it for the rehabilitation of affected areas, temporary access tracks or landscaping. Mulch provides a seed source, can limit embankment erosion, retains soil moisture and nutrients, and encourages re-growth and protection from weeds. • Return topsoil and mulched vegetation (in areas of native vegetation) to approximately the same area of the roadside it came from. • Avoid work within the drip-line of trees to prevent damage to the tree roots and compacting the soil. • Minimize the length of time the ground is exposed or excavation left open by clearing and re-vegetate the area at the earliest practically possible. • Ensure excavation works occur progressively and re-vegetation done at the earliest • Provide adequate knowledge to the workers regarding nature protection and the need of avoid felling trees during construction • Supply appropriate fuel in the work caps to prevent fuel wood collection

ECoP 13: Protection of Fauna

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities	The location of construction activities can result in the loss of wild life habitat and habitat quality,.	The Contractor shall • Limit the construction works within the designated sites allocated to the contractors • check the site for animals trapped in, or in danger from site works and use a qualified person to relocate the animal
	Impact on migratory birds, its habitat and	The Contractor shall

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	its active nests	• Not be permitted to destruct active nests or eggs of migratory birds • Minimize the tree removal during the bird breeding season. If works must be continued during the bird breeding season, a nest survey will be conducted by a qualified biologist prior to commence of works to identify and located active nests • Minimize the release of oil, oil wastes or any other substances harmful to migratory birds to any waters or any areas frequented by migratory birds.
Vegetation clearance	Clearance of vegetation may impact shelter, feeding and/or breeding and/or physical destruction and severing of habitat areas	The Contractor shall • Restrict the tree removal to the minimum required. • Retain tree hollows on site, or relocate hollows, where appropriate • Leave dead trees where possible as habitat for fauna • Fell the hollow bearing trees in a manner which reduces the potential for fauna mortality. Felled trees will be inspected after felling for fauna and if identified and readily accessible will be removed and relocated or rendered assistance if injured. After felling, hollow bearing trees will remain unmoved overnight to allow animals to move of their own volition.
Construction camps	Illegal poaching	• Provide adequate knowledge to the workers regarding protection of flora and fauna, and relevant government regulations and punishments for illegal poaching.

ECoP 14: Protection of Fisheries

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities in River	The main potential impacts to fisheries are hydrocarbon spills and leaks from riverine transport and	The Contractor shall • Ensure the riverine transports, vessels and ships are well maintained and do not have oil leakage to contaminate river water.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	disposal of wastes into the river	• Contain oil immediately on river in case of accidental spillage from vessels and ships and in this regard, make an emergency oil spill containment plan to be supported with enough equipments, materials and human resources • Do not dump wastes, be it hazardous or non-hazardous into the nearby water bodies or in the river
Construction activities on the land	The main potential impacts to aquatic flora and fauna River are increased suspended solids from earthworks erosion, sanitary discharge from work camps, and hydrocarbon spills	The Contractor shall • follow mitigation measures proposed in ECoP 3 : Water Resources Management and EC4: Drainage Management
	Filling of ponds for site preparation will impact the fishes.	The Contractor shall • Inspect any area of a water body containing fish that is temporarily isolated for the presence of fish, and all fish shall be captured and released unharmed in adjacent fish habitat • Install and maintain fish screens etc. on any water intake with drawing water from any water body that contain fish

ECoP 15: Road Transport and Road Traffic Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Increased traffic use of road by construction vehicles will affect the movement of normal road traffics and the safety of the road-users.	The Contractor shall • Prepare and submit a traffic management plan to the CSC for his approval at least 30 days before commencing work on any project component involved in traffic diversion and management. • Include in the traffic management plan to ensure uninterrupted traffic movement during construction: detailed drawings of traffic arrangements showing all detours, temporary road, temporary bridges temporary diversions,

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		necessary barricades, warning signs / lights, and road signs. • Provide signs at strategic locations of the roads complying with the schedules of signs contained in the Bangladesh Traffic Regulations. • Install and maintain a display board at each important road intersection on the roads to be used during construction, which shall clearly show the following information in Bangla: • Location: chainage and village name • Duration of construction period • Period of proposed detour / alternative route • Suggested detour route map • Name and contact address/telephone number of the concerned personnel • Name and contact address / telephone number of the Contractor • Inconvenience is sincerely regretted.
	Accidents and spillage of fuels and chemicals	• Restrict truck deliveries, where practicable, to day time working hours. • Restrict the transport of oversize loads. • Operate road traffics/transport vehicles, if possible, to non-peak periods to minimize traffic disruptions. • Enforce on-site speed limit

