Government of the People's Republic of Bangladesh
Ministry of Water Resources

Bangladesh Water Development Board

PROJECT COMPLETION REPORT: IMED 04/2003
For

Feasibility Study for the Protection of Sheikh Hasina Cantonment Area from the Erosion of Karkhana, Bighai and Payra Rivers in Barisal District

November, 2022

Government of the People's Republic of Bangladesh
Ministry of Planning
Implementation Monitoring and Evaluation Division

PROJECT COMPLETION REPORT: IMED 04/2003 (Revised)

A. PROJECT DESCRIPTION:

01.	**Name of the Project**	:	Feasibility Study for the Protection of Sheikh Hasina Cantonment Area from the Erosion of Karkhana, Bighai and Payra Rivers in Barisal District **(Project code- 224351300)**
02.	**Administrative Ministry/Division**	:	Ministry of Water Resources (MoWR)
03.	**Executing Agency**	:	Bangladesh Water Development Board (BWDB)
04.	**Location of the Project**	:	Barisal and Patuakhali district

05. Objective of the Project:

The Overall objective of the study is devising appropriate options for protection of the Sheikh Hasina Cantonment area from the erosion considering river morphology, characteristics of the project area (i.e., tidal flooding, cyclonic storm surge etc.), environmental issues, climate change and economic viability as well as analyzing impacts of those options on nearby projects (i.e., Payra bridge at Lebukhali). The specific objectives for this study are as follows:

- To identify the prevailing problems related to water resources management in the study area and underlying causes that should be tackled for mitigating those issues;
- To assess the vulnerability due to erosion and tidal action (cyclonic storm surge)at present and in future considering climate change and sea level rise;
- To prepare a holistic and integrated plan for improved water resource management of the study area considering future land use pattern, climate change and sea level rise;
- To prepare dredging alignment and dredged material management plan;
- To analyze impact of different proposed options and land development on upstream & downstream of the study area including existing infrastructures (i.e. Payra bridge at Lebukhali etc;
- To conduct a detailed Environmental and Social Impact Assessment (ESIA) for proposed interventions;
- To assess the project with respect to Environmental Sustainability, Climate Resilience and Disaster Risk and find the ways for reducing/mitigating negative impacts;
- To estimate the detail cost of the project including economic and financial analysis to acquire the extended project outcomes.

06. Estimated Cost :

(In lakh Taka)

	Original	**Latest Revised**
(a) Total	237.05	-
(b) Taka	237.05	-
(c) Foreign Currency	-	-
(d) Project Aid	-	-
(e) RPA	-	-

07.	Date of Approval	:	PCP/PFS	PP
(a) Original		:	03.02.2022	
(b) Latest Revised		:	-	
(c) No Cost Time Extension		:	-	

08. Implementation Period :

	Date of Commencement	Date of Completion
(a) Original	January 2022	June 2022
(b) Latest Revised	-	-
(c) Actual	January 2022	June 2022

09. Financing Arrangement (Source-wise):

9.1 Status of Loan/Grant

a) Foreign Financing : *Not Applicable*

Source (s)	Currency as per Agreement	Amount in US $ (Million)	Nature (Loan/Grant/ supplier's/ credit)	Date of Agreement	Date of Effective-ness	Date of Closing	
						Original	Revised
1	2	3	4	5	6	7	8

b) GOB:

(In lakh Taka)

Total amount	Loan	Grant	Cash Foreign Exchange
1	2	3	4
237.05	-	237.05	-

9.2 Utilization of Project Aid: *Not Applicable*

(In million)

Source (s)	Total Amount		Actual Expenditure		Unutilized Amount	
	In US $	In Local Currency	In US $	In Local Currency	In US $	In Local Currency
1	2	3	4	5	6	7

9.3 Re-imbursible Project Aid (RPA) : *Not Applicable*

(In lakh Taka)

R P A Amount		Amount Spent	Amount Claimed	Amount Re-imbursed	Remarks
As per PP	As per Agreement				
1	2	3	4	5	6

B. IMPLEMENTATION POSITION

01. Implementation Period:

Implementation Period as per PP		Actual Implementation period	Time Over-run (% of original implementation period)	Remarks
Original	Latest Revised			
1	2	3	4	5
January 2022-June 2022 (06 months)	-	January 2022-June 2022 (06 months)	-	-

02. Cost of the Project:

(In lakh Taka)

Description	Estimated Cost		Actual expenditure	Cost over-run (% of original cost)	Remarks
	Original	Latest revised			
1	2	3	4	5	6
TOTAL	237.05	-	230.17	-	The actual expenditure was less than the estimated cost.
TAKA	237.05	-	230.17	-	
PA	-	-	-	-	

03. Project Personnel:

Sanctioned strength as per PP	Manpower employed during execution	Status of the existing manpower			Manpower Employed	
		Manpower requirement for O&M as per pp	Existing manpower for O & M	Others		
1	2	3	4	5	Male	Female
Officer (s)	11	-	-	-	11	0
Staff(s)	11	-	-	-	6	5
Total:	22	Existing Manpower of Directorate of Planning-1, BWDB			17	5

04. Training of Project Personnel (Foreign/Local): No provision of training in this project.

Field of Training /Study tour/workshop/ Seminer etc.	Provision as per PP		Actual		Remarks
	Number of persons	Man - months	Number of persons	Man - months	
1	2	3	4	5	6
a. Foreign	-	-	-	-	
b. Local	-	-	-	-	

05. Component-wise Progress (As per latest approved PFS):

(In lakh Taka)

Items of work (As per PFS)	Unit	Target (as per PFS)		Actual Progress		Reasons for deviation (±)
		Financial	Physical (%)	Financial	Physical (%)	
1	2	3	4	5	6	7
A. Revenue						
Feasibility Study (Local professionals, 42 MM)	Lot	229.05	100%	224.47	100%	
Other stationery	LS	1.50	100%	1.47	100.00%	
Honorarium	LS	3.50	100%	2.24	64.03%	
Domestic travel expenses	LS	1.00	100%	0.00	0.00%	
Sub-total (Revenue):		**235.05**	**100%**	**228.18**	**99.04%**	
B. Capital						
1. Computer and accessories	LS	2.00	100%	1.995	100%	
Sub-total (Capital):		**2.00**	**100%**	1.995	**100%**	
Grand-Total		**237.05**	**100%**	**230.17**	**99.05%**	

06. Information regarding Project Director (s):

Name & Designation with pay Scale.	Full time	Part time	Responsible for more than one project	Date of		Remarks
				Joining	Transfer	
1	2	3	4	5	6	7
Mr. Md. Sultan Mahmud Executive Engineer (Civil) Grade-5; 43,000-69,850	Full time	-	Yes	29.03.2022	Till date	

07. Procurement of Transport (in Nos.): ***Not Applicable***

Type of transport	Number as per P.P.	Procured with date	Transferred to Transport Pool with date	Transferred to O & M with date	Condemned/ damaged with date	Remarks
1	2	3	4	5	6	7
Jeep	-	-	-	-	-	
Pick-up	-	-	-	-	-	
Motor Cycle	-	-	-	-	-	

08. Procurement of Goods, Works and Consultancy Services:

08.1 Goods & Works of the Project costing above Tk. 200.00 lakh. and Consultancy above Tk. 100.00 lakh:

Description of procurement (goods/works	Tender/Bid/Proposal Cost (in lakh Taka)		Tender/Bid/Proposal		Date of completion of works/services and supply of goods	
/consultancy) as per bid document	As per PFS	Contracted value	Invitation date	Contract signing/ L.C opening date	As per contract	Actual
1	2	3	4	5	6	7
Consultancy Services for "Feasibility Study for the Protection of Sheikh Hasina Cantonment Area from the Erosion of Karkhana, Bighai and Payra Rivers in Barisal District"	229.05	229.04	10.02.2022	13.04.2022	30.06.2022	30.06.2022

8.2 Use of Project Consultant (s) (Foreign/Local):

Name of the Field	Approved man month		Actual man month utilised	Remarks
	As per PP	As per contract		
1	2	3	4	5
a) Foreign:	-	-	-	
b) Local:	42	42	42	Conducted by IWM.

