FINAL FEASIBILITY STUDY REPORT

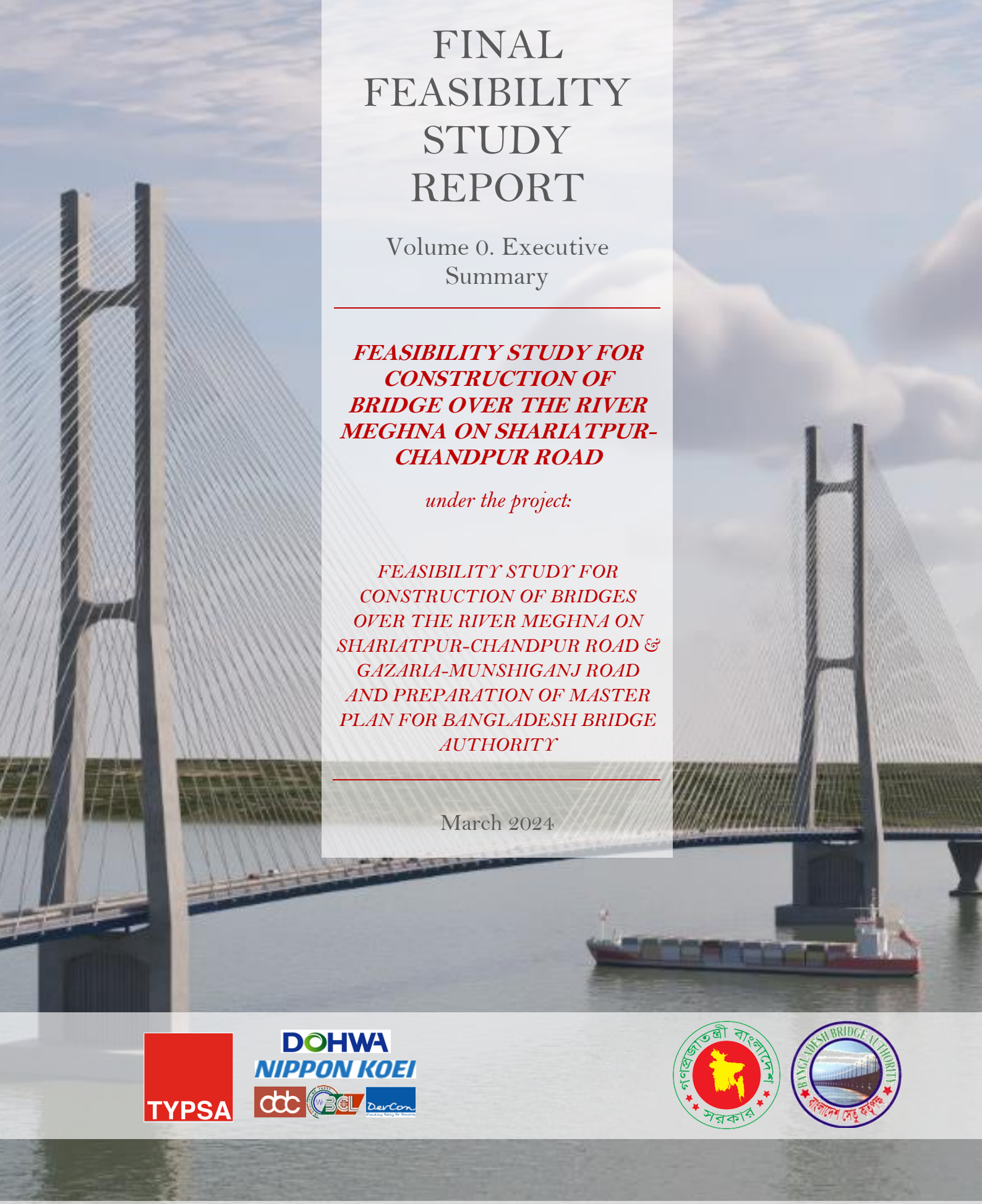
Volume 0. Executive Summary

FEASIBILITY STUDY FOR CONSTRUCTION OF BRIDGE OVER THE RIVER MEGHNA ON SHARIATPUR-CHANDPUR ROAD

under the project:

FEASIBILITY STUDY FOR CONSTRUCTION OF BRIDGES OVER THE RIVER MEGHNA ON SHARIATPUR-CHANDPUR ROAD & GAZARIA-MUNSHIGANJ ROAD AND PREPARATION OF MASTER PLAN FOR BANGLADESH BRIDGE AUTHORITY

March 2024



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BANGLADESH BRIDGE AUTHORITY বাংলাদেশ সেতু কর্তৃপক্ষ

Government of the People's Republic of Bangladesh
Ministry of Road Transport & Bridges
Bridges Division
Bangladesh Bridge Authority (BBA)

FINAL FEASIBILITY STUDY REPORT FOR CONSTRUCTION OF BRIDGE OVER THE RIVER MEGHNA ON SHARIATPUR- CHANDPUR ROAD

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List of Abbreviations

1D	One Dimensional
2D	Two Dimensional
AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ADB	Asian Development Bank
ADT	Average Daily Traffic
AP	Affected Person
ARIPA	Acquisition and Requisition of Immovable Property Act
BAU	Business as Usual
BBA	Bangladesh Bridge Authority
BDT	Bangladesh Taka
BFRI	Bangladesh Fisheries Research Institute
BIWTA	Bangladesh Inland Water Transportation Authority
BWDB	Bangladesh Water Development Board
CAPEX	Capital Expenditure
CBA	Cost Benefit Analysis
CC	Cement Concrete
CCB	Control Centre Building
CEGIS	Centre for Environmental and Geographic Information Services
CL	Lean Clay
CPR	Common Property Resources
DBFOT	Design-Build-Finance-Operate-Transfer
DC	Deputy Commissioner
DNP	Defects Notification Period
DoE	Department of Environment
DSCR	Debt Service Coverage Ratio
EBCR	Economic Benefit Cost Ratio
EBITDA	Earnings before Interest, Taxes, Depreciation and Amortization,
EFP	Economic Financial Plan
EGL	Existing Ground Level
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
ENPV	Economic Net Present Value
EPC	Engineering, Procurement and Construction
EZ	Economic Zone
FBCR	Financial Benefit-Cost Ratio
FDR	Financial Discount Rate
FHWA	Federal Highway Administration
FIDIC	The International Federation of Consulting Engineers
FIRR	Project Investment Cost
FNPV	Financial Net Present

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FS	Feasibility Study
GDP	Gross Domestic Product
GoB	Government of Bangladesh
HH	Household
IEE	Initial Environmental Examination
IFC	International Finance Corporation
INGO	International Non-Governmental Organization
IoL	Inventory of Losses
IRC	Indian Road Congress
IRR	Inner Ring Road / Inner Circular Elevated Expressway (Dhaka)
IWM	Institute of Water Modelling
JV	Joint Venture
Ke	Cost of equity
Km	Kilometre
LAP	Land Acquisition and Resettlement
LGB	Left Guide Bund
LGED	Local Government Engineering Department
LRFD	Load Resistance Factor Design
m	Meter
MDB	Multilateral Development Banks
ML	Silt
MSL	Mean Sea Level
MSS	Movable scaffolding system
MUSD	Million United States Dollar
N1	National One (Dhaka–Chattogram Highway)
NPV	Net Present Value
OPEX	Operating Expenses
PAPs	Project Affected Person
PBS	Palli Bidyut Samity
PDB	Power development Board
PCM	Public Consultation Meeting
PM	Prime Minister
PPP	Public and Private Partnership
PWD	Public Works Datum
PWD	Public Works Department
RAP	Resettlement Action Plan
RC	Replacement Cost
RHD	Roads and Highways Department
RoW	Right of Way
RTW	River Training Work
SCF	Standard Conversion Factors
SCP	Sand Compaction Pile
SHWL	Standard High-Water Level
SM	Silty Sand

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SP	Poorly Graded Sand
SPT	Standard penetration
SRD	Social Rate of Discount
SWOT	Strengths, Weakness, Opportunities, Threats
TAC	Technical Advisory Committee
ToR	Terms of Reference
USD	United States Dollar
VAT	Value Added Tax
VGF	Viability Gap Financing
VOC	Vehicle Operating Costs
WACC	Weighted Average Cost of Capital
WB	World Bank
WL	Water Level

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Executive Summary

Summary of Key Findings and Recommendations of the Feasibility Study

(Final Report – March 2024)

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Project Feasibility Final Study Report

1. PROJECT BASIC INFORMATION

Table 1. Basic Information

1.	Name of the Project	:	FEASIBILITY STUDY FOR CONSTRUCTION OF BRIDGE OVER THE RIVER MEGHNA ON SHARIATPUR-CHANDPUR ROAD
2.	(a) Sponsoring Ministry/Division (b) Implementing Agency	:	(a) Government of the People's Republic of Bangladesh Ministry of Road Transport & Bridges (b) Bridges Division Bangladesh Bridge Authority (BBA)
3.	Project Objectives (Project to be taken based on the study)	:	To assess the feasibility of a bridge and related infrastructures connecting Shariatpur to Chandpur crossing the Meghna River Analysis shall include technical, socio-economic, financial, and environmental aspects
4.	Estimated project Cost. (Taka in Crore)	:	Estimated project Cost. 15,957.21 Cr BDT
5.	Sector & Sub-Sector	:	Transport Sector / Bridges Infrastructures
6.	Project Category	:	Project Red Category (Based on Environment Conservation Rules 1997)
7.	Project Geographic Location Countrywide Division District Upazila Others (City Corporation/Pourashva)	:	The People's Republic of Bangladesh Division: Dhaka / Chattogram District: Shariatpur / Chandpur Upazila: Bhederganj and Chandpur Sadar
8.	Project Duration	:	Investment Period: 7 Y – 2025/2031 Operation Period: 30 Y – 2032/2061

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2. INTRODUCTION

2.1. Background

With a view to boost up the economy of every corner of Bangladesh equally, a roadmap and action plan (Master plan) of transport connectivity is being implemented by Bangladesh Bridge Authority. In response to long felt need for easy and quick communication among major cities of Bangladesh, the Master plan, prepared by BBA includes construction of several bridges. Among these, one of the important bridges is the one over the river Meghna on Shariatpur-Chandpur Road at Shariatpur and Chandpur Districts respectively.

At the eastern side, the proposed bridge connects to **Chandpur Sadar Upazila of Chandpur District,** and, at the western side, it connects to **Bhederganj Upazila of Shariatpur District**. Approach roads are necessary at both sides of the proposed bridge to connect to regional roads of Chandpur (R140) and Shariatpur (R860).

Figure 1. Bridge Location area

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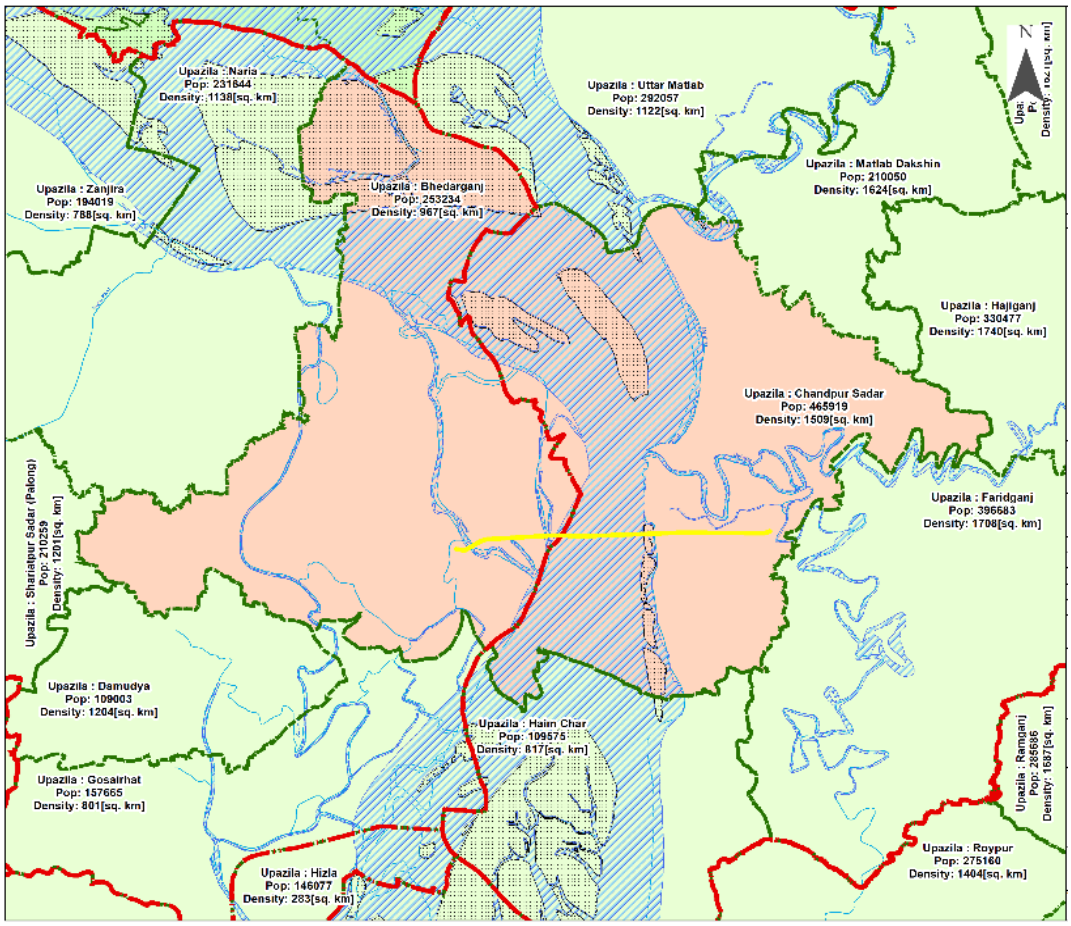

Figure 2. Shariatpur-Chandpur Bridge Location

Chandpur District is an administrative region of Chattogram Division, located in the south-eastern region of Bangladesh. According to the numbers of Upazilas, Chandpur is an "A" class district of Bangladesh and located at the confluence of the rivers of Padma, Meghna and Dakatia. The area of the district is 1,645 km^2. According to the 2022 census, Chandpur District population is 26.35 lakhs.

The district is composed of 8 Upazilas, Chandpur Sadar, Faridganj, Haimchar, Hajiganj, Kachua, Matlab Dakshin and Matlab Uttar. Among them, the proposed bridge falls in Chandpur Sadar Upazila.

Chandpur is called "*Home of Hilsa*" as one of the main breeding areas of hilsa fish. The distance of this district from the capital Dhaka is about 96 km and from Chattogram is about 208 km. Districts of Lakshmipur and Noakhali are located to the south, Cumilla district to the east, districts of Cumilla and Munshiganj to the north, and districts of Munshiganj, Shariatpur and Barishal to the west.

Shariatpur district is an administrative region of Dhaka Division in central Bangladesh. This district is bounded by Munshiganj district to the north, Barishal district to the south, Chandpur district to the east and Madaripur district to the west. Main rivers in this area are Padma, Meghna, Palong, Jayanti, and Dharmaganj. The district is composed of 6 upazilas, Shariatpur Sadar Upazila, Damudya Upazila, Naria Upazila, Zanjira Upazila, Bhedarganj Upazila, Gosairhat Upazila. The area of the district is 1,174 km^2. According to the 2022 census, Shariatpur district population is 12.94 lakhs.

For a long time, the Meghna River was called the sorrow of Chandpur. Many people of this district lost their homes and land due to erosion and flooding effects. Several times, the government took various initiatives to prevent river erosion. The town protection embankment was built, but in the face of erosion, the dam has not been stable. Every year, about 6,000 hectares of land is destroyed by river erosion and innumerable people lose their houses and crops.

A bridge over the river Meghna, at Chandpur-Shariatpur crossing, is a long-standing missing link in the national road network. All past RHD Master Plans as well as the ongoing one, highlighted the necessity of the bridge to integrate the south-west Bangladesh with the south-east region. This is an important connection due to the enormous economic activities that are taking place on the south-east part, mainly including shipping and international cargo handling in Chattogram port.

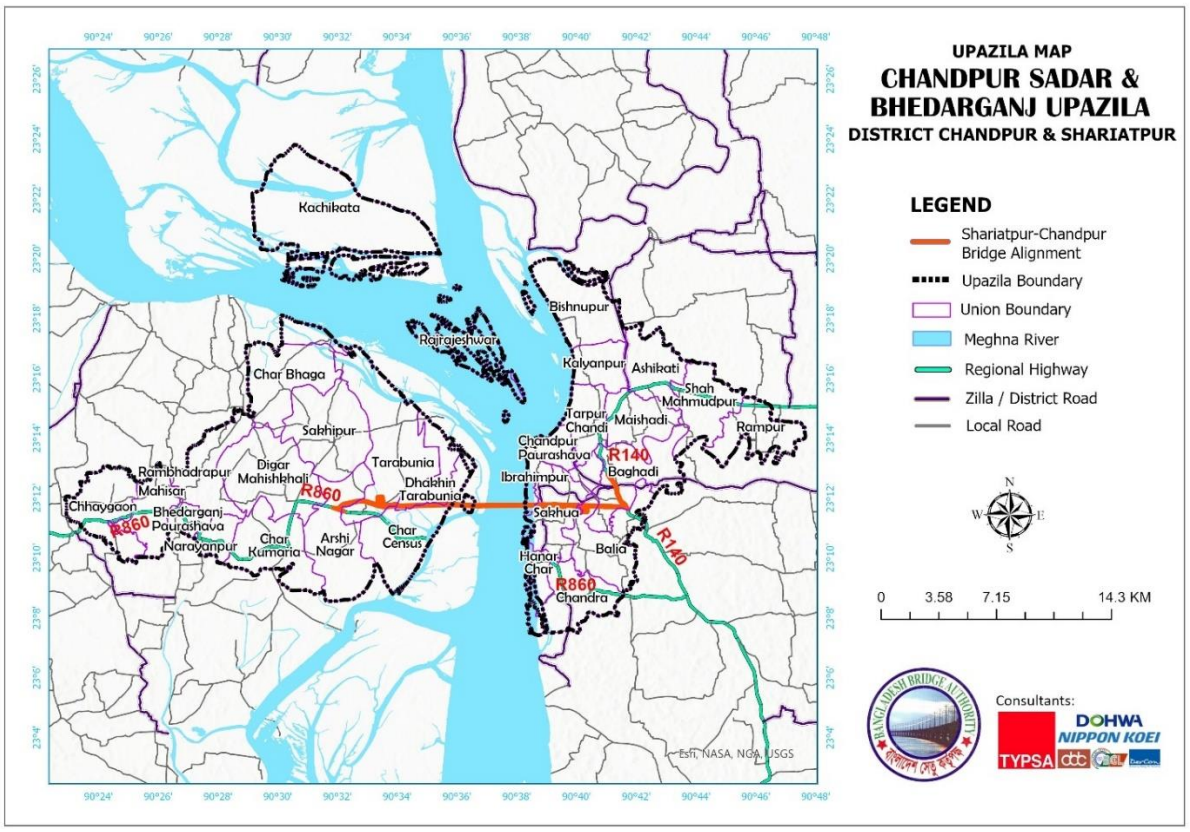

Figure 3. Shariatpur-Chandpur Bridge location, alignment, upazilas and local roads

It is expected that this important connection will integrate the whole coastal belt areas providing an improved road network that will benefit the whole area, promoting economic activity.

On this area, the existing ferry is widely recognized as Chandpur-Bhedarganj (Shariatpur) ferry. The length of the present crossing route is about 10 km. Harina ferry is 5 km away from Chandpur site, considered stable for last few years.

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The proposed bridge would connect Chandpur and Shariatpur through the provision of a direct and less costly alternative means of transportation, which would also reduce traffic pressure on Dhaka by diverting the traffic.

It would also improve the connectivity on both sides of the Meghna River and the connectivity of Barishal, Jashore, Khulna, Madaripur, Shariatpur, Chandpur and Chattogram, totalling 29 upazilas and an estimated benefited population of 5.89 Cr. This bridge would connect the three southern divisions and Chattogram seaport, Payra seaport and Mongla seaport. In addition to this, the number of vehicles on the Padma Bridge would be reduced as well as the time and money to reach Chattogram land port creating a huge opportunity for transportation between the south-western zone and eastern zone of Bangladesh.

For the reasons mentioned above, the BBA has identified this priority project for feasibility study under the current study.

Table 2. Summary of project area key features

Division	Dhaka		Chattogram	
District	Shariatpur District		Chandpur District	
Upazila	Bhedarganj Upazila		Chandpur Sadar Upazila	
	Bhedarganj Upazila (excluding Paurashava area)	Bhedarganj Paurashava	Chandpur Sadar Upazila (excluding Paurashava area)	Chandpur Paurashava
Area, km^2	259.64	2.26	285.87	22.91
No. of Union/Ward	13	9	14	15
Population (BBS2011)	245,065	8,169	306,898	159,021
(BBS2022)	268,004	10,302	331,168	203,451
Population Growth rate	0.82 %	2.13 %	0.69 %	2.27 %
Population Projection				
2026	276,868	11,209	340,462	222,521
2031	288,361	12,455	352,446	248,891
2036	300,331	13,841	364,853	278,387
Density (Persons/km^2) (BBS2022)	1,032	4,558	1,158	8,880
Predominant Economy	Agriculture, Fishery	Agriculture, Fishery, Local Business	Agriculture, Fishery	Local Business
Education (Literacy Rate %)	42.70	58.00	49.82	63.05
No. of Health Complex	-	1	42	5

Division	Dhaka		Chattogram	
District	Shariatpur District		Chandpur District	
Upazila	Bhedarganj Upazila		Chandpur Sadar Upazila	
	Bhedarganj Upazila (excluding Paurashava area)	Bhedarganj Paurashava	Chandpur Sadar Upazila (excluding Paurashava area)	Chandpur Paurashava
No. of Stadium/Park	-	-		1
Hat-Bazar	27	3	31	2
Main Industry	- (No big industry, but chicken/dairy farm, rice mill, fishery, etc.)	- (No big industry, but chicken farm, rice mill, flour mill, etc.)	10 (Power plant and jute mill as big industry)	4 (No big industry, but oil/rice/salt mill, chicken farm, fishery)
Geographic area	Rural	Urban	Urban- Rural	Urban
Port	-	-	Chandpur River Port	

2.2. Objectives of the Assignment

The objective of this assignment is to prepare a feasibility study-concept design for the construction of Shariatpur-Chandpur Bridge to provide a safe and permanent connection East-West through Meghna River.

At the West, the proposed bridge and approach roads will connect with the regional road R860 (Mostafapur-Madaripur-Shariatpur-Ibrahimpur-Harina-Chandpur Road) and, at the East, it will connect with the regional road R140 (Cumilla-Lalmai-Chandpur-Lakhmipur-Begumganj Road).

The objectives of this study are as follows:

- Find the suitable locations of the bridges.
- Identify the types of bridge or tunnel suitable for the crossings.
- Carry out preliminary design of the bridges and associated facilities.
- Cost Estimate.
- Assess socio-economic status of the area.
- Evaluate technical, social, economic, and financial viability of the projects.
- Recommend a mode of procurement.

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2.3. Approach and Methodology

This feasibility study presents the outcome of the study that has been carried out by the Consultant JV. The assignment has been carried out following the scope as provided by BBA in the Terms of Reference (ToR).

The specified scope of services for the consultancy assignment consisted of all necessary survey, investigation, planning, design, and documentation necessary for the development of the Feasibility Study of the bridge.

This includes the following activities according to the ToR of the project.

- Compilation, analysis and review of previous reports, studies, preliminary or detailed designs referred to the current feasibility study.
- Review available traffic count data and studies and carry out supplementary traffic counts.
- Detail traffic survey with O-D survey, traffic analysis and traffic forecast for a reasonable time horizon establishing traffic model.
- Detailed Hydro-morphological study of the river flow characteristics by using Mathematical Modelling.
- Determination of preliminary corridor/site selection.
- Determination of the preferred location of the bridge, (optimization of Length, Location and Alignment of the Bridge).
- Optimization of the approach road. Routes Assessment, Project Road Corridor Alternatives, Geometric Design for the preferred alternative (Typical cross sections, Plan & Profile).
- Mapping, Land Use and Topographical Model for the preferred option.
- Geological and Geotechnical Investigation Campaign for the preferred solution (field studies and Reports) for: cuts and fills geometry, pavements, sources of materials, foundation design for viaducts, bridges and other structures.
- Pavement Design.
- Structural Design. Comparative study for investment cost and O-M cost. Typological alternatives study.
- Alternatives investment budget.
- Economic and financial evaluation (30-year benefit stream period).
- Estimate the expected distribution of the project net benefits, based on the project economic analysis.
- Considering the economic evaluation, social benefits, and environmental impact, recommend the most suitable improvement option for each project road section.
- Undertake sensitive tests for the recommended improvements by appropriately varying benefits, project costs, maintenance costs, and the implementation period.
- Initial Social impact Analysis.
- Public meetings and dialogue with the communities in the project areas.
- Initial environmental examinations (IEE) and Environmental Impact Assessment.

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- Resettlement Action Plan (RAP).
- Preparation of Land Acquisition Plans.
- Determination of appropriate construction method, configuration and technology.

With respect to Shariatpur-Chandpur bridge over the river Meghna, four (4) alternatives were studied initially, to provide a safe and permanent connection north-south along the river Meghna. After the analysis of the four sites, a preferred option was selected based on the reconnaissance survey, technical, social, environmental, and financial considerations, as explained hereinafter.

2.4. Key Findings - Salient Features

Table 3. Summary of Project's Findings Salient Figures

Main salient features of Shariatpur-Chandpur Bridge		
Main alignment length	Road and bridge	16,610 m
Total bridge length		**8,040 m**
Cable stayed bridge	Length	**1,500 m**
	Main span	700 m (1 x 700)
	Back spans	400 + 400 = 800 m [2 x (1 x 140 + 1 x 260)]
	Width of cable stayed section	23 m
Composite box girders	Length	**2,100 m**
	Shariatpur side	1,100 m (11 x 100)
	Chandpur side	1,000 m (10 x 100)
	Width of composite box girder section	20.25 m
Approach bridge	Length	**4,440 m**
	Shariatpur side	3,850 m (91 x 40 + 3 x 30 + 2 x 32.5 + 55)
	Chandpur side	590 m (1 x 30 + 14 x 40)
	Width of approach bridge	20.25 m
Approach road	Total length	**8,570 m**
	Shariatpur side	4,110 m
	Chandpur side	4,460 m

Main salient features of Shariatpur-Chandpur Bridge		
	Total road width	39.5 m
	Main road (2+2-Lane Carriageway)	7.30 m = 2 x 3.65 m
	Service road (both sides)	5.50 m
Improvement of existing roads	Total length	**3,153 m**
	Shariatpur side	653 m
	Chandpur side	2,500 m
Other features in approach road		
	Small bridges	3 bridges (280 + 310 + 50) Total = 640 m
	Culverts	13 nos 7 x 2 Vent + 6 x 3 Vent
	Toll Plaza	7 nos booth each side = Total 14 nos (+ Future extendable 3 nos each side)
	Weighing scale	1 no each side = Total 2 nos 6 nos weigh bridge each side (+ Future extendable 2 nos each side)
	Engineer's Facilities and Service Area	1 no each side = Total 2 nos 2 x 28 = 56 acres
	Construction Yard 1 & 2 Shariatpur side Construction Yard 3 Chandpur side	Shariatpur side: 10 + 25 = 35 acres Chandpur side: 9 acres Total = 44 acres
River training works	Total length	9,030 m
	Shariatpur side	4,555 m
	Chandpur side	4,475 m
Land Acquisition		
	Width of right of way (ROW)	69.5 m
	Total land to be acquired	768.96 acres
	Total number of project affected units	1,068 nos
	Total number of persons affected	4,885 nos
	Resettlement area	1 no each side = Total 2 nos 2 x 5 = 10 acre

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3. MARKET/DEMAND ANALYSIS

This section assesses the need for public investments, as per the study of market and traffic demand that has been implemented. Benefits and need and justification for the implementation of the infrastructure are analyzed hereinafter:

3.1. Problem Statement

The existing problem, or potential improvement, to be addressed is mainly the lack of adequate infrastructure for efficient and convenient river crossings between East and West Bangladesh. The existing Bangabandhu Bridge and Padma Bridge are not sufficient to meet the growing demands of transportation and connectivity in Bangladesh. This results in longer travel times, limited accessibility, and hinders socio-economic development.

There are some direct causes:

- Insufficient number of bridges: currently, lack of bridges in operation for the main the rivers crossing, which is inadequate for the growing population and traffic demands.
- Limited investment in infrastructure: a lack of prioritization and allocation of resources for bridge construction in the region may have contributed to the current situation.

And some indirect causes:

- Population growth: an increasing population puts more pressure on existing infrastructure, exacerbating the problem of inadequate river crossings.
- Economic development: as Bangladesh's economy continues to grow, the need for efficient transportation and connectivity becomes more critical for businesses and industries to thrive.
- Urbanization: rapid urbanization in cities like Dhaka has led to increased traffic congestion and greater demand for improved infrastructure, including bridges.

A good way of understanding the need of the project is analyzing the situation in which the government would not carry out this investment in the bridge:

- The lack of efficient transportation and connectivity limits trade, investment, and overall economic growth in the region.
- Limited transportation infrastructure prevents residents from accessing essential services such as healthcare, education, or emergency services, ultimately impacting their quality of life.
- Without additional bridges, the existing crossings will become more congested, leading to longer travel times and increased transportation costs.
- Increased congestion can lead to higher emissions, air pollution, and negative impacts on local ecosystems.
- Limited access to opportunities and services can exacerbate social inequalities, with disadvantaged groups being disproportionately affected.

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The essential purpose of any development is social investment. A planned project is an idea for an intended future condition regarding social and economic activities, their locations and linkages, and the development of essential land, structures, and mechanisms. Viewed from the implementation angle, however, a planned project is a program of action and pre-determined coordination of legislative, fiscal, and administrative measures designed to achieve the transition from the present situation to that represented by the model. It should be noted that the essential features of both of this situation are as follows:

- a commitment to improve the human condition through economic development and social change.
- a close integration of socio-economic and environmental development in harmony with accepted development strategies. And the complete interdependence between economic, social, and environmental planning on the one hand, and legislative, fiscal, administrative, and political action planning on the other, which together make a truly comprehensive plan.

3.2. Relevance of the Project Idea

It can be observed in the image below, as Shariatpur-Chandpur bridge would allow and boost the communication by road between Chattogram, Barishal, Dhaka and Khulna. Nowadays the only road communication between Khulna and Barishal with the rest of Bangladesh is by the Padma bridge, thus the Shariatpur-Chandpur bridge will enhance the communications of these regions with Chattogram.

The regional connectivity improved by the bridge would function as a linkage between the backward regions with rest of the country by providing benefit to more than 5.89 Cr population living in 29 zilas.

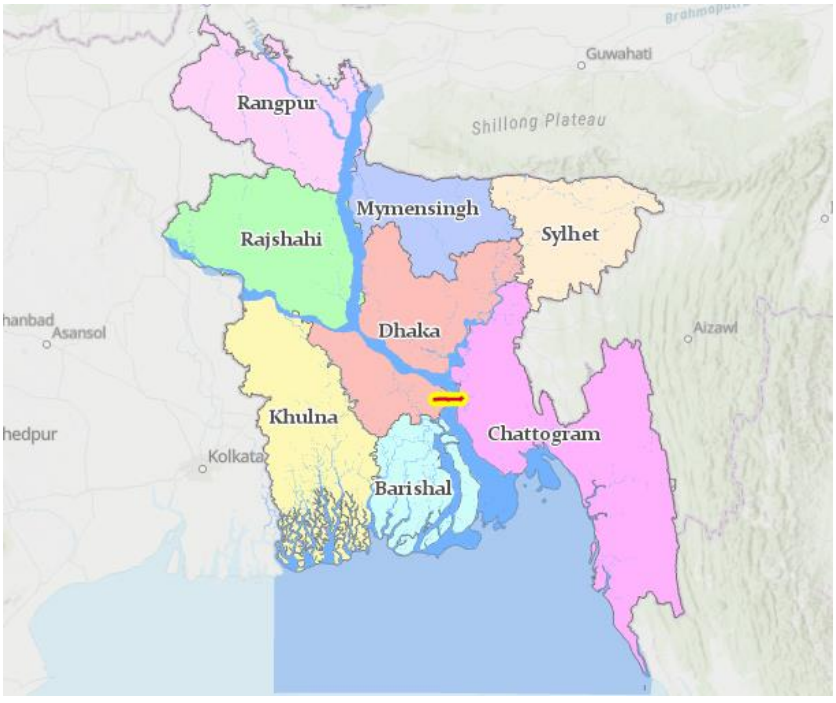

Figure 4. The project location, map of Divisions of Bangladesh

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Benefits of Shariatpur-Chandpur bridge as a need to improve the lack of infrastructure between East and West Bangladesh:

- Strategic location: Chandpur is located at the confluence of the Padma and Meghna rivers, making it a strategic point for transportation and connectivity between the eastern and western regions of Bangladesh. A bridge in this area would facilitate the movement of people, goods, and services across these major rivers.
- Economic development: the area is an important center for the fishing industry, agriculture, and trade. Building a bridge in this region can further stimulate economic growth by improving access to markets and resources, creating new business opportunities, and attracting investment.
- Population density: The Chandpur and Shariatpur districts have a significant population, which is expected to grow in the coming years. A bridge would help meet the increasing transportation demands of the growing population and contribute to improved quality of life for residents.
- Connectivity to eastern regions: A bridge in Chandpur would enhance connectivity between Dhaka, Chattogram, Barishal, and Khulna regions. This would enable more efficient transportation and support the development of these urban centers.
- Reducing pressure on existing infrastructure: Padma Bridge is currently the main option for river crossings in the area. A bridge connecting Shariatpur to Chandpur would help alleviate congestion on these existing bridges and reduce overall travel times.
- Disaster resilience: Bangladesh is prone to natural disasters such as flooding and cyclones. Improved infrastructure, such as a new bridge in Chandpur, can enhance the region's resilience to these events by providing better access to essential services and support during emergencies.
- The project will improve mobility and accessibility, posing positive economic impacts including reduction of travel time and travel cost to travellers and cargo, etc.
- The project will create different local and regional income opportunity and will have positive financial impacts.
- The project will bring potential opportunities for private sector participation in the transport infrastructure and services.
- The project will reduce road traffic accidents etc.
- The project will reduce vehicle emissions and energy consumption etc.
- Many people can come to Dhaka from their local home and adjacent districts.
- Improve safety and security of the transport users particularly women and children.
- Increase employment opportunity for local people.