ECoP 16: River Transport management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities in River	The presence of construction and dredging barges, pipe lines and other construction activities in the river can cause hindrance and risks to the river traffic.	The Contractor shall • Not obstruct other normal riverine transport while doing riverine transport and works • Identify the channel to be followed clearly using navigation aids such as buoys, beacons, and lighting • Provide proper buoyage, navigation lights and markings for bridge and dredging works

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		to guide the other normal riverine transport • Keep regular and close contacts with Bangladesh Inland Water Transport Authority (BIWTA) regarding their needs during construction of the project • Plan the river transport and transportation of large loads in coordination with BIWTA to avoid traffic congestions. • Provide signage for river traffic conforming to the BIWTA requirements • Position the dredge and pipeline in such a way that no disruption to the channel traffic will occur
	Accidents	The Contractor shall • Prepare an emergency plan for dealing with accidents causing accidental sinking of the vessels and ships • Ensure sufficient equipment and staffs available to execute the emergency plans • Provide appropriate lighting to barges and construction vessels.

ECoP 17: Construction Camp Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Siting and Location of construction camps	Campsites for construction workers are the important locations that have significant impacts such as health and safety hazards on local resources and infrastructure of nearby communities.	The Contractor shall • Locate the construction camps at areas which are acceptable from environmental, cultural or social point of view. • Consider the location of construction camps away from communities in order to avoid social conflict in using the natural resources such as water or to avoid the possible adverse impacts of the construction camps on the surrounding communities. • Submit to the CSC for approval a detailed layout plan for the development of the construction camp showing the relative locations of all temporary buildings and facilities that are to be constructed together with the location of site roads, fuel storage

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		areas (for use in power supply generators), solid waste management and dumping locations, and drainage facilities, prior to the development of the construction camps. • Local authorities responsible for health, religious and security shall be duly informed on the set up of camp facilities so as to maintain effective surveillance over public health, social and security matters
Construction Camp Facilities	Lack of proper infrastructure facilities , such as housing, water supply and sanitation facilities will increase pressure on the local services and generate substandard living standards and health hazards.	Contractor shall provide the following facilities in the campsites • Adequate housing for all workers • Safe and reliable water supply. Water supply from deep tube wells of 300 m depth that meets the national standards • Hygienic sanitary facilities and sewerage system. The toilets and domestic waste water will be collected through a common sewerage. Provide separate latrines and bathing places for males and females with total isolation by wall or by location. The minimum number of toilet facilities required is one toilet for every ten persons. • Treatment facilities for sewerage of toilet and domestic wastes • Storm water drainage facilities. Both sides of roads are to be provided with shallow v drains to drain off storm water to a silt retention pond which shall be sized to provide a minimum of 20 minutes retention of storm water flow from the whole site. Channel all discharge from the silt retention pond to natural drainage via a grassed swale at least 20 meters in length with suitable longitudinal gradient. • Paved internal roads. Ensure with grass/vegetation coverage to be made of the use of top soil that there is no dust generation from the loose/exposed sandy surface. Pave the internal roads of at least haring-bond bricks to suppress dusts and to work against possible muddy surface during monsoon. • Provide child crèches for women working construction site. The crèche shall have facilities for dormitory, kitchen, indoor and outdoor play area. Schools shall be attached to

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		these crèches so that children are not deprived of education whose mothers are construction workers • Provide in-house community/common entertainment facilities. dependence of local entertainment outlets by the construction camps to be discouraged/prohibited to the extent possible.
Disposal of waste	Management of wastes is crucial to minimize impacts on the environment	The Contractor shall • Ensure proper collection and disposal of solid wastes within the construction camps • Insist waste separation by source; organic wastes in one pot and inorganic wastes in another pot at household level. • Store inorganic wastes in a safe place within the household and clear organic wastes on daily basis to waste collector. Establish waste collection, transportation and disposal systems with the manpower and equipments/vehicles needed. • Dispose organic wastes in a designated safe place on daily basis. At the end of the day cover the organic wastes with a thin layer of sand so that flies, mosquitoes, dogs, cats, rats, are not attracted. One may dig a large hole to put organic wastes in it; take care to protect groundwater from contamination by leachate formed due to decomposition of wastes. Cover the bed of the pit with impervious layer of materials (clayey or thin concrete) to protect groundwater from contamination. • Locate the garbage pit/waste disposal site min 500 m away from the residence so that peoples are not disturbed with the odor likely to be produced from anaerobic decomposition of wastes at the waste dumping places. Encompass the waste dumping place by fencing and tree plantation to prevent children to enter and play with. • Do not establish site specific landfill sites. All solid waste will be collected and removed from the work camps and disposed in approval waste disposal sites.
Fuel supplies for cooking	Illegal sourcing of fuel wood by	The Contractor shall