09. Construction/Erection/Installation Tools & Equipment:

Description of items	Quantity (as per PP)	Quantity procured with date	Transferred to O & M with date	Disposed off as per rule with date	Balance	Remarks
1	2	3	4	5	6	7
Laptop	1 Set	1 set (procured at 27/06/2022)	-	-	1 set	Used by Planning-1, BWDB office for official

C. FINANCIAL AND PHYSICAL PROGRAMME:

01. (a) Original and revised schedule as per PFS:

(In lakh Taka)

Financial Year	Financial provision & physical target as per original PP				Financial provision & physical target as per latest revised PP			
	Total	Taka	P.A.	Physical %	Total	Taka	P.A.	Physical %
1	2	3	4	5	6	7	8	9
2021-22	237.05	237.05	-	100.00%	-	-	-	-
Total	**237.05**	**237.05**	**-**	**100.00%**	**-**	**-**	**-**	**-**

01. (b) Revised ADP allocation and progress:

(In lakh Taka)

Financial Year	Revised Allocation & target				Taka release	Expenditure & physical progress			
	Total	Taka	P.A.	Physical %		Total	Taka	P.A.	Physical %
1	2	3	4	5	6	7	8	9	10
2021-22	237.00	237.00	-	100.00%	236.00	230.17	230.17	-	99.05%
Total	**237.00**	**237.00**	**-**	**100.00%**	**236.00**	**230.17**	**230.17**	**-**	**99.05%**

D. ACHIEVEMENT OF OBJECTIVES OF THE PROJECT:

Objectives as per PP/PFS	Actual achievement	Reasons for shortfall, if any
To identify the prevailing problems related to water resources management in the study area and underlying causes that should be tackled for mitigating those issues;	Completed. Prevailing problems of the study area is presented in Final Report, Section 3.1. The causes are described in Final Report, Section 4.1.5.	-
To assess the vulnerability due to erosion and tidal action (cyclonic storm surge)at present and in future considering climate change and sea level rise;	Completed. Erosion vulnerability is presented in Section 3.1 of Final Report, and vulnerability due to storm surge is described in Final Report, Section 4.1.6	-
To prepare a holistic and integrated plan for improved water resource management of the study area considering future land use pattern, climate change and sea level rise;	Completed. Plan for improved water management is presented in Section 4.2 and Appendix- A of Final Report.	-
To prepare dredging alignment and dredged material management plan;	Completed. Dredged material management plan presented in Section 4.2.9 of Final Report.	-

Objectives as per PP/PFS	Actual achievement	Reasons for shortfall, if any
To analyze impact of different proposed options and land development on upstream & downstream of the study area including existing infrastructures (i.e. Payra bridge at Lebukhali etc;	Completed. Impact of different options is described Section 10 of Final Report.	-
To conduct a detailed Environmental and Social Impact Assessment (ESIA) for proposed interventions;	Completed. Presented in Separate EIA Report and Section 5 of Final Report.	-
To assess the project with respect to Environmental Sustainability, Climate Resilience and Disaster Risk and find the ways for reducing/mitigating negative impacts;	Completed. The Environmental sustainability, Climate resilience, Disaster risk and mitigation plan is described in Section 5 of Final Report.	-
To estimate the detail cost of the project including economic and financial analysis to acquire the extended project outcomes.	Completed. Detail cost estimation is shown in Section 4.4. Economic and Financial analysis is presented in Section 6 of Final Report.	-

**** According to all objectives & ToR, the study has addressed all the scope of Works.**

E. BENEFIT ANALYSIS

Annual Out-put: *Not Applicable* for the Study Project.

Items of out-put	Unit	Estimated quantity expected at full capacity	Actual quantity of out-put during the 1st year of operation at full capacity (or during, real production for newly completed project).
(a) (b)			

02. Cost / Benefit: *Not Applicable* (It is not an investment project, hence *not applicable*)

Item	Estimated	Actual
(1) Benefit cost ratio of the project **(i) Financial** **(ii) Economic** **(2) Internal Rate of Return** **(i) Financial** **(ii) Economic**		

03. Please give reasons for shortfall, if any, between the estimated and actual benefit:
Not Applicable

F. MONITORING AND AUDITING

Monitoring: *Nil*

Name & designation of the inspecting official	Date of Inspection	Identified Problems	Recommendations
1	2	3	4

(a) Ministry / Agency:

(b) IMED:

(c) Others: (Please specify)

0.2. Auditing during and after Implementation:

2.1. Internal Audit: *No audit conducted yet.*

Period of Audit	Date of submission of Audit Report	Major findings/ objections	Whether objections resolved or not.
1	2	3	4

2.2. External Audit:

Audit period	Date of submission of Audit Report	Major findings/ objections	Whether objections resolved or not.
1	2	3	4
01/09/2022-07/09/2022	-	No objections arisen.	-

G. DESCRIPTIVE REPORT

1. General Observations/Remarks of the Project on:

1.1 Background:

The Sheikh Hasina Cantonment, the headquarter of the 7th Infantry Division of Bangladesh Army, is being developed in Bharpasha union of Bakerganj Upozilla in Barisal district and Lebukhali union of Patuakhali district at the bank of the The Payra River. The area of the cantonment is 1532 acres. However, this area was originally floodplain and has already been experiencing river erosion, flood and navigation problems. The land has been developed for the cantonment. It is important to assess the impact of this land development on the river flow and morphology. The The Payra river is strongly influenced by tidal action. Moreover, this area is vulnerable to storm surge. The Payra river is morphologically very dynamic and erodes its bank at the meandering bends. Hence, protection of 8.50 KM river bank along the cantonment area with 1 KM dredging works is proposed in a project by BWDB. On the other hand the The Payra bridge of Roads and Highways Department (RHD) at Lebukhali is nearby the cantonment area. In these circumstances, decision was taken on 14/10/2021 in a PEC meeting held at Planning Commission to undertake a feasibility study project to understand the impact of the BWDB project on the Payra bridge. Hence, feasibility study is essential in planning and designing of infrastructure for management of erosion and improvement of navigability in the Payra river with impacts of these works on the surrounding environment and existing infrastructure.

In the above circumstances stated above, BWDB is planning to undertake a feasibility study for protection of the Sheikh Hasina Cantonment area from the erosion of the Karkhana, Bighai and Payra Rivers in Barisal district.

1.2 Justification/Adequacy

Linkage WithBangladesh Delta Plan (BDP), 2100

Bangladesh Delta Plan (BDP) 2100 is a water centric, multi sectoral techno-economic long term adaptive plan. Delta Vision and Goals show a broader scope (water, food, economy) leading to a holistic approach with 19 themes. Among those themes first two themes are directly related to Water resources. Those themes are-

i) Morphological Dynamics & River Management
ii) Water Resources

The Project will contribute to the implementation of the Bangladesh Delta Plan 2100 from technical aspect. The concept of the project is in line with BDP2100. Particularly, the Project contributes to the following goals, strategies and sub-strategies:

BDP 2100 Higher Level Goals

Goal 1: Eliminate extreme poverty by 2030;

Goal 2: Achieve upper middle-income status by 2030; and

Goal 3: Being a Prosperous Country beyond 2041.

BDP 2100 Specific Goals

Goal 1: Ensure safety from floods and climate change related disasters;

Goal 3: Ensure sustainable and integrated river systems and estuaries management;

Goal 6: Achieve optimal and integrated use of land and water resources.

Strategy at National Level

Flood Risk (FR) Management Strategies

- Strategy FR 1: Protecting Economic Strongholds and Critical Infrastructure.
    - FR 1.2: Construct adaptive and flood-storm-surge resilient building;
- Strategy FR 2: Equipping the Flood Management and Drainage (FMD) Schemes for the Future
    - FR 2.4: Restoration, redesign and modification of embankments and structures (where necessary);
    - FR 2.5: River management, excavation and smart dredging preceded by appropriate feasibility study;
- Sub-strategy FR 3.5: Flood and storm surge proofing of housing and other critical infrastructure supported by quick emergency services

Hotspot Specific Strategies

1) Coastal Zone

- Combating storm surge and salinity intrusion through effective management of existing polders;
- Increase drainage capacity and reduce flood risks;

Linkage with Sustainable Development Goals (SDGs)

Goal 6.5.1 of SDG: Degree of integrated water resources management implementation

Goal 13 of SDG: Take urgent action to combat climate change and its impacts.

1.3 Objectives

The Overall objective of the study is devising appropriate options for protection of the Sheikh Hasina Cantonment area from the erosion considering river morphology, characteristics of the project area (i.e., tidal flooding, cyclonic storm surge etc.), environmental issues, climate change and economic viability as well as analyzing impacts of those options on nearby projects (i.e., Payra bridge at Lebukhali).The goal of this feasibility study is to develop a comprehensive adaptive approach for the planning, design and implementation of the erosion protection work, river dredging and other infrastructures for mitigating prevailing problems concerned to water resources management and assessing the impacts of those proposed measures on the surrounding projects/infrastructures within the study area. The specific objectives for this study are as follows:

- To identify the prevailing problems related to water resources management in the study area and underlying causes that should be tackled for mitigating those issues;
- To assess the vulnerability due to erosion and tidal action (cyclonic storm surge)at present and in future considering climate change and sea level rise;
- To prepare a holistic and integrated plan for improved water resource management of the study area considering future land use pattern, climate change and sea level rise;
- To prepare dredging alignment and dredged material management plan;
- To analyze impact of different proposed options and land development on upstream & downstream of the study area including existing infrastructures (i.e. Payra bridge at Lebukhali etc;
- To conduct a detailed Environmental and Social Impact Assessment (ESIA) for proposed interventions;
- To assess the project with respect to Environmental Sustainability, Climate Resilience and Disaster Risk and find the ways for reducing/mitigating negative impacts;
- To estimate the detail cost of the project including economic and financial analysis to acquire the extended project outcomes.

1.4 Project revision with reasons: Not Applicable

2. Rationale of the project in respect of Concept, Design, Location and Timing.

The major problem of the study area is bank erosion of the Payra, Bighai and Karkhana rivers along and near Sheikh Hasina Cantonment. Moreover, the risks of tidal and monsoon flooding as well as cyclonic storm surge inundation are also being addressed since these may pose threat to the cantonment. Payra is a meandering river and erosion generally takes place at its outer (concave) bends.

Maximum values of the bank shear stress during high water stages are observed at the base of the outer banks of a meandering river and erosion takes place at outer banks. Sheikh Hasina Cantonment is built on the meandering bend of the Payra River where secondary current is generated and develops scouring of riverbeds near the banks and consequently induce bank erosion. Moreover, the cantonment area was previously a tidal plain and used to get inundated during high tides and monsoon season. Earth filling of the tidal plain for development of the cantonment area has created confinement of the channel that consequently increases the near bank velocity. It is observed that riverbank erosion is taking place at various stretches of the Payra River some of which are very close to the vicinity of the Sheikh Hasina Cantonment. Furthermore, confluence scour is present at the northeast side of the cantonment area where Karkhana (Pandab) and Bighai (Khairabad) rivers meet and Payra River originates.

