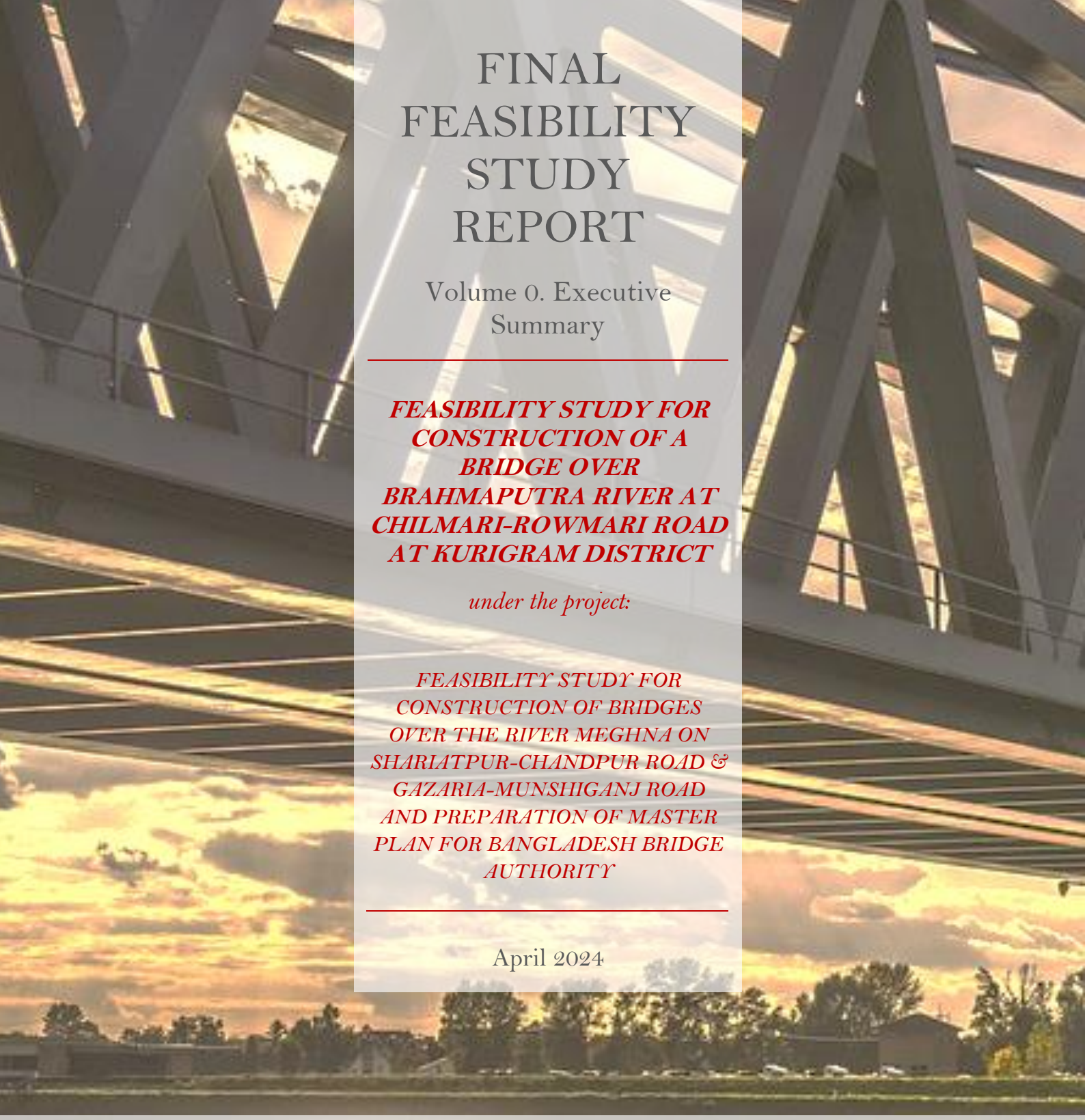

FINAL FEASIBILITY STUDY REPORT

Volume 0. Executive Summary

FEASIBILITY STUDY FOR CONSTRUCTION OF A BRIDGE OVER BRAHMAPUTRA RIVER AT CHILMARI-ROWMARI ROAD AT KURIGRAM DISTRICT

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

April 2024

TYPSA

DOHWA NIPPON KOEI

ddc BCL DevCon

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

FINAL FEASIBILITY STUDY FOR CONSTRUCTION OF A BRIDGE OVER BRAHMAPUTRA RIVER AT CHILMARI-ROWMARI ROAD AT KURIGRAM DISTRICT

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Quality Control sheet

DOCUMENT	**FINAL FEASIBILITY STUDY REPORT OF CHILMARI-ROWMARI BRIDGE. VOLUME 0-EXECUTIVE SUMMARY**			
PROJECT	TR8138-MASTER PLAN BBA			
CODE	TR8138-JV-FS-G102-RP-000001-FFS_Vol0-D03.docx			
AUTHORS:	Signed:	JV		
	Date:	03/04/2024		
VERIFIED	Signed:	MCP	JSJ	JLY
	Date:	04/04/2024	04/04/2024	04/04/2024
RECIPIENT	Bangladesh Bridge Authority (BBA)			
NOTES	Document created by the Joint Venture formed by TYPSA-DOHWA-NIPPON KOEI-DDC-BCL-DEVCON			

Control of Versions

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1	First Submission
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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 (currency)
BFRI	Bangladesh Fisheries Research Institute
BIWTA	Bangladesh Inland Water Transport Authority
BNBC	Bangladesh National Building Code
BTCL	Bangladesh Telecommunication Company Ltd
BTM	Bangladesh Transverse Mercator
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
CF	Conversion Factors
CL	Lean Clay
CPR	Common Property Resources
DBFOT	Design-Build-Finance-Operate-Transfer
DC	Deputy Commissioner
DCL	Development Consultant Ltd
DNP	Defects Notification Period
DoE	Department of Environment
DPP	Development Project Proposal
DSCR	Debt Service Coverage Ratio
EBCR	Economic Benefit Cost Ratio
EBITDA	Earnings before Interest, Taxes, Depreciation and Amortization,
ECR	Environment Conservation Rules
EFP	Economic Financial Plan
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
ENPV	Economic Net Present Value
EPC	Engineering, Procurement and Construction
EZ	Economic Zone
FDR	Fixed Deposit Receipt

FHWA	Federal Highway Administration
FIDIC	The International Federation of Consulting Engineers
FIRR	Project Investment Cost
FNPV	Financial Net Present
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)
IRR	Internal Rate of Return
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
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
RGB	Right Guide Bund
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
SIA	Social Impact Assessment
SM	Silty Sand
SP	Poorly Graded Sand
STP	Sewerage Treatment Plant
SRD	Social Rate of Discount
SWOT	Strengths, Weaknesses, Opportunities, and 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
WHO	World Health Organization
WL	Water Level

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Executive Summary

Summary of Key Findings and Recommendations of the Feasibility Study

(Final Report – April 2024)

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1. PROJECT BASIC INFORMATION

Table 1.Basic Information

1.	Name of the Project	:	FEASIBILITY STUDY FOR CONSTRUCTION OF BRIDGE OVER THE RIVER MEGHNA ON CHILMARI-ROWMARI 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 Chilmari to Rowmari crossing the Brahmaputra River Analysis shall include technical, socio-economic, financial, and environmental aspects
4.	Estimated project Cost. (Taka in Crore)	:	Estimated project Cost. 23,699.08 Cr BDT
5.	Sector & Sub-Sector	:	Transport Sector / Bridges Infrastructures
6.	Project Category (Based on Environment Conservation Rules 1997)	:	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: Rangpur District : Kurigram Upazila: Chilmari, Rowmari, Ulipur
8.	Project Duration	:	Investment Period: 5Y – 2025/2029 Construction Period: 4.5Y (54 months) Operation Period: 30 Y – 2030/2059

2. INTRODUCTION

2.1. Project Background

With the objective of boosting up the economy of every corner of Bangladesh equally, a roadmap and a comprehensive action plan (Master Plan) of transport connectivity is being implemented by Bangladesh Bridge Authority (BBA). In response to a long felt need for easy and quick communication among major cities of Bangladesh, the Master Plan, prepared by BBA includes the construction of several bridges and connectivity infrastructures. Amongst these bridges, one of the most relevant and long-time awaited one is the Chilmari-Rowmari Bridge over Brahmaputra River at Kurigram District.

The Kurigram District is in the northern region of Bangladesh along the border of India as shown in the 1. The study reach is bounded within 459121mE Longitude, 808020mN Latitude to 485213 m E Longitude, 845403 m N Latitude (in BTM coordinates), located at the Northwest region of Bangladesh.

Kurigram is bordered by Cooch Behar district of West Bengal State of India to the north, Gaibandha District to the south, Dhubri District of Assam State of India and Tura Hill District of Meghalaya State to the East, Lalmonirhat and Rangpur Districts to the west, as shown in the Figure 1.