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purposes	construction workers will impact the natural flora and fauna	• Provide fuel to the construction camps for their domestic purpose, in order to discourage them to use fuel wood or other biomass. • Made available alternative fuels like natural gas or kerosene on ration to the workforce to prevent them using biomass for cooking. • Conduct awareness campaigns to educate workers on preserving the protecting the biodiversity and wildlife of the project area, and relevant government regulations and punishments on wildlife protection.
Health and Hygiene	There will be a potential for diseases to be transmitted including malaria, exacerbated by inadequate health and safety practices. There will be an increased risk of work crews spreading sexually transmitted infections and HIV/AIDS.	The Contractor shall • Provide adequate health care facilities within construction sites. • Provide first aid facility round the clock. Maintain stock of medicines in the facility and appoint fulltime designated first aider or nurse. • Provide ambulance facility for the laborers during emergency to be transported to nearest hospitals. • Initial health screening of the laborers coming from outside areas • Train all construction workers in basic sanitation and health care issues and safety matters, and on the specific hazards of their work • Provide HIV awareness programming, including STI (sexually transmitted infections) and HIV information, education and communication for all workers on regular basis • Complement educational interventions with easy access to condoms at campsites as well as voluntary counseling and testing • Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form. Regular mosquito repellant sprays during monsoon. • Carryout short training sessions on best hygiene practices to be mandatorily participated by all workers. Place display boards at strategic locations within the camps containing messages on best hygienic practices
Safety	In adequate safety	The Contractor shall

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	facilities to the construction camps may create security problems and fire hazards	• Provide appropriate security personnel (police / home guard or private security guards) and enclosures to prevent unauthorized entry in to the camp area. • Maintain register to keep a track on a head count of persons present in the camp at any given time. • Encourage use of flameproof material for the construction of labor housing / site office. Also, ensure that these houses/rooms are of sound construction and capable of withstanding wind storms/cyclones. • Provide appropriate type of firefighting equipments suitable for the construction camps • Display emergency contact numbers clearly and prominently at strategic places in camps. • Communicate the roles and responsibilities of laborers in case of emergency in the monthly meetings with contractors.
Site Restoration	Restoration of the construction camps to original condition requires demolition of construction camps.	The Contractor shall • Dismantle and remove from the site all facilities established within the construction camp including the perimeter fence and lockable gates at the completion of the construction work. • Dismantle camps in phases and as the work gets decreased and not wait for the entire work to be completed • Give prior notice to the laborers before demolishing their camps/units • Maintain the noise levels within the national standards during demolition activities • Different contractors shall be hired to demolish different structures to promote recycling or reuse of demolished material. • Reuse the demolition debris to a maximum extent. Dispose remaining debris at the designated waste disposal site. • Handover the construction camps with all built facilities as it is if agreement between both parties (contactor and land-owner) has been made so. • Restore the site to its condition prior to commencement of the works or to an agreed condition with the landowner.

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		• Not make false promises to the laborers for future employment in O&M of the project.

ECoP 18: Cultural and Religious Issues

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities near religious and cultural sites	Disturbance from construction works to the cultural and religious sites, and contractors lack of knowledge on cultural issues cause social disturbances.	The Contractor shall • Communicate to the public through community consultation and newspaper announcements regarding the scope and schedule of construction, as well as certain construction activities causing disruptions or access restriction. • Do not block access to cultural and religious sites, wherever possible • Restrict all construction activities within the foot prints of the construction sites. • Stop construction works that produce noise (particularly during prayer time) shall there be any mosque/religious/educational institutions close to the construction sites and users make objections. • Take special care and use appropriate equipment when working next to a cultural/religious institution. • Stop work immediately and notify the site manager if, during construction, an archaeological or burial site is discovered. It is an offence to recommence work in the vicinity of the site until approval to continue is given by the CSC/PMU. • Provide separate prayer facilities to the construction workers. • Show appropriate behavior with all construction workers especially women and elderly people • Allow the workers to participate in praying during construction time • Resolve cultural issues in consultation with local leaders and supervision consultants • Establish a mechanism that allows local

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		people to raise grievances arising from the construction process. • Inform the local authorities responsible for health, religious and security duly informed before commencement of civil works so as to maintain effective surveillance over public health, social and security matters