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3.3. Proposed Project Interventions

The Project implementation would need not only the address the construction of the main infrastructure, but as it is explained within the technical features section, the construction of 8,570 m of approach roads would be needed to connect with the existing road network. Other interventions as two engineers' facilities compound, toll plaza and service buildings would be needed to be implemented by the GoB.

In addition, the necessary and critical river training works would be needed, given the relevant riverbank erosion identified in this area of the Meghna River.

3.4. Stakeholders Management

The list of involved stakeholders to be managed and coordinated for this project would be as follows:

- Ministry of Road Transport and Bridges: Responsible for overseeing the planning, implementation, and maintenance of transportation infrastructure projects in Bangladesh.
- Local Government authorities: Both Chandpur and Shariatpur districts administrations would be involved in coordinating and facilitating the project at the local level.
- Bangladesh Water Development Board (BWDB): Responsible of overseeing and coordination of the river training works.
- Bangladesh Inland Water Transportation Authority (BIWTA): River navigational conditions and requirements to be coordinated for the project.
- Local Government Engineering Department (LGED): Local roads network authority.
- Roads and Highways Department (RHD): the agency of the Government of Bangladesh responsible for the construction and maintenance of highways and bridges across Bangladesh.
- Dept. of Fisheries, Chandpur: This a regulatory authority regarding Fish resources in Meghna River
- Bangladesh Fisheries Research Institute, (BFRI): Regulatory agency for Hilsa fish protection.
- Bakhrabad Gas Distribution Company Limited, Responsible agency for the gas pipelines in the area.
- Bangladesh Power Development Board is responsible for the PDB electric lines in the area.
- Palli Bidyut Samity-2, PBS, is responsible for the electric line from the Bridge alignment area at the Chandpur end.
- Shariatpur Palli Bidyut Samity is responsible for the PBS Electric line from the Bridge alignment area at the Shariatpur end.

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3.5. Demand Analysis

A transportation model was utilized along with data from **242** survey points to analyze the demand. Both the current demand (i.e., demand currently crossing by ferry) and projected demand (i.e., demand that would use the bridge if it existed) were evaluated. The task was challenging due to the need to connect areas where the only alternative connection by road requires a detour all around Dhaka to reach the Padma bridge, located more than 80 km to the north-west. This significant difference in travel time with or without the project could result in a substantial increase in traffic generated, potentially exceeding 100% of the current demand.

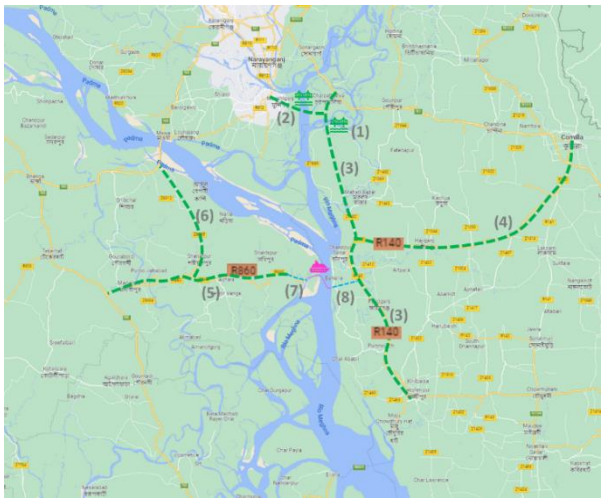
To conduct a thorough economic and financial study, it is necessary to carefully analyze the traffic and compare the situation without the project to the situation with the project. The differences in costs between these two situations will be the benefits of constructing the bridge.

3.5.1. Base Year Demand

It is important to understand the different scenarios analyzed, with and without project. Both scenarios will be compared in order to understand the benefits from the "with project" scenario compared with the "without project" scenario (case where the bridge is not built, in this case, there is no bridge but there will be some roads improvements, as well as an operating ferry service).

In the following images the difference between both scenarios is clearly shown:

Without Project



With Project

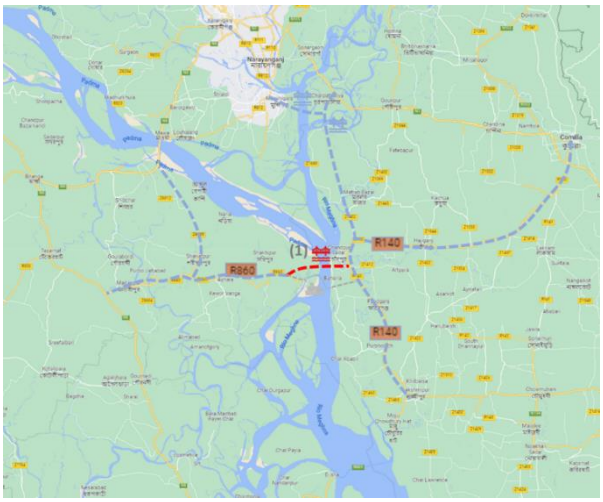


Figure 5. Scenarios Analysed

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- Padma Bridge
- Matlab Uttar bridge (1)
- Gazaria-Munshiganj bridge (2)
- Gazaria-Lakshmipur corridor (3)
- Cumilla-Chandpur improvement (4)
- R860 road improvement (5)
- Shariatpur-Padma Road improvement (6)
- West access to ferry-ghat improvement (7)
- East access to ferry-ghat improvement (8)

- It includes:
  - All of "Without project scenario" road improvements (blue colour)
  - Shariatpur-Chandpur Bridge + Access roads (1)
- It does not include (gray colour):
  - West access to ferry-ghat improvement
  - East access to ferry-ghat improvement
  - Ferry service between Shariatpur-Chandpur

For both the traffic with and without the project the Transport Model is applied in its latest update when this estimation is carried out. It is assumed in both scenarios that some roads improvements will also be executed.

3.5.2. Traffic Forecast

The forward traffic estimation comes from the relation between GDP and traffic growth observed during a series of years in different traffic counts where historical data is available. There is a clear relation between GDP and AADT, since GDP is in line with the movement of passenger and freight.

Table 4. Daily traffic volumes by type of traffic

Year	Normal traffic (without project)				Diverted			Generated		With project
	Road	IWW	EZ	Total Without Project (Normal traffic)	From road	From IWW	From EZ	Road – due to time reduction	Due to additional GDP increment	TOTAL
2022	1,255	624	0	1,880						
2023	1,346	669	0	2,015						
2024	1,451	722	0	2,172						
2025	1,567	780	0	2,347						
2026	1,695	843	0	2,539						
2027	1,836	913	124	2,874						
2028	1,983	986	124	3,093						

Year	Normal traffic (without project)				Diverted			Generated		With project
	Road	IWW	EZ	Total Without Project (Normal traffic)	From road	From IWW	From EZ	Road – due to time reduction	Due to additional GDP increment	TOTAL
2029	2,136	1,062	124	3,323						
2030	2,295	1,141	124	3,561						
2031	2,460	1,224	124	3,808						
2032	2,630	1,308	124	4,063	598	262	194	1,071	53	6,242
2033	2,806	1,396	124	4,327	1,276	558	389	2,286	152	8,988
2034	2,988	1,486	124	4,598	2,038	892	583	3,651	305	12,067
2035	3,174	1,579	124	4,877	2,887	1,263	777	5,171	522	15,497
2036	3,365	1,674	124	5,163	3,060	1,339	777	5,482	649	16,471
2037	3,560	1,771	124	5,455	3,238	1,417	777	5,800	790	17,477
2038	3,759	1,870	124	5,754	3,419	1,496	777	6,125	944	18,516
2039	3,963	1,971	124	6,058	3,604	1,577	777	6,456	1,113	19,585
2040	4,169	2,074	124	6,367	3,792	1,659	777	6,793	1,296	20,685
2041	4,379	2,178	124	6,682	3,983	1,743	777	7,135	1,495	21,814
2042	4,592	2,284	124	7,000	4,176	1,827	777	7,481	1,709	22,971
2043	4,807	2,391	124	7,322	4,372	1,913	777	7,832	1,939	24,155
2044	5,024	2,499	124	7,648	4,570	1,999	777	8,186	2,185	25,365
2045	5,244	2,608	124	7,976	4,769	2,087	777	8,543	2,447	26,600
2046	5,464	2,718	124	8,307	4,970	2,174	777	8,903	2,727	27,858

Year	Normal traffic (without project)				Diverted			Generated		With project
	Road	IWW	EZ	Total Without Project (Normal traffic)	From road	From IWW	From EZ	Road – due to time reduction	Due to additional GDP increment	TOTAL
2047	5,687	2,828	124	8,639	5,172	2,263	777	9,265	3,024	29,140
2048	5,910	2,939	124	8,973	5,375	2,352	777	9,628	3,338	30,443
2049	6,133	3,051	124	9,308	5,578	2,441	777	9,993	3,669	31,766
2050	6,357	3,162	124	9,644	5,782	2,530	777	10,357	3,803	32,893
2051	6,581	3,274	124	9,979	5,986	2,619	777	10,722	3,937	34,021
2052	6,805	3,385	124	10,314	6,189	2,708	777	11,087	4,071	35,147
2053	7,028	3,496	124	10,649	6,393	2,797	777	11,451	4,205	36,271
2054	7,251	3,607	124	10,982	6,595	2,885	777	11,814	4,338	37,391
2055	7,473	3,717	124	11,314	6,797	2,973	777	12,175	4,470	38,506
2056	7,693	3,826	124	11,644	6,997	3,061	777	12,534	4,602	39,615
2057	7,912	3,935	124	11,972	7,196	3,148	777	12,891	4,733	40,717
2058	8,129	4,043	124	12,297	7,394	3,235	777	13,245	4,863	41,811
2059	8,345	4,151	124	12,620	7,590	3,321	777	13,596	4,992	42,895
2060	8,566	4,261	124	12,951	7,791	3,409	777	13,956	5,124	44,008
2061	8,793	4,374	124	13,291	7,997	3,499	777	14,326	5,260	45,150

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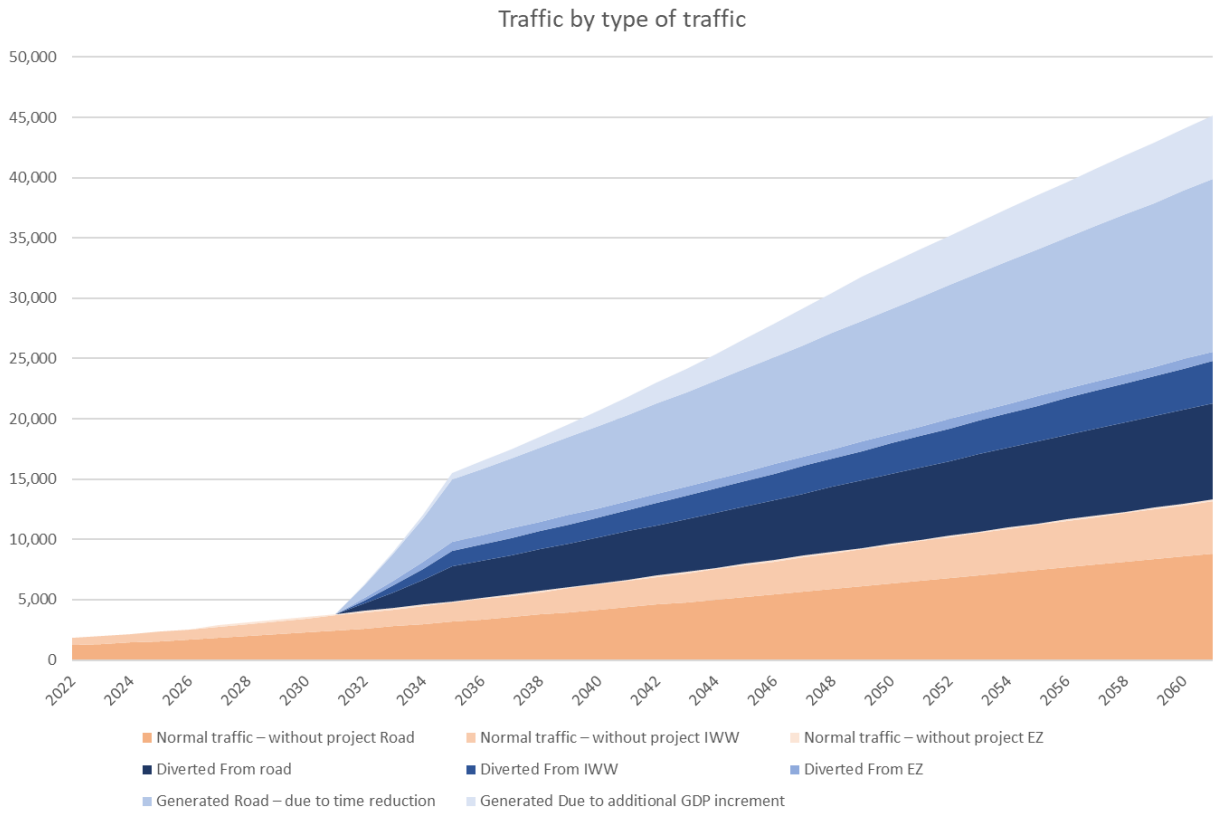

Figure 6. Daily traffic volumes by kind of traffic

3.5.3. Distance and time savings

The distance and time savings, due to the construction and operation of the bridge, is a key element being used in the cost benefit analysis. An analysis has been done for each vehicle type, identifying the average yearly savings for the 30 years of the operation of the project.

The results are illustrated in the tables below.

Table 5. Average annual time savings during the operation of the bridge

	Motorcycles (M pass-hour per year of operation)	LPV (M pass-hour per year of operation)	Buses (M pass-hour per year of operation)	Sub-total (M pass-hour per year of operation)	Trucks (M Ton-hour per year of operation)
Without project	29.78	35.47	245.26	310.51	415.06
With project	9.48	12.42	83.15	105.05	128.39
Time Savings	**20.30**	**23.05**	**162.12**	**205.47**	**286.67**

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Table 6. Average annual distance savings during the operation of the bridge

	Motorcycles (M veh-km per year of operation)	LPV (M veh-km per year of operation)	Buses (M veh-km per year of operation)	Trucks (M veh-km per year of operation)	Total (M veh-km per year of operation)
Without project	324.65	177.36	136.16	509.55	**1,147.72**
With project	303.10	159.31	120.72	414.13	**997.26**
Distance Savings	**21.56**	**18.05**	**15.44**	**95.41**	**150.46**

Constraints

- Some improvements are being made in the transport model considering more social data, these may end in changes in traffic demand forecast.
- As said before, the without project scenario is a scenario where some committed projects are built, for example: road improvements and Uttar Matlab bridge.

3.6. Need and Justification of the Project / SWOT Analysis

The identified key strengths and weaknesses of the project along with the opportunities and threats are presented in the following table.

Table 7. Project's SWOT

Strengths	Weaknesses
▪ The active participation, willingness, and support of the local government and the citizens involved. ▪ The promoting agency BBA possesses previous expertise in similar projects like Padma and Jamuna Bridge, which adds to their capabilities and potential success in executing the current project. ▪ Availability of construction material such as cement, stone, and bricks from local market ▪ Due to the river transport system, construction materials can be transported at low cost. ▪ The project is attracting interest from potential contractors and funding agencies,	▪ High-cost financing challenge. ▪ Supply of some materials source. ▪ Air and noise pollution may have some negative impacts on the environment. ▪ Disturbance to the movement of vehicles and pedestrians may occur during construction. ▪ Flooding, vessel impact and environmental aspects as Hilsa protection may pose risks during construction. ▪ In resettlement and rehabilitation, changes in economic activities, land-use, resource ownership, accessibility of natural resources and common property resources, loss of livelihoods, social disruption, and psychological trauma to affected persons etc. are included.

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Opportunities	Threats
▪ To establish better connectivity with the national transport network, particularly in areas that are currently not directly connected. ▪ To alleviate the Dhaka city road network by bypassing it for the transportation between the West and East sides of the Meghna River at that side. ▪ To facilitate smooth, inter and intra-town movement of people, goods, and services, thereby enhancing overall transportation efficiency and accessibility. ▪ To increase trade at both the local and regional levels, fostering economic growth and development in the area. ▪ To bring about improvements to the environment and public health, ensuring a sustainable and healthier living environment for the local communities. ▪ To foster sustainable decentralization, regional development, and resilient climate-adaptive practices. ▪ To contribute significantly to local economic development, creating employment opportunities in the region. ▪ 29 districts would mostly be benefited after completion of the proposed bridge. It would directly connect the second most important port of the country, Mongla and industrial zone in Khulna with the main part of the country.	▪ Influx of migrant people may have a negative impact on the quality of life. ▪ Occurrence of climate change-related and other natural hazards. ▪ The construction process could face hindrance in the event of a sudden natural disaster, impacting its continuity and progress. ▪ Excavation may result in sediments reaching watercourses. ▪ Land acquisition and rehabilitation processes can indeed be time-consuming. Furthermore, social and political obstacles can further complicate and prolong these procedures, potentially impacting the overall progress of the project. ▪ Achieving the target fund for a mega project is a formidable challenge. ▪ Due to various reasons, there is a possibility of not completing the work on time and increasing the cost of the project.

Source: Consultant Team

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4. TECHNICAL AND ENGINEERING ANALYSIS

A summary of the proposed project shall be presented with the following headings:

4.1. Design Standards

- The Eurocode has been adopted in the design of the structures: EN 1990, EN 1991-1, EN 1991-2, EN 1993, EN 1994 and EN 1998 along with EN 1337, EN 10080, EN 10138 and EN206.
- Despite being related to building structures, the Bangladesh National Building Code (BNBC) is followed in the determination of wind loads and the earthquake design spectrum.
- AASHTO LRFD 2017 specifications for Highway Bridges, with interim revisions 2020, 2022 and 2023, is considered appropriate to be used in the determination of stream pressure on piers.
- Geometric Design Standard for Bridges and Approaches and Bridge Design Standard by RHD
- Geometric Design Standards Manual (Revised) 2005 (GDSM 2005). Roads and Highways Division.
- A policy on Geometric Design of Highway and Streets" 2018, AASHTO
- Manual of Specifications and Standards for Expressways, IRC: SP: 99-2013
- Manual of Specifications and Standards for Four Laning of Highways, IRC: SP: 84-2019
- Pavement Design Guide for Roads and Highways Department 2005 for pavement design works along with "AASHTO Guide for Design of Pavement Structures 1993".

4.2. Selection of Bridge location

The most suitable bridge location for the proposed bridge connecting **Chandpur Sadar Upazila of Chandpur District** and **Bhederganj Upazila of Shariatpur District** has been selected at the **Alignment B** of the various assessed options. This alignment considers the connectivity with the approach roads from both sides of the proposed bridge to the regional roads of Chandpur (R140) and Shariatpur (R860).

The selected site should enable safe construction, economical and easily maintainable crossing, having regard to approach requirements and to the nature of the waterway and its environment. In Bangladesh, having dynamic river networks, it often requires performing different levels of hydrological and morphological analyses of the river. In general, the best suitable location for bridge crossing should meet the following criteria:

- Close to existing road network to connect the bridge with minimum length of approach road.
- Straight reach of river avoiding bends close to the bridge location.
- Minimum width of river.
- River cross-section having uniform velocity distribution at the mid-reach.
- Little or no riverbank erosion.
- The perpendicular position between bridge alignment and river reach avoiding skewness.

- Minimum impact of bridge on river morphology.

It is not expected that all the criteria mentioned above could be fulfilled to select a suitable location of bridge crossing. Thus, multi-criteria analysis was done to select a suitable bridge location out of alternative locations. These locations have been considered prospective from visual inspection of the river planform, opinion of local people about stability of the river, demand of the local people, facility of communication, reconnaissance survey and finally the model outputs focusing probable hydro-morphological features.

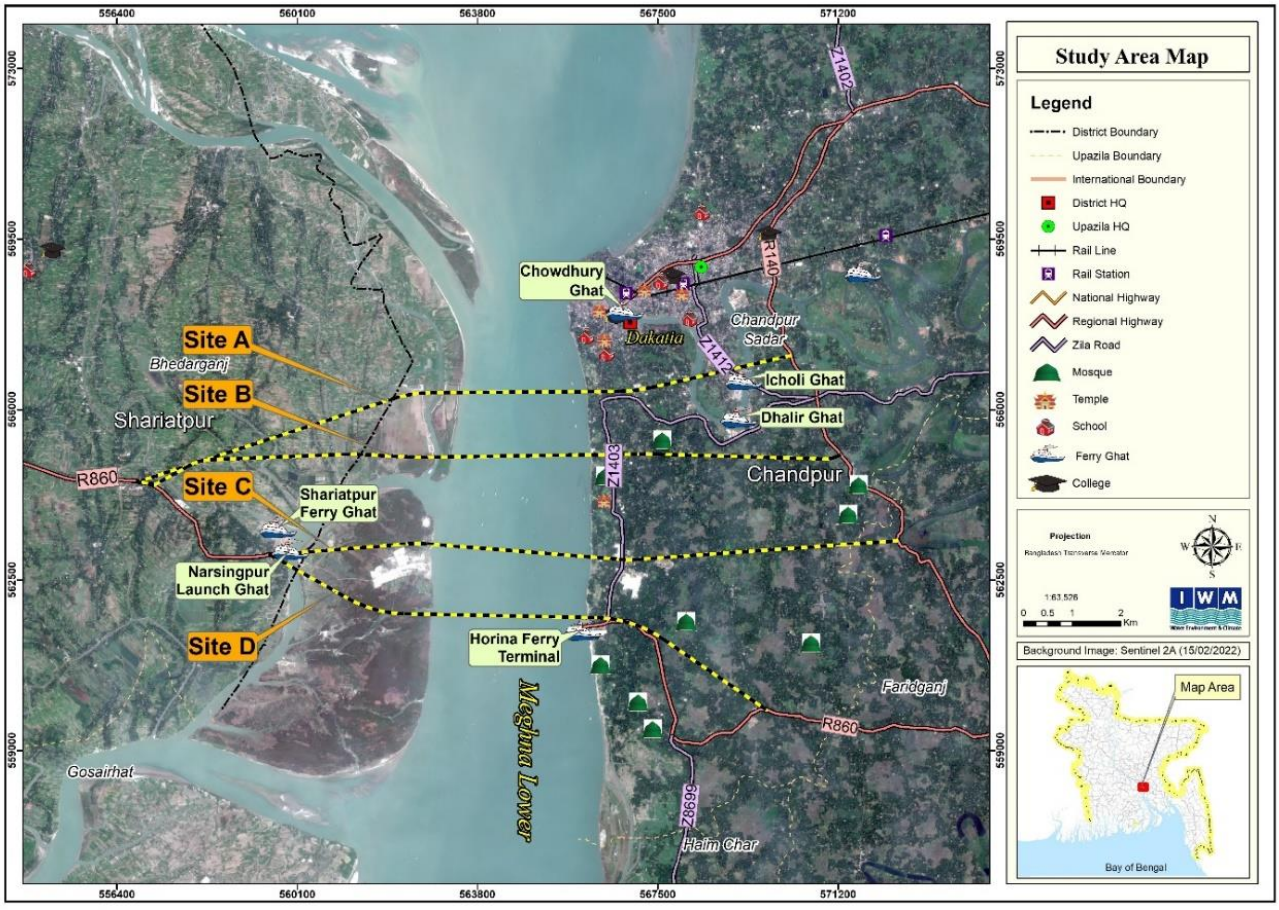

Figure 7. Image of the various alignment alternatives studied: A, B, C, D

4.3. Hydro-morphological Study

Bangladesh is a low-lying riverine country formed by a deltaic plain at the confluence of the three mighty rivers Ganges, Brahmaputra, Meghna, and their tributaries. Most of the flows of these major rivers are connected to the Bay of Bengal through Meghna estuary. The sediment load and flow volume in lower Meghna is respectively the highest and the third highest in the world. Due to this tremendous water volume and sediment load delivered by the rivers, the estuary is an area of an active land erosion-accretion and dynamic water circulation.

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The Meghna River

The Meghna River is one of the major rivers in Bangladesh. The 100 km long Upper Meghna River meets with the Padma River in Chandpur District and renamed as Lower Meghna continuing to flow till fall into the Bay of Bengal. The major tributaries of the Upper Meghna River are the Dhaleshwari and the Gumti. The Gumti River has met the Meghna at Daudkandi and increases the Meghna's flow considerably.

The Upper Meghna River, the smallest among the three major rivers in Bangladesh, has the highest water yield. Its catchment area is the highest rainfall area in the world with an annual average rainfall of 4,900 mm, that provides water yield of approximately 0.06 m^3/s per km^2. With an annual average discharge of about 4,800 m^3/s, the river drains some 151x109 m^3 of water annually to the Bay of Bengal through the Lower Meghna. The seasonal water level variation of the river is about 4 m at Satnal.

On the other hand, the Lower Meghna is the tidal reach carrying almost the entire fluvial discharge of Padma and the Upper Meghna. The net discharge through this river varies from about 10,000 m^3/s in dry season to 160,000 m^3/s in the wet season.

The Padma River

The Padma River carries the combined flow of the Ganges and the Jamuna from Aricha to the confluence with the Upper Meghna River. The river is about 120 km long (from Ganges-Jamuna confluence to Chandpur) with a highly variable width ranging from 5 km to 20 km. The length-averaged width of the Padma River is 10.2 km. The maximum-recorded width of the river attained in 2005 is 20.2 km (from Faridpur side to Harirampur side). The Padma River, draining the combined flow of the Ganges-Jamuna, has an annual average discharge of about 95,000 m^3/s. The discharge variation of Padma at Baruria is minimum of 10,000 m^3/s to maximum of 120,000 m^3/s. The seasonal water level variation is about 6 m. The lower reach of the river becomes weakly tidal during the December-April period. The water surface slope of Padma varies between 3 cm/km to 5 cm/km.

Dakatia River

The Dakatia River originates in the hills of the western part of Tripura state, India and enters Bangladesh through South Cumilla Sadar Upazilla, Cumilla. The channel that flows westward and meets the Meghna at Chandpur is known as the New Dakatia River, flowing through Bagmara, Laksam, Chitoshi, Hajigonj to meet the Meghna River at Chandpur.

The length of the river at the Bangladesh part is 141 km and the width of the river varies from 13 m to 155 m with an average width of the river being 67 m. The Dakatia is a meandering and a perineal tidal river. The highest tidal range is 1.6 m.

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4.3.1. Hydro-morphological Process

The process carried out for this project, involving the selection of the optimum alignment, has been undertaken by the Consultant with the collaboration of the specialized subcontractor (Institute of Water Modelling – IWM). The task is developed in Volume 02, being the main findings shown in the following summary table and images:

The methodology for the hydraulic design has followed the next steps:

- Collection and Compilation of data and information from different sources mainly from IWM Archive, BWDB, BIWTA. These data included:
    - Bathymetry data of the Padma, Meghna and Dakatia River.
    - Water level data at Chandpur, Satnal, Mawa, Tarpasa, Nilkamal.
    - Historical Cross-sectional data of the Meghna River.
- Primary data collection includes bathymetry survey, char survey, water level, discharge, and sediment measurement.
- Frequency analysis of the flow data and water level data corresponding to different intensity as well as analysis of water level data to determine the highest flood level, Standard High-Water Level (SHWL).
- Planform analysis of series satellite images to assess suitable location of the bridge from stability viewpoint, assessment of bank line migration indicating bank erosion.
- The developed two-dimensional (2D) model covers 45 km long stretches of the Lower Meghna River, as well as covering around 20 km of Upper Meghna, 20 km of Padma and 10 km of Dakatia River.
- Calibration of the two-dimensional model to assess its performance in terms of hydrodynamic as well as morphological outputs.
- Application of 2D model for “Without Bridge” and “With Bridge Condition” to examine the response to extreme flood condition and present in terms of bed degradation, siltation, flow in different anabranches, velocity, thalweg movement, etc.
- While General and Constriction scour can be calculated from the model results, results from with and without bridge condition has been used in calculating local scour around the bridge pier using different empirical formula.
- Based on the results of with and without bridge condition, impact at immediate upstream and downstream has been observed. These results were also used to design the bank protection work. Considering experience and observing the historical bank erosion pattern, it has been recommended to use two guide bunds along both banks to guide the flow of the river. The historical bankline shifting, the present field condition and simulated model results are the key factors to choose the location and length of the bank protection works. In this case, the length of Chandpur Guide Bund (LGB) is considered about 4,475 m. Three separate bank protection blocks have been proposed for the Shariatpur Guide Bund considering the flow dynamics of

the Lower Meghna River. The total length of the Shariatpur Guide Bund is 4,555 m. The location and length of these guide bunds is shown in Figure 8.

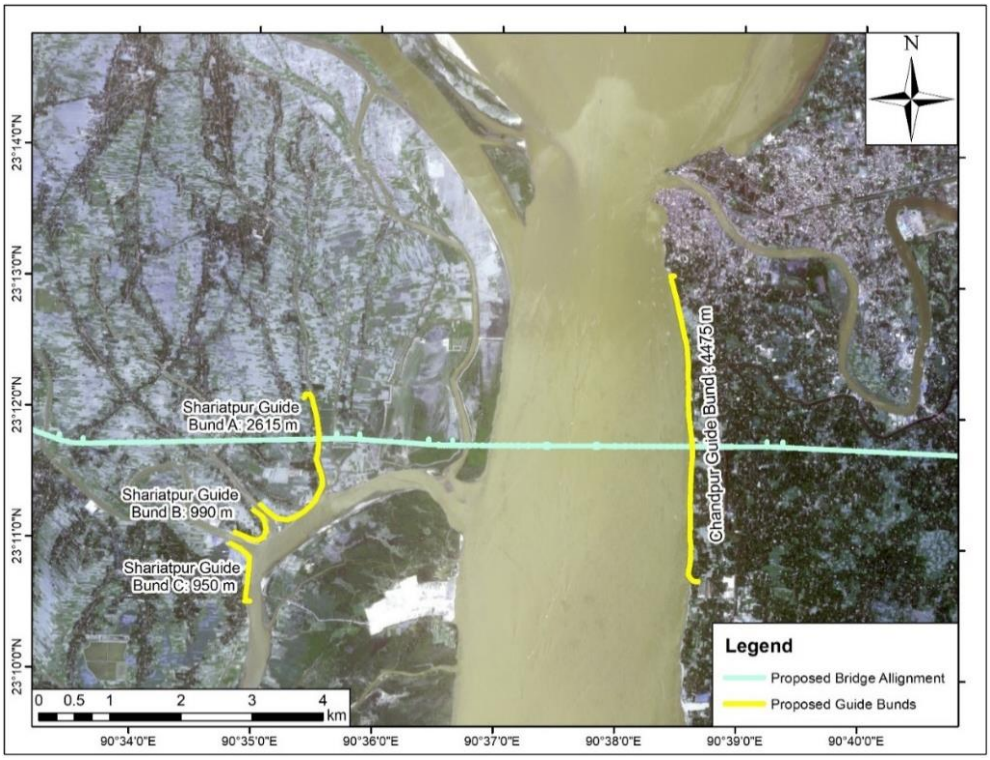

Figure 8. Bank Protection Works along both banks of Meghna River

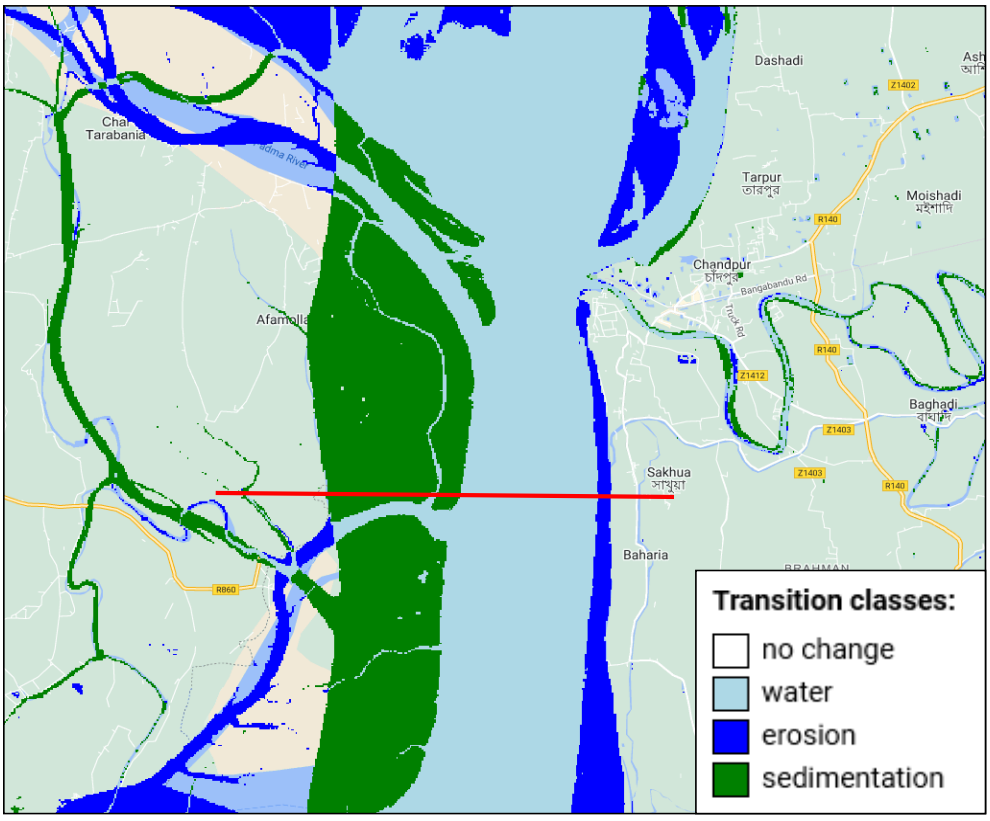

Figure 9. Erosion-Deposition trend between 1988 to 2021 near the proposed Shariatpur-Chandpur Bridge

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Table 8. Summary of hydraulic variables

Hydraulic Parameters	Magnitude	Source
Design Discharge, m^3/sec	176,641	Based on the developed 1D model
Observed High Flood level, mPWD	5.62	Observed WL of Chandpur station
SHWL, mPWD	5.49	Based on the WL of Chandpur station
Observed Low water level, mPWD	0.15	Observed WL of Chandpur station
SLWL, mPWD	0.80	Based on the WL of Chandpur station
Lowest Bed Level, mPWD (1998)	-27.79	2D Model Simulated
Observed lowest bed level (2022), mPWD	-15.64	Surveyed data (2022)
General scour level, m	8.69 m	2D Model Simulated
Constriction scour, m	3.46 m	2D Model Simulated
Local Scour, m	39.75 m	Using FHWA equation
Total Scour, m	51.90	Using FHWA equation using variables from 2D model and observed data and 2D Model Simulated

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4.4. Geotechnical Study

4.4.1. Introduction

Geotechnical investigations provide a baseline to understand the physical soil conditions of a site and help shape design approach and construction recommendations for future phases of a project. Information gathered during geotechnical investigations and instrumentation monitoring may be vital for making technical decisions.