It is one of the districts which have plenty type of islands and chars where people regularly suffer because of flood, riverbank erosion and other natural calamities. During summer, temperature is higher and during winter is lower than middle or southern part of Bangladesh. Heavy rainfall is usually observed during the rainy season like other parts of Bangladesh and the average annual rainfall is about 3,000 mm.

Several rivers are flowing through the heart of this district, being Brahmaputra-Jamuna, Dharla and Teesta the major rivers. The bridge is proposed in the upstream of Teesta River confluence, connecting Chilmari in the right bank and Rowmari in the left bank.

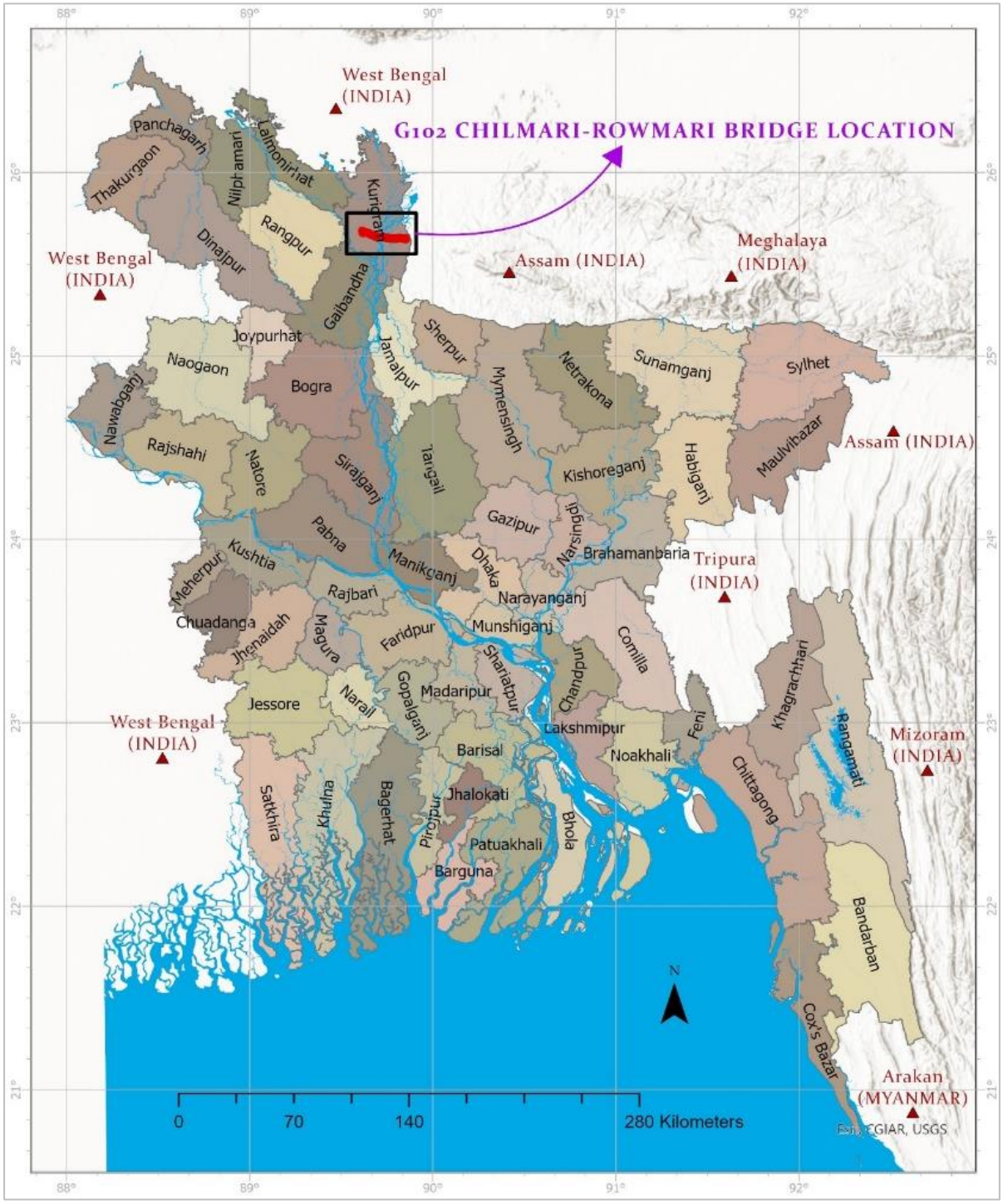


Figure 1. Location of the proposed bridge (Kurigram District)

Chilmari is an Upazila of the district of Kurigram under Rangpur division. The district of Kurigram is located in the northern part of Bangladesh while the Upazila of Chilmari is located to the south of Kurigram district. The geographical area of Chilmari is 224.98 sq km and located at 25.3513°N 89.3945°E which is situated on the western bank of Brahmaputra River.

Ulipur is an Upazila of Kurigram district under Rangpur division located at southern part of the district at 25.3926°N 89.3718°E. It is bounded by the Teesta River on the western side and Brahmaputra River

on the eastern side and mainly composed of alluvial land of Brahmaputra basin. Ulipur Upazila has a total area of 504.19 km^2.

Rowmari is an Upazila of Kurigram district under Rangpur division located at 25.5625°N 89.8500°E covering a total area of 197.8 km2. It is situated on the eastern bank of Brahmaputra River and bounded by Ulipur Upazila and Indian state of Assam on the north, by Char Rajibpur Upazila on the south, by Indian state of Assam on the east and Char Rajibpur, Chilmari and Ulipur Upazila on the west.

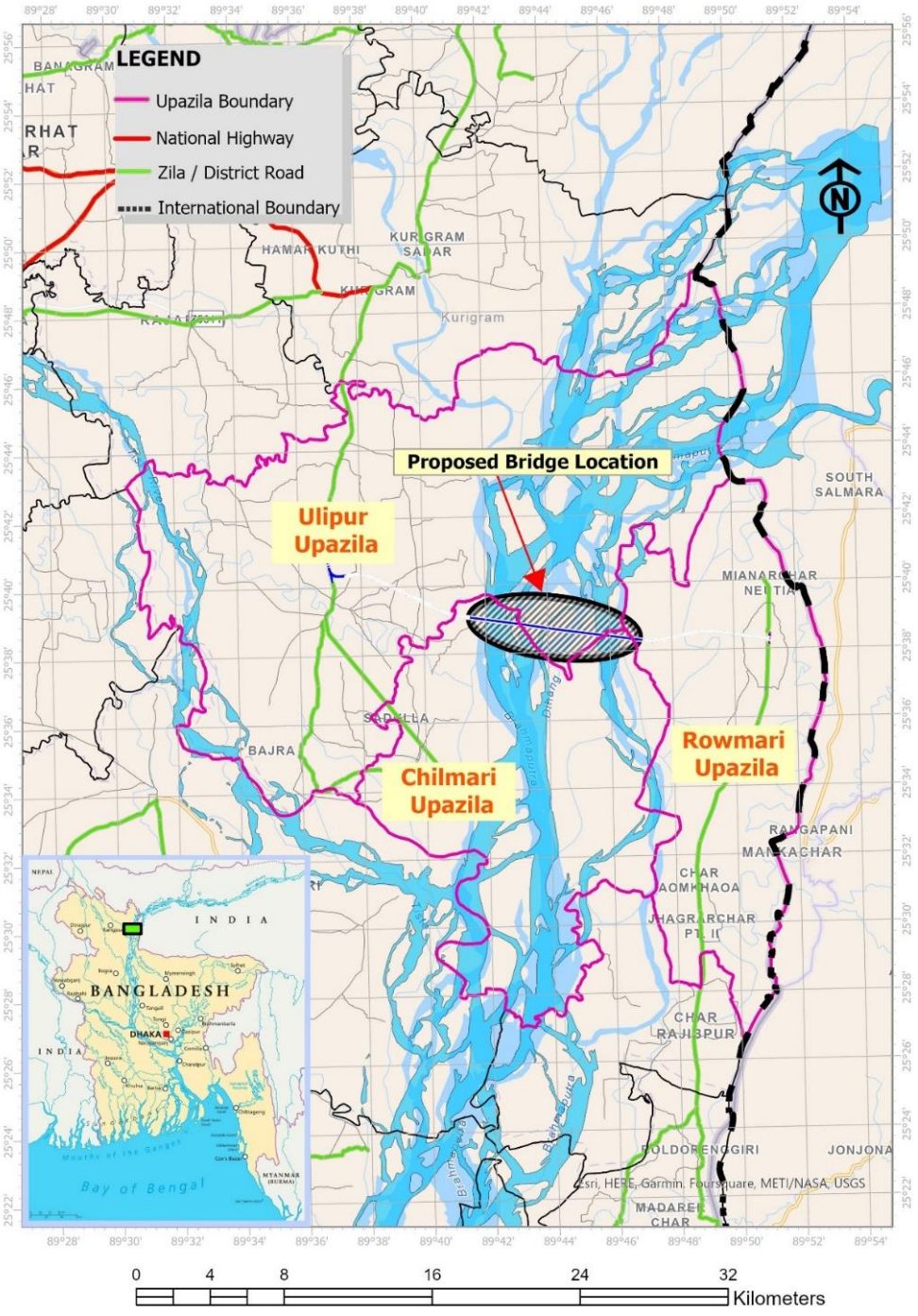


Figure 2. Ulipur, Chilmari and Rowmari Upazilas Location

The river Brahmaputra separates several Upazilas of the Kurigram district from the main district town and northern regions. This fact has caused a sense of isolation and deprivation among the people living in Rowmari located on the east bank of the river converting it in one of the marginal districts of Bangladesh. The border of the Indian states of Meghalaya, Assam and West Bengal run along with more than 200 km of Kurigram's Upazilas, separated from the mainland district by the Brahmaputra River.