ECoP 19: Worker Health and Safety

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Best practices	Construction works may pose health and safety risks to the construction workers and site visitors leading to severe injuries and deaths. The population in the proximity of the construction site and the construction workers will be exposed to a number of (i) biophysical health risk factors, (e.g. noise, dust, chemicals, construction material, solid waste, waste water, vector transmitted diseases etc), (ii) risk factors resulting from human behavior (e.g. STD, HIV etc) and (iii) road accidents from construction traffic.	The Contractor shall • Implement suitable safety standards for all workers and site visitors which shall not be less than those laid down on the international standards (e.g. International Labor Office guideline on 'Safety and Health in Construction; World Bank Group's 'Environmental Health and Safety Guidelines') and contractor's own national standards or statutory regulations, in addition to complying with the national standards of the Government of Bangladesh (e.g. `The Bangladesh Labor Code, 2006') • Provide the workers with a safe and healthy work environment, taking into account inherent risks in its particular construction activity and specific classes of hazards in the work areas, • Provide personal protection equipment (PPE) for workers, such as safety boots, helmets, masks, gloves, protective clothing, goggles, full-face eye shields, and ear protection. Maintain the PPE properly by cleaning dirty ones and replacing them with the damaged ones. • Safety procedures include provision of information, training and protective clothing to workers involved in hazardous operations and proper performance of their job • Appoint an environment, health and safety manager to look after the health and safety of

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		the workers • Inform the local authorities responsible for health, religious and security duly informed before commencement of civil works and establishment of construction camps so as to maintain effective surveillance over public health, social and security matters
	Child and pregnant labor	The Contractor shall • not hire children of less than 14 years of age and pregnant women or women who delivered a child within 8 preceding weeks, in accordance with the Bangladesh Labor Code, 2006
Accidents	Lack of first aid facilities and health care facilities in the immediate vicinity will aggravate the health conditions of the victims	• Provide health care facilities and first aid facilities are readily available. Appropriately equipped first-aid stations shall be easily accessible throughout the place of work • Document and report occupational accidents, diseases, and incidents. • Prevent accidents, injury, and disease arising from, associated with, or occurring in the course of work by minimizing, so far as reasonably practicable, the causes of hazards. In a manner consistent with good international industry practice. • Identify potential hazards to workers, particularly those that may be life-threatening and provide necessary preventive and protective measures. • Provide awareness to the construction drivers to strictly follow the driving rules • Provide adequate lighting in the construction area and along the roads
Construction Camps	Lack of proper infrastructure facilities, such as housing, water supply and sanitation facilities will increase pressure on the local services and generate substandard living standards and health hazards.	The Contractor shall provide the following facilities in the campsites to improve health and hygienic conditions as mentioned in ECoP 17 Construction Camp Management • Adequate ventilation facilities • Safe and reliable water supply. Water supply from deep tube wells that meets the national standards • Hygienic sanitary facilities and sewerage system. The toilets and domestic waste water will be collected through a common sewerage.

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		• Treatment facilities for sewerage of toilet and domestic wastes • Storm water drainage facilities. • Recreational and social facilities • Safe storage facilities for petroleum and other chemicals in accordance with ECoP 2 • Solid waste collection and disposal system in accordance with ECP1. • Arrangement for trainings • Paved internal roads. • Security fence at least 2 m height. • Sick bay and first aid facilities
Water and sanitation facilities at the construction sites	Lack of Water sanitation facilities at construction sites cause inconvenience to the construction workers and affect their personal hygiene.	• The contractor shall provide portable toilets at the construction sites, if about 25 people are working the whole day for a month. Location of portable facilities shall be at least 6 m away from storm drain system and surface waters. These portable toilets shall be cleaned once a day and all the sewerage shall be pumped from the collection tank once a day and shall be brought to the common septic tank for further treatment. • Contractor shall provide bottled drinking water facilities to the construction workers at all the construction sites.
Other ECPs	Potential risks on health and hygiene of construction workers and general public	The Contractor shall follow the following ECPs to reduce health risks to the construction workers and nearby community • ECoP 2: Fuels and Hazardous Goods Management • ECoP 4: Drainage Management • ECoP 10: Air Quality Management • ECoP 11: Noise and Vibration Management • ECoP 15: Road Transport and Road Traffic Management • ECoP 16: River Transport management
Trainings	Lack of awareness and basic knowledge in health care among the construction workforce, make them susceptible to	The Contractor shall • Train all construction workers in basic sanitation and health care issues (e.g., how to avoid malaria and transmission of sexually transmitted infections (STI) HIV/AIDS.

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	potential diseases.	• Train all construction workers in general health and safety matters, and on the specific hazards of their work Training shall consist of basic hazard awareness, site specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disaster, as appropriate. • Commence the malaria, HIV/AIDS and STI education campaign before the start of the construction phase and complement it with by a strong condom marketing, increased access to condoms in the area as well as to voluntary counseling and testing. • Implement malaria, HIV/AIDS and STIeducation campaign targeting all workers hired, international and national, female and male, skilled, semi- and unskilled occupations, at the time of recruitment and thereafter pursued throughout the construction phase on ongoing and regular basis. This shall be complemented by easy access to condoms at the workplace as well as to voluntary counseling and testing.