This section describes a summary of the geotechnical investigation findings. The factual and interpretative reports of the Geotechnical Investigation Works have been included in Volume 3.

4.4.2. Investigation Description

In-situ boring, field tests, trial pit excavation and laboratory tests were conducted. Field geotechnical investigation works started on March 22nd, 2022, and were completed on January 20th, 2023.

Information on the type of subsoil stratification, geotechnical parameters and its behaviors are obtained from comprehensive soil investigation program, which incorporates drilling of boreholes, collection of disturbed soil samples, performance of specific in situ test and laboratory testing of soil samples. The quantities of the geotechnical investigation are shown the following table:

Table 9. The quantities of the geotechnical investigation

Item		Unit	Quantity	Remarks
Borehole	On-shore	BH No	06	Identify Geological conditions and characterization
	Off-shore		03	
Field Test	SPT	Set	09	Prediction of soil strength and calculation of design parameters
	G.W. L	BH No	09	Recording of Ground Water Level
	Borehole Undisturbed Sampling	Nos.	3	Sampling for the mechanical test of clayey soil
Basic Physical Tests	Natural Moisture Content Test	Nos.	138	Identify basic characteristics of soil
	Atterberg Limit	Nos.	42	
	Specific Gravity Test	Nos.	103	
	Grain Size Analysis	Nos.	138	
	Direct Shear Test	Nos	31	Determine the Shear strength of a soil
	Bulk Density Test	Nos	3	Determine the in-situ density of soils

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Item		Unit	Quantity	Remarks
	California Bearing Ratio Test	Nos	8	Determine strength of subgrade soil
	Mica Content Test	Nos	10	Determine the % of mica content

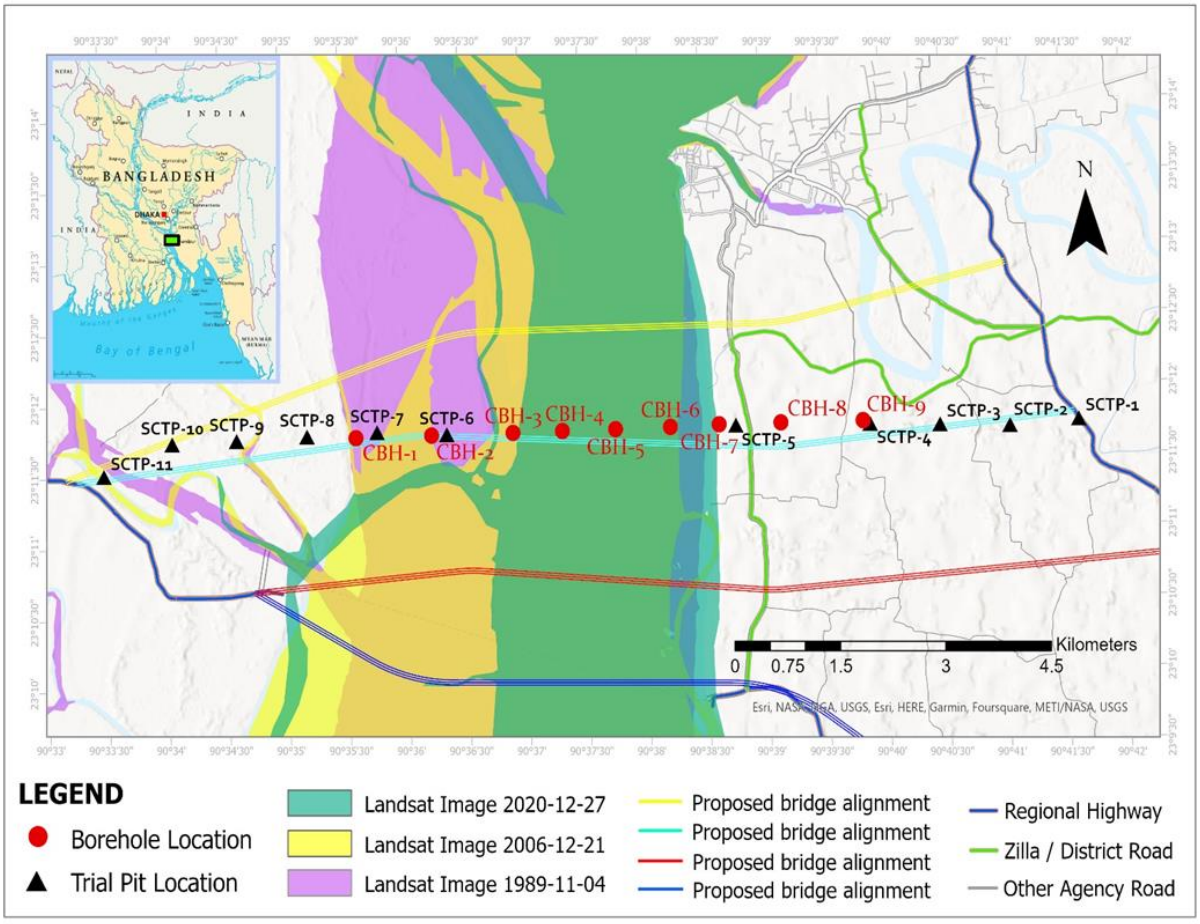

Figure 10. The location of borehole and trial pits

The soil properties for the soils Layer 1 ~ Layer 4 encountered at the site are presented in Figure 11 Sub-soil Profile of Shariatpur-Chandpur Bridge project.

It was found that sub soil deposits comprise some cohesive and cohesionless. The cohesive layer (Layer 3) is mostly consisting of low plastic, Lean inorganic CLAY and SILT (CL/ML). The layers of cohesionless soil (Layer 1, 2 & 4) are consisting of various types of SAND with some silt (SP)/ (SM)/ (SP-SM).

The soils are generally soft and the sands when exposed to the river are likely to be eroded. Furthermore, a comparatively high content of mica was observed; it is evaluated to range from 4.62 % to 20.58 %.

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- Layer 1:

The top layer 1 exists from surface EGL (RL m +4.041 at CBH-1 & -21.855m at CBH-5) to RL m +0.64 m at CBH-3 & -9.75 at CBH-6. The thickness of the layer varies from 1.50 m to 16.50 m. Encountered materials are from very soft silty CLAY at CBH-3 to poorly graded with loose silty sand with SPT "N" values are N≤10 and natural moisture content ranging from 23.9 % to 34.6 %. This layer consisted of a mixture of sand, silt and clay materials, from the laboratory tests fine materials are 3 % - 19 % & sands are 81 % - 97 % and the Specific gravity is 2.65 -2.67.

- Layer 2:

The second layer starts from layer 1 from EGL. The thickness of this layer varies from RL m +0.64 m at CBH-3 & -9.75 at CBH-6 to RL m 54.259 at CBH-2 & -96.855 m at CBH-4. The thickness of the layer varies from 45.0m to 75.0m. Encountered materials are medium dense poorly graded sand with SPT "N" values ranges are 10<N≤50. This layer consisted of a mixture of silty sand and silty materials and a localized Clay layer (layer 3) and low plastic silt (ML). Laboratory test results show fine materials are 1-10 % and sand 90-99 % and specific gravity 2.64-2.68.

- Layer 3:

The third layer is the intermediate cohesive clay layer. The thickness of the layer varies from 3.0m to 30.45 m. This is not a continuous layer, discontinuous layer exists in layer 2 and layer 4. The encountered materials are cohesive materials (silty Clay). SPT "N" values ranges are 13<N>50. Laboratory test results show fine materials vary from 60-91 %, sand 9-40 %. The natural moisture content is 17.4 %-33.9 % and specific gravity 2.63-2.68.

- Layer 4:

The fourth layer starts after layer 2 and layer 3 up to the end of the boreholes (up to 150m from riverbed). The encountered materials are very dense silty sand with SPT value N>50. This layer consisted of mostly very dense (>50) silty Sand and localized sandy Silt and thin silty Clay layer (Layer 3). Laboratory test results show fine materials vary from 4-7 % and sand from 96-93 %, the natural moisture content is 14.7 %-30.2 % and specific gravity 2.64-2.68.

The subsoil profile of Shariatpur-Chandpur Bridge and SPT N value vs depths are shown below in Figure 11.

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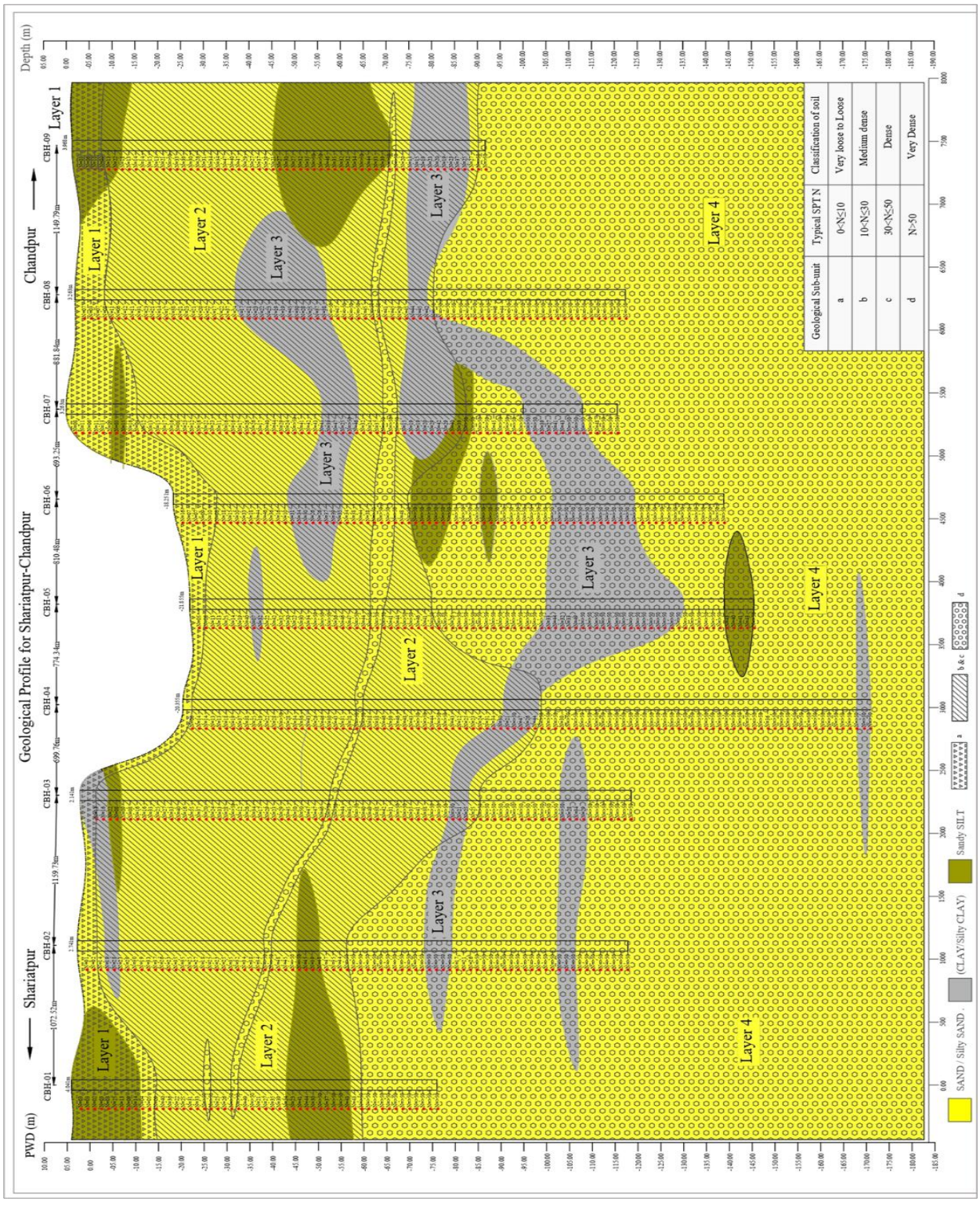

Figure 11. Sub-soil Profile of Shariatpur-Chandpur Bridge project

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4.5. Proposed Engineering Solution

The proposed solution for the bridge over the lower Meghna River, after assessing four different alignment options and various technical solutions for each, is based on **Cable Stayed Bridge with span arrangement 400-700-400 and 100 m span composite box girders over the Class I navigation area**. The total length of the bridge including access spans is 8.04 km.

The section is fully developed within Volume 05, where the criteria and engineering options are largely explained along with the process of decision-making.

Figure 12. Image of the full bridge proposed for Shariatpur-Chandpur

The vertical clearance has been fixed to 30 m in a minimum length of 700 m in order not to limit the future development of the districts upstream. For the rest of the main spans, along 3.6km, the vertical clearance is always over 18.30 m. This way, the full length of the main spans will fulfil the limitations for Class I clearance.

The foundation of the piers for the main spans, which are planned to be executed in wet conditions, have been estimated to require 6 steel driven piles Ø2.5 m of 100 m in length for all piers at the river course except the pylons of the main span and 49 steel driven piles Ø2.5 m of 130 m in length for each one of the pylons on either side of the 700 m span. Further development of the current calculations during detail design may allow for the use of a different diameter for the steel driven piles. For the approach spans with I girders, the foundations have been estimated to require Ø1.8 m bored reinforced concrete piles of 70 m in length.

The cable stayed bridge has a main span of 700 m, which avoids having the foundations where the riverbed is deeper, and two symmetrical back spans of 400 m, with an intermediate retaining pier

located at 260 m from the pylon which is meant to provide additional stiffness to the system, particularly under the effect of live loads.

A composite box girder deck has been considered, with a concrete slab of 0.40 m thick and 4.57 m total depth. Transverse ribs every 11.00 m in the main span and every 13.00 m in the back span are designed in order to provide stiffness to the structure.

The cable spacing is 13.00 m at the back span and 11.00 m in the main span, having the same number of cables on either side of each pylon, two rows of 29 cables. The distance between the pylon axis and the first cable 30.00 m for the back span and 36.50 m for the main These distances are consistent with the number of cables and spacing considered for each option.

The pylon height is designed with 30.00 m under deck soffit and 184.00 m over deck top level. These dimensions follow the currently proposed navigation clearance and the limitation for a 1V:2H slope in the cable connected to the center of the midspan.

Access spans are designed with 20.25 m width decks formed by a 0.20 m thick in situ concrete slab supported by 8 precast concrete I-girders with a spacing of 2.57 m. The maximum span of these structures is 40.00 m.

4.5.1. Alternative studied

The following topologies have been studied and analysed in order to choose the most appropriate alternative:

- Access spans
  - Precast Concrete I-Girders (40 m span)
  - Precast Concrete U-Girders (40 m span)
  - In situ Concrete Box Girders (60 m span)
- Central section
  - Composite Box Girders (100 m span)
  - Extradosed Bridge (200 m span)
  - Balanced Cantilever Bridge (200 m span)
  - Truss Bridge (200 m span)
  - Multispan Cable Stayed Bridge (400 m span)
  - Cable Stayed Bridge (700 m span)
  - Suspension Bridge (1000 m span)

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4.5.2. Tunnelling alternative

One of the engineering solutions that has been assessed as an alternative to the proposed one, is the tunnelling option, being finally discarded due to several reasons. The section 7.3 included within Volume 01, Main Report, exposes the pros and cons, and the complexity of undertaking this option as an engineering solution.

The possibility to cross under the river by means of a tunnel was explored in a conceptual level. Three options were considered for this purpose:

- Immersed tunnel option
- Double tunnel with transversal galleries
- Two-level tunnel

Any of those options, covering the tunnelling alternative, which has been particularly requested by the BBA and Technical Experts (vide TAC No. 13 meeting held on November 16th, 2023) would pose a much higher estimated cost (approximately four times the proposed bridge cost, considering both, the investment stage and also the operation and maintenance stage expenses). As a conclusion, this option based on the construction of a tunnel underneath Meghna River would not improve whatsoever this feasibility study current proposed solution outcome from the socio-economic and financial standpoint, posing as well high complexity and risks from the technical view.

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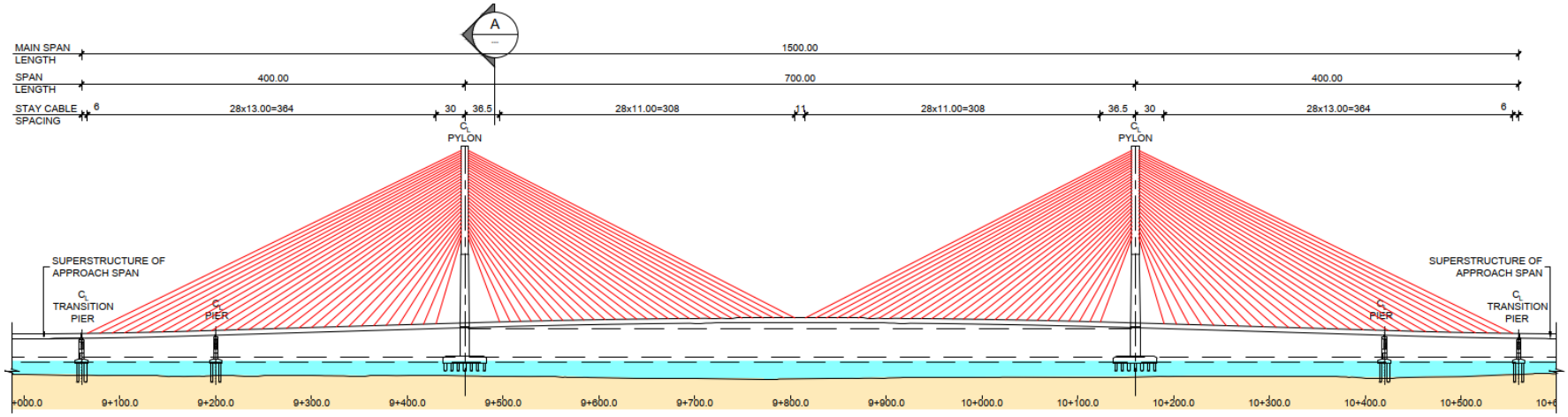

Figure 13. Elevation of cable stayed section of the bridge.

Table 10. Stretches of the bridge

	Stretch	Type	Spans (No x length)	Length (m)
1	Approach bridge	Precast I-Beams	18 x 40 + 1 x 32.5 + 1 x 55 + 1 x 32.5 + 5 x 40 + 1 x 30 + 27 x 40 + 1 x 30 + 41 x 40 + 1 x 30	3,850
2	Composite bridge	Composite box girder	11 x 100	1,100
3	Back Span	Cable stayed bridge	1 x 140 + 1 x 260	400
4	**Main Span**	**Cable stayed bridge**	**1 x 700**	**700**
5	Back Span	Cable stayed bridge	1 x 140 + 1 x 260	400
6	Composite bridge	Composite box girder	10 x 100	1,000
7	Approach bridge	Precast I-Beams	1 x 30 + 14 x 40	590
			TOTAL LENGTH (m)	8,040

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Figure 14. Image of the proposed bridge for Shariatpur-Chandpur (from Chandpur side)

4.6. Approach Roads

The design envisages a four-lane dual carriageway with an unpaved median of 3.50 m. The approximate length of the project is **19,763 m**, including the bridge and viaducts and the connections roads with the existing road. The geometric design of the project has been developed for a speed of 80 km/h. The design of curves is compatible with the adopted design speeds and Geometric Standards as laid by the American Association of States Highway and Transportation Officials (AASHTO) 2018 have been incorporated.

- **General data:**
    - **Bridge**
        - Total bridge Length: 8,040 m
          (Cable Stayed Bridge: 1,500 m - 400+700+400)
    - **Approach road length**
        - At Shariatpur District: 4,110 m (including one viaduct 280 m long)
        - At Chandpur District: 4,460 m
    - **Main alignment: 16,610 m**
    - **Improvement of existing roads: 3,100 m**
        - Shariatpur End (R860): 653 m
        - Chandpur End (R140): 2,5 km (including one viaduct 310 m long)
    - **Total project length including the existing improvement length: 19,763 m.**

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- **Cross section for the approach Road:**

  - Total road RoW variable with a medium value of over 69.5 m width.
  - 2-lane carriageway width 7.30 m plus 1.5 m outer shoulder and 0.50 inner shoulder.
  - Central Median (3.50 m wide).
  - 2-Service Road Lanes 5.50 m, plus 1.50 m outer soft shoulder and 0.50 m inner side safety.
  - 2 additional truck lanes with 7.30 m width for the entry and exit from the axle load stations along 1 km length approximately.
  - At grade intersections (roundabouts) with the regional road at Shariatpur Side (R860) and at Chandpur side (R140).
  - Improvement of the existing road R140 along 2,50 km approximately from the proposed roundabout for the Consultant (BBA request).
  - 2 Toll Plazas at both Shariatpur and Chandpur ends (7 toll booths plus the reserved areas for 3 future ones).
  - 2 Axle Load Stations and Service Yards at both Shariatpur-Chandpur ends (6 weights bridges/each).
  - 2 Service Area and Engineering Facilities.
  - 280 m long bridge at Ch 2+210.
  - 310 m long bridge at R140.
  - Box culverts at locations as drainage structures.

- **Cross section for the Bridge**

  - Total width of Bridge: 23.00 m.
  - 2-lane carriageway width 7.30 m plus 1.5 m outer shoulder 0.70 m width and 0.50 inner shoulder.
  - 1 footpath of 0.80 m width.
  - Central safety barrier width 0.65 m.
  - Side safety barrier width (each side) 0.50 m.

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Table 11. Road Design Criteria

DESIGN STANDARDS			
Design Elements	Unit	Design Parameters	Source
Road Standard		Type 2	Figure 4.1, RHD Standard, Page 12
Design Speed	Km/h	80	RHD, Table 2.2, Page-5
Stopping Sight Distance (SSD)	m	120	RHD, Table 2.3, Page-5
Intermediate Sight Distance (ISD)	m	250	RHD, Table 2.3, Page-6
Cross-Sectional Elements			
Carriageway Width	m	7.30	In each direction
Lane Width	m	3.65	RHD, Table 2.1, Page-4
Service Road/NMT	m	3.0-6.0	RHD, Table 4.1, Page-20
Outer Shoulder Width	m	1.5	RHD, Table 2.1, Page-4
Minimum Inner Shoulder Width	m	0.5	RHD, Table 4.13, Page-72
Central Median	m	1.2	AASHTO
Minimum Median Width with Barrier	m	3.5	RHD, Table 4.12, Page-70
Normal Cross fall	%	3	RHD, Table 4.7, Page-17
Cross fall of Shoulder soft	%	5	RHD, Table 4.7, Page-17
Embankment Slope (Absolute Min)	H:V	2:1	RHD, Table 4.9, Page-18
Horizontal Alignment			
Minimum Radius	m	500	RHD Table 5.1, Page-75
Maximum Super Elevation	%	3 to 5	RHD, Table 5.2, Page-76
Min. Transition Length	m	25 to 65	RHD, Table 5.3, Page-75
Vertical Alignment			
Maximum Grade	%	3 to 6	3 % as per Asian Highway Standard, 6 % maximum on the approach to structures
Minimum K Value			
Crest Vertical curve		35	RHD, Table 6.1, Page-82
Sag Vertical curve		26	AASHTO

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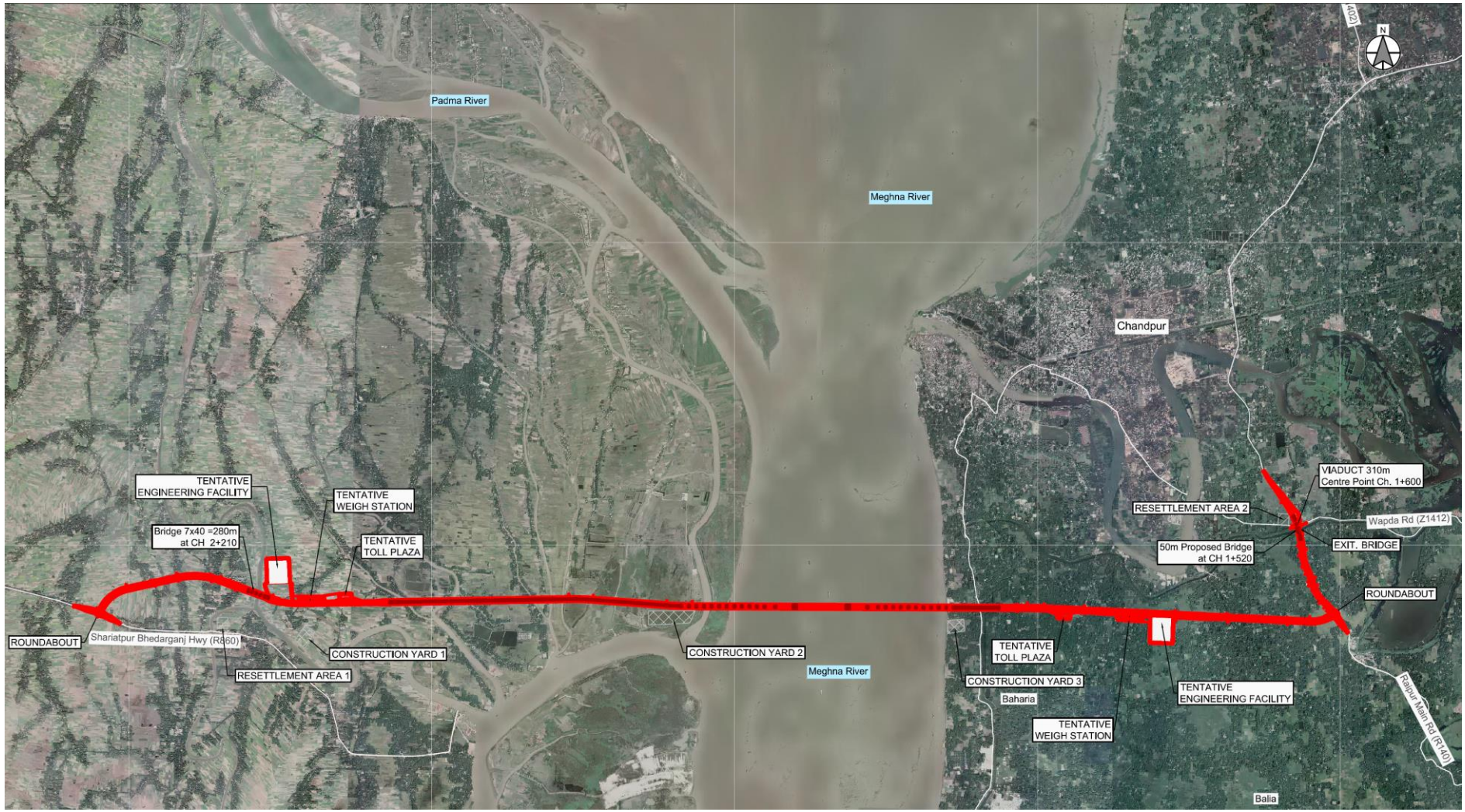

Figure 15. Final proposed alignment

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4.7. Cost estimate

The cost estimate for the preferred solution (**Alignment Option B**) is as follows:

Table 12. Summary of Preliminary Cost Estimation

No.	Item	Amount (BDT)	Amount (Cr BDT)	Amount (Million USD)
1	General and Site Facilities	4,089,578,592	408.96	38.22
2	Main Span (Cable Stayed Bridge)	57,007,392,332	5,700.74	532.78
3	Approach Spans	19,508,321,574	1,950.83	182.32
4	Approach Road including small structures	14,417,233,874	1,441.72	134.74
5	Toll Plaza & Engineering Facilities	5,835,766,566	583.58	54.54
6	Bank Protection Work	21,874,048,488	2,187.40	204.43
(A)	**Subtotal**	**122,732,341,426**	**12,273.23**	**1,147.03**
(B)	Provisional Sum for Physical Contingency = 3% of (A)	3,681,970,243	368.20	34.41
(C)	**Sub Total (A+B)**	**126,414,311,668**	**12,641.43**	**1,181.44**
(D)	Provisional Sum for Price Contingency = 6% of (C)	7,584,858,700	758.49	70.89
(E)	Engineer's Estimate = (C+D)	133,999,170,368	13,399.92	1,252.33
(F)	**Land Acquisition and Resettlement Costs**	**16,981,655,219**	**1,698.17**	**158.71**
(G)	Design Cost = 2% of (A)	2,454,646,829	245.46	22.94
(H)	Construction Supervision = 5% of (A)	6,136,617,071	613.66	57.35
(I)	Project Estimate = (E+F+G+H)	159,572,089,487	15,957.21	1,491.33

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4.8. Implementation timeline

The estimated implementation timeline, in accordance with conversations held with BBA officials is:

PRE-INVESTMENT PERIOD

- Y0 from July 2024 to June 2025 - DPP implementation - Procurement process for Detailed Design and RAP+LAP implementation / **12 months.**
- Project Detailed Design Phase, including RAP and LAP implementation phase and Main Contractor Tender Process / **19 months** - from November 2024 to May 2026.
- Construction period including Testing and commissioning / **66 months** - from July 2026 to December 2031.