The study area is located in the coastal zone of Bangladesh. Hence, tidal and monsoon flooding are also threats for the cantonment area. In addition of riverbank erosion and flooding, cyclonic storm surge is also a potential threat for the area. The vulnerability of the cantonment for erosion and tidal/ storm surge flooding area is likely to increase due to climate change and sea level rise in future.

3. Brief description on planning and financing of the project and its applicability.

- **Project Identification**

Government of Bangladesh has established the Sheikh Hasina Cantonment on the banks of the Payra River in Bakerganj upazilla of Barishal district and also in Lebukhali union of Patuakhali district. This cantonment is the headquarter of 7th Infantry Division of Bangladesh Army. However, the under-development cantonment area has been experiencing river erosion problems and the risk of tidal flooding and cyclonic storm surge is high in the area.

The Payra River is morphologically very dynamic and erodes its bank at the meandering bends. Bank erosion is taking place at various reaches of the Payra River some of which are very close to the vicinity of the Sheikh Hasina Cantonment. Recently, a bridge has been built over the Payra River replacing the ferry service at Lebukhali adjacent to the cantonment area. Bangladesh Water Development Board (BWDB) is considering erosion protection measures and dredging works in order to improve erosion, flood and navigation problems in the Payra River near Sheikh Hasina Cantonment. In this context, BWDB engaged Institute of Water Modelling (IWM) through a formal contract signed on 13th April 2022 to carry out a feasibility study in order to plan and design infrastructure for management of flood, erosion and improvement of navigability in the Payra River as well as assess impacts of these works on the surrounding environmen

- **Project Preparation**

The Sheikh Hasina Cantonment (1532 acres) area is situated at the bank of the rivers Karkhana, Bighai and Payra. This cantonment is the first of this kind in the districts of Barishal and Patuakhali. It is also very important from national security and strategic concerns. River erosion has already been occurred upstraem of the Bighai river. So, protection of 8.50 KM river bank along the cantonment area and required dredging is an urgent. The Payra bridge at Lebukhali is nearby the cantonment area. In this regard, devising different options for bank protections and channel stabilization can be formulated with analyzing the impacts of those interventions on the surrounding infrastructures and projects including the under construction RHD bridge at Lebukhali.

Appraisal

DPEC Meeting was held on 12.01.2022 at MoWR.

Credit Negotiation

- **Credit Agreement: N/A**
- **Credit Effectiveness: N/A**
- **Loan Disbursement: N/A**
- **Loan Conditionalities: N/A**
- **Project Approval:** The project was approved by the Honorable State Minister, MoWR on - 03.02.2022
- **Others (if any).**

4. Analysis of the Post-Implementation situation and result of the project: *Not Applicable for this study project*

4.1 Whether the beneficiaries of the project have clear knowledge about the Target/ Objectives of the project.

4.2 Programme for use of created-facilities of the project

4.3 O & M programme of the project.

4.4 Impact of the project -

4.4.1 Direct

4.4.2 Indirect

4.5 Transfer of Technology and Institutional Building through the project

4.6 Employment generation through the project.

4.7 Possibility of Self employment

4.8 Possibility of women-employment opportunity

4.9 Women's participation in development

4.10 Probable Impact on Socio-Economic activity.

4.11 Impact on environment

4.12 Sustainability of the project

4.13 Contribution to poverty alleviation/reduction

4.14 Opinion of the public representatives, local elite, local administration, teachers, religious leaders, women's representatives etc.

4.15 Contribution of Micro-credit programmes and Comments on overlapping with any NGO activities.

5. *Problems encountered during Implementation (with duration & steps taken to remove those)*

5.1 Project Management
5.2 Project Director
5.3 Land Acquisition
5.4 Procurement
5.5 Consultancy
5.6 Contractor
5.7 Manpower
5.8 law & Order
5.9 Natural clamity
5.10 Project financing, allocation and release.
5.11 Design formulation/approval
5.12 Project aid disbursement and re-imbursment
5.13 Mission of the development partners.
5.14 Time & Cost Over-run
5.15 Project Supervision/Inspection
5.16 Delay in Decision
5.17 Transport
5.18 Training
5.19 Approval
5.20 Others.

It is a consultancy service procurement project. The above problems don't occur

6. Remarks & Recommendations of the Project Director:

"Feasibility Study for the Protection of Sheikh Hasina Cantonment Area from the Erosion of Karkhana, Bighai and Payra Rivers in Barisal District" was sanctioned in administrative approval from Ministry of Water Resources given on 03/02/2022. The project was planned to be completed by 30/06/2022 and has been completed successfully within planned duration.

The Overall objective of the study is devising appropriate options for protection of the Sheikh Hasina Cantonment area from the erosion considering river morphology, characteristics of the project area (i.e., tidal flooding, cyclonic storm surge etc.), environmental issues, climate change and economic viability as well as analyzing impacts of those options on nearby projects (i.e., Payra bridge at Lebukhali). The study area comprises of the Sheikh Hasina Cantonment on the bank of the Payra river channel in Bhorpasha union of Barishal district and Lebukhali union of Patuakhali district. Sheikh Hasina Cantonment is considered one of the key point installations of the country. Karkhana and Bighai river at North-east of the cantonment area confluenced as Payra river which is flowing south of the cantonment. This cantonment consists of 7 (seven) islands of which 06 are at right bank of the Payra river in Barishal district and the remaining is at the left bank of the Payra river in Patuakhali district.

The project has been formulated with due attention to the main objective of the study i.e., to develop a comprehensive adaptive approach for the planning, design and implementation of the erosion protection work, river dredging and other infrastructures for mitigating prevailing problems concerned to water resources management and assessing the impacts of those proposed measures on the surrounding projects/infrastructures within the study area. BWDB initially proposed protection of 8.50 KM river bank along the cantonment area with 1 KM dredging works in a DPP. On the other hand, Payra bridge of Roads and Highways Department (RHD) at Lebukhali is nearby the cantonment area. In these circumstances, decision was taken on 14/10/2021 in a PEC meeting held at Planning Commission to undertake a feasibility study project to understand the impact of the BWDB project on the Payra bridge. Hence, this study project was formulated.

Detailed bathymatric survey, water level measurements, discharge measurements, river bed materials sampling, environmental data collection were carried out in the study area along with other secondary data. Field visit, reconnaissance survey and social consultation were conducted related to water resources; and consulted with various stakeholders including army officers of 7th Infantry Division, BWDB, RHD and BBA officials and local people. In this stsdy, detailed hydrological analysis, river modeling and storm surge modeling comprising Cyclone model & Hydrodynamic model were developed prior to developing recommendations.

Bank protection work along with river dredging was recommended in this study. Bank protection works from 1 km upstream of the outfall of the Bighai River to Uttar Rampur along the right bank of the Payra River is required according to the study analysis. The length of required bank protection works is 11.200 km. However, 8.500 km bank protection works, from 1 km upstream of the outfall of Bighai River to the end of the cantonment area is recommended to be implemented on a priority basis. The length of proposed dredging alignment is 1.50 km, bottom width 200m and volume of dredging is estimated as 1.86 million cubic meters. The implementation period is proposed to 4 years and to be completed by 4 consecutive years. Estimated cost for the proposed development project is Tk. 95089.54 lakh (financial) and Tk. 75087.31 lakh (economic). EIRR, NPV and B/C Ratio are 18.00%, 28409.84 lac Tk. and 1.45 respectively. The project is economically feasible to implement based on the financial and economic analysis.

All the objectives/scopes have been accomplished under this study project. The design, cost estimate and ESIA have been conducted through this study. The DPP of the investment project would be

finalized for implementation of the proposed physical componenets based on the findings of this study project.

Date: 22.11.2022

(Md. Sultan Mahmud)
Executive Engineer (Civil)
& Project Director
Directorate of Planning-1
BWDB, Dhaka

Signature and seal of the Project Director

7. Remarks/Comments of Agency Head

The Sheikh Hasina Cantonment is being developed on the banks of Payra river in Bakerganj upazilla of Barishal district and also in Lebukhali union of Patuakhali district. The area was previously a tidal plane of the river and used to get inundated during high tides and monsoon season. This tidal plane/ floodplain area has been developed by earthfilling in order to establish the cantonment. The land development has created confinement of the channel that consequently increases the near bank velocity. It is observed that river has been experiencing erosion at various stretches of the Payra River over the years, some of which are very close to the vicinity of the Sheikh Hasina Cantonment. Erosion protection measures are needed to protect the right bank of Payra River that include bank protection works and dredging of a submerged char on the opposite bank of the cantonment. The present study also focuses the impact of the proposed dredging works along the cantonment area and at Payra Bridge over the Payra River. With the concent from MoWR, BWDB will soon take necessary steps to update and finalize the DPP of the implementation project as soon as possible.

27.11.2022

Date: .....

(FAZLUR RASHID)
Director General
BWDB, Dhaka.

Signature and Seal

8. Remarks/Comments of the officer in- charge of the Ministry/Division

The objective of the project is to protect the Sheikh Hasina Cantonment area from erosion considering river morphology, characteristics of the project area (tidal flooding and cyclonic storm), environmental issues, climate change and economic viability as well as analyzing those options of nearby projects. The study focused on a comprehensive adaptive approach for the planning, design and implementation of the erosion protection work, river dredging and other infrastructures for mitigating prevailing problems. Bank protection and river dredging is proposed in the study and as per NPV, EIRR and B/C ratio the project is economically feasible for implementation.