The Brahmaputra river is a trans-boundary river which flows through Tibet, northeast of India, and Bangladesh. It is the 9th largest river in the world by discharge, and the 15th by length.

With its origin in the Manasarovar Lake region, near Mount Kailash, on the northern side of the Himalayas, where it is known as the Yarlung Tsangpo River, it flows along southern Tibet to break through the Himalayas in great gorges. It then flows southwest through the Assam Valley as the Brahmaputra and south through Bangladesh as the Jamuna. In the vast Ganges Delta, it merges with the Ganges, Padma in Bangladesh, and becomes the Meghna before reaching the Bay of Bengal.

About 3,969 km long, the Brahmaputra is an important river for irrigation and transportation in the region. The average depth of the river is 30 m. The river is prone to catastrophic flooding in the monsoon season. The average discharge of the river is about 19,800 m3/s and floods reach about 100,000 m3/s. It is a classic example of a braided river and is highly susceptible to channel migration and avulsion. It is also one of the few rivers in the world that exhibits a tidal bore. It is navigable for most of its length.

The proposed bridge would link Chilmari and Rowmari Upazilas connecting both west and east banks of the Brahmaputra River, as shown in the image below. The location of the proposed bridge is 474227mE Longitude and 835943mN Latitude (BTM coordinates system). It would connect with the road R562 at the westbound and the road R464 at the eastbound, which are the nearest Regional Highway near the study area. The proposed alignment is shown in the Figure 3.

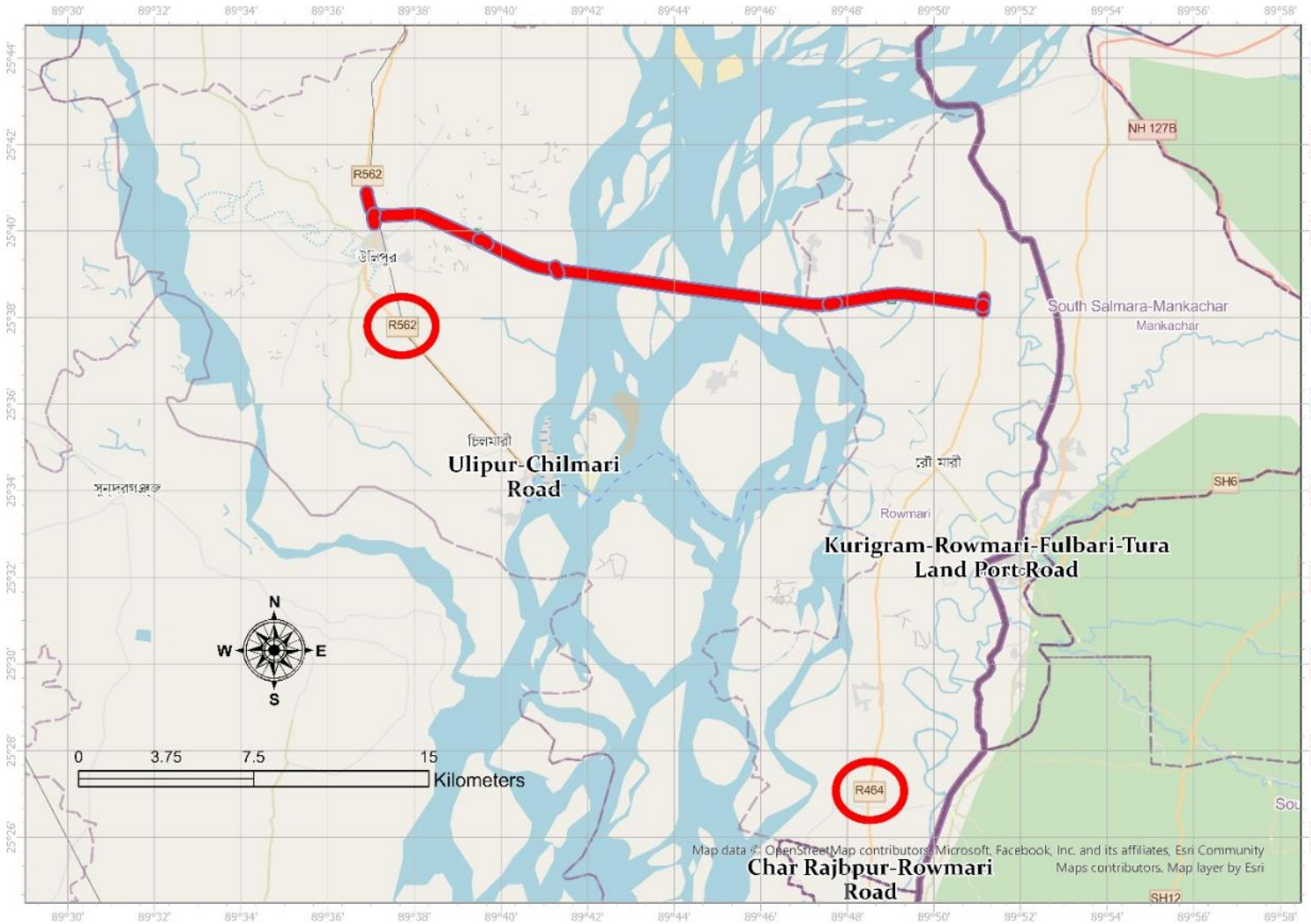


Figure 3. Location of the Bridge and proposed road approach

It is worthwhile to address the interface within the project and the one that the BIWTA is currently planning. This is the construction of a river port near to the location of the bridge. Establishment of a river port at Chilmari (Ramna, Jorgachh, Rajibpur, Rowmari, Nayarhay) project. The location at Chilmari side is exactly at existing Ramna Ghat. On Rowmari side, currently there is not any location selected. The port is located 8.6 km southwards as shown in Figure 4 which is located away from the bridge alignment and the proposed river protection works as shown in Figure 5.

Figure 4. Proposed location for Chilmari port (Ramna Ghat)

(*) Location of Construction Yard subject to the final location of the Char Land and contingent on future river erosion

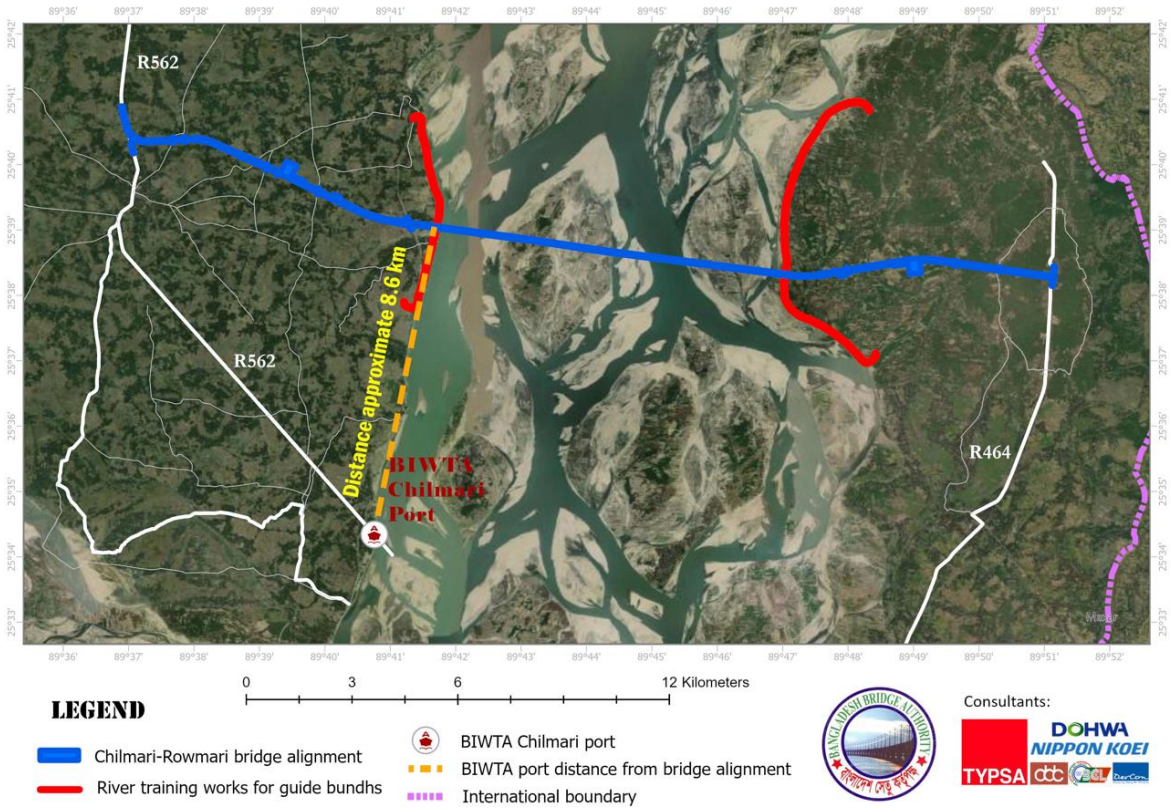


Figure 5. Location of bridge, river training works and Chilmari port

2.2. Objectives of the assignment

The objective of this project is to prepare a Feasibility Study for the construction of Chilmari-Rowmari Bridge over the Brahmaputra River,