TOTAL PROJECT INVESTMENT PERIOD BEFORE OPERATION: 84 months = 7Y

- Starting year of implementation: Y1 = January 2025
- Starting of construction: Y1 + 1/2 Y2 = July 2026
- Finishing year of construction (66 months) including T&C: Y7 = December 2031
- Defects Notification Period (DNP 1 year) January 2032 to December 2032

Total PROJECT OPERATION PERIOD: 30 Y = January 2032 to December 2061

TOTAL PROJECT PERIOD: 30 + 7 = 37 Y

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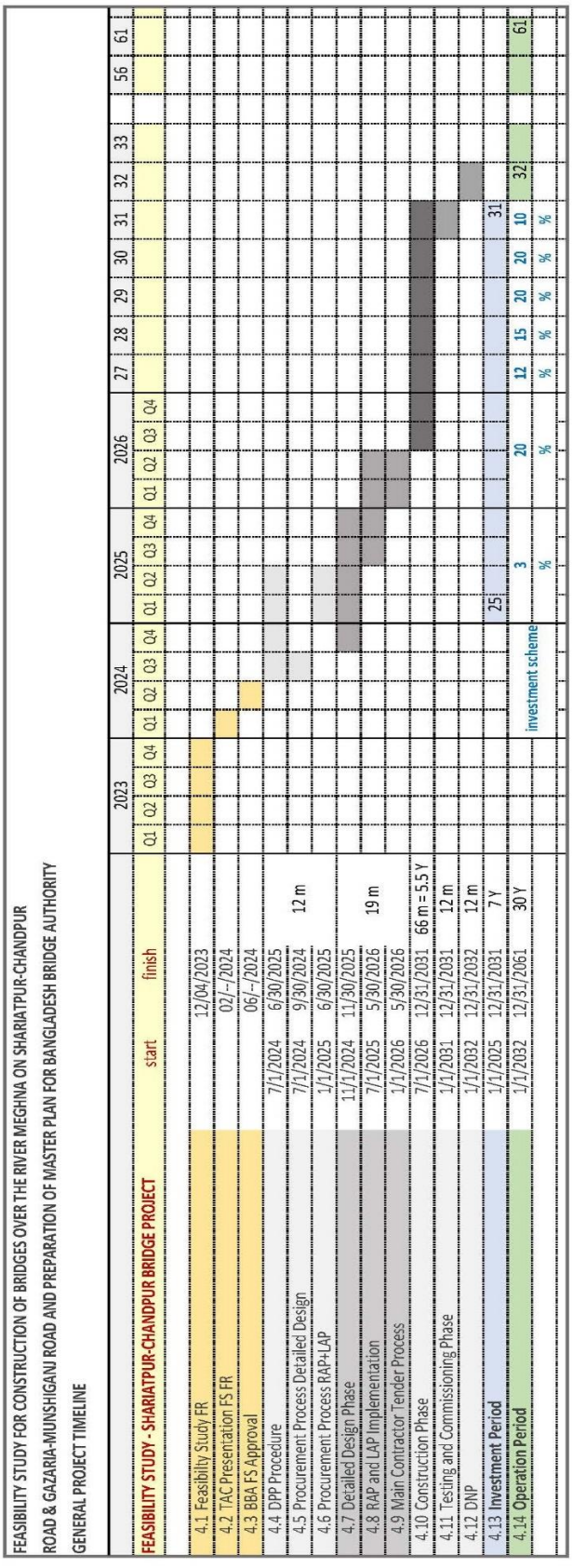

Figure 16. Project Implementation proposed Timeline

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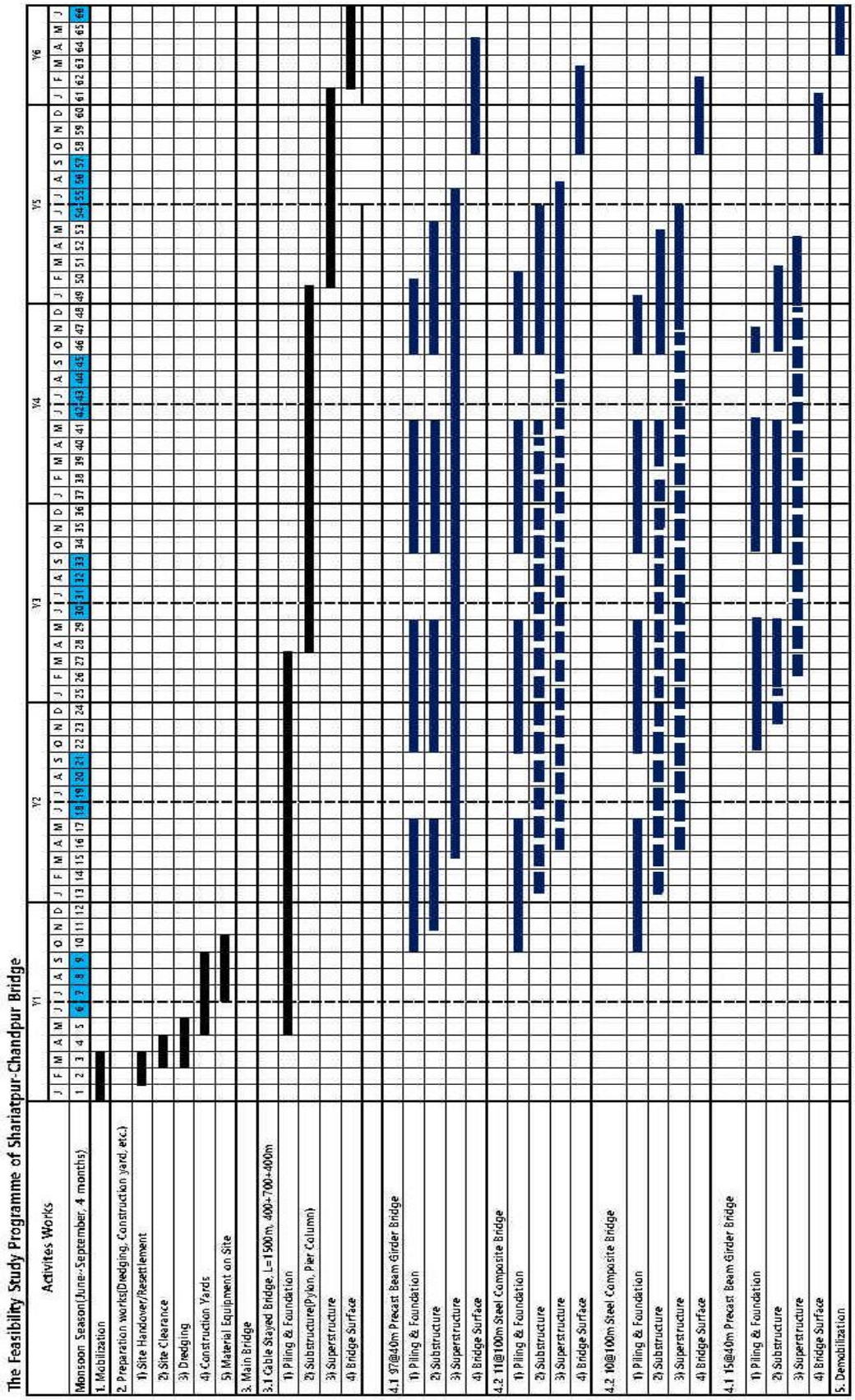

Figure 17. Project Construction Work Programme

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5. ENVIRONMENTAL SUSTAINABILITY, CLIMATE RESILIENCE AND DISASTER RISK ANALYSIS

5.1. Environmental, Climate Change and Disaster Risk Analysis

The Shariatpur-Chandpur Bridge project poses, as any infrastructure project, some environmental risks. The risks can be mitigated by implementing some counter measures. The anticipated environmental impacts included, during construction stages, are loss of trees, impact on fauna and aquatic ecosystem, water pollution, soil pollution, noise pollution, air pollution, vibration, drainage congestion, soil erosion and deterioration of public health. To reduce these impacts, the necessary mitigation measures would be based on tree plantation, avoiding of dumping of wastes, cement, bentonite and other chemicals in water and soil, use of noise barriers and roadside greenbelt, provision of ample drainage, culverts, and river protection. To protect public health including workers, necessary steps would be to provide safe water, good food and sanitation facilities for workers in construction camps. Using simulation models, it has been assessed that, during operation of the bridge, beyond 20 m air and noise quality will not exceed the National standards of Government of Bangladesh for residential areas.

As the project is located within the Hilsa sanctuary, notified by Department of Fishery (Government of Bangladesh), it may cause harm to the production of Hilsa if the Environmental mitigation measures are not implemented properly. It is advised to strictly pause all construction works in the main river channels and riverbanks during the breeding season of Hilsa as per the guideline and regulations of the department of fishery. During this time, work can be done in the construction yards which would be sufficiently far away from the main river channels.

Environmental and Social Risk Assessment have been undertaken through a series of consultations and review sessions. The principals in AS/NZS ISO 31000:2009, as well as the proponent's internal risk assessment documentation, guided the risk assessment.[1] The risk assessment approach is not designed to identify and evaluate positive impacts associated with the project. It is, nevertheless, important to consider these impacts to ensure that benefits are maximized and to obtain a full understanding of the project. Social and Environmental risk associated with the project has been listed in table below (risk ratings are not assigned to positive impacts).

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[1] AS/NZS ISO 31000:2009. This Joint Australian/New Zealand Standard was prepared by Joint Technical. Committee OB-007, Risk Management. ISO 31000:2009 **provides principles and generic guidelines on risk management**. ISO 31000:2009 can be used by any public, private or community enterprise, association, group or individual. Therefore, ISO 31000:2009 is not specific to any industry or sector

5.2 The Induced Environmental Impacts at Regional Level

The Induced Environmental Impacts at Regional Level due to the project has been presented in the following table:

Table 13. Induced Impacts

Impact/ Consequences	Degree of Impact/Consequences	Period/Interval	Risk Hedge
Land acquisition and resettlement	High negative impact	Long term impact	Partly mitigable
Air and Noise Pollution	Medium negative Impact	Short term impact	Fully mitigable
Waste Generation	Medium negative impact	Short term impact	Fully mitigable
Health Impacts	Medium negative impact	Short term impact	Fully mitigable
Business Development	High positive impact	Long term impact	Enhancement
Industrialization	High positive impact	Long term impact	Enhancement
Tourism	High positive impact	Long term impact	Enhancement
Employment opportunities	High positive impact	Long term impact	Enhancement

It is expected that the connectivity of the south-eastern part of the region with the south-western part of country will provide increased accessibility to markets, land ports, and growth centres. This will lead to development of business (including agriculture and fisheries), industry, communication, tourism, and urbanization. The induced development has both negative and positive impacts. The positive impacts are increased in the socio-economic conditions of the region through employment generation and poverty reduction. There are also negative impacts like air and noise pollution due to construction activities, increase in traffic levels and industrial development, generation of wastes due to increased living standards, consequent health impacts due to pollution and waste generation, loss of biodiversity, and land acquisition and resettlement.

There is high risk of earthquake, erosion and flood in the project area. The river training work including guide bunds will help mitigate soil erosion and flooding. Structural design & construction (Bridge and approach roads) have been conducted keeping the flood level rise due to climate change and earthquake risk in consideration. Considering the geography and geological feature of the project area following risk index has been assessed related to the climate related changes and natural disasters.

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Table 14. Climate / Disaster Risk assessment

District/Risk Area	Shariatpur	Chandpur
	Risk Index	
Cyclone	High	High
Drought (Kharif)	Very Low	Very Low
Drought (Pre Kharif)	Low	Low
Earthquake	Very Low	High
Erosion	Very High	Very High
Flood	Very High	Very High
Flash flood	Very Low	Very Low
Salinity	Moderate	Very Low
Sea-level rise	Moderate	Moderate
Landslide	Very Low	Very Low
Storm Surge	Low	Low

5.3 Environmental Management Plan Cost

A comprehensive Environmental Management Plan (EMP) has been developed to reduce and mitigate the impacts of the project. Estimated EMP cost is shown below:

Table 15. Environmental Management Plan Cost

Sl. No.	Activities/ Items	Unit	Rate in Taka	Quantity	Amount in Taka
1.	Tree plantation	Nos.	300.00*	153,300.00	45,990,000.00
2.	Vetiver plantation	Nos.	50.00**	366,666.00	18,333,300.00
3.	Maintenance of tree saplings and Vetiver / Bermuda saplings (24 months x 11.72 km long)	Month/km	8130.00**	281.35	2,287,375.50
4.	Environmental Monitoring (Air, water, soil, noise and vibration	Month	115,000.00***	66.00	7,590,000.00
5.	Dust Control Measure	Month	30,000.00****	66.00	1,980,000.00
6.	Health and Safety	LS	600,0000.00	1	600,000.00
7.	Training and Workshops	No	44,000.00##	30.00	1,320,000.00
8.	Arborist/Caretaker (24 months x 8 people) including watering, weeding and seeding, etc)	Person/Month	21,119.00###	192.00	4,054,848.00
	Total				**82,155,523.50**

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The Environmental Management Plan has been developed using the modern technologies which are most economic both in environmental and economic sense. The EMP will be the part of the contract document hence cost is mandatory and there is no viable alternative to these measures.

Environmental Impact Assessment (EIA) is required by the Ministry of Environment, Forests and Climate Change (MoEFCC) as further assessment. Terms of Reference (ToR) provided by the Department of Environment (DoE) outlines the scope of the EIA.

5.4 Assessment of Disaster Resilience

Bangladesh is one of the country's most vulnerable to climate change, as well as disaster prone. Countries flat topography, low-lying and climatic features, combined with its population density and socio-economic environment, make it highly susceptible to many natural hazards, including floods, droughts, cyclones, and earthquakes. To combat such a situation a contingency plan has been prepared.

5.1.1. Contingency plan

Contingency plan involves anticipating a specific hazard based on specific events or known risks at local, national, regional, or even global levels (e.g., earthquakes, floods or disease outbreaks), and establishing operational procedures for response, based on expected resource requirements and capacity. It also means rehearsing our procedures and working out where the gaps are, so that we can be ready when we are needed most. Plans need to be regularly updated and tested through simulations. Steps considered for the disaster management cycle are – Prevention, Preparedness, Response and Recovery

5.1.2. Disaster Management Plan for the project

The disaster management plan of the project consists of preventive measures including, among others, the following.

- Formulation and strict implementation of safety codes and measures.
- Periodic inspection of safety measures recommended and equipment.
- Preventive Maintenance.
- Workforce awareness about electric shock, equipment related accidents.
- Declaring the project area, a "no smoking zone"
- Mock drill on Emergency plan
- Provision and inspection of firefighting equipment and fire hydrant system in all the sections.
- Proper training of the employees about the importance of codes.
- Training the employees and the residents of the surrounding villages about the actions to be taken during an accident, disaster etc.

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5.1.3. Emergency Response for Typical Emergencies Identified

For this project emergency response procedure that needs to be implemented during typical emergency situations has been included in the emergency response plan –

- **Emergency Response plan for fire**

This procedure will be followed during any fire incident; the site people need to follow the instructions to ensure resurrection of the safe working condition.

- **Emergency Response plan for earthquake**

Earthquakes are unpredictable natural disasters which are of short duration, but the consequences can be severe. Based on the information available in the public domain and research publications indicates that the Chandpur and Shariatpur District comes under the seismic zone – II with seismic coefficient 0.20 (moderate) and the plan include all the procedures the site people need to follow during an Earthquake event, After the quake and Response Procedure

- **Emergency Response plan for flooding**

As the area is a flood prone area an emergency plan for flood incident has been prepared which includes -

In case of any flood, incident flood alert communication procedure for red alert, Orange alert, evacuation procedures and communication with district authorities for rescue operation.

- **Emergency Response plan for windstorm**

As the area is a flood prone area an emergency plan for flood incident has been prepared which includes the response for - Once a storm alert has been issued, Once the storm has arrived and after the cyclone and communication procedures with district authorities.

- **Public communication during emergency**

The following safety precautions will be taken with respect to the emergency which demand protection to public:

  - Immediately block the public road and allow the emergency vehicle only.
  - Continuously announce in the nearest community for evacuation if necessary.
  - Call external Govt. authority (Fire service & Civil defense, Union perished, Police etc.) to take control of the community according to govt. protocol.

5.1.4. Steps considered in preparation of Emergency Response Plan

- Step-1: Determine the potential hazards associated with the incident, substance or circumstances and take appropriate action identify the type and qualities of dangerous goods involved and any known associated hazards.

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Determine potential hazards stemming from local conditions such as inclement weather, water bodies etc. and ensure that the initial response team is aware of these conditions.

- Step-2: Determine the source/cause of the event resulting to the emergency and prevent further losses.
- Step-3: Assess the incident site for any further information on hazards or remedies.
- Step-4: Initiate redress procedures.
- Step-5: Report the incidence its nature cause impact applied redress procedures and any further assistance required etc. to the appropriate company, government and/or landowner.
- Step-6: Take appropriate steps with respect to hazards to wildlife, other resources and addressing public and media concerns and issues, as applicable. Response priorities are to protect human lives, property, and the environment.
- Procedure for assessing and reporting the residual risk to the concerned authority.

5.5 Conclusion

It may be concluded that, regarding the proposed Shariatpur-Chandpur Bridge Project, all safeguards and preventive strategies related to environmental impact have been included in EMP climate related. Furthermore, the activity related to emergency and disaster plan has been considered in design and in EMP to be implemented during construction. It is suggested that EMP be part of the contractor's contract document.

It has been assessed that if EMP is duly and properly implemented in the project, the Shariatpur-Chandpur Bridge Project will be an environmentally sound and sustainable project. It can be said in the context of Shariatpur-Chandpur Bridge Project that aggregated positive impacts outweigh the negative impacts through the recommended mitigation measures.

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6. SOCIAL SAFEGUARD ASSESSMENT

6.1. Project Area and socio-economic profile

As defined prior in this Executive Summary Report, the main alignment for the proposed bridge on Shariatpur-Chandpur is 16,610 m including the road approaches and the proposed bridges over river Meghna. The total bridge length is 8,040 m being the cable stayed bridge length of 1,500 m (spans 400 + 700 + 400). The approach road length at Shariatpur end is 4,110 m (including a minor bridge of 280 m long) and at Chandpur end is 4,460 m. The improved length of the existing roads is estimated in a length of 653 m and 2,449 m at Shariatpur and Chandpur respectively. Those project features have impact on the area as follows:

Table 16. Demographic profile of Chandpur and Shariatpur districts 2022:

Districts	Households	Total Population	Male	Female
Chandpur	635,458	2,635,748	1,405,682	1,228,774
Shariatpur	308,963	1,294,561	672,752	621,288

Source: Census 2022 (by Bangladesh govt.)

The total directly benefited population is estimated to be around 40 lakhs belonging to the Districts of Chandpur and Shariatpur.

The total project affected HHs is 1,056 including 945 HHs will be physically displaced. The total number of projects affected person is 4,885. The education level in the project-affected area is about 72 %. Business and other profession are dominated by male while 33.63 % of total female are only housewife.

6.2. Consultation and Participation

During the stakeholder's consultation meetings, people were briefed about the project benefits, roles and responsibilities of the project authority, local government institutions and other stakeholders. Mitigation measures of potential adverse impacts including compensation at replacement cost, resettlement benefits, income and livelihood restoration, grants to vulnerable people and employment opportunity of the eligible PAPs in project civil works were also discussed in the meetings. Upon disseminating information by the consultant/project authority, stakeholders identified some pertinent issues relating to the compensation, displacement, resettlement, livelihood restoration, etc.

A total of two consultation Meetings were held at separate locations during the period from November 2022 with the affected people, BBA, Consultant and Sub-consultant and others all stakeholders were present. A total of 131 people were present at the meetings. Meetings were held within the footprint of the proposed sites to address the affected people and other stakeholders associated with the road. Stakeholders were briefed about the project goals and objectives, potential impacts on the people, mitigation measures as per the Acquisition and Requisition of Immoveable Property Act (ARIPA 2017).

and GOB Resettlement Policy for the affected people on involuntary resettlement, ultimate benefits of the local people, land acquisition requirements and process, roles of the affected people and project authority in delivering compensation and grievance redress. The opinion of the people was sought and well recorded during the consultation meeting. Local government representatives affected people and beneficiary groups raised their voice and made suggestions to improve the terminals for their better communication and business.

Major consultation discussion and responses are described in Chapter 4 of Resettlement Action Plan Volume 8. There were also some small consultation meetings conducted to disseminate project information to the local people during the Social Survey.

6.3. Legal and Policy Framework and Grievance Redress Mechanism

To address the legal framework for land acquisition and resettlement of the affected people by the project, the Acquisition and Requisition of Immovable Property Act, 2017 (ARIPA) would be endorsed. This project would follow specific grievance redress mechanism to ensure that the voices of the APs merge with implementation decisions.

6.4. Summary of project impact

After carrying out the LAP by the specialized subconsultant and the Consultant in-house team of experts, it has been estimated that around **768.96 acres of land** will require acquisition for the project. Of the total land, 412.06 acre will be required for Right of Way. Additional 356.90 acres of land will be required for other project relevant interventions. It was estimated that, about 10 acres of land will be required for two resettlement area. It is identified that the land acquisition will require from 1,954 plots of 26 administrative mouzas. According to the detailed census and IOL survey, total 1,068 project affected units including 1,056 HHs and 12 CPRs will be affected by losing their immoveable assets. Apart from the primary structures a significant quantity of secondary structures will also be affected. The assessment also identified that 205 business premises including running business will be affected by the project interventions. Table below shows summary of land acquisition impacts by Interventions.

Table 17. Summary of project impact

Sl. No.	Project Impacts	Chandpur	Shariatpur	Total
A.1	Affected Land for RoW	243.94	168.12	412.06
A.1.1	Amount of affected private land (acre)	151.822	138.598	290.42
A.1.2	Amount of affected Govt land (acre)	92.124	29.522	121.64

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Sl. No.	Project Impacts	Chandpur	Shariatpur	Total
A.2	Affected Land for Resentment area, Construction Area, and River Training Activities	250.97	105.93	356.90
A	**Amount of affected land (acre)**	**494.91**	**274.05**	**768.96**
B	Number of Mouza	18	8	26
C	Number of affected Landowners	2,343	803	3,146
D	Number of Household	868	**188**	**1,056**
E	Number of CPRs affected	11	1	12
F	Total number of Project Affected Units (D+E)	879	189	1,068
G	Number of businesses affected	143	62	205
H	Number of Employee affected	48	55	103
I	Number of trees affected	60,583	42,652	1,03,235
J	Total number of persons affected	2,682	2,203	4,885

Table 18. Summary of affected land

	Affected land	Chandpur	Shariatpur	Total
A	Amount of affected private land (acre)	151.81	138.59	290.41
B	Amount of affected Govt land (acre)	92.12	29.52	121.64
C(A+B)	Affected Land for RoW	243.94	168.12	412.06
D	Affected Land for Resettlement area, Construction Area and River Training Activities	250.97	105.93	356.90
E(C+D)	Amount of affected land (acre)	494.91	274.05	768.96

6.5. Estimated Social Impact Cost

Land acquisition and Resettlement budget for the project is **BDT 16,981,655,219.**

The total estimated DC budget is BDT 10,648,688,882. Top-up cost is BDT 2,700,459,660.60 considered as resettlement benefits.

Land categories have been identified based on the Khatians. Government Mouza rate has been collected from relevant land office and market survey was conducted to collect current market rate of the land.

Table 19. Summary of Cost Estimate and Budget

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SL.	Category of Loss	Total
A	Land for RoW (Private)	4,709,726,481
	Land for RoW (Govt)	1,191,781,672
	Additional Land for Resettlement area, Construction Area and River Training Activities	6,299,447,299
	LAP Budget	12,200,955,453
B	Compensation for structure	1,794,907,054
C	Compensation for Trees	623,549,840
D	LAP Budget (A+B+C)	14,619,412,347
E	Other Resettlement Benefits	1,418,906,991
F	Operation cost for RAP Implementing Agency/ INGO	30,000,000
G	Operation cost for External Monitoring Agency	25,000,000
H	Contingency @2% of the Sub-total	292,388,247
I	Administrative cost @ 5% on the DC budget	595,947,634
	Grand Total (LAP and RAP Budget)	16,981,655,219

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7. COST-BENEFIT AND FINANCIAL ANALYSIS

7.1. Economic Analysis

The economic adjustments from financial data using standard conversion factor have been appraised from the point of view of the entire economy, considering costs and benefits.

(a) Identify the direct, indirect, and associated cost and benefit components.

In the case of the implementation of a new public transport infrastructure, within a pre-existing network transport system, the sources of benefits to be studied could a priori are the following:

- Change in travel time costs (savings), for users in the system, before and after the construction of bridge. Diverted traffic and generated traffic should be analysed separately.
- Net savings in system vehicle operating costs of all modes involved: energy, fuel, lubricants.
- Lower accident costs for travellers
- Investment and conservation cost variation (maintenance and repairs) in infrastructures
- Lower environmental costs (emissions reduction, pollution reduction, etc.).

In the table below are summarized some basic elements that compose total project Capital expenses. These costs are indicated without VAT and capitalised to year 2025[2], when the estimation was carried out:

Table 20. Basic elements that compose total project Capex (capitalised to 2025)

Number	Item	Cr BDT
1	General and Site Facilities	398.70
2	Main Span (Cable stayed)	5,557.60
3	Approach Bridges	1,901.80
4	Approach Road including small structures	1,405.50
5	Toll Plaza & Engineering Facilities	568.90
6	Bank Protection Work	2,132.50
7	Provisional Sum for Physical Contingency	358.90
8	Provisional Sum for Price Contingency	739.40
9	Land Acquisition and Resettlement Costs	1,779.70
10	Design Cost	223.70
11	Construction Supervision	559.20
	TOTAL	15,625.96

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[2] *An increment of 4.80% has been applied to account for price increase from 2023 to 2025, considering the inflation rate of 2024.*

(b) Adjust them where necessary.

Capex costs are adjusted considering the inflation from 2022 to 2025 (starting year of investments):

Table 21. Capital expenses deployment with project (Cr BDT)

Capital expenditures	2025	2026	2027	2028	2029	2030	2031
Split by year of the CAPEX	3%	20%	12%	15%	20%	20%	10%

Besides capital expenses for the with- project scenario, the consultant has considered investments **for the without scenario**. It has been considered that some of the investments of the "With project" scenario will also be needed for the without scenario but on a reduced basis, making the "without project" scenario investments around 30% of the ones needed in the "With project" scenario. Again, the equivalent costs are also presented in terms of 2025 prices.

Table 22. Capital expenses deployment without project (Cr BDT)

Capital expenditures	2025	2026	2027	2028	2029	2030	2031
TOTAL	170.8	963.5	578.1	722.6	963.5	963.5	481.7

Table 23. Maintenance expenses with and without project. Values per year (Cr BDT)

	With project		Without project	
Maintenance	Ordinary maintenance [Cr BDT/year]	Extraordinary [Cr BDT/year (when applied)]	Ordinary maintenance [Cr BDT/year]	Extraordinary [Cr BDT/year (when applied)]
Main bridge	55.58	666.91 (Y15, Y25)	-	-
Approaching viaducts	19.02	76.07 (Y10, Y20, Y30)	-	-
Approaching roads	14.06	84.33 (Y10, Y20, Y30)	9.15	54.90 (Y10, Y20, Y30)
Bank protection and river training works	42.65	127.95 (every 3Y)	17.06	51.18 (every 3Y)
Toll Plaza and Facilities	11.38	45.51 (Y15, Y25)	-	-
Ferry-ghat terminal	-	-	19.52	-
TOTAL (sum during Operation period (30Y)	**4,280.30**	**3,101.20**	**1,371.86**	**621.59**

The following figures shows the split of the main positive NPV flows, showing that the passenger time savings is the element with the highest impact: around 55%.

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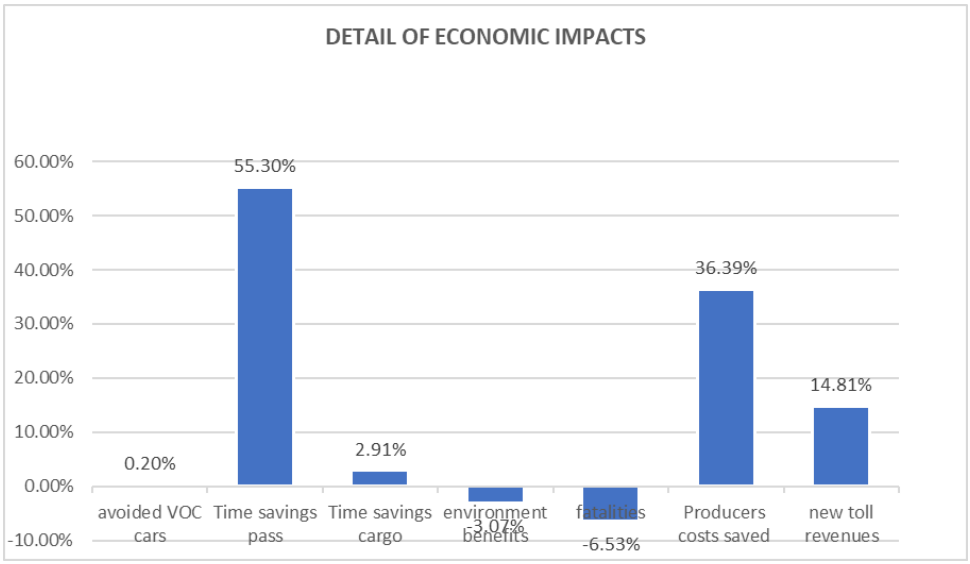

Figure 18: Detail of economic impacts

(c) Convert the value of cost and benefit components into economic price by using Standard Conversion Factors (SCF) determined by the Government.

The conversion factors (CF) are employed to transform the market input prices into shadow prices. They represent ratios that connect both prices and they consider a more realistic value for the considered inputs. The values used frequently in ADB's Technical Assistance Consultants reports[3] have been applied for some of the outflows in this socioeconomic analysis. In particular:

Table 24. Considered Conversion factors.

Cost concept	CF value
Initial Capex	0.90
O&M costs	0.88
Reinvestment costs	0.88
Residual Value	0.90

(d) Construct the cash flow.

After having presented and described all assumptions, as well as the main methodologic elements, the project economic flows were calculated and projected for the period of analysis Project economic flows for the different years considered in the period have been estimated and projected (in Cr BDT). They are represented in the following figures, first undiscounted and then discounted:

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[3] For instance, ADB TAC report: "supporting Sustainable Urban transport I Aizawl City" (2016). Same CF values are present for instance in: "Detailed Project Report for Rail Based Mass Transit system in Kanpur" (RITES, 2019)

Table 25. Economic model projections summary by type of impacts

		NPV	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040	2045	2050	2055	2060	2061
SOCIO ECONOMIC COSTS																			
Project initial investments	Cr BDT	**-6,807.7**	**-268.2**	**-1,945.5**	**-1,167.3**	**-1,459.2**	**-1,945.5**	**-1,945.5**	**-972.8**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Residual value	Cr BDT	**91.8**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**5,431.6**
Renovation works	Cr BDT	**-560.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**-93.3**	**-93.3**	**-160.8**	**-93.3**	**-160.8**	**-93.3**	**-93.3**	**-160.8**	**-93.3**	**-227.8**
Change in Producer Surplus:	Cr BDT	**5,812.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**241.5**	**432.1**	**656.4**	**918.3**	**1,416.8**	**2,109.1**	**3,032.5**	**4,197.5**	**5,716.1**	**6,079.0**
Producers costs savings for the system	Cr BDT	4,173.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	176.2	291.6	430.1	594.7	968.4	1,510.6	2,272.5	3,315.7	4,719.3	5,058.9
Existing traffic	Cr BDT	*910.9*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*90.5*	*100.6*	*111.7*	*123.8*	*200.7*	*312.0*	*468.0*	*681.2*	*967.5*	*1,036.7*
Diverted traffic	Cr BDT	*3,262.8*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*85.7*	*191.0*	*318.4*	*470.9*	*767.7*	*1,198.6*	*1,804.5*	*2,634.5*	*3,751.8*	*4,022.2*
Toll revenues **generated traffic**	Cr BDT	1,681.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.2	142.5	229.8	328.9	457.8	614.2	785.3	918.7	1,049.4	1,076.6
Vehicle Op costs (generated traffic)	Cr BDT	-42.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.9	-2.1	-3.5	-5.3	-9.3	-15.8	-25.3	-36.9	-52.7	-56.5
TOTAL ECONOMIC COSTS		**-1,463.2**	**-268.2**	**-1,945.5**	**-1,167.3**	**-1,459.2**	**-1,945.5**	**-1,945.5**	**-972.8**	**148.2**	**338.8**	**495.6**	**825.0**	**1,256.0**	**2,015.8**	**2,939.2**	**4,036.6**	**5,622.8**	**11,282.8**
SOCIO ECONOMIC BENEFITS																			
Change in Consumer Surplus:	Cr BDT	**8,024.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**349.0**	**516.5**	**720.2**	**966.1**	**1,695.1**	**2,879.0**	**4,705.4**	**7,245.1**	**10,853.7**	**11,756.2**
Existing traffic	Cr BDT	*2,781.8*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	239.1	268.4	300.8	336.7	577.4	954.0	1,522.1	2,351.3	3,532.0	3,827.7
Avoided (saved) costs private vehicle	Cr BDT	101.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.9	13.0	14.2	15.5	23.5	34.0	47.6	64.7	85.8	90.7
User passenger time savings	Cr BDT	2,476.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	211.2	237.2	266.0	297.9	512.5	849.4	1,358.8	2,103.9	3,166.9	3,433.3
User freight time savings	Cr BDT	204.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.0	18.2	20.6	23.2	41.4	70.6	115.7	182.6	279.3	303.7
Diverted traffic	Cr BDT	*1,391.8*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.8	79.8	133.2	197.3	324.0	510.5	776.1	1,144.7	1,646.8	1,769.3
Avoided (saved) costs private vehicle	Cr BDT	167.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	11.5	19.0	27.7	42.2	61.5	86.4	117.8	156.5	165.5
User passenger time savings	Cr BDT	998.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.9	57.9	96.6	142.9	234.0	366.9	554.4	812.2	1,160.5	1,244.9
User freight time savings	Cr BDT	225.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	10.4	17.7	26.6	47.8	82.1	135.3	214.7	329.8	358.9
Generated traffic	Cr BDT	*3,850.7*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.1	168.3	286.2	432.2	793.7	1,414.5	2,407.2	3,749.2	5,674.9	6,159.3
user Time costs savings	Cr BDT	3,803.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.0	167.7	285.0	430.0	786.6	1,397.3	2,371.9	3,687.3	5,572.8	6,046.7
user freight time savings	Cr BDT	125.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	4.9	8.4	12.9	25.0	46.3	80.9	127.7	195.3	212.4
additional costs private vehicle	Cr BDT	-78.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.0	-4.4	-7.3	-10.8	-17.9	-29.1	-45.5	-65.8	-93.1	-99.7
Variation in Externalities	Cr BDT	**-1,090.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**-43.5**	**-92.3**	**-148.0**	**-211.2**	**-295.1**	**-399.7**	**-515.4**	**-600.5**	**-683.9**	**-701.2**
accidents	Cr BDT	-741.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-30.7	-64.6	-103.0	-146.4	-201.6	-269.7	-344.6	-401.1	-456.5	-468.0
Emissions	Cr BDT	-300.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-11.0	-23.8	-38.7	-55.9	-80.7	-112.3	-147.6	-172.3	-196.5	-201.5
Air polution	Cr BDT	-173.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-6.1	-13.6	-22.1	-32.0	-46.4	-64.8	-85.3	-99.6	-113.7	-116.6
Climate change	Cr BDT	-127.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-4.8	-10.3	-16.6	-23.8	-34.3	-47.5	-62.2	-72.6	-82.8	-84.9
well to tank	Cr BDT	-47.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.8	-3.8	-6.2	-8.9	-12.8	-17.8	-23.3	-27.2	-31.0	-31.8
ECONOMIC IMPACTS	Cr BDT	**6,934.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**305.5**	**424.2**	**572.2**	**754.9**	**1,400.0**	**2,479.3**	**4,190.0**	**6,644.6**	**10,169.8**	**11,055.0**
NET BENEFITS	Cr BDT	**5,471.0**	**-268.2**	**-1,945.5**	**-1,167.3**	**-1,459.2**	**-1,945.5**	**-1,945.5**	**-972.8**	**453.7**	**763.0**	**1,067.8**	**1,579.9**	**2,656.0**	**4,495.1**	**7,129.3**	**10,681.3**	**15,792.6**	**22,337.7**