Date: .....

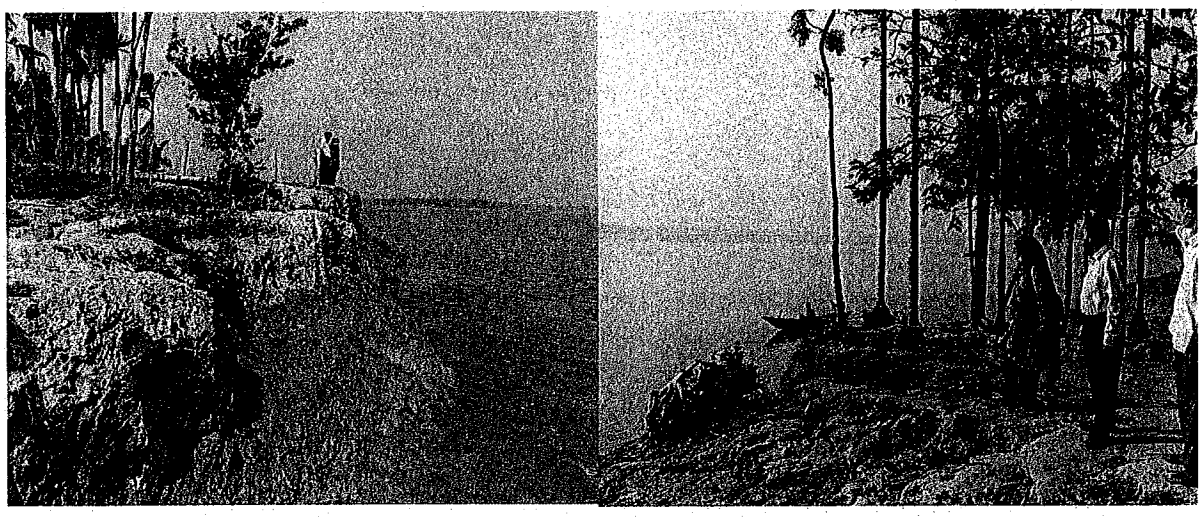
Signature and Seal

Approved
30/04/22
(ফজলুর রশিদ)
মহাপরিচালক
বাপাউবো, ঢাকা।

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

MINISTRY OF WATER RESOURCES

BANGLADESH WATER DEVELOPMENT BOARD



Feasibility Study for the Protection of Sheikh Hasina Cantonment Area from the Erosion of Karkhana, Bighai and Payra Rivers in Barishal District

Final Report

June 2022

IWM
Water Environment & Climate

EXECUTIVE SUMMARY

E1 Introduction

Government of Bangladesh has established the Sheikh Hasina Cantonment on the banks of Payra River in Bakerganj upazilla of Barishal district and also in Lebukhali union of Patuakhali district. This cantonment is the headquarter of 7th Infantry Division of Bangladesh Army. However, the under-development cantonment area has been experiencing river erosion problems and the risk of tidal flooding and cyclonic storm surge is high in the area.

Payra River is morphologically very dynamic and erodes its bank at the meandering bends. Bank erosion is taking place at various reaches of Payra River some of which are very close to the vicinity of the Sheikh Hasina Cantonment. Recently, a bridge has been built over Payra River replacing the ferry service at Lebukhali adjacent to the cantonment area. Water Development Board (BWDB) is considering erosion protection measures and dredging works in order to improve erosion, flood and navigation problems in Payra River near Sheikh Hasina Cantonment. The study area is presented in **Figure E.1**.

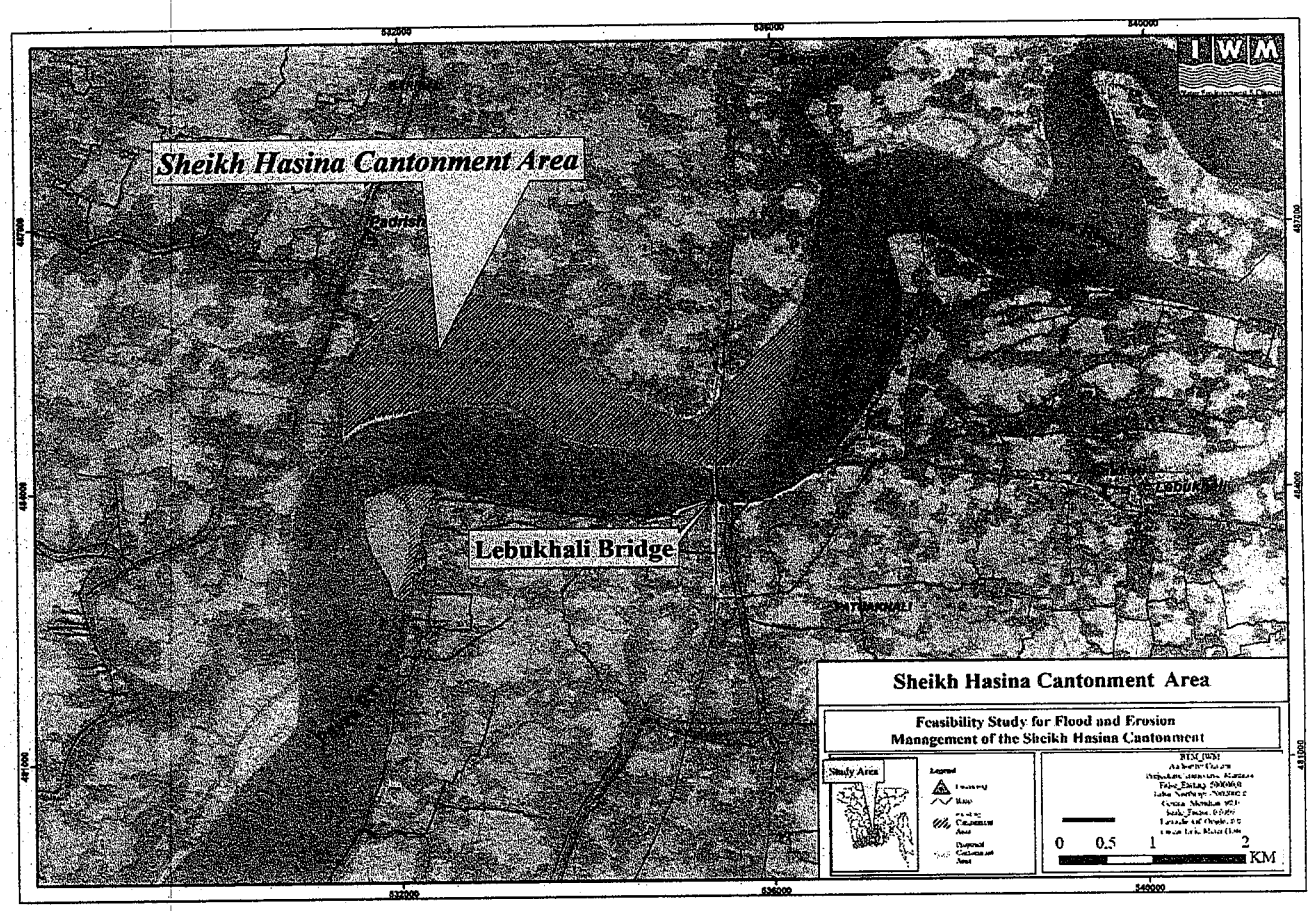
In this context, BWDB engaged Institute of Water Modelling (IWM) through a formal contract signed on 13th April 2022 to carry out a feasibility study in order to plan and design infrastructure for management of flood, erosion and improvement of navigability in Payra River as well as assess impacts of these works on the surrounding environment.

The overall objective of the study is devising appropriate options for protection of the Sheikh Hasina Cantonment area from the erosion considering river morphology, characteristics of the project area (i.e. tidal flooding, cyclonic storm surge etc.), environmental issues, climate change and economic viability as well as analysing impacts of those options on nearby projects (i.e., Payra bridge at Lebukhali).

The specific objectives for this study are as follows:

- To identify the prevailing problems related to water resources management in the study area and underlying causes that should be tackled for mitigating those issues.
- To assess the vulnerability due to erosion and tidal action (including cyclonic storm surge) at present and in future considering climate change and sea level rise.
- To prepare a holistic and integrated plan for improved water resource management of the study area considering future land use pattern, climate change and sea level rise;
- To prepare dredging alignment and dredged material management plan;
- To analyze impact of different proposed options and land development on upstream & downstream of the study area including existing infrastructures (i.e. Payra bridge at Lebukhali etc.;
- To conduct a detailed Environmental and Social Impact Assessment (ESIA) for proposed interventions;
- To assess the project with respect to Environmental Sustainability, Climate Resilience and Disaster Risk and find the ways for reducing/mitigating negative impacts;
- To estimate the detail cost of the project including economic and financial analysis to acquire the extended project outcomes.