On the West side, the proposed bridge and approach roads would connect with the regional road R562 (Kurigram-Ulipur-Chillmari Road) and, on the East, it would connect with the regional road R464 (Jamalpur (Nandibazar)-Dhanua Kamalpur-Rowmari-Datbhanga Road),

The objectives of this study are as follows:

- Find the most suitable location for the bridges out of an alignment multicriteria analysis.
- Identify and propose the optimum engineering solution (type of bridge or tunnel) suitable for the crossing.
- Assess socio-economic status of the area.
- Carry out data collection and field investigations needed to pre-design the engineering selected solution.
- Evaluate technical, social, environmental, economic, and financial viability of the project.
- Recommend the mode of procurement.
- Carry out preliminary design of the bridges and associated facilities.
- Carry out preliminary cost estimate of the bridges and associated facilities.
- Provide a sound conclusion to the Client regarding the viability of the project.

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 completed following the scope 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 other 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.
- 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.
- Detailed Hydro-morphological study of the river flow characteristics by using Mathematical Modelling.
- 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).
- Pavement Design for trunk road an auxiliary road.
- 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 expected distribution of 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.
- Resettlement Action Plan (RAP).
- Preparation of Land Acquisition Plans.
- Determination of appropriate construction method, configuration and technology.

With respect to this study four (4) alternatives were studied initially, to provide a safe and permanent connection north-south along the river Brahmaputra. 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 Figures Table

Table 2. Summary of Project's Findings Salient Figures

Main salient features of Chilmari-Rowmari Bridge		
Main alignment length	Road and bridges	25,180 m
Total bridge length		10,780 m
Main span Steel Truss spans	Length	8,900 m
	Main span (Chilmari side)	600 m (3 x 200)
	Intermediate span	4,300 m (43 x 100)
	Main span	1,000 m (5 x 200)
	Lateral span (Rowmari side)	3,000 m (30 x 100)
	Class of navigation	Class I
	Width of Main span section	20.48 m
Approach spans	Length	1,880 m
	Chilmari side	840 m (21 x 40)
	Rowmari side	1,040 m (26 x 40)
	Width of approach bridge	20.25 m
Approach road	Total length	14,400 m
	Chilmari side	8,400 m
	Rowmari side	6,000 m
	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	1,090 m
	Chilmari side (R562)	520 m
	Rowmari side (R464)	570 m

Main salient features of Chilmari-Rowmari Bridge		
Other features in approach road	Rail overpass	465 m
	Small bridges	2 bridges (120 + 360) Total = 480 m
	Culverts	19 nos 3 x 3 x 3.5 m
	Underpass	5 nos 2 x 5 x 4.5 m
	Toll Plaza	7 nos booth each side = Total 14 nos (+ Future extendable 3 nos each side)
	Weighing Station	1 no each side = Total 2 nos 4 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	Chilmari side Char Rowmari side	26.7 acres 189. acres 21.6 acres Total = 238 acres
River training works	Total length	14,000 m
	Chilmari side	6,000 m
	Rowmari side	8,000 m
Land Acquisition		
	Width of right of way (ROW)	69.5 m
	Total land to be acquired	623.57 acres
	Total number of project affected units	492 nos
	Total number of persons affected	1,964 nos
	Resettlement area	1 no each side = Total 2 nos 2 x 5 = 10 acre

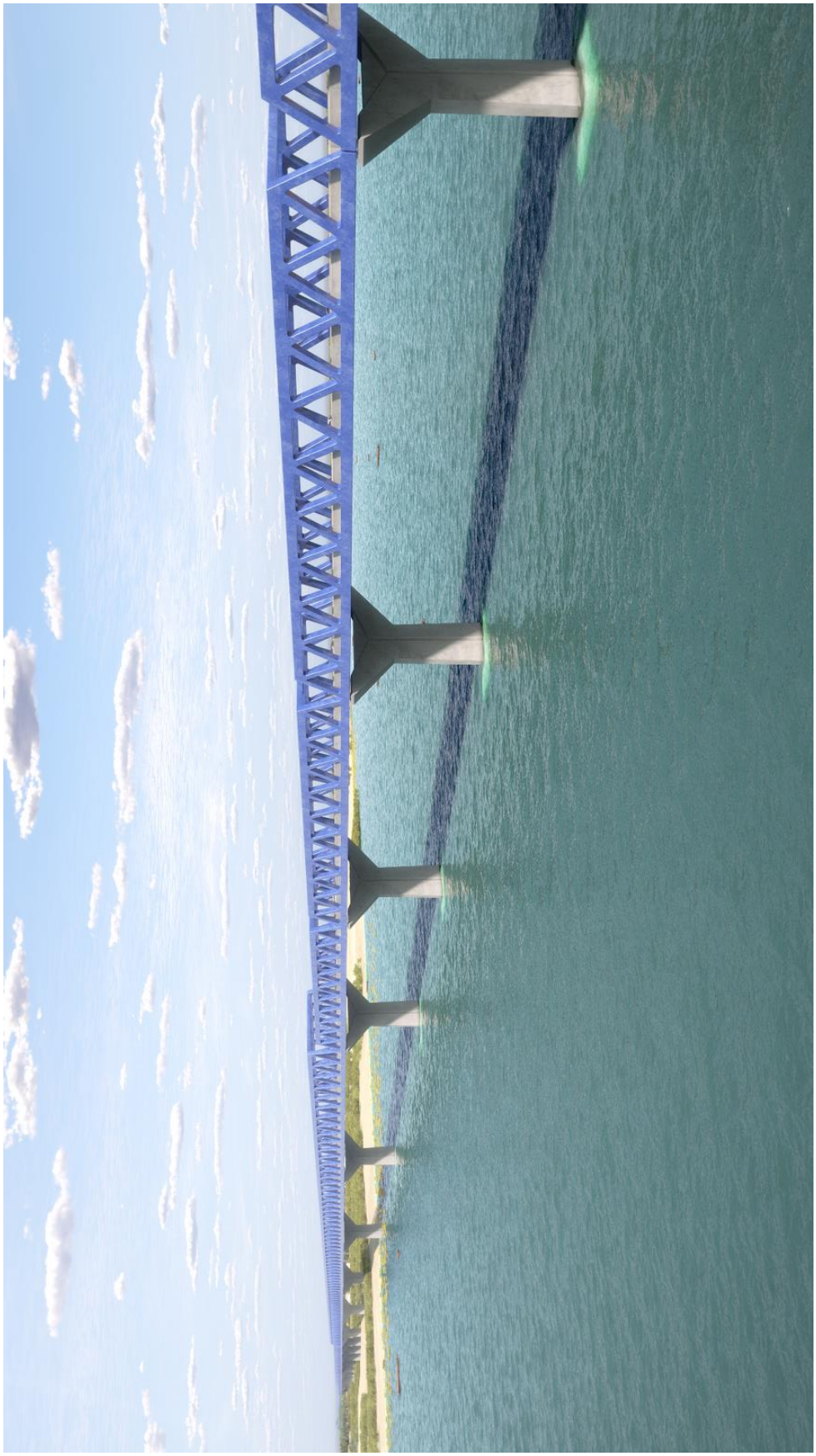


Figure 6. Image of the proposed bridge over Brahmaputra River

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 improvement to be addressed by this feasibility study, is mainly the lack of adequate infrastructure for efficient and convenient river crossings between both sides of the Brahmaputra River at the northern area of the country. The existing Bangabandhu Bridge located south from Rangpur Division covers a good part of the transportation demand at both sides of the Jamuna River. It is located very far for the population living in the Kurigram Zila and the northernmost upazilas of Bangladesh. In addition, the growing demand of transportation and connectivity in Bangladesh is resulting in a clearly needed infrastructure issue to be addressed by the Government of Bangladesh.