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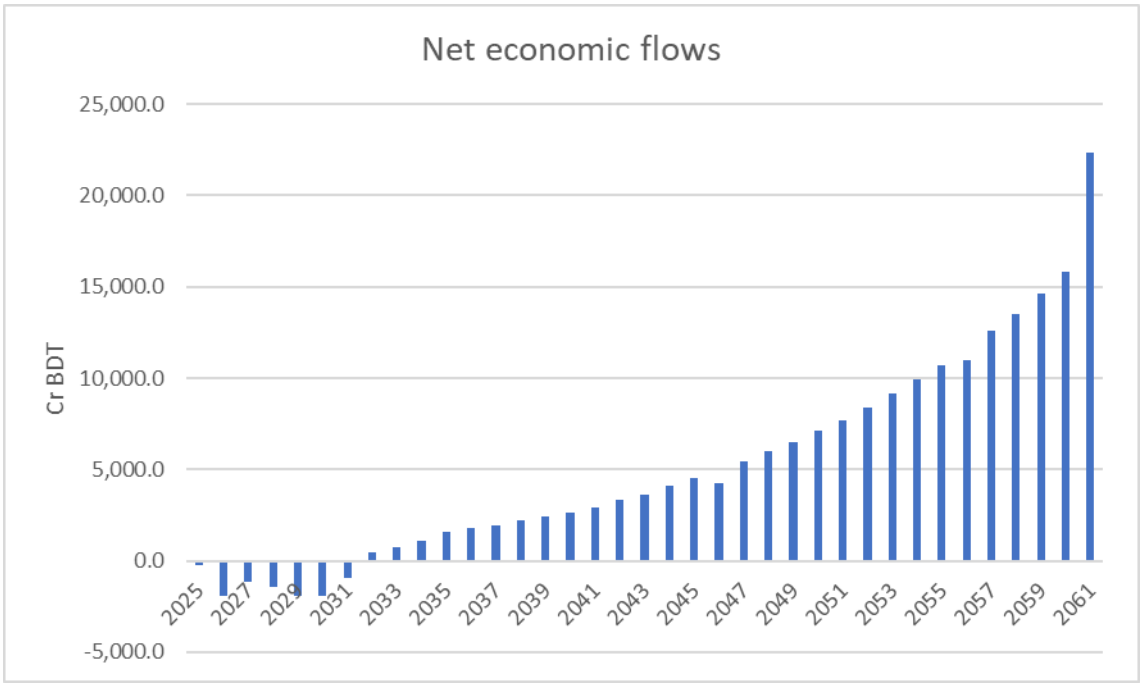

Figure 19: Undiscounted economic flows (Cr BDT)

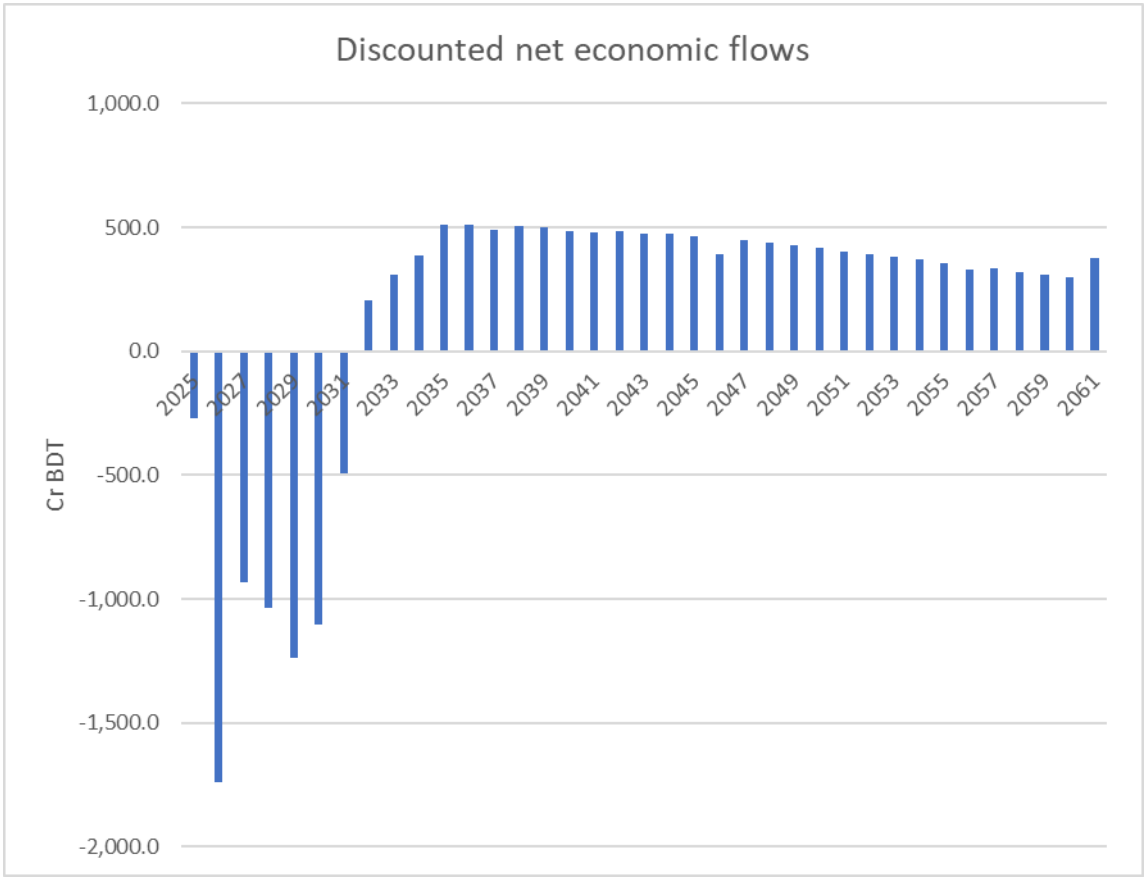

Figure 20: Discounted economic flows (Cr BDT)

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(e) Mention the Assumption.

The base year for study projections has been set in 2025 (1st January) and the horizon year in 2061 (31st December)

- Total Investments period: 7 years (2025-2031)
- Total operations period: 30 years (2032-2061)

Since socioeconomic analysis is referred to the first year of operation, prices and costs initially estimated to 2022 have been converted to 2025 applying the foreseen inflation.

The values used for value of time (VoT) in the model are clearly conservative values considering the different recent studies (ADB, JICA, etc.) and projects analysed in Bangladesh as well as other international references.

Table 26. Values for VoT

Mode	VoT BDT/pass-h (2022)	VoT BDT/pass-h (2025)
Motorcycles	90.95 BDT/pass-h	99.07 BDT/pass-h
Light vehicles	101.65 BDT/pass-h	110.73 BDT/pass-h
Buses	80.25 BDT/pass-h	87.41 BDT/pass-h
Trucks	3.75 BDT/ton-h	4.08 BDT/ton-h

Value of Time is first capitalized from 2022 terms to 2025 terms. The total increase is 8.93%, which is: 0.7 x increase in GDP pc growth of years 2023 (5.94%) and 2024 (6.93%).

After capitalization VOT values have an annual increase (over projection period 2025 - 2061) of 4.5%/ year[4].

Vehicle Operating costs (VOC's) adopted were obtained in a case- by- case modal basis, undertaking a comparative study with cases mostly from Bangladesh, but also from India, or other international benchmarks references. In general, we have adopted (likewise the adoption of figures for Value of Time) a quite conservative approach when selecting VOC values.

Vehicle Operating cost (VOC) value is first capitalized from 2022 terms to 2025 terms. The total increase is 16.47%, which is the compound inflation rate passed in the years 2023 and 2024.

[4] *0.7 x last year GDP growth pc computed (ie 2024: 6.43%): 0.7 x 6.43% = 4.5%.*

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After capitalization VOC values have an annual increase (over projection period 2025 - 2061) of 3%/ year, which can be considered as a conservative approach for the economic appraisal[5].

The figures adopted are:

Table 27. Vehicle operating costs by mode

Mode	BDT / veh – km (2022)	BDT / veh – km (2025)
Motorcycles	10.70	12.46
Light vehicles	14.98	17.45
Buses	32.10	37.39
Trucks	42.80	49.85

It has been considered a reference social discount rate of **12%** for the economic analysis, following the Memo no 20.804.014.00.00.014.027.18-177 sent by the Planning Division of the *Ministry of Planning of Bangladesh*.

Residual value has been estimated according to traditional procedures and international best practices: EU Cost- Benefit handbook, ADB guidelines, World Bank, etc. More precisely we have used the standard approach of estimating the amount of depreciation not computed in the analysis period (*net book value or remaining depreciation costs method)*. We find the "Net Book Value" approach[6] less distorting than the alternative approach.

(f) Compute the following indicators and interpret the results:

(i) Economic Net Present Value (ENPV)

In our case **Project Net Present Value** was estimated taking as reference the first year of the considered period – 2025 – when the investments would start. **ENPV estimated in real terms would reach: 5,471.01 Cr BDT.**

Economic Net Present Value obtained is clearly positive which means that, in economic terms the benefits generated by the project are fully sufficient to compensate the rise in costs, both of the construction and operation of the bridge.

Or in more precise economic terms: **potential social benefits, understood as what society is willing to pay in order to have access to the new bridge, seem to be higher than social costs, or the group of goods and services to which society must renounce if it decides to implement the new bridge.**

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[5] *Considering that official inflation estimates for last known periods were unusually high (around 6%) and probably for international short- term reasons.*

[6] *CBA handbook EU 2014, pages 34, 35*

(ii) Economic Benefit Cost Ratio (EBCR)

Project **cost benefit ratio** reaches **4.74** indicating the positive economic value creation from the projection of economic discounted flows.

(iii) Economic Internal Rate of Return (EIRR)

Project Economic IRR was obtained from the economic flows estimated for each year. **The result is an E-IRR equal to 16.01%.** This data is higher than the considered social rate of discount (12%) or opportunity cost of capital, so t**he project can be considered as feasible (IRR > SRD and E-NPV positive)**.

(iv) Payback period

Regarding the Payback period and since the project NPV is positive, there is a specific year when the initial investments are fully recovered. A project can be "liquid" depending on the timing at which cumulated NPV start to be positive. **In the case of Shariatpur-Chandpur, this break-even point is reached in 2047.**

7.2. Financial Analysis

A financial analysis has been carried out to evaluate whether Shariatpur-Chandpur bridge project ("the Bridge", "the Project") can generate enough operating income above operating expenses, repay easily external funding and remunerate equity investors under market conditions.

The procurement alternatives considered in the financial analysis are the following ones:

- Traditional procurement or Public Project: The Government of Bangladesh ("GoB") oversees project implementation as well as of the operation and maintenance of the Bridge and related works. During operation period, GoB collects toll fares from users.
- PPP procurement or PPP Contract: A private PPP company oversees the construction, operation and maintenance of the Bridge and collects tolls from users. Should expected revenues are not enough to cover total project costs, GoB grants and equity (from Public Budgets) will be part of the funding to implement the Project, in addition to those funds provided by a combination of the PPP investors and banks term loans.

In the case of the PPP contracts, the government has designed by law a viability gap funding (VGF) to estimate the required grant to support projects that are economically feasible and necessary but financially unviable. The aim of VGF is to make commercially nonviable infrastructure projects attractive to private investor through PPP arrangement. But the VGF in the form of the capital grant or annuity or both shall not exceed 40% of the total estimate project cost.

The approach to determining the most effective contract structure is as follows:

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- Firstly, the project is analyzed as a Public Project or Traditional Procurement, as more reasonable for this type of projects.
- Besides, the PPP contract alternative is analyzed as it is typically more efficient to alleviate the use of GoB resources, and to shorten construction schedule.
- If the PPP contract is not viable on its own, the Viability Gap Funding ("VGF") needed to make it viable is calculated:
    - If it does not exceed 40%, the PPP structure is considered viable.
    - If the VGF required exceeds 40%, PPP structure is discarded.

(a) Components of cost & revenues

From the point of view of the revenues, the implementation of a user toll system is planned to minimize the budgetary resources from the GoB. The toll revenues should be used to cover the operation and maintenance expenses during the life of the Project as well as part of the initial investments, considering the forecasted demand and the toll fares structure.

Concerning the toll fares, four categories or vehicle classes have been considered: motorcycles, light vehicles, buses and trucks.

(b) Cost & revenues in monetary value

Costs are presented in monetary values, starting by the initial investments and, secondly, by operation and maintenance expenses.

Table 28. Investment budget

Investment budget (VAT included)	Cr BDT (2023)	Cr BDT (2025)
General and Site facilities	409.00	428.60
Main Bridge	1,441.70	1,510.90
Approach Bridges and Connection Bridge	583.60	611.60
Approach Road including small structures	5,700.70	5,974.40
Toll plaza and & CCB	1,950.80	2,044.50
Bank protection work	2,187.40	2,292.40
Land acquisition and Resettlement costs	1,698.20	1,779.70
Design costs	245.50	257.20
Supervision costs	613.70	643.10
Contingencies	1,126.70	1,180.80
CAPEX	15,957.20	16,723.20

The following table shows the detail of the sources and application of funds during the construction schedule:

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Table 29. Sources and application of funds year by year. PPP contract structure

Sources & Application of Funds (Cr BDT)	2025	2026	2027	2028	2029	2030	2031
Government grants	3,182	21,216	12,729	15,912	21,216	21,216	10,608
Private equity	1,378	3,077	2,243	3,196	4,783	5,471	3,487
Long term financing resources (debt)	4,133	9,232	6,729	9,587	14,348	16,412	10,460
Investments	4,704	32,929	20,745	27,228	38,120	40,026	21,013
Other initial costs (capitalized interests)	3,989	596	956	1,466	2,226	3,073	3,541
Total	8,693	33,525	21,702	28,694	40,346	43,098	24,554

Table 30. Operating expenses

Operating expenses (VAT included)	Cr BDT / year
Operation	7.50
Overall expenses. Company structure	5.00

The resulting ordinary and extraordinary maintenance amount per year is shown in the following table:

Table 31. Maintenance expenses. Amount per year

Maintenance (Cr BDT. VAT included)	Investment	Maintenance / year
Main bridge	5,558	100.00
Approaching viaducts	1,902	26.60
Approaching roads	1,406	22.50
Bank protection and river training	2,132	85.30
Toll Plaza	569	14.40
Total		248.90

Once detailed de project costs, the revenues are detailed. They come from the tolls to users per type of vehicles as well as from the traffic projected in four categories of vehicles, as shown in the following charts:

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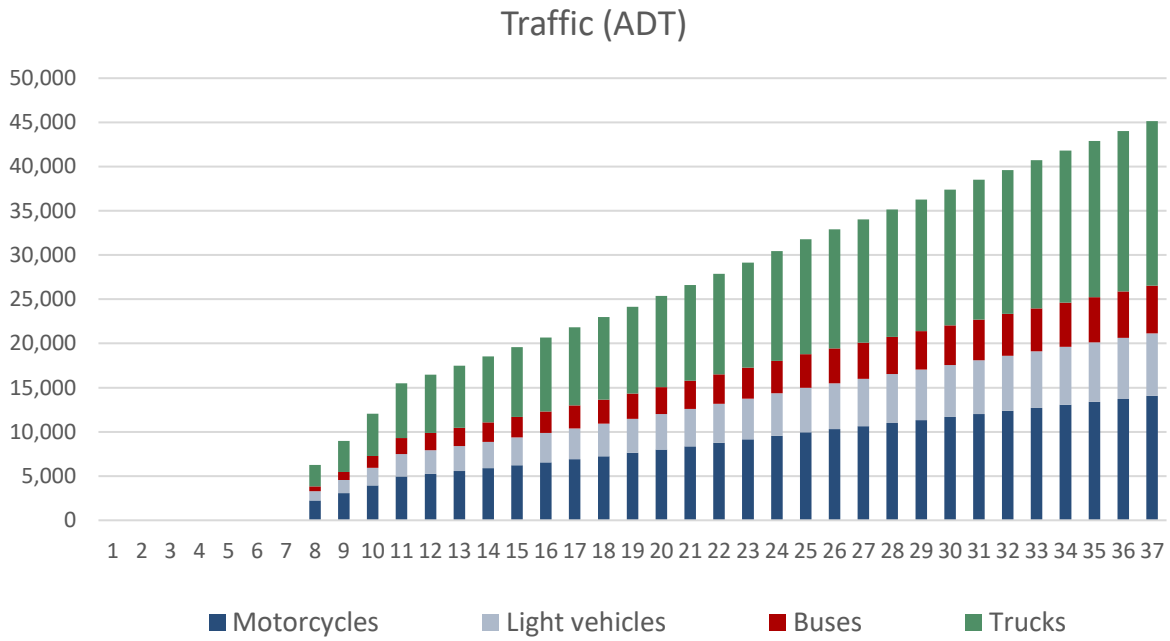

Figure 21. Toll revenues

The most important classes of vehicles are trucks (41% of total vehicles) and motorcycles (31%).

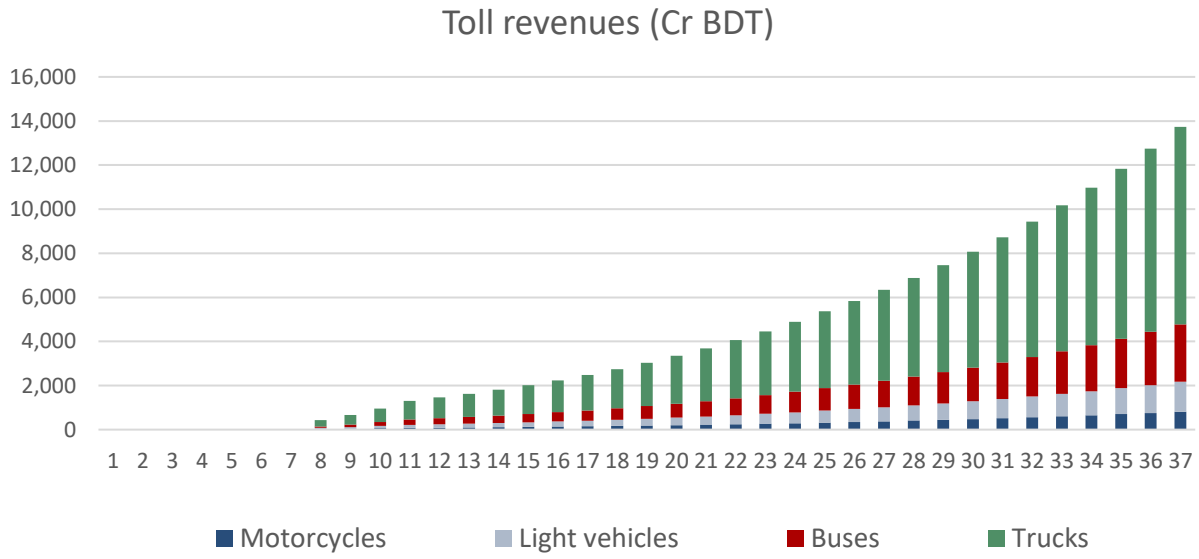

Figure 22. Toll revenues

Toll revenues have different impacts on the Project cash flows: both buses and trucks are the most important classes, representing together 84% of total revenues, being trucks 65%.

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(c) Cash flow

The following tables show the 37 years of projected cash flows during the period of analysis for both contract alternatives: Public Project and PPP Contract, respectively. Notice that the cash flow projections include the construction period, the first two years of operation and every five years of the operation period:

Table 32. Project cash flows. Public Project or Traditional procurement

CASH FLOWS (Cr BDT)	2025 Year 1	2026 Year 2	2027 Year 3	2028 Year 4	2029 Year 5	2030 Year 6	2031 Year 7	2032 Year 8	2034 Year 10	2039 Year 15	2044 Year 20	2049 Year 25	2054 Year 30	2059 Year 35	2061 Year 37
Operating revenues	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**425**	**954**	**2,013**	**3,343**	**5,363**	**8,071**	**11,831**	**13,736**
Toll revenues	0	0	0	0	0	0	0	425	954	2,013	3,343	5,363	8,071	11,831	13,736
Other commercial revenues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operation & Maintenance expenses	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-212**	**-432**	**-298**	**-380**	**-898**	**-620**	**-791**	**-2,542**
Maintenance & Overhaul	0	0	0	0	0	0	0	-201	-420	-282	-361	-873	-587	-750	-2,496
Operation	0	0	0	0	0	0	0	-11	-12	-16	-20	-25	-32	-41	-46
Net Cash Flows due to Operations	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**213**	**522**	**1,715**	**2,963**	**4,465**	**7,451**	**11,041**	**11,194**
Cash Flows due to Investments	**-696**	**-3,358**	**-2,177**	**-2,874**	**-4,033**	**-4,298**	**-2,437**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**505**
Initial CAPEX	-696	-3,358	-2,177	-2,874	-4,033	-4,298	-2,437	0	0	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual Value of Investments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	505
Project cash flows	**-696**	**-3,358**	**-2,177**	**-2,874**	**-4,033**	**-4,298**	**-2,437**	**213**	**522**	**1,715**	**2,963**	**4,465**	**7,451**	**11,041**	**11,698**

CASH FLOWS (Cr BDT)	2025 Year 1	2026 Year 2	2027 Year 3	2028 Year 4	2029 Year 5	2030 Year 6	2031 Year 7	2032 Year 8	2034 Year 10	2039 Year 15	2044 Year 20	2049 Year 25	2054 Year 30	2059 Year 35	2061 Year 37
Outflows	**-696**	**-3,358**	**-2,177**	**-2,874**	**-4,033**	**-4,298**	**-2,437**	**-1,140**	**-1,332**	**-1,127**	**-1,138**	**-1,584**	**-1,234**	**-1,334**	**-3,057**
Project Development (Initial CAPEX)	-470	-3,293	-2,075	-2,723	-3,812	-4,003	-2,101	0	0	0	0	0	0	0	0
Financing Fees	-226	-65	-102	-151	-221	-296	-335	0	0	0	0	0	0	0	0
Operating expenses	0	0	0	0	0	0	0	-212	-432	-298	-380	-898	-620	-791	-2,542
Loan Repayments															
Interest	0	0	0	0	0	0	0	-521	-492	-421	-350	-278	-207	-136	-107
Principal Repayments	0	0	0	0	0	0	0	-408	-408	-408	-408	-408	-408	-408	-408
Inflows	**553**	**2,401**	**1,602**	**2,156**	**3,076**	**3,341**	**1,958**	**425**	**954**	**2,013**	**3,343**	**5,363**	**8,071**	**11,831**	**13,736**
Borrowings	553	2,401	1,602	2,156	3,076	3,341	1,958	0	0	0	0	0	0	0	0
Operating revenues	0	0	0	0	0	0	0	425	954	2,013	3,343	5,363	8,071	11,831	13,736
Future Developments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Project cash flows after grants	**-144**	**-957**	**-574**	**-718**	**-957**	**-957**	**-479**	**-716**	**-378**	**886**	**2,206**	**3,779**	**6,836**	**10,497**	**10,679**

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Table 33. Project cash flows. PPP Contract

CASH FLOWS (Million BDT)	2025 Year 1	2026 Year 2	2027 Year 3	2028 Year 4	2029 Year 5	2030 Year 6	2031 Year 7	2032 Year 8	2034 Year 10	2039 Year 15	2044 Year 20	2049 Year 25	2054 Year 30	2059 Year 35	2061 Year 37
Operating revenues	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4,247**	**9,536**	**20,129**	**33,434**	**53,629**	**80,706**	**118,314**	**137,358**
Toll revenues	0	0	0	0	0	0	0	4,247	9,536	20,129	33,434	53,629	80,706	118,314	137,358
Other revenues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public contributions	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Availability payment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating subsidy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating expenses	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-2,192**	**-4,402**	**-3,084**	**-3,936**	**-9,150**	**-6,412**	**-8,183**	**-25,723**
Maintenance	0	0	0	0	0	0	0	-2,008	-4,198	-2,825	-3,605	-8,728	-5,873	-7,495	-24,964
Operation	0	0	0	0	0	0	0	-111	-122	-156	-199	-253	-324	-413	-455
SPV Structure	0	0	0	0	0	0	0	-74	-81	-104	-132	-169	-216	-275	-303
Corporate tax	0	0	0	0	0	0	0	0	0	-3,098	-7,358	-11,478	-19,760	-29,735	-30,149
EBITDA	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2,055**	**5,134**	**13,947**	**22,140**	**33,001**	**54,535**	**80,395**	**81,486**
Investments	**-8,693**	**-33,525**	**-21,702**	**-28,694**	**-40,346**	**-43,098**	**-24,554**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	-8,693	-33,525	-21,702	-28,694	-40,346	-43,098	-24,554	0	0	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Project cash flows	**-8,693**	**-33,525**	**-21,702**	**-28,694**	**-40,346**	**-43,098**	**-24,554**	**2,055**	**5,134**	**13,947**	**22,140**	**33,001**	**54,535**	**80,395**	**81,486**
Public Contributions	**3,182**	**21,216**	**12,729**	**15,912**	**21,216**	**21,216**	**10,608**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Government capital contributions	1,591	10,608	6,365	7,956	10,608	10,608	5,304	0	0	0	0	0	0	0	0
Multilateral capital contributions	1,591	10,608	6,365	7,956	10,608	10,608	5,304	0	0	0	0	0	0	0	0
Project cash flows (after contributions)	**-5,510**	**-12,309**	**-8,972**	**-12,782**	**-19,130**	**-21,883**	**-13,947**	**2,055**	**5,134**	**13,947**	**22,140**	**33,001**	**54,535**	**80,395**	**81,486**
Funding	**5,510**	**12,309**	**8,972**	**12,782**	**19,130**	**21,883**	**13,947**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Equity	1,378	3,077	2,243	3,196	4,783	5,471	3,487	0	0	0	0	0	0	0	0
Multilateral term loan	4,133	9,232	6,729	9,587	14,348	16,412	10,460	0	0	0	0	0	0	0	0
Cash flow before debt service (multilateral)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2,055**	**5,134**	**13,947**	**22,140**	**33,001**	**54,535**	**80,395**	**81,486**
Debt service. Multilateral term loan	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-4,254**	**-4,254**	**-10,729**	**0**	**0**	**0**	**0**	**0**
Interest	0	0	0	0	0	0	0	-4,254	-4,254	-2,801	0	0	0	0	0
Debt repayment	0	0	0	0	0	0	0	0	0	-7,928	0	0	0	0	0
Cash flow after debt service (multilateral)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-2,199**	**880**	**3,219**	**22,140**	**33,001**	**54,535**	**80,395**	**81,486**
Commercial banks credit line. Drawdowns	0	0	0	0	0	0	0	2,199	0	0	0	0	0	0	0
Cash flow before debt service (commercial)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**880**	**3,219**	**22,140**	**33,001**	**54,535**	**80,395**	**81,486**
Debt service. Commercial term loan	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-677**	**0**	**0**	**0**	**0**	**0**	**0**
Interest	0	0	0	0	0	0	0	0	-138	0	0	0	0	0	0
Debt repayment	0	0	0	0	0	0	0	0	-539	0	0	0	0	0	0
Free cash flows	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**203**	**3,219**	**22,140**	**33,001**	**54,535**	**80,395**	**81,486**
Dividends	0	0	0	0	0	0	0	0	0	-3,219	-19,399	-30,260	-52,093	-78,393	-81,486
Annual cash	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**203**	**0**	**2,741**	**2,741**	**2,442**	**2,002**	**0**
Initial cash balance	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**18**	**5,966**	**5,966**	**19,670**	**32,776**	**44,106**	**48,110**
Cash movements of the year	0	0	0	0	0	0	0	0	203	0	2,741	2,741	2,442	2,002	0
Ending cash balance	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**221**	**5,966**	**8,707**	**22,411**	**35,218**	**46,108**	**48,110**

The projected cash flows of the above table, as well as in the following chart, can be classified in two periods: investment cash flows during the construction period and operating cash flows (EBITDA) during the operation period. The resulting Project Cash Flows are negative during the construction period, because the annual investment costs are higher than annual capital grants, while positive during the operation period:

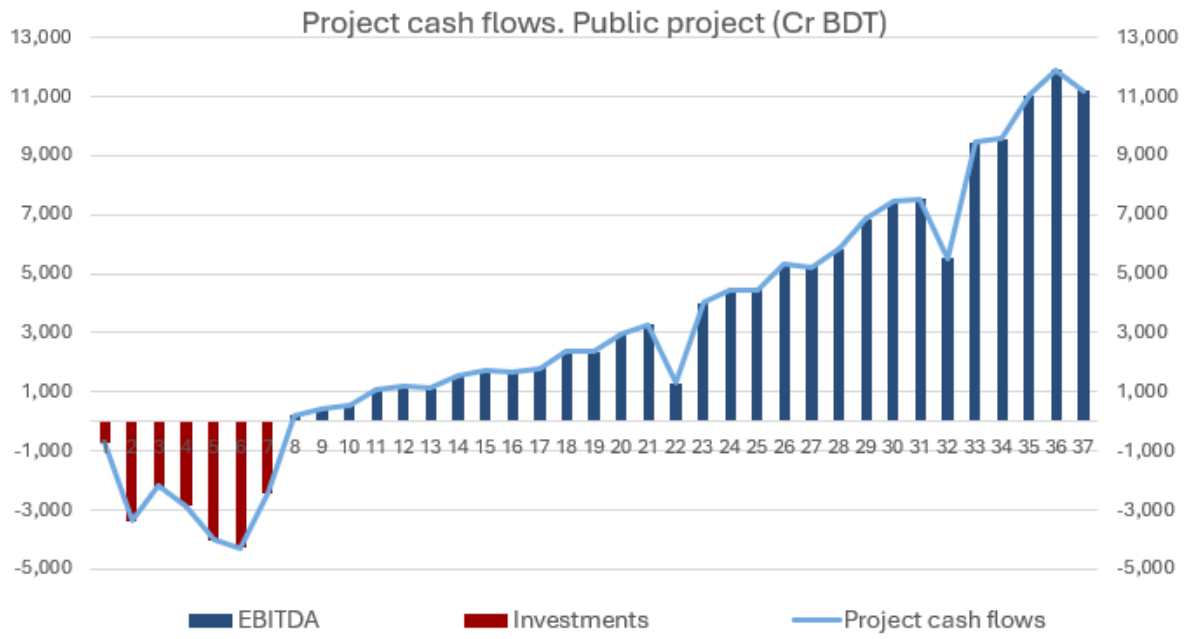

Figure 23. Projected cash flows. PPP Contract

As above mentioned, first years represent the investment period, with cash outflows and negative project cash flows; these cash outflows represent the amount of investments. Since year 8, EBITDA becomes positive for the whole operating period, with operating revenues higher than operating expenses, generating positive project cash flows (right-hand vertical axel of the above figure) with a sharp reduction in years 15 and 25 of operation (years 22 and 32, respectively), when certain extraordinary maintenance costs are considered, reducing project cash flows although remaining positive.

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(d) Key Assumptions considered.

Table 34. General assumptions. Macroeconomic assumptions

General assumptions	
Inflation rate	5.00%
Financial Discount Rate (Project). WACC	12.0% [7]
Exchange rate USD / BDT	107

Following Government regulation[8], financial discount rate ("FDR") is fixed at 12.00 %. It will be used as a financial discount rate to estimate the financial indicators in the financial analysis of all contract structures. Considering that the average FDR being used in this analysis is 12.00 %, a reasonable estimation of the cost of equity for investors could be around 16.00%.

Table 35. General assumptions. Terms related assumptions.

Terms	Years
Analysis	37
Investment period (including Detail design)	7
Operation	30
Base year for analysis	2025
Starting year of operations	2032

Maintenance expenses have been estimated as an annual % over the respective investment amount, for ordinary maintenance. In the case of extraordinary maintenance, a percentage over the respective investment amount has been calculated every certain period, as detailed in the following table:

Table 36. Maintenance expenses. Assumptions

Maintenance expenses	Over CAPEX
Main bridge	
Ordinary	1.0 %
Extraordinary (years 15, 25, 35, 45)	12.0 %
Approaching viaducts	
Ordinary	1.0 %
Extraordinary (years 10, 20, 30, 40)	4.0 %
Approaching roads	

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[7] Nonetheless, in case of a traditional procurement (Public Project scheme) there are no private funds whereas the institutional funds (multilateral funds) complete funds from the GoB (budgetary contributions).
8 Memo no 20.804.014.00.00.014.027.18-177, dated 04/09/2018.

Maintenance expenses	Over CAPEX
Ordinary	1.0 %
Extraordinary (years 10, 20, 30, 40...)	6.0 %
Bank protection and river training	
Ordinary	2.0 %
Extraordinary (every three years)	6.0 %
Toll plaza	
Ordinary	2.0 %
Extraordinary (years 15, 25, 35, 45...)	8.0 %

From the point of view of the revenues, the assumptions considered are those related to the demand projections as well as the toll rates, as described below:

Table 37. Toll fares structure

Toll rates (BDT)	BDT (with VAT 2023)	BDT (w/o VAT 2023)	BDT (w/o VAT 2025)
Motorcycles	300.00	260.87	273.39
Light vehicles	1,000.00	869.57	911.30
Buses	2,500.00	2,173.91	2,278.26
Trucks	2,500.00	2,173.91	2,278.26

In the alternative of Public Project, GoB will provide funds (grants) to the project company during implementation period. The remaining funding would be provided to the project company by the private investors, as private equity (share capital), and as long-term financing (from multilateral and commercial banks) in the typical 25%/75% structure, respectively, of project financing.