River system of the Study Region

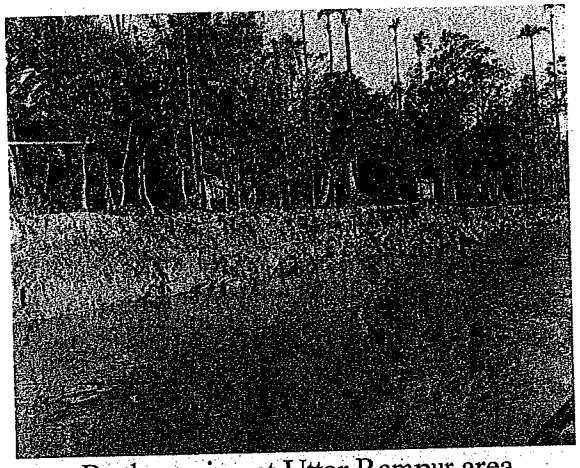


Study Area

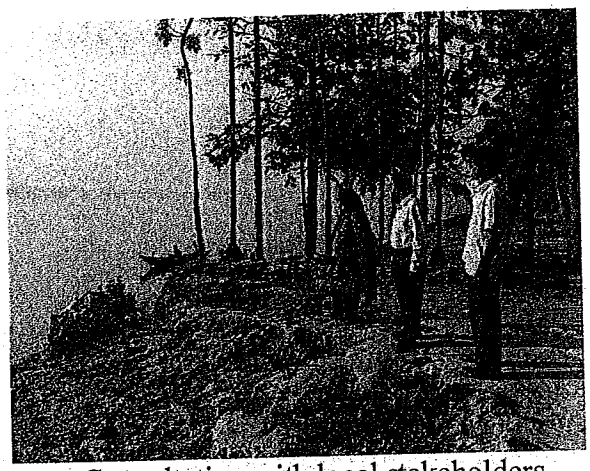
Figure E.1: Map showing river system of the study region (left) and the study area (right)

E2 Problem Statement and Demand Analysis

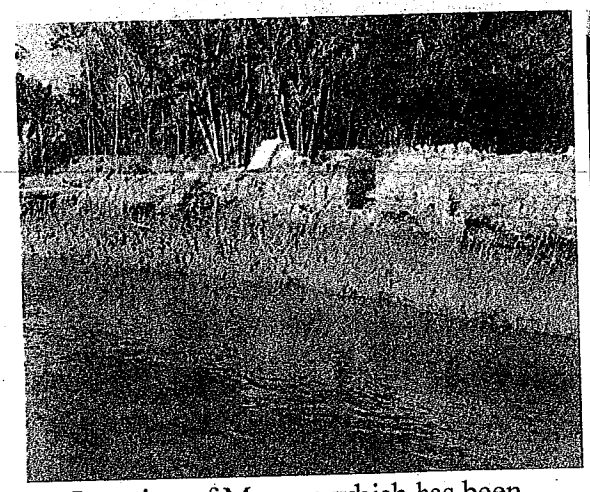
Riverbank erosion has been identified as the major problem in the study area from several field visits and stakeholder consultations. Right bank of Payra River at Uttar Rampur has been experiencing severe erosion for last 3 years. One mosque and embankment has been washed out last year. The embankment on river bank is also in vulnerable condition. According to the local people, bank erosion increased after the land development work started at Sheikh Hasina Cantonment Area. One char was observed in the middle of the river which inundates during the extreme high tide.



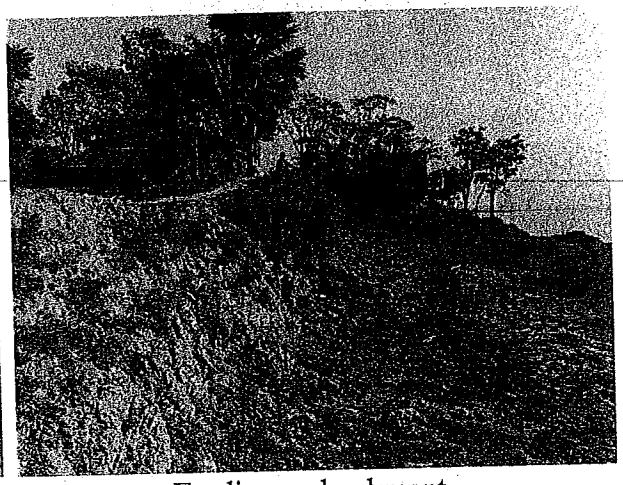
Bank erosion at Uttar Rampur area



Consultation with local stakeholders



Location of Mosque which has been washed out recently due to bank erosion



Eroding embankment

Figure E.2: Riverbank erosion at Uttar Rampur on right bank of Payra River immediate downstream of the cantonment

Erosion is also taking place at the left bank of the river at Angaria. The intensity of erosion has increased during the last five years and the river width has increased by about 150-180 m during this period. BWBD has already reconstructed an embankment for flood protection. Local people mentioned that there is a deep scour hole created adjacent to the left bank.

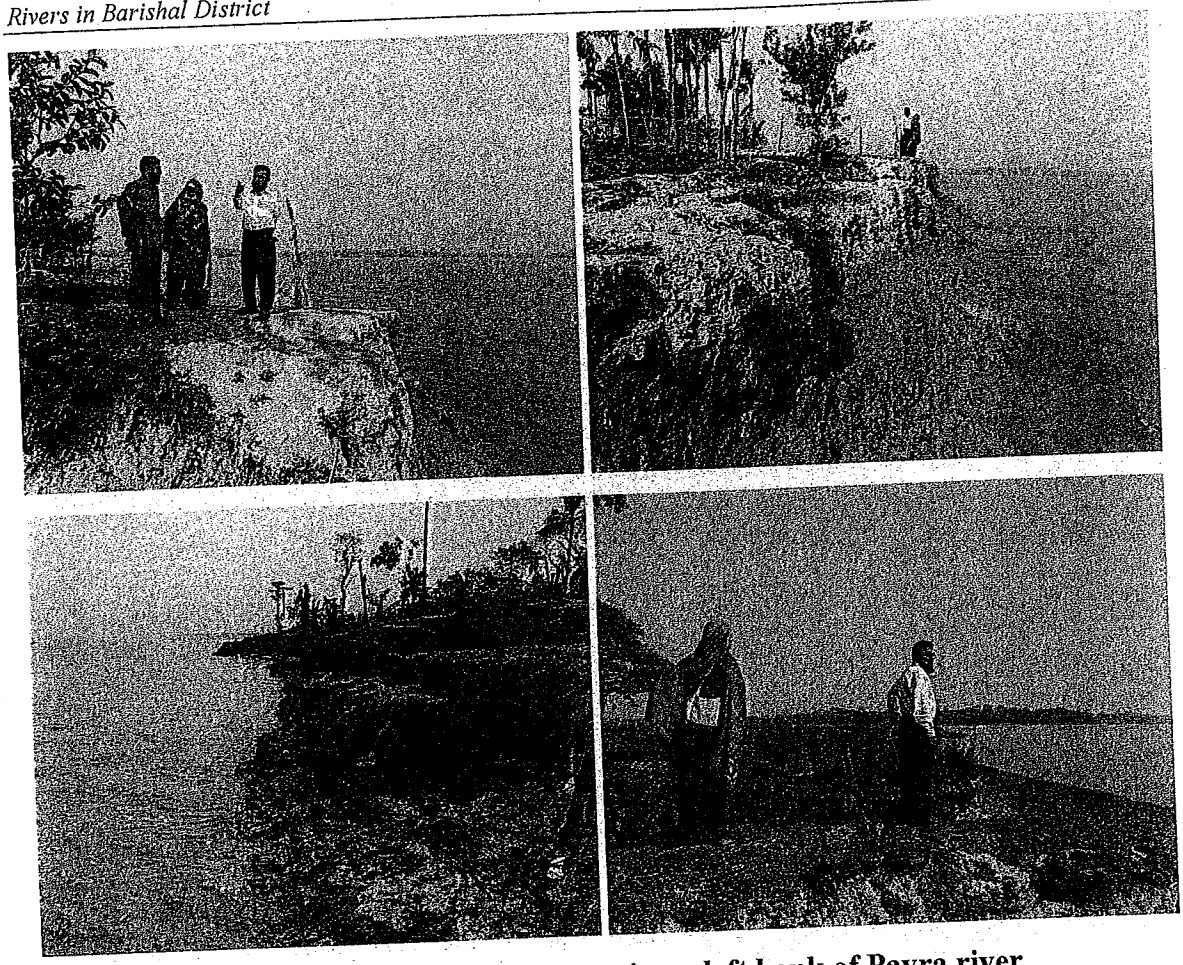


Figure E.3: Erosion at Angaria on left bank of Payra river

Similar erosion is found from satellite image analysis. The riverbank shifting derived from the image analysis of the years 2000, 2005, 2010, 2014, 2016, 2018, 2020 and 2022 as well as the erosion-accretion trend. **Table E.1** presents the two-yearly erosion and accretion analysis from 2016 to 2022 at different reaches of Payra River near Sheikh Hasina Cantonment. The chainage of these reaches is shown in **Figure E.4** showing the long term (2000-2022) erosion-accretion.