The matter to be addressed relates to some direct causes:

- Insufficient number of bridges in the zone under study: Currently, only the Bangabandhu Bridge is enabling to cross the Brahmaputra/Jamuna River. This is undoubtedly insufficient to meet the currently 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 to 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 consequences of a lack of this infrastructure, the Chilmari-Rowmari bridge:

- The lack of efficient transportation and connectivity can limit trade, investment, and overall economic growth in the region. The isolation and remoteness conditions of part of the population living in the area.
- Limited transportation infrastructure can prevent residents from accessing essential services such as healthcare, education, and emergency services, ultimately impacting their quality of life.
- Without the bridge, existing means for crossings would become more congested, leading to longer travel times.
- Limited access to opportunities and services can exacerbate social inequalities, with disadvantaged groups being disproportionately affected.

3.2. Relevance of the Project Idea

Due to the lack of existing bridge in the upper Jamuna River area, the people living in both sides of the river, normally use engine boats and trawler services for crossing the river and transporting of goods to Chilmari-Ulipur to or from Rowmari. No ferry service, that would enable vehicles and goods transportation exists nowadays connecting both sides, which results on a clear of lack of connectivity in terms of logistics. During the rainy season, several accidents have been reported along the route transporting people from Rowmari to Chilmari.

The population from Rowmari Upazila, although currently have road connectivity to the Kurigram district capital, must travel through a long distance in the south via Jamalpur, Sherpur, Bogura and Rangpur. Due to the fragile communication between Chilmari and Rowmari, some people from the char[1] areas of Chilmari and Ulipur Upazilas avoid travelling to Dhaka through Rowmari. Moreover, heavy vehicles carrying goods from the Land Port located at the Rowmari border with India cannot easily reach Kurigram, so a new bridge would bring many benefits for the region's economy and commerce.

For all these reasons, the construction of a bridge, at the crossing point, would have a very positive impact on local and regional levels, integrating the outlaying Upazilas with the mainland districts. This project would also be deemed to be a component of a broader transportation enhancement approach, together with other initiatives under study.

The list of benefits of Chilmari-Rowmari bridge as a need to improve the lack of infrastructure:

- Remote areas connectivity: Rowmari, Chilmari and Ulipur are in a remote region of Bangladesh. A bridge in this area would facilitate the movement of people, goods, and services across these major rivers.
- Economic development: Kurigram 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 Kurigram district has 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 India and Bangladesh E-W corridor: The bridge would enhance connectivity between those areas and would foster the international transborder corridor. This would enable more efficient transportation and support the development of these regions.
- Reducing pressure on existing infrastructure: As mentioned earlier, the Bangabandhu Bridge is currently the main options for river crossings between East and West Bangladesh at this

[1] *Char: a tract of land surrounded by the waters of a river stream, sea, or lake. They are usually sand bars emerging as islands within the river channel (island chars) or as attached land to the riverbanks (attached chars).*

part of Jamuna River. A bridge in Chilmari-Rowmari 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 the proposed new bridge, can enhance the region's resilience to these events by providing better access to essential services and support during emergencies.

3.3. Proposed Project Interventions

The Project implementation would need not only the address main intervention which is the construction of the main infrastructure (main bridge and accessing bridges), but as it is explained within the technical features section, the construction of 14,400 m of approach roads would be needed to connect with the existing road network. Other interventions as two engineers' facilities compounds, 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

The following list includes the stakeholders that have been considered when implementing the Feasibility Study. Further detailed information of each case can be found in the specific section of Volume 10.

- Ministry of Road Transport and Bridges: Responsible for overseeing the planning, implementation, and maintenance of transportation infrastructure projects in Bangladesh.
- Local Government authorities: Chilmari, Ulipur and Rowmari district administrations would be involved in coordinating and facilitating the project at the local level.
- Bangladesh Water Development Board (BWDB): Responsible of the overseeing and coordination of the river training works.
- LGED: Local roads network authority.
- Road Transport and Highways Division: responsible for roads and highways.
- The Roads and Highways Department (RHD): an agency of the Government of Bangladesh responsible for the construction and maintenance of highways and bridges across Bangladesh. The Department is a subsidiary of the Road Transport and Highways Division.
- Bangladesh Fisheries Research Institute, (BFRI): Regulatory agency for Hilsha fish protection
- Bangladesh Power Development Board.
- Bangladesh Telecommunication Company Ltd. (BTCL): Responsible for Telephone and Internet connection and maintenance.
- Palli Bidyut Samity (PBS), Kurigram, Lalmonirhat: Responsible for providing electricity in the rural areas of Kurigram and Lalmonirhat district.
- Palli Bidyut Samity (PBS), Jamalpur: Responsible for providing electricity in the rural areas of the Jamalpur district.

3.5. Demand Analysis

To analyze the traffic demand, a transportation model implemented by the Consultant has been utilized along with the data obtained from **242** traffic survey points. Both the current demand (i.e., demand from currently crossing boats) and the projected demand (i.e., demand that would use the bridge if constructed) were evaluated within the study. A 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 would be the benefits of constructing the bridge.

This study considers a range of scenarios in order to gain a better understanding of the distribution of traffic in the network under each scenario. Defining these scenarios is a crucial step, as it enables a more accurate cost-benefit analysis to be performed. This analysis can compare the "with" and "without" project scenarios, without taking into account the cost of road improvements that would take place in both scenarios. This approach allows for a thorough examination of the potential impact of the project on traffic patterns in the area.

The scenarios considered are as follows:

- **Existing scenario (S0):**
  The existing scenario refers to the current situation. The analysis of the existing scenario is only used as a base for the analysis of the following two scenarios defined and for this reason no results related to the existing scenario are be presented.

Figure 7: Current Scenario (S0)

- **Scenario without Chilmari-Rowmari bridge project (without project) (S1):**

In this scenario it has been assumed that there is an improvement of the roads along the Chilmari-Rowmari upazila, with only the existing Chilmari Ghat connecting Chilmari with Rowmari (and hence with the corridor) by ferry. In addition, it has been assumed that the following key ongoing or potential projects are in place (as illustrated in the following Image): This scenario is conceptual and applied in the socioeconomic analysis.

- New Teesta bridge (1) + Improved 86 km roads Palashbari-Gaibandha-Kurigram (2) (committed)
- Improved road corridor from Jamalpur-Rowmari (3)
- Ferryghat service to cross the river (4)

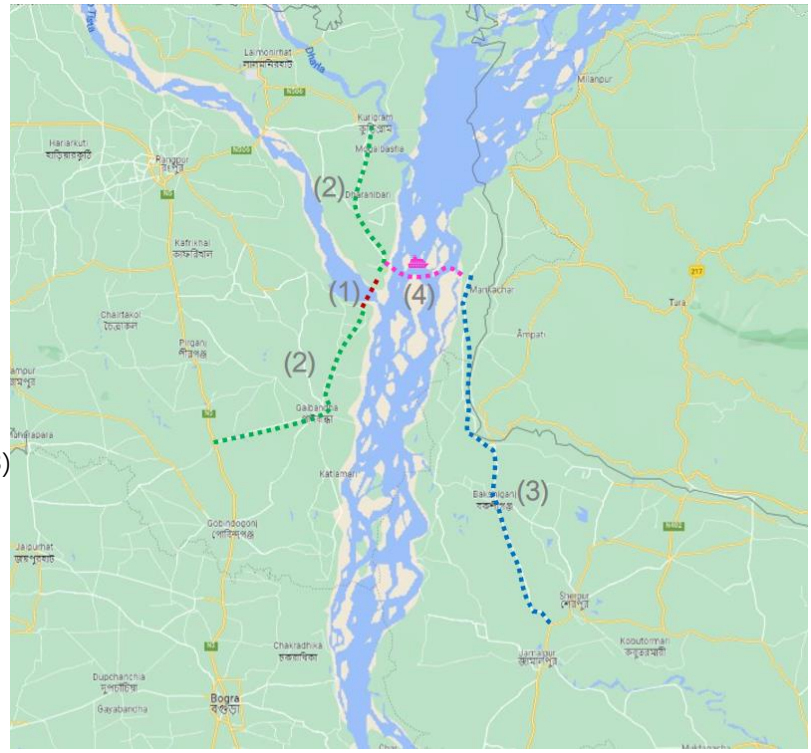


Figure 8: Without Project Scenario (S1)

- **Scenario with Chilmari-Rowmari bridge project (with project) (S2):**

The *With Chilmari-Rowmari Bridge Project scenario* is defined as the previous scenario (*Without Chilmari-Rowmari Bridge Project*) without the Ferryghat and considering the further addition of the construction of the Chilmari-Rowmari Bridge. In the following map the "With project scenario" can be seen with the:

- Chilmari-Rowmari Bridge
- Teesta Bridge + Improved roads Palashbari-Gaibandha-Kurigram (commited)
- Improved road corridor from Jamalpur-Rowmari