(e) Financial indicators and results:

Above cash flows generate the following financial indicators for the Project,

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(i) Public Project or Traditional procurement

The following table shows the financial indicators for the Traditional procurement structure:

Table 38. Financial outcomes. Traditional procurement

FINANCIAL RESULTS	After Grants
Project F-IRR (unlevered)	8.95%
Project F-NPV (@ 12.0%). Cr BDT (unlevered)	-5,585.3
F-BCR (@ 12.0%) (unlevered)	0.65 x
GoB F-IRR (levered)	13.66%
Net GoB contributions (constant Cr BDT) (levered)	1,242.8
Term of multilateral loan (drawdown + repayment)	37 years

As detailed in the table above, the Project cash flows, in the unlevered scenario, generate a positive Project FIRR of 8.95 %, although not reaching FDR 12.00 %, thus generating a negative FNPV (-5,585.3 Cr BDT). FBCR reaches 0.65x, lower than 1.0x.

In the levered scenario, including GoB contributions and multilateral debt cash flows, total net GoB revenues from the Project, in discounted BDT, are estimated in 1,242.8 Cr BDT, representing a leveraged F-IRR of 13.66 % (higher than FDR of 12.00 %).

(ii) PPP Contract

The following table shows the financial indicators for the PPP Contract structure:

Table 39. Financial outcomes. PPP Contract

FINANCIAL RESULTS	Bf Grants	After Grants
F-IRR. Project	7.50 %	12.00 %
NPV (@ 12.0%). Cr BDT	-6,651.20	0.0
GoB Grants required. Cr BDT		10,607.90
VGF (% over total Project costs)		25.49 %
F-IRR. Investors		16.59 %
NPV (@ Ke%). Cr BDT		1,304.30
Term of multilateral loan (drawdown + repayment)		12 years
DSCR. Minimum		1.30 x
DSCR. Average		1.31 x

As shown in the above table, results before and after grants have different values.

Results before grants are not sustainable. Both FIRR and FNPV for the project after capital grants are positive and they show that the feasibility of the Project is reached with 10,608 Cr BDT of GoB grants, which represent a VGF of 25.49 %.

(iii) Value for Money (VfM)

The VfM involves estimating the net cost to the GOB of implementing and operating the project in two alternative processes:

- Alternative A: the Project is developed as a public project with the resulting CAPEX and OPEX payments by the BBA as well as the corresponding toll revenues to be collected.
- Alternative B: the Project is developed as a PPP contract, with the resulting VGF payments by the BBA. In this case, neither CAPEX nor OPEX are costs for the GoB, but for the PPP project company. Furthermore, the operating revenues from tolls are also revenues from the PPP project company rather than GoB revenues.

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Again, results before and after grants have different values. Results before grants are not sustainable. FNPV for the project after capital grants is positive and shows that the feasibility of the Project is reached with 16,798 Cr BDT of GoB grants.

Results generated by VfM analysis are shown in the following figure and table:

Net cost to BBA under PPP (Cr BDT)	=	P.V. of CAPEX by BBA	+	P.V. of OPEX by BBA	-	P.V. of Revenue to BBA	+	VGF	+	P.V. of risks retained by BBA
78,152	=	0	+	0	-	0	+	74,494	+	3,657

Net cost to BBA for not doing PPP (Cr BDT)	=	P.V. of CAPEX by BBA	+	P.V. of OPEX by BBA	-	P.V. of Revenue to BBA	+	P.V. of risks retained by BBA
75,695	=	137,120	+	19,840	-	96,872	+	15,606

Net benefit of BBA in case of PPP (Cr BDT)	=	Net cost to BBA for not doing PPP (Cr BDT)	-	Net cost to BBA under PPP (Cr BDT)
-246	=	7,570	-	7,815

Figure 24: Value for Money process of calculation.

Results of the above chart are summarised in the following table.

Table 40. Value for Money results

Total costs (NOT including cost of risks)	Cr BDT
[1] 'Net costs to BBA (Traditional procurement)	7,570.00
[2] Net costs to BBA (PPP Contract)	7,815.00
Net benefit of BBA in case of PPP ([3] = [1] - [2])	-246.00
Net benefit of BBA / Total CAPEX (= [3] / CAPEX)	-1.79 %

The above table shows that there is not a potential benefit for the GoB in case the Project is implemented through a PPP contract, estimated a potential loss of -246 Cr BDT (equivalent to 1.79 % of CAPEX) despite most of the risks would be assigned to the private partner. This difference means that, in case the Project is implemented because of VGF maximum limit is not reached, even then it should not represent an advantage for the GoB to implement it as a PPP Contract.

(iv) Factors of potential financial improvement

Even though the Project shows financial results that indicate that it is not financially viable, there are a number of factors that may have a positive influence on such indicators and, therefore, could facilitate financial viability. These factors have been classified into two types: endogenous and exogenous.

- Endogenous factors: One of the most relevant factors is the tax treatment of the Project, which could favour its profitability. Furthermore, other endogenous factors of the Project are potential activities to be operated by the tolled bridge operator itself, such as service areas, parking areas (mainly for truck and buses), etc.

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- Exogenous factors: These factors are mainly related to the economic development of towns and poles in the Project's area of influence, which would favour the movement of people and goods and, therefore, increase the demand for the use of the Bridge.

The conclusions arisen from the financial assessment are the following ones:

- The projected demand is mainly coming from the trucks (41%) and their revenues will be higher (65%) due to the toll rates.
- Operating expenses come mainly from maintenance of the infrastructure, with several years of particularly high extraordinary maintenance costs (years 15 and 25 of operation).
- Operating result (EBITDA) is expected to be positive and growing during the period of analysis, with several years of lower, but positive, EBITDA due to the high extraordinary maintenance costs (years 15 and 25 of operation).
- The Project requires GoB grants to reach the target FDR of 12.00 % in case of PPP Contract, amounting 10,608 Cr BDT, which represents 25.50 % of total project costs.
- Financial indicators, with the Public Project contract structure, show a Project with a positive FIRR of 8.95 % (unlevered), which is lower the FDR (12.00 %), representing a negative F-IRR of -5,585.30 Cr BDT and FBCR reaches 0.65x, lower than 1.0x. However, levered F-IRR is 13.66 %, higher than 12.00 %, which means that the total net GoB revenues from the Project during the period analysed are 1,242.80 Cr BDT.
- The financial analysis with the PPP Contract structure, including the GoB grant, shows positive financial indicators. 12.00 % FIRR of the project (unlevered) and 16.59 % FIRR for investors, being higher than the target opportunity cost for investors IRR of 16.00 %. The high amount of investments of the Project together with high levels of demand, despite the positive EBITDA, require capital grants (VGF) to reduce the net investment cost and to make the Project feasible, as above mentioned, amounting 10,608 Cr BDT, which represents 25.49 % of total project costs.
- Such estimated VGF is lower than the maximum of 40.00 % set up by law for PPP Contract structures and so, the PPP Contract structure could be implemented according to the VGF regulations.
- VfM analysis does not generate a potential benefit for the GoB in case the Project is implemented through a PPP contract, estimated in a potential loss of -246 Cr (equivalent to -1.79 % of CAPEX). This negative benefit does not represent and advantage of implementing and operating the Project under a PPP contract structure.
- There could be several factors that would make the project more attractive to private investors by increasing the economic activity in the zone and, consequently, increasing the demand of the tolled bridge Besides, there are fiscal issues which could increase Project's profitability.

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8. INSTITUTIONAL AND PROCUREMENT ANALYSIS

When addressing the approach considerations for a specific procurement strategy plan, the following aspects of a project need to be carefully examined:

- Expediting the procurement process is a key aspect.
- Cost Uncertainty: Rates and construction cost estimate certainty is a challenging matter given today the current global macro-economic environment of high inflation and raw materials scarcity. In any case during the forecasting stages of the financial model implemented it has been taken into consideration this level of possible prices escalation.
- Time certainty for completion of the project (Client and the Contractor/Concessionaire). Minimum time over-run should be a key fact to be considered within the type of contract being implemented. Schedule constraints and responsibility to be very well determined in the type of contract (delay damages/penalty clauses).
- Design aspects: the Detailed Design to be provided by the BBA to the awarded contractor. The Ability to contractually cope and to technically accommodate design changes in the final set of shop drawings at construction phase shall be considered within the type of contract.
- Responsibility: throughout the project's life, each party's accountability must be very critically stipulated within the contract documents.
- Complexity: Client may involve a specific innovative component to be executed or finally design. The option of awarding the project to a joint venture, led by a top worldwide international contractor together with domestic subcontractors for some sections of the project is a recommended.
- Quality Assurance: Client may involve an independent agency to regulate and monitor Quality Controls during execution and maintenance of work.
- Risk Allocation: Clearly defined areas of risk allocation, a thorough risk assessment to be implemented before tendering the project. Main risks could be considered the following ones: construction risks (cost or time overrun risk, geotechnical risk) and demand risk.

From a financial perspective, the project cannot reach by itself operating or financial sustainability, which leads to a financial issue, requiring therefore an important support from Government contributions or grants.

In the case of PPP mode, the estimated level of required grant is 25.50 %, (VGF < 40.00 %) which could lead to opt or recommend for a toll-based **PPP Concession Agreement**, as a viable option, sharing project's risks although increasing the public funding compared to the other option.

On the other hand, a **Public Government Project Contract** following an open international bidding process for construction (Tier 1 International Contractor tender process) is also a possible recommended scheme to be adopted, including a guarantee period of 1-2 years. In this case, demand risk should be retained by the Government, avoiding that this relevant risk poses a higher cost in the case that it is transferred to a private operator (PPP scheme).

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The classic risk sharing format for such a contract shall be as follows.

Table 41. Risk sharing format

BBA-Government	Contractor
Arrange for funding	Design review and proof checking
Land Acquisition	Construction and timely completion
Open bidding process and contract award for Construction	Guarantee Period of 1-2 years

Two main factors must not be overlooked while preparing the bidding documents.

1. Proof checking of structural design by an independent consultant selected by the BBA/ Government.
2. The successful bidder shall carry out his own Geo Technical investigation to confirm the accuracy of the data furnished in the feasibility studies. Design work to proceed only after such confirmation in writing by the successful bidder.

BBA may provide a supervision consultant to ensure monitoring of the quality, progress, and cost of the project during construction.

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9. CONCLUSION

The essential purpose of any investment is the socio-economic development and growth. In this regard, a feasibility study assesses a plan, a proposal for an intended future condition considering social and economic activities, their locations and linkages, and the development of essential land, structures and other components.

Viewed from the implementation standpoint and as a summarizing outcome derived from this feasibility study, considering all technical, social, and environmental standpoints, it may be concluded that the project, located at Chandpur district, consisting of the 8,040 m long bridge, crossing the Meghna River at the selected alignment B, through the designed 700 m main span cable-stayed (400 m + 700 m + 400 m) combined with composite box girder bridge and a series of other needed associated components would be technically and socially viable.

The proposed solution was selected amongst a manifold of options, covering four different sites or alignments, and after assessing several technical options for the bridge at each site. Additionally, and as a preliminary approach assessment, the tunnel solution was also evaluated. This option was clearly discarded due to the high complexity and increase in cost (four times the proposed solution cost, considering both, the investment stage and also the operation and maintenance stage expenses).

The Consultant recommends this project, with the proposed bridge solution, to be implemented by the BBA, as it would provide sound social and economic progress and benefits to the population living in the directly related areas. It would also promote and enhance potential connectivity corridors, as the East-West link in the southern part of the country.

The regional connectivity improved by the bridge would function as a key linkage between the south-eastern and south-western regions of the country. If the proposed bridge is built, a population of near 6 Cr, living in 29 districts belonging to Dhaka, Khulna, and Chattogram divisions would benefit from this major transportation improvement. However, it must be approached with careful planning, considering various aspects such as environmental impact, infrastructure investment, and social implications. Engaging with local communities and stakeholders during the planning and implementation stages is essential for the success of such a project.

Environmental assessment has been carried out accordingly with the current DOE guidelines and recommendations, being the project under red category, and its risks would be duly mitigated through the implementation of the proper Environmental Impact Assessment (EIA) and Environmental management Plan (EMP) during the construction phase.

Social safeguard aspects have been assessed following the current legislation and guidelines, and the project impact, that would require resettlement of part of the affected areas, would be mitigated to the implementation of the Social Impact Assessment Action Plan. Consultation to the community of the affected area was carried out with a positive response from both local authorities and population.

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The completion of this project construction has been estimated in 66 months. After 7 years of investment phase (2025 to 2031), operation phase would start in 2032 and would end in 2061 (30 years).

The project investment cost, including all the components and the land acquisition and resettlement estimated budget has been estimated as **15,957.21 Cr BDT**.

The traffic studies forecast for the final year of operation (2061), including the associated traffic passing from and to India, is estimated as **45,150 vehicles** (3 wheelers are precluded from the study).

The Economic Cost-Benefit Analysis (CBA) has been assessed running the abovementioned traffic scenario. The results obtained from the economic model, in this case, are as follows: **EIRR 16.01 %, ENPV 5,471.01 Cr BDT, C/B ratio 4.74** and **pay-back year 2047.**

Alternatively, CBA model has been assessed without considering the traffic from and to India. In this case the values obtained are shown in the Annexure of this volume. **EIRR 14.16 %, ENPV 2,670.05 Cr BDT, C/B ratio 1.70** and **pay-back year 2052.**

The **Public Project Financial indicators**, in the case of a **levered** contract structure, show a positive **FIRR of 13.66 %,** which would be higher than the target FDR of 12.00 %. In this scenario, the Net GoB total cash flows are estimated in **1,243 Cr BDT**, as net revenues for the GoB during the life of the Project.

The financial analysis for the project in the **unlevered** scenario, show an **FIRR 8.95%** and a **F-BCR** of **0.65.**

The Project shows financial feasibility under a **PPP structure** as the required grant of 10,608 Cr BDT, would represent 25.5 % of total project costs. This level of required grant (or VGF) does not exceed the limit of 40% set up by law for PPP contract structures.

In terms of GDP impact, the project estimated increase accumulated during the 7 years investment period plus 30 years of operation is evaluated as **0.76 %** over the national **GDP.**

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Annexure 01 – Economic and Financial Model Calculation Sheets

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Economic Analysis

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CBA including traffic from India

CBA

FS OF SHARIATPUR-CHANDPUR BRIDGE (WITH INDIAN TRAFFIC)		2025	2026	2027	2028	2029
		Year 1	Year 2	Year 3	Year 4	Year 5
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**					
Change in Consumer Surplus	**8,024.31**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Existing traffic	**2,781.79**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
User passenger time savings	2,476.00	0.00	0.00	0.00	0.00	0.00
User freight time savings	204.80	0.00	0.00	0.00	0.00	0.00
Vehicle Operating Costs (VOC) savings	100.99	0.00	0.00	0.00	0.00	0.00
Diverted traffic	**1,391.84**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
User passenger time savings	998.53	0.00	0.00	0.00	0.00	0.00
User freight time savings	225.57	0.00	0.00	0.00	0.00	0.00
Vehicle Operating Costs (VOC) savings	167.74	0.00	0.00	0.00	0.00	0.00
Generated traffic	**3,850.68**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
User time costs savings	3,803.69	0.00	0.00	0.00	0.00	0.00
User freight time savings	125.54	0.00	0.00	0.00	0.00	0.00
Additional Vehicle Operating Costs (VOC)	-78.55	0.00	0.00	0.00	0.00	0.00
Variation in Externalities	**-1,090.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Accidents	-741.88	0.00	0.00	0.00	0.00	0.00
Emissions	-300.51	0.00	0.00	0.00	0.00	0.00
Air polution	-172.96	0.00	0.00	0.00	0.00	0.00
Climate change	-127.55	0.00	0.00	0.00	0.00	0.00
Well to tank	-47.71	0.00	0.00	0.00	0.00	0.00
TOTAL ECONOMIC BENEFITS (Cr BDT)	**6,934.20**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-6,807.71**	**-268.22**	**-1,945.54**	**-1,167.33**	**-1,459.16**	**-1,945.54**
Residual value	**91.85**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-560.20**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Change in Producer Surplus:	**5,812.87**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Producers costs savings for the system	4,173.69	0.00	0.00	0.00	0.00	0.00
Existing traffic	910.91	0.00	0.00	0.00	0.00	0.00
Diverted traffic	3,262.79	0.00	0.00	0.00	0.00	0.00
Toll revenues (generated traffic)	1,681.18	0.00	0.00	0.00	0.00	0.00
Vehicle Op costs (generated traffic)	-42.01	0.00	0.00	0.00	0.00	0.00
TOTAL ECONOMIC COSTS (Cr BDT)	**-1,463.20**	**-268.22**	**-1,945.54**	**-1,167.33**	**-1,459.16**	**-1,945.54**
NET BENEFITS (Cr BDT)	**5,471.01**	**-268.22**	**-1,945.54**	**-1,167.33**	**-1,459.16**	**-1,945.54**

IRR (%)	**16.01%**
NPV (Cr BDT)	**5,471.01**
Pay Back	**2,047**
Benefit / Cost	**4.74**

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CBA

FS OF SHARIATPUR-CHANDPUR BRIDGE (WITH INDIAN TRAFFIC)		2030 Year 6	2031 Year 7	2032 Year 8	2033 Year 9	2034 Year 10
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**					
Change in Consumer Surplus	**8,024.31**	**0.00**	**0.00**	**349.00**	**516.45**	**720.20**
Existing traffic	**2,781.79**	**0.00**	**0.00**	**239.09**	**268.40**	**300.83**
User passenger time savings	2,476.00	0.00	0.00	211.16	237.19	266.02
User freight time savings	204.80	0.00	0.00	16.05	18.19	20.57
Vehicle Operating Costs (VOC) savings	100.99	0.00	0.00	11.88	13.02	14.24
Diverted traffic	**1,391.84**	**0.00**	**0.00**	**35.78**	**79.80**	**133.22**
User passenger time savings	998.53	0.00	0.00	25.95	57.86	96.56
User freight time savings	225.57	0.00	0.00	4.58	10.39	17.66
Vehicle Operating Costs (VOC) savings	167.74	0.00	0.00	5.25	11.54	18.99
Generated traffic	**3,850.68**	**0.00**	**0.00**	**74.14**	**168.25**	**286.15**
User time costs savings	3,803.69	0.00	0.00	73.98	167.72	284.98
User freight time savings	125.54	0.00	0.00	2.12	4.89	8.44
Additional Vehicle Operating Costs (VOC)	-78.55	0.00	0.00	-1.96	-4.36	-7.26
Variation in Externalities	**-1,090.10**	**0.00**	**0.00**	**-43.52**	**-92.27**	**-147.97**
Accidents	-741.88	0.00	0.00	-30.75	-64.58	-103.01
Emissions	-300.51	0.00	0.00	-10.97	-23.84	-38.75
Air polution	-172.96	0.00	0.00	-6.14	-13.55	-22.14
Climate change	-127.55	0.00	0.00	-4.83	-10.29	-16.61
Well to tank	-47.71	0.00	0.00	-1.80	-3.84	-6.21
TOTAL ECONOMIC BENEFITS (Cr BDT)	**6,934.20**	**0.00**	**0.00**	**305.49**	**424.19**	**572.24**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-6,807.71**	**-1,945.54**	**-972.77**	**0.00**	**0.00**	**0.00**
Residual value	**91.85**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-560.20**	**0.00**	**0.00**	**-93.27**	**-93.27**	**-160.83**
Change in Producer Surplus:	**5,812.87**	**0.00**	**0.00**	**241.48**	**432.07**	**656.43**
Producers costs savings for the system	4,173.69	0.00	0.00	176.21	291.63	430.14
Existing traffic	910.91	0.00	0.00	90.49	100.65	111.72
Diverted traffic	3,262.79	0.00	0.00	85.72	190.98	318.42
Toll revenues (generated traffic)	1,681.18	0.00	0.00	66.19	142.53	229.83
Vehicle Op costs (generated traffic)	-42.01	0.00	0.00	-0.93	-2.09	-3.54
TOTAL ECONOMIC COSTS (Cr BDT)	**-1,463.20**	**-1,945.54**	**-972.77**	**148.21**	**338.80**	**495.61**
NET BENEFITS (Cr BDT)	**5,471.01**	**-1,945.54**	**-972.77**	**453.69**	**762.99**	**1,067.84**

IRR (%)	**16.01%**
NPV (Cr BDT)	**5,471.01**
Pay Back	**2,047**
Benefit / Cost	**4.74**

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CBA

FS OF SHARIATPUR-CHANDPUR BRIDGE (WITH INDIAN TRAFFIC)		2035	2036	2037	2038	2039
		Year 11	Year 12	Year 13	Year 14	Year 15
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**					
Change in Consumer Surplus	**8,024.31**	**966.14**	**1,083.96**	**1,214.55**	**1,359.09**	**1,518.83**
Existing traffic	**2,781.79**	**336.66**	**376.17**	**419.66**	**467.47**	**519.93**
User passenger time savings	2,476.00	297.89	333.06	371.81	414.42	461.22
User freight time savings	204.80	23.23	26.17	29.43	33.04	37.02
Vehicle Operating Costs (VOC) savings	100.99	15.54	16.94	18.42	20.00	21.68
Diverted traffic	**1,391.84**	**197.27**	**218.66**	**241.91**	**267.13**	**294.47**
User passenger time savings	998.53	142.94	158.36	175.09	193.23	212.84
User freight time savings	225.57	26.63	30.05	33.85	38.05	42.70
Vehicle Operating Costs (VOC) savings	167.74	27.70	30.25	32.96	35.85	38.93
Generated traffic	**3,850.68**	**432.21**	**489.13**	**552.98**	**624.49**	**704.43**
User time costs savings	3,803.69	430.04	486.26	549.28	619.81	698.63
User freight time savings	125.54	12.92	14.80	16.93	19.32	22.01
Additional Vehicle Operating Costs (VOC)	-78.55	-10.75	-11.93	-13.23	-14.65	-16.21
Variation in Externalities	**-1,090.10**	**-211.20**	**-226.36**	**-242.32**	**-259.10**	**-276.70**
Accidents	-741.88	-146.41	-156.44	-166.98	-178.02	-189.57
Emissions	-300.51	-55.87	-60.30	-64.99	-69.95	-75.17
Air polution	-172.96	-32.02	-34.59	-37.31	-40.18	-43.21
Climate change	-127.55	-23.85	-25.71	-27.69	-29.77	-31.96
Well to tank	-47.71	-8.92	-9.61	-10.35	-11.13	-11.95
TOTAL ECONOMIC BENEFITS (Cr BDT)	**6,934.20**	**754.94**	**857.60**	**972.23**	**1,099.99**	**1,242.13**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-6,807.71**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**91.85**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-560.20**	**-93.27**	**-93.27**	**-160.83**	**-93.27**	**-93.27**
Change in Producer Surplus:	**5,812.87**	**918.27**	**1,004.58**	**1,097.27**	**1,196.65**	**1,303.06**
Producers costs savings for the system	4,173.69	594.67	658.08	726.82	801.23	881.63
Existing traffic	910.91	123.76	136.82	150.98	166.29	182.83
Diverted traffic	3,262.79	470.91	521.26	575.84	634.94	698.80
Toll revenues (generated traffic)	1,681.18	328.91	352.47	377.14	402.92	429.81
Vehicle Op costs (generated traffic)	-42.01	-5.31	-5.97	-6.69	-7.49	-8.37
TOTAL ECONOMIC COSTS (Cr BDT)	**-1,463.20**	**825.00**	**911.32**	**936.45**	**1,103.39**	**1,209.79**
NET BENEFITS (Cr BDT)	**5,471.01**	**1,579.94**	**1,768.92**	**1,908.68**	**2,203.37**	**2,451.92**

IRR (%)	**16.01%**
NPV (Cr BDT)	**5,471.01**
Pay Back	**2,047**
Benefit / Cost	**4.74**

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Team leader

CBA

FS OF SHARIATPUR-CHANDPUR BRIDGE (WITH INDIAN TRAFFIC)		2040	2041	2042	2043	2044
		Year 16	Year 17	Year 18	Year 19	Year 20
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**					
Change in Consumer Surplus	**8,024.31**	**1,695.12**	**1,889.41**	**2,103.24**	**2,338.27**	**2,596.24**
Existing traffic	**2,781.79**	**577.40**	**640.26**	**708.93**	**783.81**	**865.35**
User passenger time savings	2,476.00	512.53	568.68	630.06	697.03	769.99
User freight time savings	204.80	41.41	46.23	51.52	57.33	63.68
Vehicle Operating Costs (VOC) savings	100.99	23.47	25.35	27.35	29.45	31.68
Diverted traffic	**1,391.84**	**324.04**	**355.99**	**390.46**	**427.60**	**467.56**
User passenger time savings	998.53	234.03	256.88	281.48	307.95	336.37
User freight time savings	225.57	47.83	53.48	59.69	66.50	73.97
Vehicle Operating Costs (VOC) savings	167.74	42.18	45.64	49.29	53.15	57.22
Generated traffic	**3,850.68**	**793.68**	**893.15**	**1,003.85**	**1,126.86**	**1,263.33**
User time costs savings	3,803.69	786.57	884.53	993.49	1,114.50	1,248.71
User freight time savings	125.54	25.03	28.41	32.19	36.40	41.10
Additional Vehicle Operating Costs (VOC)	-78.55	-17.92	-19.78	-21.82	-24.05	-26.47
Variation in Externalities	**-1,090.10**	**-295.13**	**-314.38**	**-334.47**	**-355.39**	**-377.15**
Accidents	-741.88	-201.64	-214.22	-227.32	-240.93	-255.06
Emissions	-300.51	-80.67	-86.44	-92.48	-98.80	-105.40
Air polution	-172.96	-46.41	-49.76	-53.27	-56.95	-60.79
Climate change	-127.55	-34.26	-36.68	-39.21	-41.85	-44.61
Well to tank	-47.71	-12.82	-13.72	-14.67	-15.66	-16.69
TOTAL ECONOMIC BENEFITS (Cr BDT)	**6,934.20**	**1,399.99**	**1,575.03**	**1,768.77**	**1,982.87**	**2,219.09**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-6,807.71**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**91.85**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-560.20**	**-160.83**	**-186.12**	**-93.27**	**-160.83**	**-93.27**
Change in Producer Surplus:	**5,812.87**	**1,416.84**	**1,538.34**	**1,667.93**	**1,805.98**	**1,952.89**
Producers costs savings for the system	4,173.69	968.38	1,061.84	1,162.39	1,270.43	1,386.36
Existing traffic	910.91	200.66	219.87	240.52	262.69	286.48
Diverted traffic	3,262.79	767.71	841.97	921.87	1,007.73	1,099.88
Toll revenues (generated traffic)	1,681.18	457.80	486.90	517.10	548.39	580.77
Vehicle Op costs (generated traffic)	-42.01	-9.34	-10.40	-11.57	-12.84	-14.24
TOTAL ECONOMIC COSTS (Cr BDT)	**-1,463.20**	**1,256.01**	**1,352.22**	**1,574.66**	**1,645.15**	**1,859.62**
NET BENEFITS (Cr BDT)	**5,471.01**	**2,656.01**	**2,927.25**	**3,343.43**	**3,628.03**	**4,078.71**

IRR (%)	**16.01%**
NPV (Cr BDT)	**5,471.01**
Pay Back	**2,047**
Benefit / Cost	**4.74**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

CBA

FS OF SHARIATPUR-CHANDPUR BRIDGE (WITH INDIAN TRAFFIC)		2045	2046	2047	2048	2049
		Year 21	Year 22	Year 23	Year 24	Year 25
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**					
Change in Consumer Surplus	**8,024.31**	**2,879.04**	**3,188.66**	**3,527.22**	**3,896.99**	**4,300.35**
Existing traffic	**2,781.79**	**954.02**	**1,050.30**	**1,154.70**	**1,267.75**	**1,390.01**
User passenger time savings	2,476.00	849.38	935.63	1,029.20	1,130.57	1,240.26
User freight time savings	204.80	70.62	78.19	86.43	95.39	105.11
Vehicle Operating Costs (VOC) savings	100.99	34.02	36.48	39.07	41.79	44.64
Diverted traffic	**1,391.84**	**510.50**	**556.60**	**606.03**	**658.96**	**715.60**
User passenger time savings	998.53	366.86	399.53	434.50	471.88	511.79
User freight time savings	225.57	82.13	91.05	100.76	111.34	122.84
Vehicle Operating Costs (VOC) savings	167.74	61.51	66.02	70.76	75.74	80.97
Generated traffic	**3,850.68**	**1,414.52**	**1,581.76**	**1,766.50**	**1,970.28**	**2,194.74**
User time costs savings	3,803.69	1,397.31	1,561.63	1,743.06	1,943.10	2,163.37
User freight time savings	125.54	46.32	52.12	58.54	65.65	73.51
Additional Vehicle Operating Costs (VOC)	-78.55	-29.11	-31.98	-35.10	-38.48	-42.14
Variation in Externalities	**-1,090.10**	**-399.74**	**-423.16**	**-447.40**	**-472.46**	**-498.34**
Accidents	-741.88	-269.69	-284.83	-300.47	-316.61	-333.25
Emissions	-300.51	-112.28	-119.44	-126.88	-134.60	-142.59
Air polution	-172.96	-64.80	-68.97	-73.31	-77.81	-82.47
Climate change	-127.55	-47.48	-50.47	-53.57	-56.79	-60.12
Well to tank	-47.71	-17.77	-18.88	-20.05	-21.25	-22.50
TOTAL ECONOMIC BENEFITS (Cr BDT)	**6,934.20**	**2,479.30**	**2,765.50**	**3,079.82**	**3,424.52**	**3,802.01**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-6,807.71**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**91.85**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-560.20**	**-93.27**	**-787.76**	**-93.27**	**-93.27**	**-160.83**
Change in Producer Surplus:	**5,812.87**	**2,109.06**	**2,274.91**	**2,450.87**	**2,637.38**	**2,834.92**
Producers costs savings for the system	4,173.69	1,510.60	1,643.59	1,785.80	1,937.68	2,099.74
Existing traffic	910.91	311.96	339.22	368.35	399.46	432.63
Diverted traffic	3,262.79	1,198.64	1,304.37	1,417.44	1,538.22	1,667.10
Toll revenues (generated traffic)	1,681.18	614.22	648.73	684.30	720.89	758.51
Vehicle Op costs (generated traffic)	-42.01	-15.76	-17.42	-19.23	-21.19	-23.33
TOTAL ECONOMIC COSTS (Cr BDT)	**-1,463.20**	**2,015.79**	**1,487.15**	**2,357.60**	**2,544.11**	**2,674.09**
NET BENEFITS (Cr BDT)	**5,471.01**	**4,495.09**	**4,252.65**	**5,437.42**	**5,968.64**	**6,476.10**

IRR (%)	**16.01%**
NPV (Cr BDT)	**5,471.01**
Pay Back	**2,047**
Benefit / Cost	**4.74**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

CBA

FS OF SHARIATPUR-CHANDPUR BRIDGE (WITH INDIAN TRAFFIC)		2050	2051	2052	2053	2054
		Year 26	Year 27	Year 28	Year 29	Year 30
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**					
Change in Consumer Surplus	**8,024.31**	**4,705.44**	**5,142.18**	**5,612.49**	**6,118.36**	**6,661.85**
Existing traffic	**2,781.79**	**1,522.06**	**1,664.50**	**1,817.97**	**1,983.13**	**2,160.65**
User passenger time savings	2,476.00	1,358.77	1,486.68	1,624.54	1,772.95	1,932.54
User freight time savings	204.80	115.66	127.08	139.42	152.74	167.11
Vehicle Operating Costs (VOC) savings	100.99	47.62	50.75	54.02	57.43	61.00
Diverted traffic	**1,391.84**	**776.13**	**840.77**	**909.72**	**983.20**	**1,061.45**
User passenger time savings	998.53	554.38	599.76	648.09	699.51	754.17
User freight time savings	225.57	135.31	148.83	163.46	179.26	196.31
Vehicle Operating Costs (VOC) savings	167.74	86.44	92.18	98.17	104.43	110.97
Generated traffic	**3,850.68**	**2,407.24**	**2,636.91**	**2,884.80**	**3,152.03**	**3,439.75**
User time costs savings	3,803.69	2,371.87	2,597.13	2,840.20	3,102.15	3,384.13
User freight time savings	125.54	80.89	88.87	97.50	106.82	116.87
Additional Vehicle Operating Costs (VOC)	-78.55	-45.51	-49.09	-52.90	-56.94	-61.24
Variation in Externalities	**-1,090.10**	**-515.43**	**-532.52**	**-549.60**	**-566.64**	**-583.62**
Accidents	-741.88	-344.59	-355.94	-367.28	-378.59	-389.87
Emissions	-300.51	-147.56	-152.52	-157.47	-162.42	-167.35
Air polution	-172.96	-85.34	-88.22	-91.09	-93.95	-96.80
Climate change	-127.55	-62.21	-64.30	-66.39	-68.47	-70.55
Well to tank	-47.71	-23.28	-24.06	-24.85	-25.63	-26.40
TOTAL ECONOMIC BENEFITS (Cr BDT)	**6,934.20**	**4,190.01**	**4,609.66**	**5,062.89**	**5,551.72**	**6,078.23**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-6,807.71**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**91.85**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-560.20**	**-93.27**	**-186.12**	**-160.83**	**-93.27**	**-93.27**
Change in Producer Surplus:	**5,812.87**	**3,032.52**	**3,241.21**	**3,461.50**	**3,693.94**	**3,939.06**
Producers costs savings for the system	4,173.69	2,272.48	2,456.43	2,652.14	2,860.19	3,081.17
Existing traffic	910.91	467.98	505.60	545.62	588.14	633.28
Diverted traffic	3,262.79	1,804.50	1,950.82	2,106.53	2,272.06	2,447.90
Toll revenues (generated traffic)	1,681.18	785.30	812.09	838.86	865.57	892.19
Vehicle Op costs (generated traffic)	-42.01	-25.26	-27.31	-29.50	-31.83	-34.30
TOTAL ECONOMIC COSTS (Cr BDT)	**-1,463.20**	**2,939.25**	**3,055.09**	**3,300.68**	**3,600.67**	**3,845.80**
NET BENEFITS (Cr BDT)	**5,471.01**	**7,129.25**	**7,664.75**	**8,363.57**	**9,152.39**	**9,924.03**