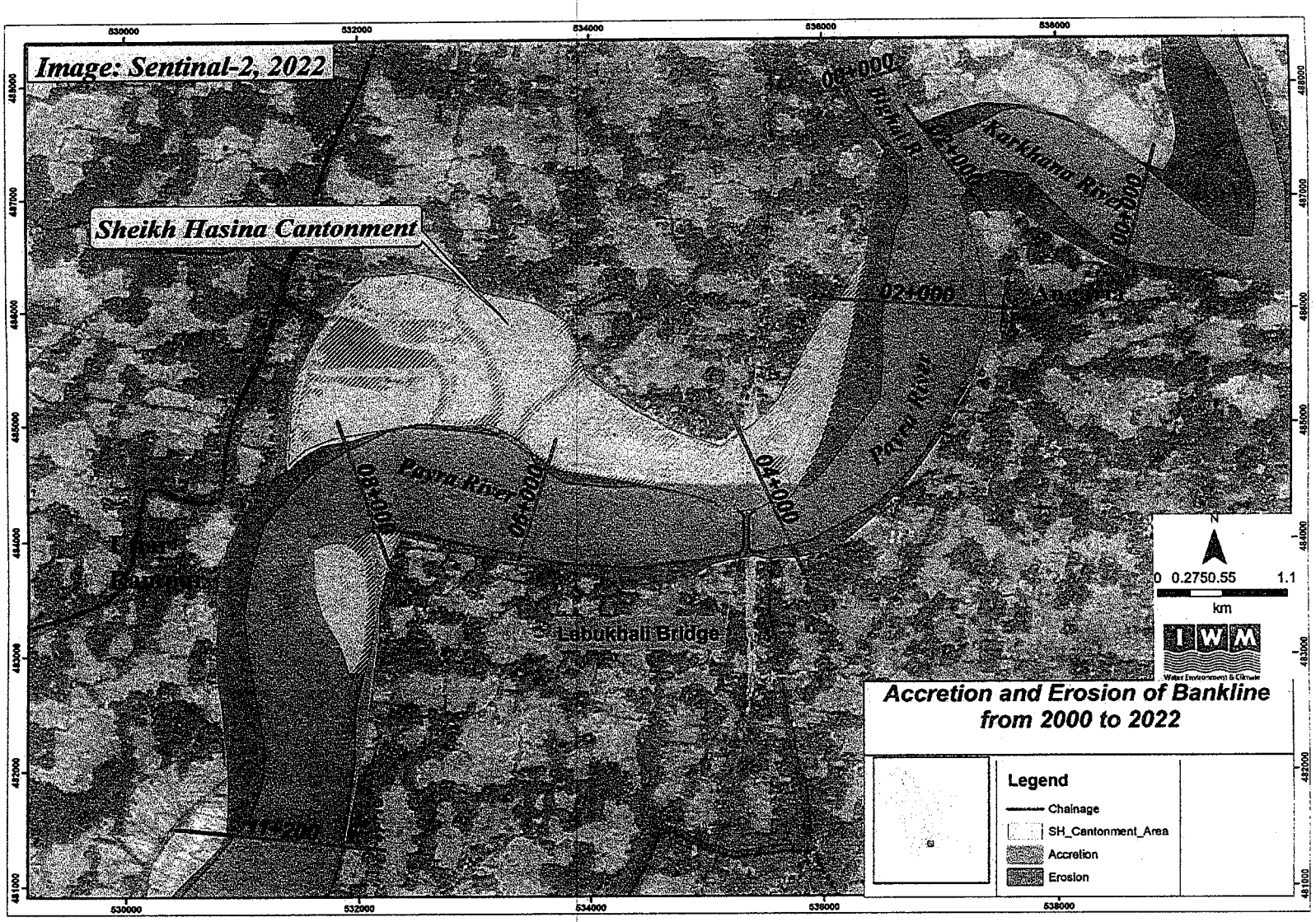


Figure E.4: Long term erosion and Accretion in Payra River near Sheikh Hasina Cantonment (2000 to 2022)

Table E.1: Short term erosion and accretion in Payra River near Sheikh Hasina Cantonment (2016 to 2022)

Location		Year 2016-2018		Year 2018-2020		Year 2020-2022		Year 2016-2022	
Bank	Chainage (m)	Accretion Area (ha)	Erosion Area (ha)	Accretion Area (ha)	Erosion Area (ha)	Accretion Area (ha)	Erosion Area (ha)	Accretion Area (ha)	Erosion Area (ha)
Right Bank	00+00 to 2+000	0.00	7.50	2.43	0.09	0.68	4.20	0.00	10.86
Left Bank	00+00 to 2+000	0.37	1.37	0.00	7.38	0.00	7.08	0.00	15.50
Right Bank	00+00 to 2+000	0.00	6.13	0.04	1.27	0.03	2.40	0.00	8.91
	2+000 to 4+000	0.28	1.80	0.04	3.48	0.00	5.47	0.00	10.76
	4+000 to 6+000	0.23	1.78	0.00	1.60	0.16	1.45	0.30	4.25
	6+000 to 8+000	0.00	4.60	0.00	0.00	0.00	2.13	0.00	7.55
	8+000 to 11+200	0	17.3	0	13.78	0	17.54	0.00	39.45
Left Bank	00+00 to 2+000	1.34	0.84	0.00	1.70	0.00	2.30	0.33	3.80
	2+000 to 4+000	2.65	0.45	0.00	0.00	0.00	4.75	1.25	1.40
	4+000 to 6+000	4.21	0.00	0.00	0.00	2.30	1.45	3.70	0.50
	6+000 to 8+000	0.87	0.07	0.00	0.00	0.60	0.67	0.50	0.40
	8+000 to 11+200	4.80	0.06	0.64	0.15	0.43	1.13	2.45	0.28

Similar erosion conditions have been found from satellite image analysis. The analysis also shows that erosion along Payra River at the eastern side of the cantonment and also in the southwest of the cantonment has increased in recent years, especially after development of floodplain in the Sheikh Hasina Cantonment area. The yearly erosion rate is calculated along the right bank of Payra River for the period from 2000 to 2014 (before any land development) and also from 2016 to 2022 (after land development started) and the results are presented in **Table E.2** as well as **Figure E.5** and **Figure E.6.**

Table E.2: Annual Rate of Bankline Shifting along the right bank from 2000 to 2014

River Name	Chainage	Rate of Bankline Shifting (m/yr) from 2000 to 2014		Rate of Bankline Shifting (m/yr) from 2016 to 2022	
		Erosion	Accretion	Erosion	Accretion
Bighai/Payra River	00+000	1.00	-	0.82	-
	01+000	8.77	-	8.19	-
	02+000	8.20	-	12.98	-
	03+000	15.95	-	8.14	-
	04+000	-	12.77	4.25	-
	05+000	-	4.91	2.45	-
	06+000	0.11	-	8.50	-
	07+000	-	1.37	4.22	-
	08+000	3.78	-	11.18	-
Karkhana River	00+000	-	5.23	16.24	-
	01+000	-	3.57	6.08	-
	02+000	7.06	-	6.60	-

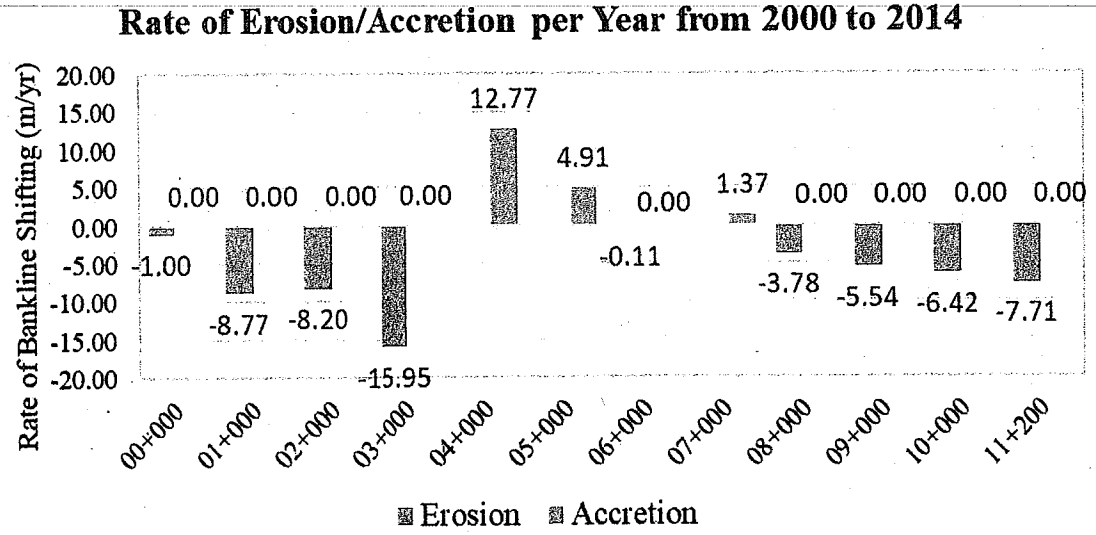


Figure E.5: Yearly shifting of right bank Bighai/Payra River (2000 to 2014)

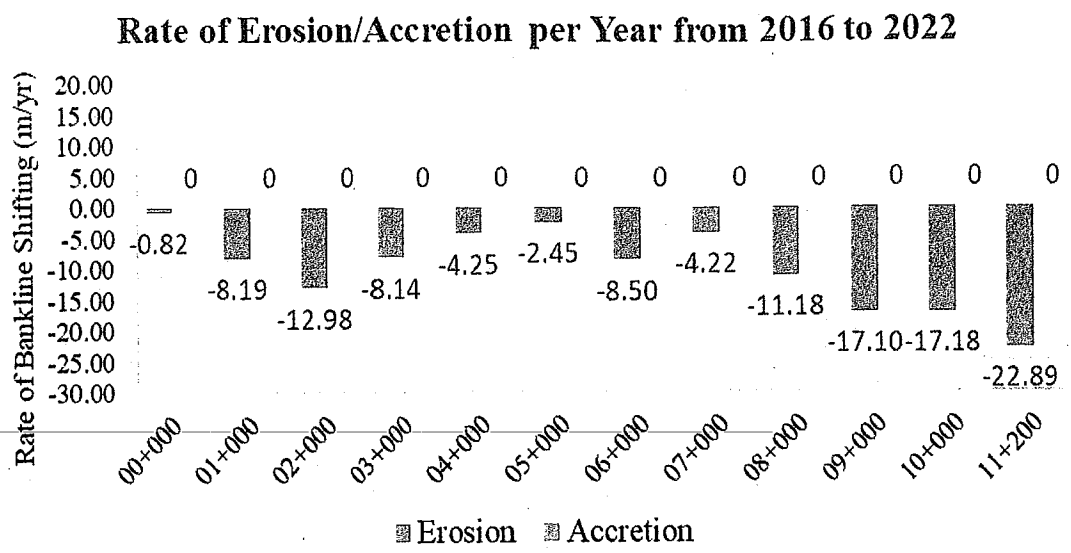


Figure E.6: Yearly shifting of right bank Bighai/Payra River (2016 to 2022)

The cantonment is a Key Point Installation (KPI) of the country and the base of 7th Infantry Division of Bangladesh Army. The cantonment has been built spending about 1,500 crore taka in order to ensure national defense as well as fighting against national disaster of six districts of coastal Bangladesh. The cantonment will be at risk if the bank protection measures are not taken. The resources costing about 4,838.41 crore taka including installations 3900.20 crore taka will be at risk if this project is not implemented.