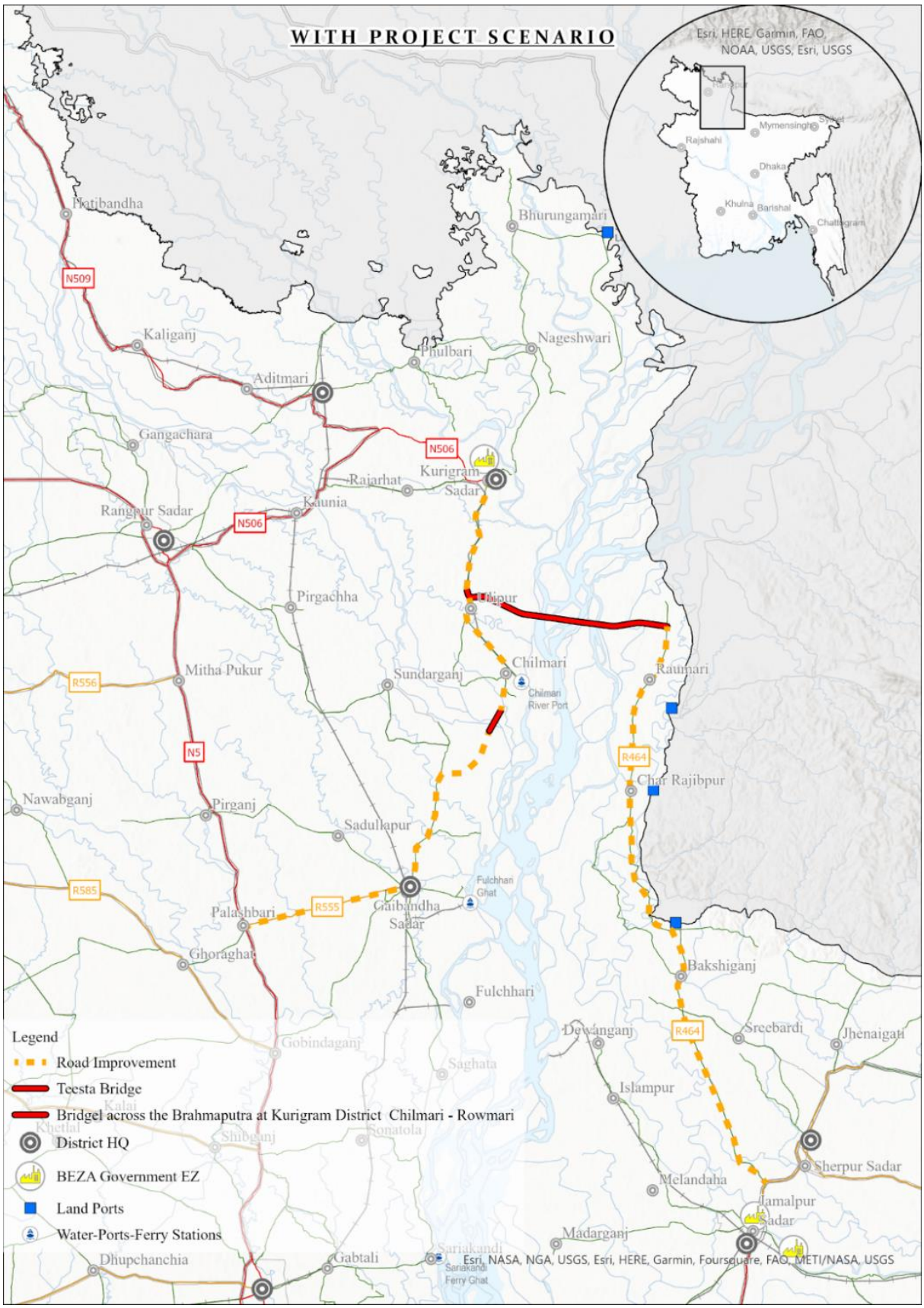


Figure 9: With Project Scenario (S2)

Definition of Scenarios Based on external traffic allowed.

During the elaboration of this feasibility study, the traffic of Indian vehicles passing through the territory of Bangladesh is not allowed. Currently, there are many vehicles, and especially trucks that are crossing from the NEI (Northeast India) towards the rest of mainland India through the Siliguri Corridor. This is due to the no free-trade agreement between India and Bangladesh. As observed in the Figure below, land internal traffic should detour Bangladesh by the North:

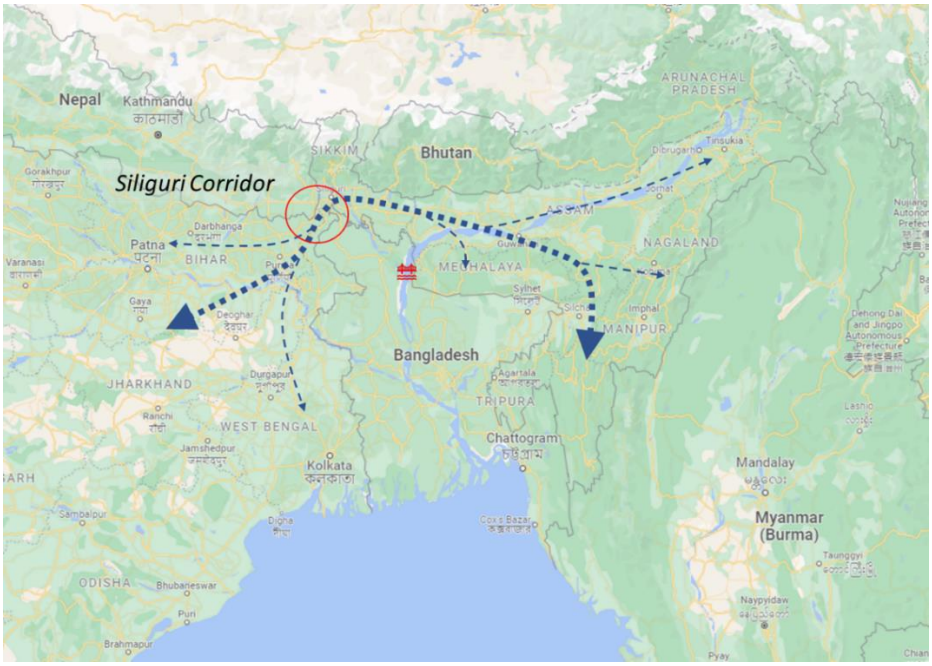


Figure 10: Traffic paths from NEI to the mainland surrounding Bangladesh

The opening of borders to Indian trucks to cross Bangladesh would provide a direct and shorter connection that could use the proposed Chilmari-Rowmari Bridge

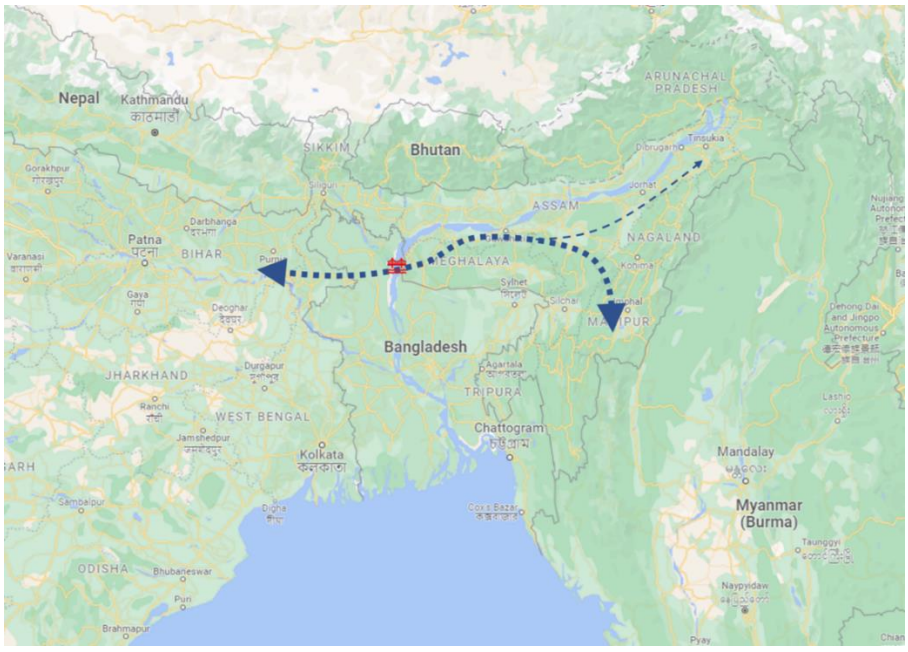


Figure 11: Traffic paths for NEI traffic to mainland throughout Chilmari-Rowmari Bridge

This possibility has been considered in the definition of scenarios, so two main scenarios have been assessed according to the criteria of including or not the traffic passing from and to India.

- Scenario without Indian passing traffic.
- **Scenario with Indian passing traffic.**

In the following image the traffic summary for the base year is presented. Note that the traffic generated as a result of an additional GDP increment is 0, since there has been no increase in GDP in the base year.