IRR (%)	**16.01%**
NPV (Cr BDT)	**5,471.01**
Pay Back	**2,047**
Benefit / Cost	**4.74**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

CBA

FS OF SHARIATPUR-CHANDPUR BRIDGE (WITH INDIAN TRAFFIC)		2055 Year 31	2056 Year 32	2057 Year 33	2058 Year 34	2059 Year 35
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**					
Change in Consumer Surplus	**8,024.31**	**7,245.13**	**7,870.44**	**8,540.13**	**9,256.61**	**10,022.43**
Existing traffic	**2,781.79**	**2,351.25**	**2,555.68**	**2,774.70**	**3,009.12**	**3,259.77**
User passenger time savings	2,476.00	2,103.95	2,287.86	2,484.96	2,695.99	2,921.71
User freight time savings	204.80	182.58	199.23	217.10	236.29	256.85
Vehicle Operating Costs (VOC) savings	100.99	64.72	68.60	72.63	76.84	81.21
Diverted traffic	**1,391.84**	**1,144.71**	**1,233.22**	**1,327.24**	**1,427.04**	**1,532.91**
User passenger time savings	998.53	812.22	873.84	939.18	1,008.44	1,081.79
User freight time savings	225.57	214.69	234.47	255.74	278.57	303.06
Vehicle Operating Costs (VOC) savings	167.74	117.79	124.91	132.32	140.03	148.05
Generated traffic	**3,850.68**	**3,749.17**	**4,081.55**	**4,438.19**	**4,820.45**	**5,229.75**
User time costs savings	3,803.69	3,687.29	4,012.88	4,362.14	4,736.42	5,137.09
User freight time savings	125.54	127.69	139.33	151.83	165.24	179.63
Additional Vehicle Operating Costs (VOC)	-78.55	-65.81	-70.65	-75.78	-81.21	-86.97
Variation in Externalities	**-1,090.10**	**-600.52**	**-617.34**	**-634.04**	**-650.62**	**-667.06**
Accidents	-741.88	-401.09	-412.25	-423.34	-434.35	-445.26
Emissions	-300.51	-172.26	-177.14	-181.98	-186.80	-191.57
Air polution	-172.96	-99.64	-102.47	-105.27	-108.06	-110.82
Climate change	-127.55	-72.61	-74.67	-76.71	-78.74	-80.75
Well to tank	-47.71	-27.18	-27.95	-28.71	-29.47	-30.22
TOTAL ECONOMIC BENEFITS (Cr BDT)	**6,934.20**	**6,644.61**	**7,253.11**	**7,906.09**	**8,605.99**	**9,355.37**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-6,807.71**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**91.85**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-560.20**	**-160.83**	**-720.20**	**-93.27**	**-160.83**	**-93.27**
Change in Producer Surplus:	**5,812.87**	**4,197.47**	**4,469.76**	**4,756.57**	**5,058.57**	**5,376.45**
Producers costs savings for the system	4,173.69	3,315.70	3,564.43	3,828.01	4,107.15	4,402.58
Existing traffic	910.91	681.17	731.94	785.73	842.66	902.90
Diverted traffic	3,262.79	2,634.53	2,832.48	3,042.28	3,264.49	3,499.67
Toll revenues (generated traffic)	1,681.18	918.69	945.05	971.23	997.22	1,022.98
Vehicle Op costs (generated traffic)	-42.01	-36.92	-39.71	-42.67	-45.80	-49.11
TOTAL ECONOMIC COSTS (Cr BDT)	**-1,463.20**	**4,036.64**	**3,749.56**	**4,663.30**	**4,897.75**	**5,283.18**
NET BENEFITS (Cr BDT)	**5,471.01**	**10,681.25**	**11,002.67**	**12,569.39**	**13,503.74**	**14,638.55**

IRR (%)	**16.01%**
NPV (Cr BDT)	**5,471.01**
Pay Back	**2,047**
Benefit / Cost	**4.74**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

CBA

FS OF SHARIATPUR-CHANDPUR BRIDGE (WITH INDIAN TRAFFIC)		2060 Year 36	2061 Year 37
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**		
Change in Consumer Surplus	**8,024.31**	**10,853.71**	**11,756.24**
Existing traffic	**2,781.79**	**3,531.99**	**3,827.69**
User passenger time savings	2,476.00	3,166.91	3,433.32
User freight time savings	204.80	279.25	303.66
Vehicle Operating Costs (VOC) savings	100.99	85.83	90.72
Diverted traffic	**1,391.84**	**1,646.78**	**1,769.27**
User passenger time savings	998.53	1,160.48	1,244.88
User freight time savings	225.57	329.77	358.88
Vehicle Operating Costs (VOC) savings	167.74	156.53	165.50
Generated traffic	**3,850.68**	**5,674.94**	**6,159.28**
User time costs savings	3,803.69	5,572.78	6,046.65
User freight time savings	125.54	195.29	212.36
Additional Vehicle Operating Costs (VOC)	-78.55	-93.13	-99.73
Variation in Externalities	**-1,090.10**	**-683.93**	**-701.25**
Accidents	-741.88	-456.47	-467.96
Emissions	-300.51	-196.47	-201.49
Air polution	-172.96	-113.66	-116.57
Climate change	-127.55	-82.81	-84.93
Well to tank	-47.71	-31.00	-31.79
TOTAL ECONOMIC BENEFITS (Cr BDT)	**6,934.20**	**10,169.78**	**11,054.99**
SOCIO ECONOMIC COSTS (Cr BDT)			
Project initial investments	**-6,807.71**	**0.00**	**0.00**
Residual value	**91.85**	**0.00**	**5,431.56**
Renovation works	**-560.20**	**-93.27**	**-227.77**
Change in Producer Surplus:	**5,812.87**	**5,716.06**	**6,078.97**
Producers costs savings for the system	4,173.69	4,719.30	5,058.87
Existing traffic	910.91	967.47	1,036.66
Diverted traffic	3,262.79	3,751.84	4,022.21
Toll revenues (generated traffic)	1,681.18	1,049.43	1,076.58
Vehicle Op costs (generated traffic)	-42.01	-52.67	-56.48
TOTAL ECONOMIC COSTS (Cr BDT)	**-1,463.20**	**5,622.80**	**11,282.75**
NET BENEFITS (Cr BDT)	**5,471.01**	**15,792.58**	**22,337.75**

IRR (%)	**16.01%**
NPV (Cr BDT)	**5,471.01**
Pay Back	**2,047**
Benefit / Cost	**4.74**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

CBA excluding traffic from India

CBA

FS OF SHARIATPUR-CHANDPUR BRIDGE (WITHOUT INDIAN TRAFFIC)		2025	2026	2027	2028	2029
		Year 1	Year 2	Year 3	Year 4	Year 5
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**					
Change in Consumer Surplus	**7,825.34**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Existing traffic	**2,781.79**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
User passenger time savings	2,476.00	0.00	0.00	0.00	0.00	0.00
User freight time savings	204.80	0.00	0.00	0.00	0.00	0.00
Vehicle Operating Costs (VOC) savings	100.99	0.00	0.00	0.00	0.00	0.00
Diverted traffic	**1,192.87**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
User passenger time savings	998.53	0.00	0.00	0.00	0.00	0.00
User freight time savings	26.60	0.00	0.00	0.00	0.00	0.00
Vehicle Operating Costs (VOC) savings	167.74	0.00	0.00	0.00	0.00	0.00
Generated traffic	**3,850.68**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
User time costs savings	3,803.69	0.00	0.00	0.00	0.00	0.00
User freight time savings	125.54	0.00	0.00	0.00	0.00	0.00
Additional Vehicle Operating Costs (VOC)	-78.55	0.00	0.00	0.00	0.00	0.00
Variation in Externalities	**-1,334.99**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Accidents	-852.25	0.00	0.00	0.00	0.00	0.00
Emissions	-416.74	0.00	0.00	0.00	0.00	0.00
Air polution	-241.71	0.00	0.00	0.00	0.00	0.00
Climate change	-175.03	0.00	0.00	0.00	0.00	0.00
Well to tank	-66.00	0.00	0.00	0.00	0.00	0.00
TOTAL ECONOMIC BENEFITS (Cr BDT)	**6,490.35**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-6,760.28**	**-265.35**	**-1,932.29**	**-1,159.37**	**-1,449.21**	**-1,932.29**
Residual value	**91.16**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-556.84**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Change in Producer Surplus:	**3,405.67**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Producers costs savings for the system	1,766.50	0.00	0.00	0.00	0.00	0.00
Existing traffic	910.91	0.00	0.00	0.00	0.00	0.00
Diverted traffic	855.59	0.00	0.00	0.00	0.00	0.00
Toll revenues (generated traffic)	1,681.18	0.00	0.00	0.00	0.00	0.00
Vehicle Op costs (generated traffic)	-42.01	0.00	0.00	0.00	0.00	0.00
TOTAL ECONOMIC COSTS (Cr BDT)	**-3,820.30**	**-265.35**	**-1,932.29**	**-1,159.37**	**-1,449.21**	**-1,932.29**
NET BENEFITS (Cr BDT)	**2,670.05**	**-265.35**	**-1,932.29**	**-1,159.37**	**-1,449.21**	**-1,932.29**

IRR (%)	**14.16%**
NPV (Cr BDT)	**2,670.05**
Pay Back	**2,052**
Benefit / Cost	**1.70**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

CBA

FS OF SHARIATPUR-CHANDPUR BRIDGE (WITHOUT INDIAN TRAFFIC)		2030	2031	2032	2033	2034
		Year 6	Year 7	Year 8	Year 9	Year 10
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**					
Change in Consumer Surplus	**7,825.34**	**0.00**	**0.00**	**344.96**	**507.29**	**704.62**
Existing traffic	**2,781.79**	**0.00**	**0.00**	**239.09**	**268.40**	**300.83**
User passenger time savings	2,476.00	0.00	0.00	211.16	237.19	266.02
User freight time savings	204.80	0.00	0.00	16.05	18.19	20.57
Vehicle Operating Costs (VOC) savings	100.99	0.00	0.00	11.88	13.02	14.24
Diverted traffic	**1,192.87**	**0.00**	**0.00**	**31.74**	**70.63**	**117.63**
User passenger time savings	998.53	0.00	0.00	25.95	57.86	96.56
User freight time savings	26.60	0.00	0.00	0.54	1.23	2.08
Vehicle Operating Costs (VOC) savings	167.74	0.00	0.00	5.25	11.54	18.99
Generated traffic	**3,850.68**	**0.00**	**0.00**	**74.14**	**168.25**	**286.15**
User time costs savings	3,803.69	0.00	0.00	73.98	167.72	284.98
User freight time savings	125.54	0.00	0.00	2.12	4.89	8.44
Additional Vehicle Operating Costs (VOC)	-78.55	0.00	0.00	-1.96	-4.36	-7.26
Variation in Externalities	**-1,334.99**	**0.00**	**0.00**	**-54.30**	**-115.28**	**-184.71**
Accidents	-852.25	0.00	0.00	-35.61	-74.95	-119.57
Emissions	-416.74	0.00	0.00	-16.09	-34.76	-56.19
Air polution	-241.71	0.00	0.00	-9.17	-20.01	-32.45
Climate change	-175.03	0.00	0.00	-6.92	-14.76	-23.73
Well to tank	-66.00	0.00	0.00	-2.61	-5.56	-8.95
TOTAL ECONOMIC BENEFITS (Cr BDT)	**6,490.35**	**0.00**	**0.00**	**290.66**	**392.01**	**519.91**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-6,760.28**	**-1,932.29**	**-966.14**	**0.00**	**0.00**	**0.00**
Residual value	**91.16**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-556.84**	**0.00**	**0.00**	**-92.63**	**-92.63**	**-160.19**
Change in Producer Surplus:	**3,405.67**	**0.00**	**0.00**	**178.92**	**292.58**	**423.64**
Producers costs savings for the system	1,766.50	0.00	0.00	113.65	152.14	197.35
Existing traffic	910.91	0.00	0.00	90.49	100.65	111.72
Diverted traffic	855.59	0.00	0.00	23.17	51.49	85.63
Toll revenues (generated traffic)	1,681.18	0.00	0.00	66.19	142.53	229.83
Vehicle Op costs (generated traffic)	-42.01	0.00	0.00	-0.93	-2.09	-3.54
TOTAL ECONOMIC COSTS (Cr BDT)	**-3,820.30**	**-1,932.29**	**-966.14**	**86.29**	**199.94**	**263.45**
NET BENEFITS (Cr BDT)	**2,670.05**	**-1,932.29**	**-966.14**	**376.95**	**591.95**	**783.37**

IRR (%)	**14.16%**
NPV (Cr BDT)	**2,670.05**
Pay Back	**2,052**
Benefit / Cost	**1.70**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

CBA

FS OF SHARIATPUR-CHANDPUR BRIDGE (WITHOUT INDIAN TRAFFIC)		2035 Year 11	2036 Year 12	2037 Year 13	2038 Year 14	2039 Year 15
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**					
Change in Consumer Surplus	**7,825.34**	**942.65**	**1,057.45**	**1,184.69**	**1,325.52**	**1,481.16**
Existing traffic	**2,781.79**	**336.66**	**376.17**	**419.66**	**467.47**	**519.93**
User passenger time savings	2,476.00	297.89	333.06	371.81	414.42	461.22
User freight time savings	204.80	23.23	26.17	29.43	33.04	37.02
Vehicle Operating Costs (VOC) savings	100.99	15.54	16.94	18.42	20.00	21.68
Diverted traffic	**1,192.87**	**173.78**	**192.15**	**212.05**	**233.57**	**256.80**
User passenger time savings	998.53	142.94	158.36	175.09	193.23	212.84
User freight time savings	26.60	3.14	3.54	3.99	4.49	5.04
Vehicle Operating Costs (VOC) savings	167.74	27.70	30.25	32.96	35.85	38.93
Generated traffic	**3,850.68**	**432.21**	**489.13**	**552.98**	**624.49**	**704.43**
User time costs savings	3,803.69	430.04	486.26	549.28	619.81	698.63
User freight time savings	125.54	12.92	14.80	16.93	19.32	22.01
Additional Vehicle Operating Costs (VOC)	-78.55	-10.75	-11.93	-13.23	-14.65	-16.21
Variation in Externalities	**-1,334.99**	**-263.24**	**-281.53**	**-300.70**	**-320.75**	**-341.68**
Accidents	-852.25	-169.87	-181.31	-193.29	-205.80	-218.86
Emissions	-416.74	-80.57	-86.49	-92.70	-99.21	-106.01
Air polution	-241.71	-46.63	-50.07	-53.69	-57.49	-61.45
Climate change	-175.03	-33.94	-36.41	-39.01	-41.72	-44.56
Well to tank	-66.00	-12.80	-13.74	-14.71	-15.74	-16.81
TOTAL ECONOMIC BENEFITS (Cr BDT)	**6,490.35**	**679.41**	**775.92**	**884.00**	**1,004.78**	**1,139.49**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-6,760.28**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**91.16**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-556.84**	**-92.63**	**-92.63**	**-160.19**	**-92.63**	**-92.63**
Change in Producer Surplus:	**3,405.67**	**573.68**	**622.83**	**675.17**	**730.83**	**789.95**
Producers costs savings for the system	1,766.50	250.09	276.32	304.72	335.40	368.52
Existing traffic	910.91	123.76	136.82	150.98	166.29	182.83
Diverted traffic	855.59	126.33	139.50	153.74	169.11	185.69
Toll revenues (generated traffic)	1,681.18	328.91	352.47	377.14	402.92	429.81
Vehicle Op costs (generated traffic)	-42.01	-5.31	-5.97	-6.69	-7.49	-8.37
TOTAL ECONOMIC COSTS (Cr BDT)	**-3,820.30**	**481.05**	**530.19**	**514.98**	**638.20**	**697.32**
NET BENEFITS (Cr BDT)	**2,670.05**	**1,160.46**	**1,306.11**	**1,398.98**	**1,642.98**	**1,836.81**

IRR (%)	**14.16%**
NPV (Cr BDT)	**2,670.05**
Pay Back	**2,052**
Benefit / Cost	**1.70**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

CBA

FS OF SHARIATPUR-CHANDPUR BRIDGE (WITHOUT INDIAN TRAFFIC)		2040	2041	2042	2043	2044
		Year 16	Year 17	Year 18	Year 19	Year 20
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**					
Change in Consumer Surplus	**7,825.34**	**1,652.93**	**1,842.24**	**2,050.59**	**2,279.61**	**2,531.00**
Existing traffic	**2,781.79**	**577.40**	**640.26**	**708.93**	**783.81**	**865.35**
User passenger time savings	2,476.00	512.53	568.68	630.06	697.03	769.99
User freight time savings	204.80	41.41	46.23	51.52	57.33	63.68
Vehicle Operating Costs (VOC) savings	100.99	23.47	25.35	27.35	29.45	31.68
Diverted traffic	**1,192.87**	**281.85**	**308.82**	**337.81**	**368.94**	**402.31**
User passenger time savings	998.53	234.03	256.88	281.48	307.95	336.37
User freight time savings	26.60	5.64	6.31	7.04	7.84	8.72
Vehicle Operating Costs (VOC) savings	167.74	42.18	45.64	49.29	53.15	57.22
Generated traffic	**3,850.68**	**793.68**	**893.15**	**1,003.85**	**1,126.86**	**1,263.33**
User time costs savings	3,803.69	786.57	884.53	993.49	1,114.50	1,248.71
User freight time savings	125.54	25.03	28.41	32.19	36.40	41.10
Additional Vehicle Operating Costs (VOC)	-78.55	-17.92	-19.78	-21.82	-24.05	-26.47
Variation in Externalities	**-1,334.99**	**-363.49**	**-386.19**	**-409.76**	**-434.21**	**-459.54**
Accidents	-852.25	-232.45	-246.59	-261.25	-276.46	-292.19
Emissions	-416.74	-113.12	-120.52	-128.22	-136.21	-144.50
Air polution	-241.71	-65.60	-69.92	-74.41	-79.08	-83.92
Climate change	-175.03	-47.52	-50.60	-53.81	-57.14	-60.58
Well to tank	-66.00	-17.92	-19.08	-20.29	-21.55	-22.84
TOTAL ECONOMIC BENEFITS (Cr BDT)	**6,490.35**	**1,289.44**	**1,456.05**	**1,640.83**	**1,845.39**	**2,071.46**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-6,760.28**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**91.16**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-556.84**	**-160.19**	**-181.98**	**-92.63**	**-160.19**	**-92.63**
Change in Producer Surplus:	**3,405.67**	**852.65**	**919.07**	**989.33**	**1,063.59**	**1,141.98**
Producers costs savings for the system	1,766.50	404.19	442.57	483.80	528.04	575.44
Existing traffic	910.91	200.66	219.87	240.52	262.69	286.48
Diverted traffic	855.59	203.53	222.70	243.28	265.35	288.96
Toll revenues (generated traffic)	1,681.18	457.80	486.90	517.10	548.39	580.77
Vehicle Op costs (generated traffic)	-42.01	-9.34	-10.40	-11.57	-12.84	-14.24
TOTAL ECONOMIC COSTS (Cr BDT)	**-3,820.30**	**692.46**	**737.08**	**896.70**	**903.40**	**1,049.34**
NET BENEFITS (Cr BDT)	**2,670.05**	**1,981.91**	**2,193.14**	**2,537.53**	**2,748.79**	**3,120.80**

IRR (%)	**14.16%**
NPV (Cr BDT)	**2,670.05**
Pay Back	**2,052**
Benefit / Cost	**1.70**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

CBA

FS OF SHARIATPUR-CHANDPUR BRIDGE (WITHOUT INDIAN TRAFFIC)		2045	2046	2047	2048	2049
		Year 21	Year 22	Year 23	Year 24	Year 25
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**					
Change in Consumer Surplus	**7,825.34**	**2,806.59**	**3,108.35**	**3,438.34**	**3,798.78**	**4,191.99**
Existing traffic	**2,781.79**	**954.02**	**1,050.30**	**1,154.70**	**1,267.75**	**1,390.01**
User passenger time savings	2,476.00	849.38	935.63	1,029.20	1,130.57	1,240.26
User freight time savings	204.80	70.62	78.19	86.43	95.39	105.11
Vehicle Operating Costs (VOC) savings	100.99	34.02	36.48	39.07	41.79	44.64
Diverted traffic	**1,192.87**	**438.06**	**476.29**	**517.15**	**560.75**	**607.25**
User passenger time savings	998.53	366.86	399.53	434.50	471.88	511.79
User freight time savings	26.60	9.69	10.74	11.88	13.13	14.49
Vehicle Operating Costs (VOC) savings	167.74	61.51	66.02	70.76	75.74	80.97
Generated traffic	**3,850.68**	**1,414.52**	**1,581.76**	**1,766.50**	**1,970.28**	**2,194.74**
User time costs savings	3,803.69	1,397.31	1,561.63	1,743.06	1,943.10	2,163.37
User freight time savings	125.54	46.32	52.12	58.54	65.65	73.51
Additional Vehicle Operating Costs (VOC)	-78.55	-29.11	-31.98	-35.10	-38.48	-42.14
Variation in Externalities	**-1,334.99**	**-485.72**	**-512.76**	**-540.64**	**-569.36**	**-598.91**
Accidents	-852.25	-308.44	-325.21	-342.50	-360.28	-378.57
Emissions	-416.74	-153.09	-161.97	-171.14	-180.59	-190.33
Air polution	-241.71	-88.94	-94.12	-99.48	-105.01	-110.70
Climate change	-175.03	-64.16	-67.85	-71.65	-75.58	-79.62
Well to tank	-66.00	-24.19	-25.58	-27.01	-28.49	-30.01
TOTAL ECONOMIC BENEFITS (Cr BDT)	**6,490.35**	**2,320.87**	**2,595.59**	**2,897.70**	**3,229.41**	**3,593.09**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-6,760.28**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**91.16**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-556.84**	**-92.63**	**-787.12**	**-92.63**	**-92.63**	**-160.19**
Change in Producer Surplus:	**3,405.67**	**1,224.64**	**1,311.73**	**1,403.40**	**1,499.80**	**1,601.11**
Producers costs savings for the system	1,766.50	626.18	680.41	738.33	800.10	865.93
Existing traffic	910.91	311.96	339.22	368.35	399.46	432.63
Diverted traffic	855.59	314.22	341.19	369.97	400.64	433.30
Toll revenues (generated traffic)	1,681.18	614.22	648.73	684.30	720.89	758.51
Vehicle Op costs (generated traffic)	-42.01	-15.76	-17.42	-19.23	-21.19	-23.33
TOTAL ECONOMIC COSTS (Cr BDT)	**-3,820.30**	**1,132.01**	**524.61**	**1,310.77**	**1,407.17**	**1,440.93**
NET BENEFITS (Cr BDT)	**2,670.05**	**3,452.88**	**3,120.20**	**4,208.46**	**4,636.58**	**5,034.01**

IRR (%)	**14.16%**
NPV (Cr BDT)	**2,670.05**
Pay Back	**2,052**
Benefit / Cost	**1.70**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

CBA

FS OF SHARIATPUR-CHANDPUR BRIDGE (WITHOUT INDIAN TRAFFIC)		2050 Year 26	2051 Year 27	2052 Year 28	2053 Year 29	2054 Year 30
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**					
Change in Consumer Surplus	**7,825.34**	**4,586.08**	**5,010.90**	**5,468.31**	**5,960.24**	**6,488.69**
Existing traffic	**2,781.79**	**1,522.06**	**1,664.50**	**1,817.97**	**1,983.13**	**2,160.65**
User passenger time savings	2,476.00	1,358.77	1,486.68	1,624.54	1,772.95	1,932.54
User freight time savings	204.80	115.66	127.08	139.42	152.74	167.11
Vehicle Operating Costs (VOC) savings	100.99	47.62	50.75	54.02	57.43	61.00
Diverted traffic	**1,192.87**	**656.78**	**709.49**	**765.54**	**825.08**	**888.29**
User passenger time savings	998.53	554.38	599.76	648.09	699.51	754.17
User freight time savings	26.60	15.96	17.55	19.28	21.14	23.15
Vehicle Operating Costs (VOC) savings	167.74	86.44	92.18	98.17	104.43	110.97
Generated traffic	**3,850.68**	**2,407.24**	**2,636.91**	**2,884.80**	**3,152.03**	**3,439.75**
User time costs savings	3,803.69	2,371.87	2,597.13	2,840.20	3,102.15	3,384.13
User freight time savings	125.54	80.89	88.87	97.50	106.82	116.87
Additional Vehicle Operating Costs (VOC)	-78.55	-45.51	-49.09	-52.90	-56.94	-61.24
Variation in Externalities	**-1,334.99**	**-619.67**	**-640.44**	**-661.18**	**-681.88**	**-702.52**
Accidents	-852.25	-391.57	-404.58	-417.57	-430.53	-443.45
Emissions	-416.74	-197.03	-203.74	-210.43	-217.12	-223.78
Air polution	-241.71	-114.61	-118.51	-122.41	-126.30	-130.18
Climate change	-175.03	-82.42	-85.23	-88.03	-90.82	-93.60
Well to tank	-66.00	-31.07	-32.13	-33.18	-34.24	-35.29
TOTAL ECONOMIC BENEFITS (Cr BDT)	**6,490.35**	**3,966.41**	**4,370.47**	**4,807.13**	**5,278.36**	**5,786.18**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-6,760.28**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**91.16**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-556.84**	**-92.63**	**-181.98**	**-160.19**	**-92.63**	**-92.63**
Change in Producer Surplus:	**3,405.67**	**1,696.05**	**1,795.33**	**1,899.11**	**2,007.59**	**2,120.95**
Producers costs savings for the system	1,766.50	936.01	1,010.55	1,089.75	1,173.85	1,263.06
Existing traffic	910.91	467.98	505.60	545.62	588.14	633.28
Diverted traffic	855.59	468.03	504.94	544.14	585.71	629.78
Toll revenues (generated traffic)	1,681.18	785.30	812.09	838.86	865.57	892.19
Vehicle Op costs (generated traffic)	-42.01	-25.26	-27.31	-29.50	-31.83	-34.30
TOTAL ECONOMIC COSTS (Cr BDT)	**-3,820.30**	**1,603.42**	**1,613.34**	**1,738.92**	**1,914.96**	**2,028.32**
NET BENEFITS (Cr BDT)	**2,670.05**	**5,569.83**	**5,983.81**	**6,546.05**	**7,193.31**	**7,814.50**

IRR (%)	**14.16%**
NPV (Cr BDT)	**2,670.05**
Pay Back	**2,052**
Benefit / Cost	**1.70**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

CBA

FS OF SHARIATPUR-CHANDPUR BRIDGE (WITHOUT INDIAN TRAFFIC)		2055 Year 31	2056 Year 32	2057 Year 33	2058 Year 34	2059 Year 35
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**					
Change in Consumer Surplus	**7,825.34**	**7,055.76**	**7,663.63**	**8,314.55**	**9,010.89**	**9,755.10**
Existing traffic	**2,781.79**	**2,351.25**	**2,555.68**	**2,774.70**	**3,009.12**	**3,259.77**
User passenger time savings	2,476.00	2,103.95	2,287.86	2,484.96	2,695.99	2,921.71
User freight time savings	204.80	182.58	199.23	217.10	236.29	256.85
Vehicle Operating Costs (VOC) savings	100.99	64.72	68.60	72.63	76.84	81.21
Diverted traffic	**1,192.87**	**955.34**	**1,026.40**	**1,101.66**	**1,181.32**	**1,265.59**
User passenger time savings	998.53	812.22	873.84	939.18	1,008.44	1,081.79
User freight time savings	26.60	25.32	27.65	30.16	32.85	35.74
Vehicle Operating Costs (VOC) savings	167.74	117.79	124.91	132.32	140.03	148.05
Generated traffic	**3,850.68**	**3,749.17**	**4,081.55**	**4,438.19**	**4,820.45**	**5,229.75**
User time costs savings	3,803.69	3,687.29	4,012.88	4,362.14	4,736.42	5,137.09
User freight time savings	125.54	127.69	139.33	151.83	165.24	179.63
Additional Vehicle Operating Costs (VOC)	-78.55	-65.81	-70.65	-75.78	-81.21	-86.97
Variation in Externalities	**-1,334.99**	**-723.06**	**-743.48**	**-763.78**	**-783.92**	**-803.89**
Accidents	-852.25	-456.31	-469.10	-481.81	-494.42	-506.93
Emissions	-416.74	-230.41	-237.01	-243.56	-250.06	-256.51
Air polution	-241.71	-134.04	-137.88	-141.69	-145.48	-149.23
Climate change	-175.03	-96.37	-99.13	-101.87	-104.59	-107.28
Well to tank	-66.00	-36.33	-37.37	-38.40	-39.43	-40.45
TOTAL ECONOMIC BENEFITS (Cr BDT)	**6,490.35**	**6,332.70**	**6,920.14**	**7,550.78**	**8,226.98**	**8,951.22**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-6,760.28**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**91.16**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-556.84**	**-160.19**	**-719.56**	**-92.63**	**-160.19**	**-92.63**
Change in Producer Surplus:	**3,405.67**	**2,239.40**	**2,363.16**	**2,492.43**	**2,627.47**	**2,768.52**
Producers costs savings for the system	1,766.50	1,357.64	1,457.82	1,563.87	1,676.05	1,794.65
Existing traffic	910.91	681.17	731.94	785.73	842.66	902.90
Diverted traffic	855.59	676.47	725.88	778.14	833.39	891.74
Toll revenues (generated traffic)	1,681.18	918.69	945.05	971.23	997.22	1,022.98
Vehicle Op costs (generated traffic)	-42.01	-36.92	-39.71	-42.67	-45.80	-49.11
TOTAL ECONOMIC COSTS (Cr BDT)	**-3,820.30**	**2,079.22**	**1,643.59**	**2,399.80**	**2,467.28**	**2,675.88**
NET BENEFITS (Cr BDT)	**2,670.05**	**8,411.92**	**8,563.74**	**9,950.58**	**10,694.26**	**11,627.10**

IRR (%)	**14.16%**
NPV (Cr BDT)	**2,670.05**
Pay Back	**2,052**
Benefit / Cost	**1.70**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

CBA

FS OF SHARIATPUR-CHANDPUR BRIDGE (WITHOUT INDIAN TRAFFIC)		2060 Year 36	2061 Year 37
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**		
Change in Consumer Surplus	**7,825.34**	**10,562.84**	**11,439.69**
Existing traffic	**2,781.79**	**3,531.99**	**3,827.69**
User passenger time savings	2,476.00	3,166.91	3,433.32
User freight time savings	204.80	279.25	303.66
Vehicle Operating Costs (VOC) savings	100.99	85.83	90.72
Diverted traffic	**1,192.87**	**1,355.90**	**1,452.71**
User passenger time savings	998.53	1,160.48	1,244.88
User freight time savings	26.60	38.89	42.33
Vehicle Operating Costs (VOC) savings	167.74	156.53	165.50
Generated traffic	**3,850.68**	**5,674.94**	**6,159.28**
User time costs savings	3,803.69	5,572.78	6,046.65
User freight time savings	125.54	195.29	212.36
Additional Vehicle Operating Costs (VOC)	-78.55	-93.13	-99.73
Variation in Externalities	**-1,334.99**	**-824.39**	**-845.43**
Accidents	-852.25	-519.77	-532.94
Emissions	-416.74	-263.13	-269.92
Air polution	-241.71	-153.08	-157.04
Climate change	-175.03	-110.05	-112.88
Well to tank	-66.00	-41.49	-42.56
TOTAL ECONOMIC BENEFITS (Cr BDT)	**6,490.35**	**9,738.45**	**10,594.26**
SOCIO ECONOMIC COSTS (Cr BDT)			
Project initial investments	**-6,760.28**	**0.00**	**0.00**
Residual value	**91.16**	**0.00**	**5,390.94**
Renovation works	**-556.84**	**-92.63**	**-227.13**
Change in Producer Surplus:	**3,405.67**	**2,918.44**	**3,077.86**
Producers costs savings for the system	1,766.50	1,921.68	2,057.76
Existing traffic	910.91	967.47	1,036.66
Diverted traffic	855.59	954.22	1,021.10
Toll revenues (generated traffic)	1,681.18	1,049.43	1,076.58
Vehicle Op costs (generated traffic)	-42.01	-52.67	-56.48
TOTAL ECONOMIC COSTS (Cr BDT)	**-3,820.30**	**2,825.81**	**8,241.66**
NET BENEFITS (Cr BDT)	**2,670.05**	**12,564.27**	**18,835.92**

IRR (%)	**14.16%**
NPV (Cr BDT)	**2,670.05**
Pay Back	**2,052**
Benefit / Cost	**1.70**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