A scour hole has been found in Payra River near Payra Bridge from the hydrographic survey carried by IWM in January 2022 where the deepest scour level is -36.5 mPWD. However, the design maximum scour level at pier location of Payra Bridge is considered -31.3 mPWD (Source: Final Report on "Feasibility Study of Payra Bridge on Barisal-Patuakhali Road (N8)", June 2011). It is a issue of concern that the existing scour level near the bridge is below the design scour level of the bridge. This issue has been apprised to the client, BWDB as well as the concerned authority, Roads and Highways Department (RHD) for taking necessary precautions.

E3 Technological and Engineering Design

E3.1 Proposed Interventions

IWM proposed revetment and dredging combinedly for the present study along the right bank of Bighai and Payra rivers adjacent to the Sheikh Hasina Cantonment area. The location and length of proposed bank protection measures is given in **Table E.3** and **Figure E.7**. The design and considerations of the bank protection measures as well as the proposed dredging plan and strategy are discussed in **Section 4.2** of the main report.

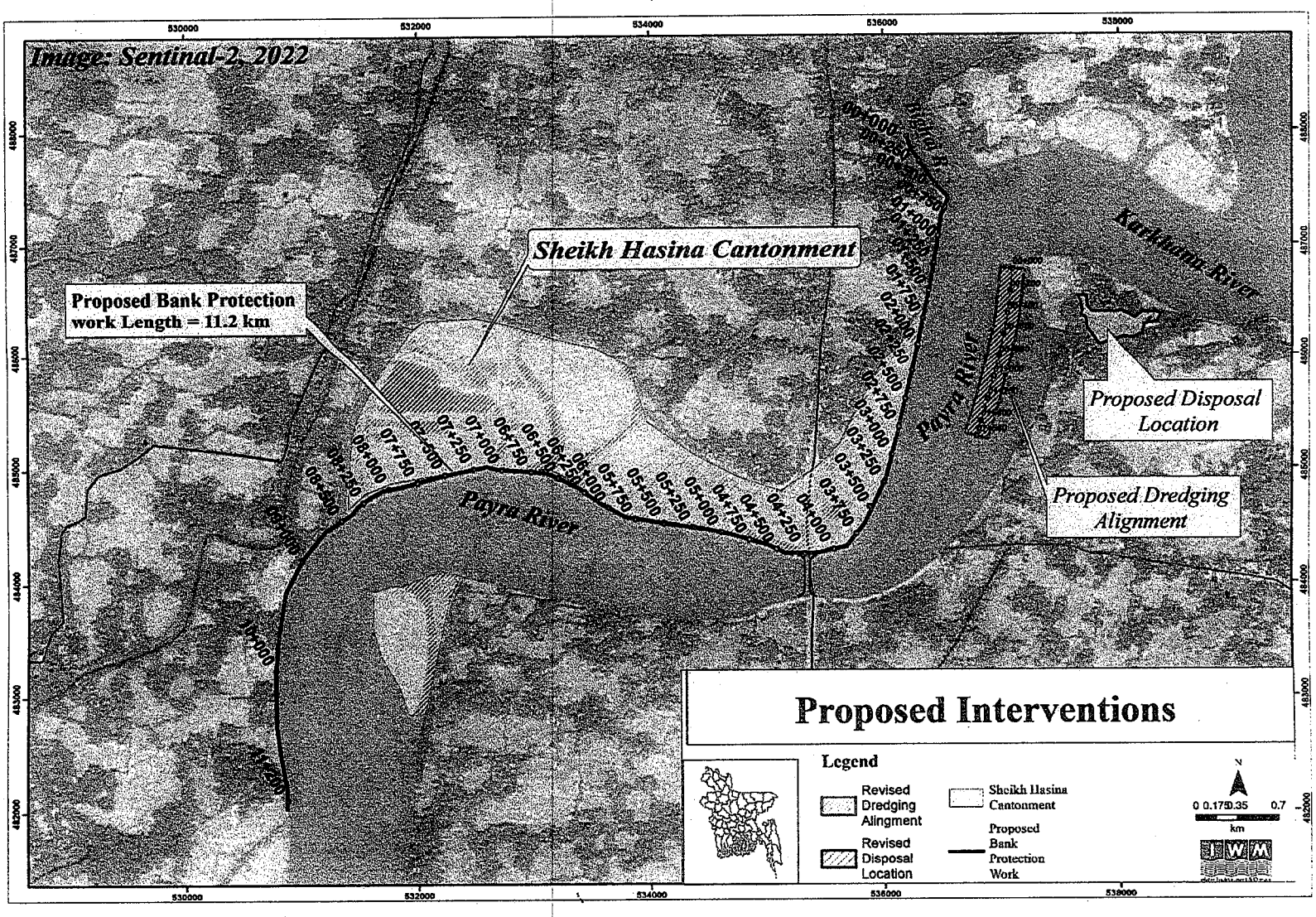


Figure E.7: Map showing the locations of Proposed Intervention (Protective measures and dredging alignment)

Table E.3: Location and Length of Bank Protection Measures

Location	Proposed Length (km)	Remarks
Revetment works from 1 Km (chainage 0+000m) at the outfall of Bighai River to Uttar Rampur (chainage 11+200m) along the right bank of Payra River	11.2	8.5km reach of revetment works (from chainage km 0+000 to km 08+500) is proposed on a priority basis to save the KPI
Dredging of submerged char near Angaria	1.5	The bottom width of dredging alignment is 200m, bottom level -4mPWD and side slopes 1:4. Total dredging volume is estimated as 1.86 Mm^3.

E3.2 Impacts of the Interventions

The base condition (without interventions) and the proposed option (bank protection and dredging) is simulated by the mathematical model. Dredging of the submerged char will increase the conveyance of the channel eventually decrease of flow velocity at the opposite bank (along east side of the cantonment area). Decrease of flow velocity consequently reduces bank erosion along the cantonment.

The reshaping of the channel cross-section will influence the horizontal flow distribution but the secondary flow components will continue eroding the channel bed near the outer bank again after dredging works are completed unless the bed is suitably protected. Riverbank protection measures are required to protect the land against river erosion.

Simulation of current speed with and without interventions show that dominant current direction during flood and ebb period near the dredging location and eroding bank of Sheikh Hasina Cantonment. A map showing the change in maximum current speed map for a whole year due to dredging of the char at inner bank is presented in **Figure E.8**. the figure shows that current speed is increased near the inner bank with a magnitude of 0.05 to 0.8m/s near the dredged channel. However, the maximum current speed along the outer bank of the river in east side of the cantonment area decreases from 0.8 to 0.24m/s. However, no change of maximum current speed is found near Payra Bridge.