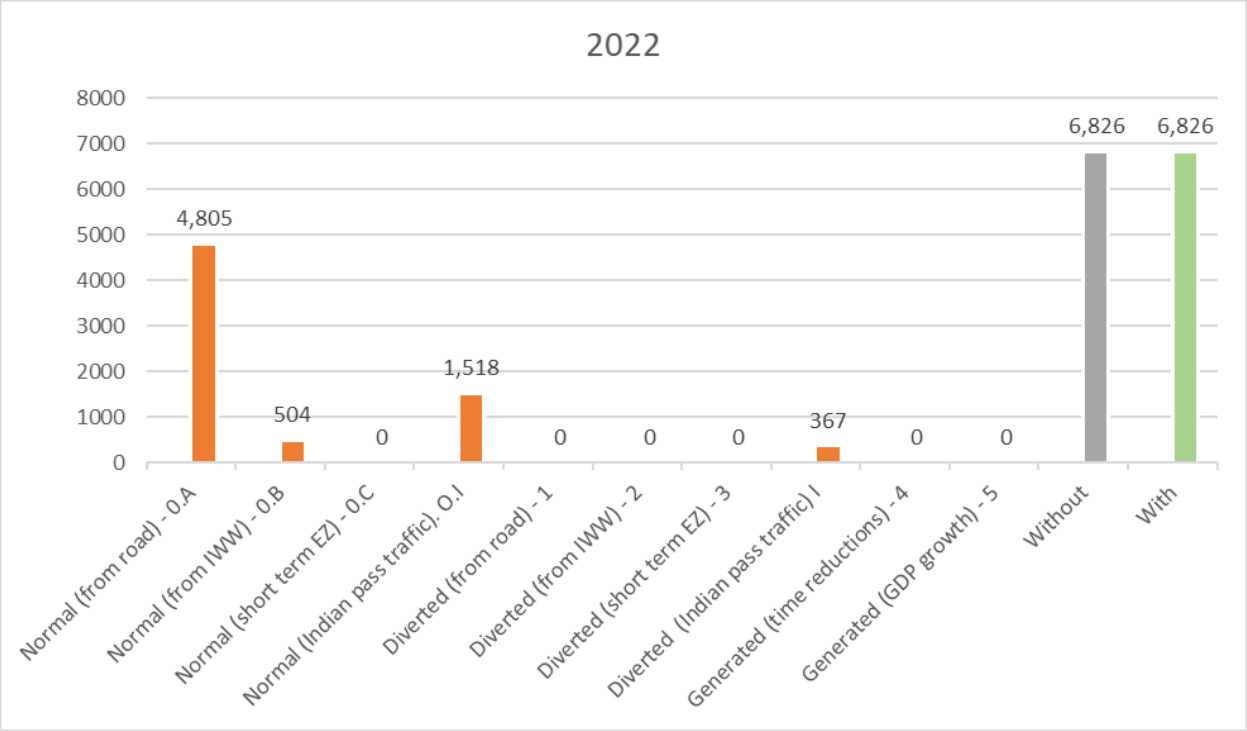


Figure 12. Summary of the base year traffic

Traffic Forecast

The forward traffic estimation outcome is derived 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 3. Daily traffic volumes by kind of traffic – With Indian traffic

Year	Normal traffic – without project					Diverted			Generated			With project
	Road	IWW	EZ	Indian passing traffic (road)	Total Without Project (Normal traffic)	From road	From IWW	Indian passing traffic (road)	From EZ	Road – due to time reduction	Due to additional GDP increment	TOTAL
2022	4,805	504	0	1,518	6,826							
2025	5,748	603	0	1,711	8,061							
2030	7,817	820	8	2,072	10,716	1,417	164	1	125	257	13	12,693
2035	10,151	1,064	8	2,436	13,659	7,361	851	4	589	1,334	412	24,210
2040	12,643	1,325	8	2,790	16,767	9,168	1,060	4	675	1,661	969	30,304
2045	15,204	1,594	8	3,126	19,932	11,024	1,275	4	757	1,997	1,746	36,735
2050	17,748	1,861	8	3,440	23,057	12,869	1,489	4	832	2,332	2,610	43,193
2055	20,209	2,119	8	3,726	26,062	14,654	1,695	4	902	2,655	2,972	48,943
2059	22,081	2,315	8	3,936	28,340	16,011	1,852	4	952	2,901	3,247	53,307

Table 4. Daily traffic volumes by type of vehicles – with Indian traffic

	Without project					With project				
	Motorcycles	LPV	Buses	Trucks	Total without project	Motorcycles	LPV	Buses	Trucks	Total with project
2022	1,088	1,581	2,337	1,820	6,826					
2025	1,302	1,839	2,789	2,132	8,061					
2030	1,773	2,377	3,778	2,789	10,716	1,978	2,658	4,368	3,690	12,693
2035	2,301	2,958	4,889	3,511	13,659	3,456	4,411	8,083	8,260	24,210
2040	2,866	3,561	6,072	4,268	16,767	4,422	5,374	10,225	10,284	30,304
2045	3,445	4,167	7,287	5,033	19,932	5,468	6,360	12,503	12,404	36,735
2050	4,022	4,759	8,492	5,785	23,057	6,532	7,333	14,801	14,526	43,193
2055	4,579	5,323	9,657	6,504	26,062	7,437	8,231	16,838	16,438	48,943
2059	5,003	5,747	10,542	7,048	28,340	8,125	8,908	18,386	17,888	53,307