Financial Analysis - Public Project Scheme - Cash Flow

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SHARIATPUR-CHANDPUR BRIDGE

			2025 Year 1	2026 Year 2	2027 Year 3	2028 Year 4	2029 Year 5
Construction period	7 years		1	1	1	1	1
Operation period	30 years		0	0	0	0	0
Term of analysis	37 years		1	1	1	1	1
Price indexation	5.00%		1.00	1.05	1.10	1.16	1.22
CASH FLOWS (Cr BDT)			2025 Year 1	2026 Year 2	2027 Year 3	2028 Year 4	2029 Year 5
Operating revenues			**0**	**0**	**0**	**0**	**0**
Toll revenues			0	0	0	0	0
Other commercial revenues			0	0	0	0	0
Operation & Maintenance expenses			**0**	**0**	**0**	**0**	**0**
Maintenance & Overhaul			0	0	0	0	0
Operation			0	0	0	0	0
Net Cash Flows due to Operations		**8,118.2**	**0**	**0**	**0**	**0**	**0**
Cash Flows due to Investments			**-696**	**-3,358**	**-2,177**	**-2,874**	**-4,033**
Initial CAPEX		19,873	-696	-3,358	-2,177	-2,874	-4,033
Other CAPEX		0	0	0	0	0	0
Residual Value of Investments		-505	0	0	0	0	0
Project cash flows	**8.9%**	**-5,585.3**	**-696**	**-3,358**	**-2,177**	**-2,874**	**-4,033**
CASH FLOWS (Cr BDT)			2025 Year 1	2026 Year 2	2027 Year 3	2028 Year 4	2029 Year 5
Outflows			**-696**	**-3,358**	**-2,177**	**-2,874**	**-4,033**
Project Development (Initial CAPEX)		-11,394	-470	-3,293	-2,075	-2,723	-3,812
Financing Fees			-226	-65	-102	-151	-221
Operating expenses			0	0	0	0	0
Loan Repayments							
Interest		-1,526	0	0	0	0	0
Principal Repayments		-1,486	0	0	0	0	0
Inflows			**553**	**2,401**	**1,602**	**2,156**	**3,076**
Borrowings		9,241	553	2,401	1,602	2,156	3,076
Operating revenues		9,072	0	0	0	0	0
Future Developments		0	0	0	0	0	0
Government cash flows	**13.7%**	**1,235.1**	**-144**	**-957**	**-574**	**-718**	**-957**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

SHARIATPUR-CHANDPUR BRIDGE

	2030 Year 6	2031 Year 7	2032 Year 8	2033 Year 9	2034 Year 10	2035 Year 11	2036 Year 12
Construction period	1	1	0	0	0	0	0
Operation period	0	0	1	1	1	1	1
Term of analysis	1	1	1	1	1	1	1
Price indexation	1.28	1.34	1.41	1.48	1.55	1.63	1.71

CASH FLOWS (Cr BDT)	2030 Year 6	2031 Year 7	2032 Year 8	2033 Year 9	2034 Year 10	2035 Year 11	2036 Year 12
Operating revenues	**0**	**0**	**425**	**663**	**954**	**1,303**	**1,457**
Toll revenues	0	0	425	663	954	1,303	1,457
Other commercial revenues	0	0	0	0	0	0	0
Operation & Maintenance expenses	**0**	**0**	**-212**	**-222**	**-432**	**-245**	**-257**
Maintenance & Overhaul	0	0	-201	-211	-420	-232	-244
Operation	0	0	-11	-12	-12	-13	-13
Net Cash Flows due to Operations	**0**	**0**	**213**	**441**	**522**	**1,058**	**1,199**
Cash Flows due to Investments	**-4,298**	**-2,437**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	-4,298	-2,437	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0	0
Residual Value of Investments	0	0	0	0	0	0	0
Project cash flows	**-4,298**	**-2,437**	**213**	**441**	**522**	**1,058**	**1,199**

CASH FLOWS (Cr BDT)	2030 Year 6	2031 Year 7	2032 Year 8	2033 Year 9	2034 Year 10	2035 Year 11	2036 Year 12
Outflows	**-4,298**	**-2,437**	**-1,140**	**-1,137**	**-1,332**	**-1,131**	**-1,129**
Project Development (Initial CAPEX)	-4,003	-2,101	0	0	0	0	0
Financing Fees	-296	-335	0	0	0	0	0
Operating expenses	0	0	-212	-222	-432	-245	-257
Loan Repayments							
Interest	0	0	-521	-507	-492	-478	-464
Principal Repayments	0	0	-408	-408	-408	-408	-408
Inflows	**3,341**	**1,958**	**425**	**663**	**954**	**1,303**	**1,457**
Borrowings	3,341	1,958	0	0	0	0	0
Operating revenues	0	0	425	663	954	1,303	1,457
Future Developments	0	0	0	0	0	0	0
Government cash flows	**-957**	**-479**	**-716**	**-473**	**-378**	**172**	**328**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

SHARIATPUR-CHANDPUR BRIDGE

	2037 Year 13	2038 Year 14	2039 Year 15	2040 Year 16	2041 Year 17	2042 Year 18	2043 Year 19
Construction period	0	0	0	0	0	0	0
Operation period	1	1	1	1	1	1	1
Term of analysis	1	1	1	1	1	1	1
Price indexation	1.80	1.89	1.98	2.08	2.18	2.29	2.41

CASH FLOWS (Cr BDT)	2037 Year 13	2038 Year 14	2039 Year 15	2040 Year 16	2041 Year 17	2042 Year 18	2043 Year 19
Operating revenues	**1,625**	**1,810**	**2,013**	**2,235**	**2,477**	**2,742**	**3,030**
Toll revenues	1,625	1,810	2,013	2,235	2,477	2,742	3,030
Other commercial revenues	0	0	0	0	0	0	0
Operation & Maintenance expenses	**-500**	**-284**	**-298**	**-579**	**-679**	**-345**	**-670**
Maintenance & Overhaul	-486	-269	-282	-563	-662	-327	-651
Operation	-14	-15	-16	-16	-17	-18	-19
Net Cash Flows due to Operations	**1,125**	**1,526**	**1,715**	**1,656**	**1,798**	**2,397**	**2,360**
Cash Flows due to Investments	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0	0
Residual Value of Investments	0	0	0	0	0	0	0
Project cash flows	**1,125**	**1,526**	**1,715**	**1,656**	**1,798**	**2,397**	**2,360**

CASH FLOWS (Cr BDT)	2037 Year 13	2038 Year 14	2039 Year 15	2040 Year 16	2041 Year 17	2042 Year 18	2043 Year 19
Outflows	**-1,357**	**-1,127**	**-1,127**	**-1,393**	**-1,479**	**-1,131**	**-1,442**
Project Development (Initial CAPEX)	0	0	0	0	0	0	0
Financing Fees	0	0	0	0	0	0	0
Operating expenses	-500	-284	-298	-579	-679	-345	-670
Loan Repayments							
Interest	-450	-435	-421	-407	-392	-378	-364
Principal Repayments	-408	-408	-408	-408	-408	-408	-408
Inflows	**1,625**	**1,810**	**2,013**	**2,235**	**2,477**	**2,742**	**3,030**
Borrowings	0	0	0	0	0	0	0
Operating revenues	1,625	1,810	2,013	2,235	2,477	2,742	3,030
Future Developments	0	0	0	0	0	0	0
Government cash flows	**268**	**683**	**886**	**841**	**998**	**1,611**	**1,588**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

SHARIATPUR-CHANDPUR BRIDGE

	2044 Year 20	2045 Year 21	2046 Year 22	2047 Year 23	2048 Year 24	2049 Year 25	2050 Year 26
Construction period	0	0	0	0	0	0	0
Operation period	1	1	1	1	1	1	1
Term of analysis	1	1	1	1	1	1	1
Price indexation	2.53	2.65	2.79	2.93	3.07	3.23	3.39

CASH FLOWS (Cr BDT)	2044 Year 20	2045 Year 21	2046 Year 22	2047 Year 23	2048 Year 24	2049 Year 25	2050 Year 26
Operating revenues	**3,343**	**3,684**	**4,055**	**4,456**	**4,892**	**5,363**	**5,833**
Toll revenues	3,343	3,684	4,055	4,456	4,892	5,363	5,833
Other commercial revenues	0	0	0	0	0	0	0
Operation & Maintenance expenses	**-380**	**-399**	**-2,761**	**-440**	**-462**	**-898**	**-510**
Maintenance & Overhaul	-361	-379	-2,739	-417	-438	-873	-483
Operation	-20	-21	-22	-23	-24	-25	-27
Net Cash Flows due to Operations	**2,963**	**3,285**	**1,294**	**4,016**	**4,429**	**4,465**	**5,323**
Cash Flows due to Investments	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0	0
Residual Value of Investments	0	0	0	0	0	0	0
Project cash flows	**2,963**	**3,285**	**1,294**	**4,016**	**4,429**	**4,465**	**5,323**

CASH FLOWS (Cr BDT)	2044 Year 20	2045 Year 21	2046 Year 22	2047 Year 23	2048 Year 24	2049 Year 25	2050 Year 26
Outflows	**-1,138**	**-1,142**	**-3,489**	**-1,155**	**-1,163**	**-1,584**	**-1,181**
Project Development (Initial CAPEX)	0	0	0	0	0	0	0
Financing Fees	0	0	0	0	0	0	0
Operating expenses	-380	-399	-2,761	-440	-462	-898	-510
Loan Repayments							
Interest	-350	-335	-321	-307	-293	-278	-264
Principal Repayments	-408	-408	-408	-408	-408	-408	-408
Inflows	**3,343**	**3,684**	**4,055**	**4,456**	**4,892**	**5,363**	**5,833**
Borrowings	0	0	0	0	0	0	0
Operating revenues	3,343	3,684	4,055	4,456	4,892	5,363	5,833
Future Developments	0	0	0	0	0	0	0
Government cash flows	**2,206**	**2,542**	**565**	**3,302**	**3,729**	**3,779**	**4,652**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

SHARIATPUR-CHANDPUR BRIDGE

	2051 Year 27	2052 Year 28	2053 Year 29	2054 Year 30	2055 Year 31	2056 Year 32	2057 Year 33
Construction period	0	0	0	0	0	0	0
Operation period	1	1	1	1	1	1	1
Term of analysis	1	1	1	1	1	1	1
Price indexation	3.56	3.73	3.92	4.12	4.32	4.54	4.76

CASH FLOWS (Cr BDT)	2051 Year 27	2052 Year 28	2053 Year 29	2054 Year 30	2055 Year 31	2056 Year 32	2057 Year 33
Operating revenues	**6,337**	**6,877**	**7,454**	**8,071**	**8,729**	**9,432**	**10,182**
Toll revenues	6,337	6,877	7,454	8,071	8,729	9,432	10,182
Other commercial revenues	0	0	0	0	0	0	0
Operation & Maintenance expenses	**-1,106**	**-1,040**	**-590**	**-620**	**-1,204**	**-3,916**	**-717**
Maintenance & Overhaul	-1,078	-1,010	-559	-587	-1,170	-3,880	-680
Operation	-28	-29	-31	-32	-34	-36	-37
Net Cash Flows due to Operations	**5,232**	**5,837**	**6,864**	**7,451**	**7,526**	**5,516**	**9,465**
Cash Flows due to Investments	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0	0
Residual Value of Investments	0	0	0	0	0	0	0
Project cash flows	**5,232**	**5,837**	**6,864**	**7,451**	**7,526**	**5,516**	**9,465**

CASH FLOWS (Cr BDT)	2051 Year 27	2052 Year 28	2053 Year 29	2054 Year 30	2055 Year 31	2056 Year 32	2057 Year 33
Outflows	**-1,763**	**-1,683**	**-1,219**	**-1,234**	**-1,804**	**-4,502**	**-1,289**
Project Development (Initial CAPEX)	0	0	0	0	0	0	0
Financing Fees	0	0	0	0	0	0	0
Operating expenses	-1,106	-1,040	-590	-620	-1,204	-3,916	-717
Loan Repayments							
Interest	-250	-235	-221	-207	-193	-178	-164
Principal Repayments	-408	-408	-408	-408	-408	-408	-408
Inflows	**6,337**	**6,877**	**7,454**	**8,071**	**8,729**	**9,432**	**10,182**
Borrowings	0	0	0	0	0	0	0
Operating revenues	6,337	6,877	7,454	8,071	8,729	9,432	10,182
Future Developments	0	0	0	0	0	0	0
Government cash flows	**4,574**	**5,194**	**6,235**	**6,836**	**6,925**	**4,930**	**8,893**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

SHARIATPUR-CHANDPUR BRIDGE

	2058 Year 34	2059 Year 35	2060 Year 36	2061 Year 37
Construction period	0	0	0	0
Operation period	1	1	1	1
Term of analysis	1	1	1	1
Price indexation	5.00	5.25	5.52	5.79

CASH FLOWS (Cr BDT)	2058 Year 34	2059 Year 35	2060 Year 36	2061 Year 37
Operating revenues	**10,981**	**11,831**	**12,748**	**13,736**
Toll revenues	10,981	11,831	12,748	13,736
Other commercial revenues	0	0	0	0
Operation & Maintenance expenses	**-1,393**	**-791**	**-830**	**-2,542**
Maintenance & Overhaul	-1,354	-750	-787	-2,496
Operation	-39	-41	-43	-46
Net Cash Flows due to Operations	**9,587**	**11,041**	**11,918**	**11,194**
Cash Flows due to Investments	**0**	**0**	**0**	**505**
Initial CAPEX	0	0	0	0
Other CAPEX	0	0	0	0
Residual Value of Investments	0	0	0	505
Project cash flows	**9,587**	**11,041**	**11,918**	**11,698**

CASH FLOWS (Cr BDT)	2058 Year 34	2059 Year 35	2060 Year 36	2061 Year 37
Outflows	**-1,951**	**-1,334**	**-1,359**	**-3,057**
Project Development (Initial CAPEX)	0	0	0	0
Financing Fees	0	0	0	0
Operating expenses	-1,393	-791	-830	-2,542
Loan Repayments				
Interest	-150	-136	-121	-107
Principal Repayments	-408	-408	-408	-408
Inflows	**10,981**	**11,831**	**12,748**	**13,736**
Borrowings	0	0	0	0
Operating revenues	10,981	11,831	12,748	13,736
Future Developments	0	0	0	0
Government cash flows	**9,030**	**10,497**	**11,389**	**10,679**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

Financial Analysis - PPP Scheme - Cash Flow

SANCHEZ JIMENEZ JOSE LUIS
Team leader

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SHARIATPUR-CHANDPUR BRIDGE

CASH FLOWS (Million BDT)			2025 Year 1	2026 Year 2	2027 Year 3	2028 Year 4	2029 Year 5
Operating revenues			**0**	**0**	**0**	**0**	**0**
Toll revenues			0	0	0	0	0
Other revenues			0	0	0	0	0
Public contributions			**0**	**0**	**0**	**0**	**0**
Availability payment			0	0	0	0	0
Operating subsidy			0	0	0	0	0
Operating expenses			**0**	**0**	**0**	**0**	**0**
Maintenance			0	0	0	0	0
Operation			0	0	0	0	0
SPV Structure			0	0	0	0	0
Corporate tax		-81,222	0	0	0	0	0
EBITDA			**0**	**0**	**0**	**0**	**0**
Investments			**-8,693**	**-33,525**	**-21,702**	**-28,694**	**-40,346**
Initial CAPEX		200,612	-8,693	-33,525	-21,702	-28,694	-40,346
Other CAPEX		0	0	0	0	0	0
Project cash flows	**7.5%**	**-66,512.4**	**-8,693**	**-33,525**	**-21,702**	**-28,694**	**-40,346**
Public Contributions			**3,182**	**21,216**	**12,729**	**15,912**	**21,216**
Government capital contributions		53,039	1,591	10,608	6,365	7,956	10,608
Multilateral capital contributions		53,039	1,591	10,608	6,365	7,956	10,608
Project cash flows (after contributions)	**12.0%**	**0.3**	**-5,510**	**-12,309**	**-8,972**	**-12,782**	**-19,130**
Funding			**5,510**	**12,309**	**8,972**	**12,782**	**19,130**
Equity		23,633	1,378	3,077	2,243	3,196	4,783
Multilateral term loan		70,900	4,133	9,232	6,729	9,587	14,348
Cash flow before debt service (multilateral)			**0**	**0**	**0**	**0**	**0**
Debt service. Multilateral term loan			**0**	**0**	**0**	**0**	**0**
Interest			0	0	0	0	0
Debt repayment			0	0	0	0	0
Cash flow after debt service (multilateral)			**0**	**0**	**0**	**0**	**0**
Commercial banks credit line. Drawdowns			0	0	0	0	0
Cash flow before debt service (commercial)			**0**	**0**	**0**	**0**	**0**
Debt service. Commercial term loan			**0**	**0**	**0**	**0**	**0**
Interest			0	0	0	0	0
Debt repayment			0	0	0	0	0
Free cash flows			**0**	**0**	**0**	**0**	**0**
Dividends			0	0	0	0	0
Annual cash			**0**	**0**	**0**	**0**	**0**
Initial cash balance			**0**	**0**	**0**	**0**	**0**
Cash movements of the year			0	0	0	0	0
Ending cash balance			**0**	**0**	**0**	**0**	**0**

SANCHEZ JIMENEZ JOSE LUIS
Team leader

SHARIATPUR-CHANDPUR BRIDGE

CASH FLOWS (Million BDT)	2030 Year 6	2031 Year 7	2032 Year 8	2033 Year 9	2034 Year 10	2035 Year 11	2036 Year 12
Operating revenues	**0**	**0**	**4,247**	**6,634**	**9,536**	**13,032**	**14,566**
Toll revenues	0	0	4,247	6,634	9,536	13,032	14,566
Other revenues	0	0	0	0	0	0	0
Public contributions	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Availability payment	0	0	0	0	0	0	0
Operating subsidy	0	0	0	0	0	0	0
Operating expenses	**0**	**0**	**-2,192**	**-2,302**	**-4,402**	**-2,537**	**-2,664**
Maintenance	0	0	-2,008	-2,108	-4,198	-2,324	-2,440
Operation	0	0	-111	-116	-122	-128	-134
SPV Structure	0	0	-74	-77	-81	-85	-90
Corporate tax	0	0	0	0	0	0	0
EBITDA	**0**	**0**	**2,055**	**4,332**	**5,134**	**10,494**	**11,901**
Investments	**-43,098**	**-24,554**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	-43,098	-24,554	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0	0
Project cash flows	**-43,098**	**-24,554**	**2,055**	**4,332**	**5,134**	**10,494**	**11,901**
Public Contributions	**21,216**	**10,608**	**0**	**0**	**0**	**0**	**0**
Government capital contributions	10,608	5,304	0	0	0	0	0
Multilateral capital contributions	10,608	5,304	0	0	0	0	0
Project cash flows (after contributions)	**-21,883**	**-13,947**	**2,055**	**4,332**	**5,134**	**10,494**	**11,901**
Funding	**21,883**	**13,947**	**0**	**0**	**0**	**0**	**0**
Equity	5,471	3,487	0	0	0	0	0
Multilateral term loan	16,412	10,460	0	0	0	0	0
Cash flow before debt service (multilateral)	**0**	**0**	**2,055**	**4,332**	**5,134**	**10,494**	**11,901**
Debt service. Multilateral term loan	**0**	**0**	**-4,254**	**-4,254**	**-4,254**	**-8,072**	**-9,155**
Interest	0	0	-4,254	-4,254	-4,254	-4,136	-3,859
Debt repayment	0	0	0	0	0	-3,937	-5,296
Cash flow after debt service (multilateral)	**0**	**0**	**-2,199**	**78**	**880**	**2,422**	**2,746**
Commercial banks credit line. Drawdowns	0	0	2,199	0	0	0	0
Cash flow before debt service (commercial)	**0**	**0**	**0**	**78**	**880**	**2,422**	**2,746**
Debt service. Commercial term loan	**0**	**0**	**0**	**-60**	**-677**	**-1,839**	**0**
Interest	0	0	0	-134	-138	-105	0
Debt repayment	0	0	0	74	-539	-1,734	0
Free cash flows	**0**	**0**	**0**	**18**	**203**	**582**	**2,746**
Dividends	0	0	0	0	0	0	0
Annual cash	**0**	**0**	**0**	**18**	**203**	**582**	**2,746**
Initial cash balance	**0**	**0**	**0**	**0**	**18**	**221**	**804**
Cash movements of the year	0	0	0	18	203	582	2,746
Ending cash balance	**0**	**0**	**0**	**18**	**221**	**804**	**3,550**

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SHARIATPUR-CHANDPUR BRIDGE

CASH FLOWS (Million BDT)	2037 Year 13	2038 Year 14	2039 Year 15	2040 Year 16	2041 Year 17	2042 Year 18	2043 Year 19
Operating revenues	**16,251**	**18,102**	**20,129**	**22,347**	**24,771**	**27,415**	**30,297**
Toll revenues	16,251	18,102	20,129	22,347	24,771	27,415	30,297
Other revenues	0	0	0	0	0	0	0
Public contributions	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Availability payment	0	0	0	0	0	0	0
Operating subsidy	0	0	0	0	0	0	0
Operating expenses	**-5,095**	**-2,937**	**-3,084**	**-5,898**	**-6,902**	**-3,570**	**-6,828**
Maintenance	-4,860	-2,690	-2,825	-5,626	-6,616	-3,270	-6,513
Operation	-141	-148	-156	-163	-172	-180	-189
SPV Structure	-94	-99	-104	-109	-114	-120	-126
Corporate tax	-685	-2,461	-3,098	-3,065	-3,597	-5,489	-5,596
EBITDA	**10,471**	**12,703**	**13,947**	**13,384**	**14,272**	**18,356**	**17,873**
Investments	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0	0
Project cash flows	**10,471**	**12,703**	**13,947**	**13,384**	**14,272**	**18,356**	**17,873**
Public Contributions	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Government capital contributions	0	0	0	0	0	0	0
Multilateral capital contributions	0	0	0	0	0	0	0
Project cash flows (after contributions)	**10,471**	**12,703**	**13,947**	**13,384**	**14,272**	**18,356**	**17,873**
Funding	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Equity	0	0	0	0	0	0	0
Multilateral term loan	0	0	0	0	0	0	0
Cash flow before debt service (multilateral)	**10,471**	**12,703**	**13,947**	**13,384**	**14,272**	**18,356**	**17,873**
Debt service. Multilateral term loan	**-8,054**	**-9,772**	**-10,729**	**-10,295**	**-10,979**	**-14,120**	**-12,976**
Interest	-3,565	-3,235	-2,801	-2,324	-1,809	-1,145	-378
Debt repayment	-4,489	-6,537	-7,928	-7,972	-9,169	-12,975	-12,598
Cash flow after debt service (multilateral)	**2,416**	**2,931**	**3,219**	**3,089**	**3,294**	**4,236**	**4,897**
Commercial banks credit line. Drawdowns	0	0	0	0	0	0	0
Cash flow before debt service (commercial)	**2,416**	**2,931**	**3,219**	**3,089**	**3,294**	**4,236**	**4,897**
Debt service. Commercial term loan	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Interest	0	0	0	0	0	0	0
Debt repayment	0	0	0	0	0	0	0
Free cash flows	**2,416**	**2,931**	**3,219**	**3,089**	**3,294**	**4,236**	**4,897**
Dividends	0	-2,931	-3,219	-3,089	-3,294	-4,236	-4,897
Annual cash	**2,416**	**0**	**0**	**0**	**0**	**0**	**0**
Initial cash balance	**3,550**	**5,966**	**5,966**	**5,966**	**5,966**	**5,966**	**5,966**
Cash movements of the year	2,416	0	0	0	0	0	0
Ending cash balance	**5,966**	**5,966**	**5,966**	**5,966**	**5,966**	**5,966**	**5,966**

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SHARIATPUR-CHANDPUR BRIDGE

CASH FLOWS (Million BDT)	2044 Year 20	2045 Year 21	2046 Year 22	2047 Year 23	2048 Year 24	2049 Year 25	2050 Year 26
Operating revenues	**33,434**	**36,845**	**40,548**	**44,565**	**48,917**	**53,629**	**58,332**
Toll revenues	33,434	36,845	40,548	44,565	48,917	53,629	58,332
Other revenues	0	0	0	0	0	0	0
Public contributions	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Availability payment	0	0	0	0	0	0	0
Operating subsidy	0	0	0	0	0	0	0
Operating expenses	**-3,936**	**-4,133**	**-27,752**	**-4,557**	**-4,785**	**-9,150**	**-5,275**
Maintenance	-3,605	-3,786	-27,387	-4,174	-4,382	-8,728	-4,832
Operation	-199	-209	-219	-230	-241	-253	-266
SPV Structure	-132	-139	-146	-153	-161	-169	-177
Corporate tax	-7,358	-8,242	-2,765	-10,248	-11,383	-11,478	-13,837
EBITDA	**22,140**	**24,469**	**10,030**	**29,759**	**32,750**	**33,001**	**39,220**
Investments	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0	0
Project cash flows	**22,140**	**24,469**	**10,030**	**29,759**	**32,750**	**33,001**	**39,220**
Public Contributions	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Government capital contributions	0	0	0	0	0	0	0
Multilateral capital contributions	0	0	0	0	0	0	0
Project cash flows (after contributions)	**22,140**	**24,469**	**10,030**	**29,759**	**32,750**	**33,001**	**39,220**
Funding	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Equity	0	0	0	0	0	0	0
Multilateral term loan	0	0	0	0	0	0	0
Cash flow before debt service (multilateral)	**22,140**	**24,469**	**10,030**	**29,759**	**32,750**	**33,001**	**39,220**
Debt service. Multilateral term loan	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Interest	0	0	0	0	0	0	0
Debt repayment	0	0	0	0	0	0	0
Cash flow after debt service (multilateral)	**22,140**	**24,469**	**10,030**	**29,759**	**32,750**	**33,001**	**39,220**
Commercial banks credit line. Drawdowns	0	0	0	0	0	0	0
Cash flow before debt service (commercial)	**22,140**	**24,469**	**10,030**	**29,759**	**32,750**	**33,001**	**39,220**
Debt service. Commercial term loan	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Interest	0	0	0	0	0	0	0
Debt repayment	0	0	0	0	0	0	0
Free cash flows	**22,140**	**24,469**	**10,030**	**29,759**	**32,750**	**33,001**	**39,220**
Dividends	-19,399	-21,729	-7,290	-27,019	-30,009	-30,260	-36,479
Annual cash	**2,741**	**2,741**	**2,741**	**2,741**	**2,741**	**2,741**	**2,741**
Initial cash balance	**5,966**	**8,707**	**11,448**	**14,189**	**16,930**	**19,670**	**22,411**
Cash movements of the year	2,741	2,741	2,741	2,741	2,741	2,741	2,741
Ending cash balance	**8,707**	**11,448**	**14,189**	**16,930**	**19,670**	**22,411**	**25,152**

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SHARIATPUR-CHANDPUR BRIDGE

CASH FLOWS (Million BDT)	2051 Year 27	2052 Year 28	2053 Year 29	2054 Year 30	2055 Year 31	2056 Year 32	2057 Year 33
Operating revenues	**63,371**	**68,767**	**74,538**	**80,706**	**87,294**	**94,324**	**101,820**
Toll revenues	63,371	68,767	74,538	80,706	87,294	94,324	101,820
Other revenues	0	0	0	0	0	0	0
Public contributions	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Availability payment	0	0	0	0	0	0	0
Operating subsidy	0	0	0	0	0	0	0
Operating expenses	**-11,242**	**-10,593**	**-6,107**	**-6,412**	**-12,262**	**-39,399**	**-7,423**
Maintenance	-10,777	-10,104	-5,593	-5,873	-11,696	-38,805	-6,798
Operation	-279	-293	-308	-324	-340	-357	-375
SPV Structure	-186	-196	-205	-216	-226	-238	-250
Corporate tax	-13,582	-15,326	-18,147	-19,760	-19,962	-14,433	-25,409
EBITDA	**38,547**	**42,848**	**50,284**	**54,535**	**55,069**	**40,492**	**68,988**
Investments	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0	0
Project cash flows	**38,547**	**42,848**	**50,284**	**54,535**	**55,069**	**40,492**	**68,988**
Public Contributions	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Government capital contributions	0	0	0	0	0	0	0
Multilateral capital contributions	0	0	0	0	0	0	0
Project cash flows (after contributions)	**38,547**	**42,848**	**50,284**	**54,535**	**55,069**	**40,492**	**68,988**
Funding	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Equity	0	0	0	0	0	0	0
Multilateral term loan	0	0	0	0	0	0	0
Cash flow before debt service (multilateral)	**38,547**	**42,848**	**50,284**	**54,535**	**55,069**	**40,492**	**68,988**
Debt service. Multilateral term loan	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Interest	0	0	0	0	0	0	0
Debt repayment	0	0	0	0	0	0	0
Cash flow after debt service (multilateral)	**38,547**	**42,848**	**50,284**	**54,535**	**55,069**	**40,492**	**68,988**
Commercial banks credit line. Drawdowns	0	0	0	0	0	0	0
Cash flow before debt service (commercial)	**38,547**	**42,848**	**50,284**	**54,535**	**55,069**	**40,492**	**68,988**
Debt service. Commercial term loan	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Interest	0	0	0	0	0	0	0
Debt repayment	0	0	0	0	0	0	0
Free cash flows	**38,547**	**42,848**	**50,284**	**54,535**	**55,069**	**40,492**	**68,988**
Dividends	-35,807	-40,406	-47,843	-52,093	-52,628	-38,050	-66,986
Annual cash	**2,741**	**2,442**	**2,442**	**2,442**	**2,442**	**2,442**	**2,002**
Initial cash balance	**25,152**	**27,893**	**30,334**	**32,776**	**35,218**	**37,660**	**40,101**
Cash movements of the year	2,741	2,442	2,442	2,442	2,442	2,442	2,002
Ending cash balance	**27,893**	**30,334**	**32,776**	**35,218**	**37,660**	**40,101**	**42,104**

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SHARIATPUR-CHANDPUR BRIDGE

CASH FLOWS (Million BDT)	2058 Year 34	2059 Year 35	2060 Year 36	2061 Year 37
Operating revenues	**109,808**	**118,314**	**127,480**	**137,358**
Toll revenues	109,808	118,314	127,480	137,358
Other revenues	0	0	0	0
Public contributions	**0**	**0**	**0**	**0**
Availability payment	0	0	0	0
Operating subsidy	0	0	0	0
Operating expenses	**-14,195**	**-8,183**	**-8,593**	**-25,723**
Maintenance	-13,540	-7,495	-7,870	-24,964
Operation	-393	-413	-434	-455
SPV Structure	-262	-275	-289	-303
Corporate tax	-25,743	-29,735	-32,143	-30,149
EBITDA	**69,870**	**80,395**	**86,744**	**81,486**
Investments	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0
Other CAPEX	0	0	0	0
Project cash flows	**69,870**	**80,395**	**86,744**	**81,486**
Public Contributions	**0**	**0**	**0**	**0**
Government capital contributions	0	0	0	0
Multilateral capital contributions	0	0	0	0
Project cash flows (after contributions)	**69,870**	**80,395**	**86,744**	**81,486**
Funding	**0**	**0**	**0**	**0**
Equity	0	0	0	0
Multilateral term loan	0	0	0	0
Cash flow before debt service (multilateral)	**69,870**	**80,395**	**86,744**	**81,486**
Debt service. Multilateral term loan	**0**	**0**	**0**	**0**
Interest	0	0	0	0
Debt repayment	0	0	0	0
Cash flow after debt service (multilateral)	**69,870**	**80,395**	**86,744**	**81,486**
Commercial banks credit line. Drawdowns	0	0	0	0
Cash flow before debt service (commercial)	**69,870**	**80,395**	**86,744**	**81,486**
Debt service. Commercial term loan	**0**	**0**	**0**	**0**
Interest	0	0	0	0
Debt repayment	0	0	0	0
Free cash flows	**69,870**	**80,395**	**86,744**	**81,486**
Dividends	-67,867	-78,393	-84,742	-81,486
Annual cash	**2,002**	**2,002**	**2,002**	**0**
Initial cash balance	**42,104**	**44,106**	**46,108**	**48,110**
Cash movements of the year	2,002	2,002	2,002	0
Ending cash balance	**44,106**	**46,108**	**48,110**	**48,110**

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Annexure 02 – National GDP Impact

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The GDP impact calculation has been carried out following international methodology for economic impact estimation studies. It has been estimated as a sum of three impacts: direct, indirect and induced, as follows:

GDP IMPACT CALCULATION		Cr BDT
GDP economic impact. Direct Impact		**6,630.50**
Personnel expenses. Construction	22 %	4,831.70
Personnel expenses. Operation	65 %	0
EBITDA. Construction & Maintenance	8 %	1,771.50
EBITDA. Operation	15 %	27.30
GDP economic impact. Indirect Impact		**15,500.80**
Suppliers. Construction	70 %	15,500.80
Suppliers. Operation	20 %	0
GDP economic impact. Induced Impact		**14,907.20**
Bridge activity		4,831.70
Induced activity of the bridge		10,075.50

- Right-hand column shows the addition of all the economic projections generated, in constant BDT (not considering inflation)
- Direct impact is the impact generated by the project itself and is similar to the Gross Added Value, which means the addition of personnel expenses and EBITDA both in the implementation phase and in the operation phase.
- Indirect impact is the impact generated by the suppliers of the project, also in both the implementation phase and the operation phase.
- Induced impact is the impact generated by all the personnel expenses with the money spent on any other activity in the region / country. It has been calculated as the induced impact of the bridge activity, based on the personnel expenses of the bridge itself (in construction and in operation), and the induced impact of the activity of the bridge, based on the personnel expenses of the indirect impact multiplied by the 65% estimated of personnel expenses of any service activity.

In summary, it is the sum of the effects generated by the bridge, either by its construction or by its operation, both directly and those produced by each of the activities derived from the project:

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Total impact on GDP (Cr BDT 2022)	37,038.40
Direct impact	6,630.50
Indirect impact	15,500.80
Induced impact	14,907.20
GDP Bangladesh (million USD 2022)	453,852
GDP Bangladesh (Cr BDT 2022)	48,562,164
Project impact on GDP	0.76 %

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