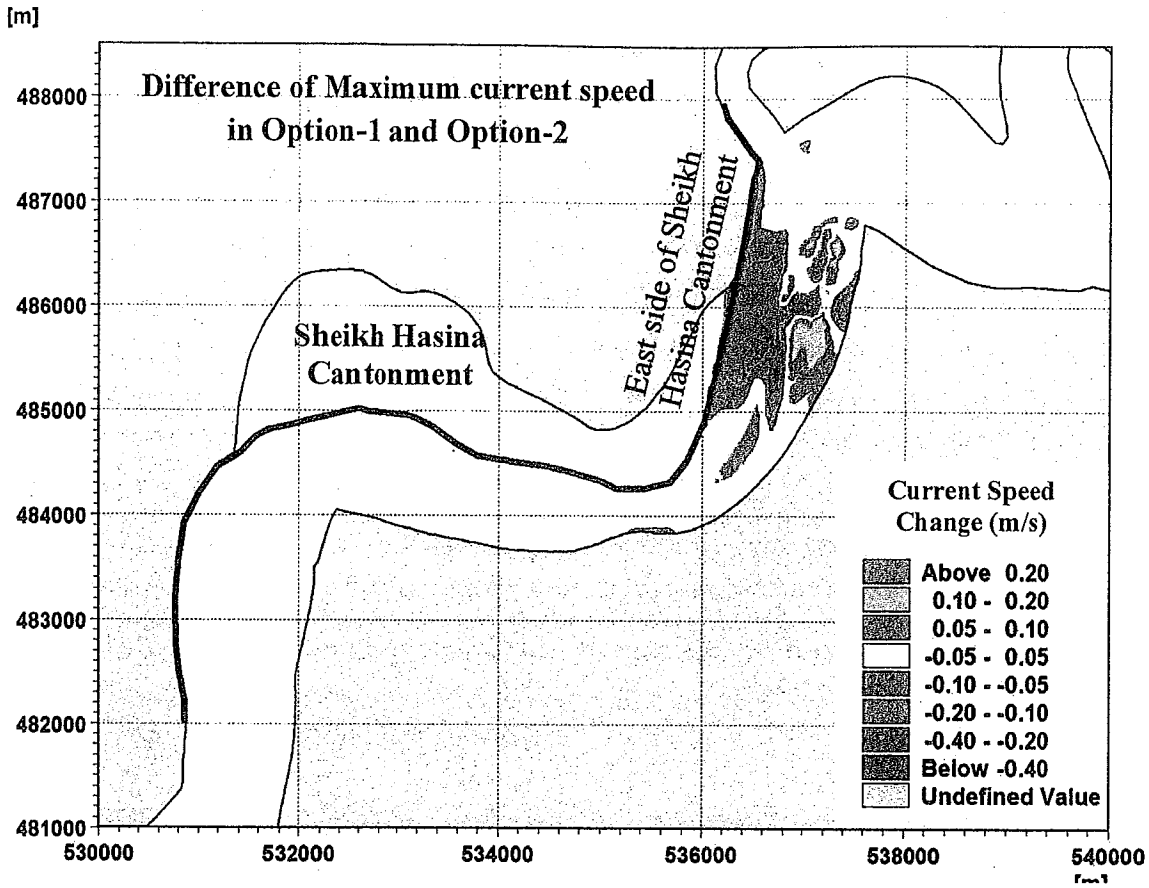


Figure E.8: Change in maximum current speed map over a year due to dredging

E4 Environmental Sustainability, Climate Resilience and Disaster Risk Analysis

E4.1 Environmental Impacts and Environmental Management Plan (EMP)

Valued Environmental Components (VECs) are defined as fundamental elements of the physical, biological or socio-economic environment that are likely to be impacted by a proposed project. In this project, the following VECs are likely to be affected by the project activities:

- Water Quality
- River Bank Erosion
- Fish Habitats/ Kum/ Scour
- Benthic Habitat
- Air quality and Noise

The project is likely to have positive impacts on riverbank erosion and protection against other disasters. Moreover, the fish habitats are likely to get positive impacts due to dredging and deepening of the flood channel. However, turbidity of river water may increase which will have negative impacts on fisheries resources. Use of cutter suction dredgers, silt curtains, compartmentalization of disposal site, as recommended in the Environmental Management Plan (EMP), will mitigate the negative impacts on water quality and fisheries. The benthic habitat is likely to be impacted during dredging period but it will be replenished within 6

months to 1 year. Proper maintenance of dredgers and other equipment as well as the vehicles and vessels are also recommended as part of the EMP. Moreover, tree plantation along riverbank is also suggested as Environmental Enhancement Plan in order to compensate the residual impacts.

The following environmental recommendations are based on the baseline scenario, likely impacts of the Project on different environmental parameter, environmental and social guidelines, regulations and policies and stakeholder consultations:

- Recommended mitigation measures as depicted in the Environment Management Plan needs to be implemented. The EMP shall be included in the bid document of civil works and need to become part of the civil works contracts. The timely implementation of EMP will reduce negative impacts;
- The Environmental Monitoring Plan shall be strictly followed by BWDB, consultants and contractor to ensure compliance with the mitigation measures;
- BWDB and the contractor shall abide by relevant environmental rules, regulations including workers' health and safety aspect, prevention of air, noise and water pollution and protection of aquatic fauna and flora.

E4.2 Climate Change and Disaster Risk Analysis

The erosion scenario is expected to aggravate by climate change scenario in future. The rise in sea level will cause increase of water level and flow in the Payra river which will consequently worsen the prevailing erosion problem in this area and engulf more land into the Payra River. Moreover, the change in rainfall, temperature and wind speed will also have some effects on the situation. Furthermore, monsoon and tidal flooding and inundation during cyclonic storm surge are likely to be aggravated by climate change conditions. By taking adequate measures (bank protection work) erosion problem can be minimized. The dredging of the left bank of Payra river (near the confluences of Bighai and Pandab river) will divert the flow from the right bank at Cantonment area. By diverting the flow and reducing the velocity at the Cantonment area will improve to solve the erosion problem in this area.

Contingency plans are an essential part of risk management. There are various uncertainties which may occur during the project period for which a contingency plan is required. These uncertain situations may be of any of the following categories:

- Natural disasters such as tidal flooding, cyclonic storm surge or earthquake
- Emergency such as fire, accidents, explosion or any medical emergency
- Other external factors such as leakage of sediment, oil spill due to negligence, etc.

A contingency plan (Details in **Section 5.3**) is developed to prevent and contain accidental sediment release into river water, oil leakage/spills, fire or any other natural or man-made incident. The contingency plan should be included in contractors' costs.

E5 Cost-Benefit Analysis

E5.1 Project Costs

Capital Costs

Total investment cost of the project at financial price and economic prices are estimated as BDT 95089.54 lakh and BDT 75087.31 lakh respectively. The year wise Financial and Economic Costs used in the analysis are given in **Table E.4**.

Table E.4: Year wise Financial and Economic Investment Cost (Lakh taka)

Year	Financial Costs	Economic cost
1	11432.83	9022.24
2	28916.17	22850.06
3	28861.17	22806.54
4	25879.37	20408.47
Total	95089.54	75087.31

Project O&M Costs

Annual Operation and Maintenance (O&M) costs of the project facilities have been estimated based on the civil works cost. The annual O&M cost is estimated as 1998.56 BDT lakh.in financial and 1533.99 BDT in economic analysis.

E5.2 Project Benefits

The Economic benefits of the project have been identified and quantified as far as possible for economic analysis. The objective of establishing the river bank protection and river dredging.

Therefore, the benefits of the river bank protection and river dredging could be listed as follows:

- Immovable and Movable Properties to be saved after implementation of the project which have been calculated on market price resulting of financial value estimated Taka 441601.99 Lakh and Economic value Taka 398766.60 lakh over the period from the 5th year to project life time 25 years and Yearly Financial value estimated Taka 21028.67 Lakh and Economic value Taka 18988.89 lakh..

Induced Benefit

- Employment Opportunity of Local People

Non-Quantified Benefits

A number of potential benefits, both, quantifiable and non- quantifiable, have not been quantified, as dependable data for making reasonable estimates are not available. Some of these non-quantified benefits have profound socio-economic implications for poverty reduction such as income generation of the local people.

E5.3 Key Economic Indicators and Findings

The economic indicators are computed for the Project to judge its economic viability. These indicators include Net Present Value (NPV), Benefit Cost Ratio (B/C Ratio) and Economic Internal Rate of Return (EIRR).

The analytical results of economic analysis are summarized in **Table E.5**.

Table E.5: Results of Base case Economic and Financial Analysis (Lakh BDT)

Viability Indicator	Result
1. Capital Cost Financial (Lakh BDT)	95089.54
2. Capital Cost Economic (Lakh BDT)	75087.31
3. O&M Cost Financial (Lakh BDT)	1998.56
4. O&M Cost Economic (Lakh BDT)	1533.99
5. Economic Benefit Cost Ratio (EBCR @ 12%)	1.45
6. Economic Net Present Value (ENPV @ 12%) Lakh BDT	28409.84
7. Economic Internal Rate Return (EIRR %)	18.00%

The results indicate that the Project is economically viable, as it secures a rate of return that exceeds 12%, i.e., the opportunity cost of capital, presently used by all sectors of the economy in Bangladesh. In conclusion, the analysis of the interventions and impact is that project is technically feasible, economically viable, socially acceptable and environmental-friendly. Considering the importance of people's livelihood and self-sustainable, this project is being recommended for implementation.

E6 Recommendations

River dredging and protective measures are recommended for reducing erosion vulnerability and loss of land. Details of recommended interventions are:

- Bank protection works from 1 Km upstream of the outfall of Bighai River (km 0+000) to Uttar Rampur (km 11+200) along the right bank of Payra River is required. The length of required bank protection works is 11.200 km.
  However, 8.500 km bank protection works, from 1 Km upstream of the outfall of Bighai River (km 0+000) to the end of the cantonment area (km 08+500), shall be implemented on a priority basis.
- Dredging of a char near Angaria at design level -4mPWD at the upstream of Payra Bridge along the left bank of Payra River. The length of proposed dredging alignment is 1.500 Km, bottom width 200m and side slope is 1:4. The volume of dredging, including capital and maintenance dredging, is estimated as 1.86 Million Cubic Meter. It is evident from the mathematical model results that dredging in Payra river increases the conveyance capacity and reduces the near bank velocity. Pre-dredging hydrographic survey needs to be carried out before implementation and the dredging plan has to be revisited and dredging volume shall be recalculated based on the changed morphological condition.
- Analysis of mathematical model results shows that proposed dredging intervention does not have any negative impact on Payra Bridge.

- The dredged material shall be used to develop low lying area of Angaria area.
- Land development of 7th Island above existing land level is not recommended since it will decrease conveyance capacity of the river and increase erosion along the right bank of Payra River near Uttar Rampur.