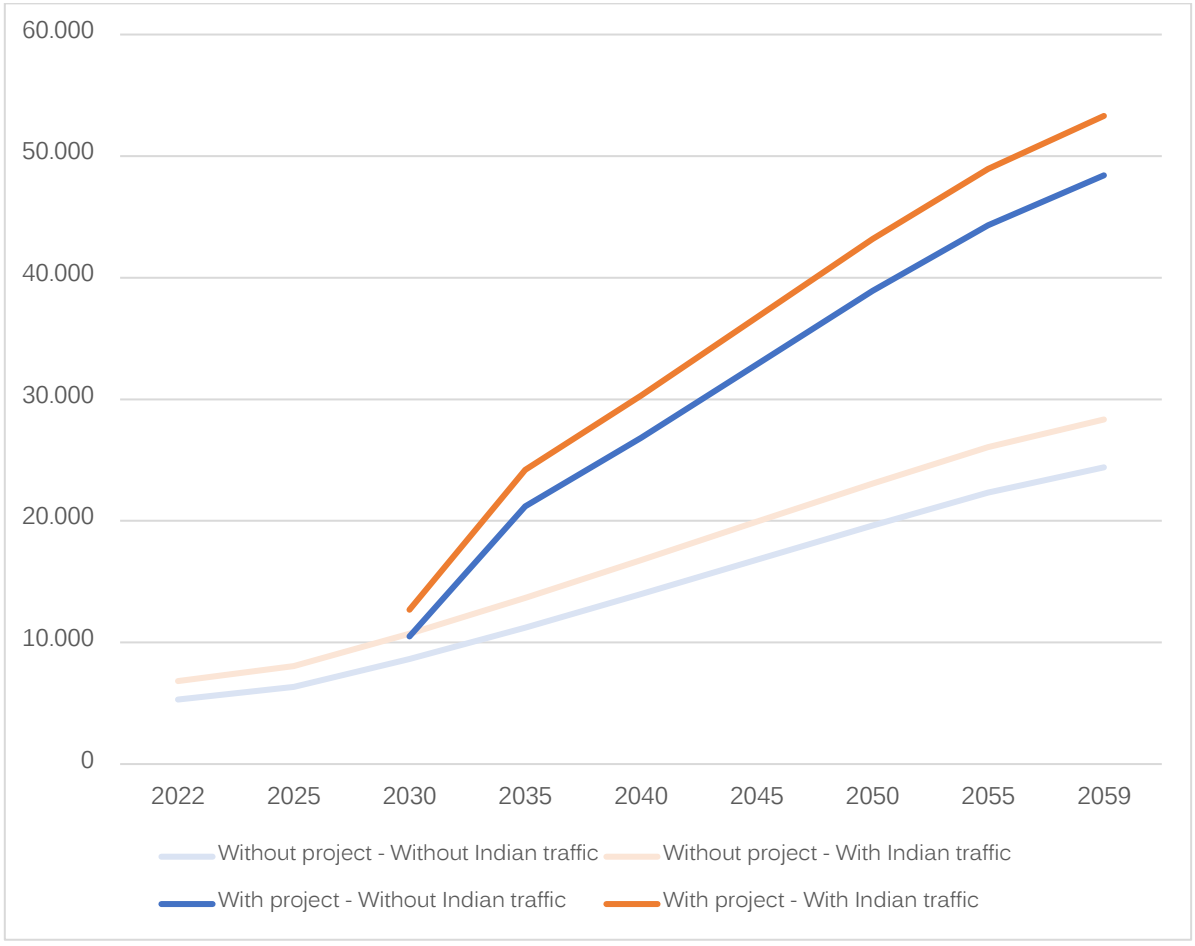


Figure 13. Daily traffic volumes by scenario

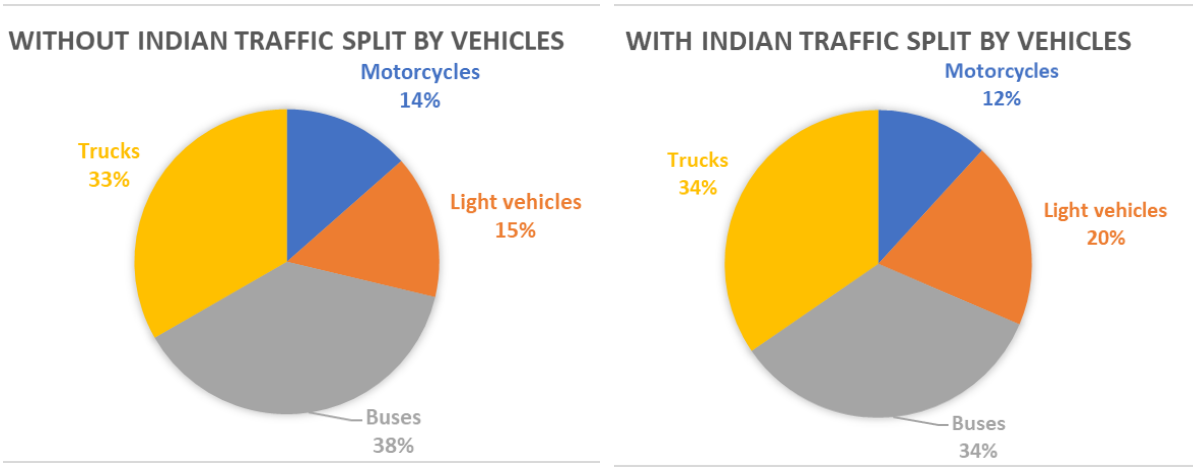


Figure 14. Split by type of vehicles

Expected daily Fuel and Time Savings

The fuel and time saving analysis summarizes some of the main key positive impacts of the proposed infrastructure. Comparison has been compared versus the base year data.

The analysis has been carried out for 2,197 vehicles analysing three scenarios.

¿Why 2,197 vehicles? Because 2,197 is the number of vehicles per day that currently, nowadays, would save "time" if the bridge was built. It is assumed that, at least, 2,197 vehicles would use the bridge.

Table 5: Project's savings fuel-time

KM	Motorcycles	LPV	Bus	HGV	Total
Current Situation	129,046	61,914	259,552	407,522	**858,033**
With Project	45,668	61,476	251,937	394,282	**753,363**
Distance Savings (KM)					
Current Situation - With Project	83,378	438	7,615	13,240	**104,671**
Consumption l/Km	**0.02**	**0.07**	**0.25**	**0.25**	
L (eq) saved (per day) Current Situation - With Project	1,668	31	1,904	3,310	**6,912**

Hours	Motorcycles	LPV	Bus	HGV	Total
Current Situation	5,018	5,349	168,383	9,416	**188,165**
Time Savings					
Current Situation - With Project	3,466	538	18,568	612	**23,183**

Please note that the hours displayed above represent the total time (in hours) spent traveling by the passengers. Consider the following occupancy (passenger/vehicle):

Motorcycles	2
LPV	4
Bus	28
HGV	1

Constraints

- Some improvements and refinement are being made in the transport model considering a more detailed and complete social data. This may end in some changes in the traffic demand forecast.
- As said before, the without project scenario is one where some committed projects are built.

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 6: Project's SWOT

Strengths	Weaknesses
▪ Local government and citizen's willingness and support to the project. ▪ National interest project, long-time expected. ▪ Previous expertise in similar projects as Padma Bridge by the promoting agency BBA. ▪ It appears to be interest and availability of potential contractors and funding agencies.	▪ Impact on land acquisition and resettlement. ▪ High-cost financing challenge. ▪ Remote area from the capital Dhaka, and distance to some supply of materials source.
Opportunities	**Threats**
▪ To improve national transportation network in a currently weakly-connected area. ▪ To connect remote and isolated locations. ▪ To facilitate international and in-country road corridors for the movement of people, goods, and services. Economic Corridor EC4 (Dhaka-Rangpur-India) ▪ To increase trade at the local and regional levels. ▪ Overall improvement to the environment and public health. ▪ To contribute to local economic development and generation of employment for the people. ▪ Benefits social and economic for the population of Kurigram District. ▪ To foster sustainable decentralization, regional and resilient climate-adaptive development	▪ Occurrence of climate change-related and other natural hazards. ▪ Environmental risks as: ▪ Air and noise pollution may have some negative impacts on the environment. ▪ Disturbance to the movement of vehicles and pedestrians may occur during construction. ▪ Excavation may result in sediments reaching watercourses. ▪ Achieving the funding goals. ▪ Achieving the project construction timeline and minimizing the cost deviation may be a challenge. Remoteness, complex and big infrastructure project.

Source: Consultant Team

4. TECHNICAL AND ENGINEERING ANALYSIS

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

4.1. Location of the Alignment

As stated previously, the feasibility study of for a bridge over Brahmaputra River at Chilmari-Rowmari Road at Kurigram District is proposed in the upstream of Teesta River confluence, connecting Chilmari in the right bank and Rowmari in the left bank.

The selection of the right site for the proposed bridge is a crucial decision for the success of the project. The Consultant, based on the recommendation and assessment carried out by the IWM (Institute of Water Modelling) and after studying several factors which were the basis of the multicriteria analysis, ended up with the conclusion for the alignment selection. Several detailed reconnaissance visits were undertaken where the various physical, economic as well as social aspects were examined with extensive interaction with local officials as well as residents. The Consultant proposed a group of four alternative locations (Option A, Option B, Option C, Option D), as shown in the Figure 15 below, to finally propose the preferred one: **Option Alignment D.**

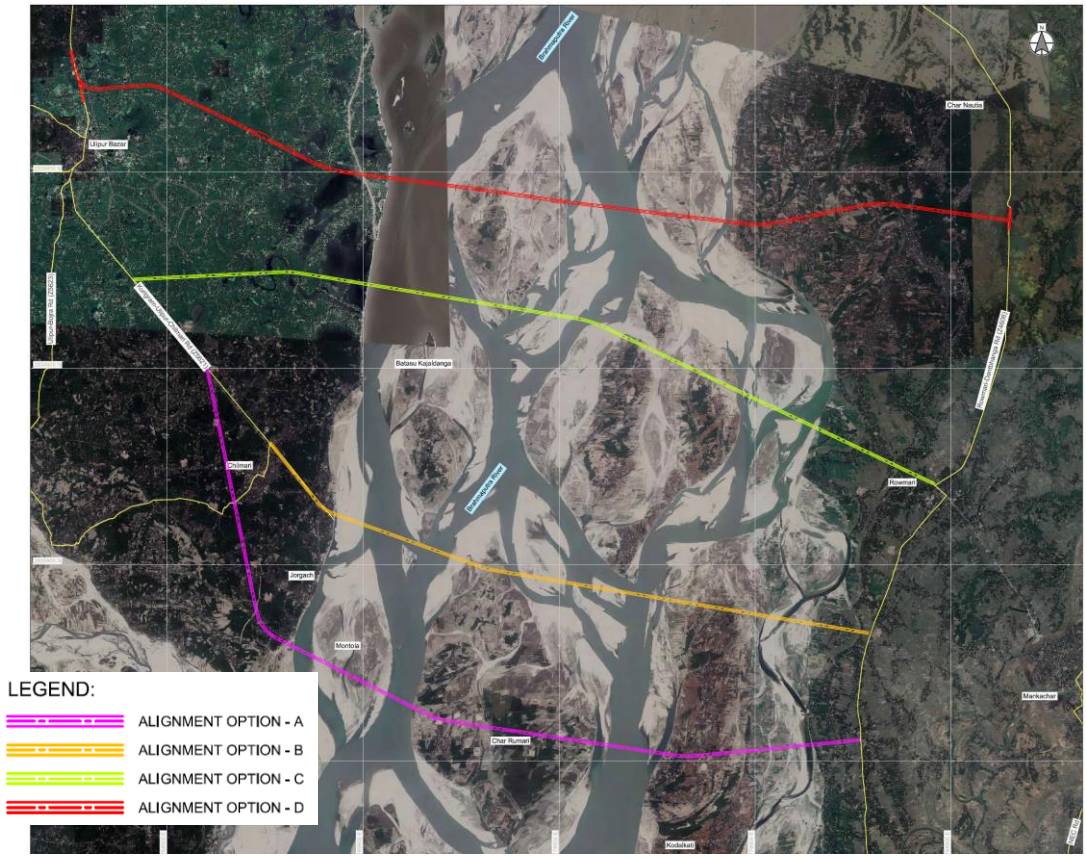


Figure 15. Chilmari-Rowmari Bridge Alternative Alignments

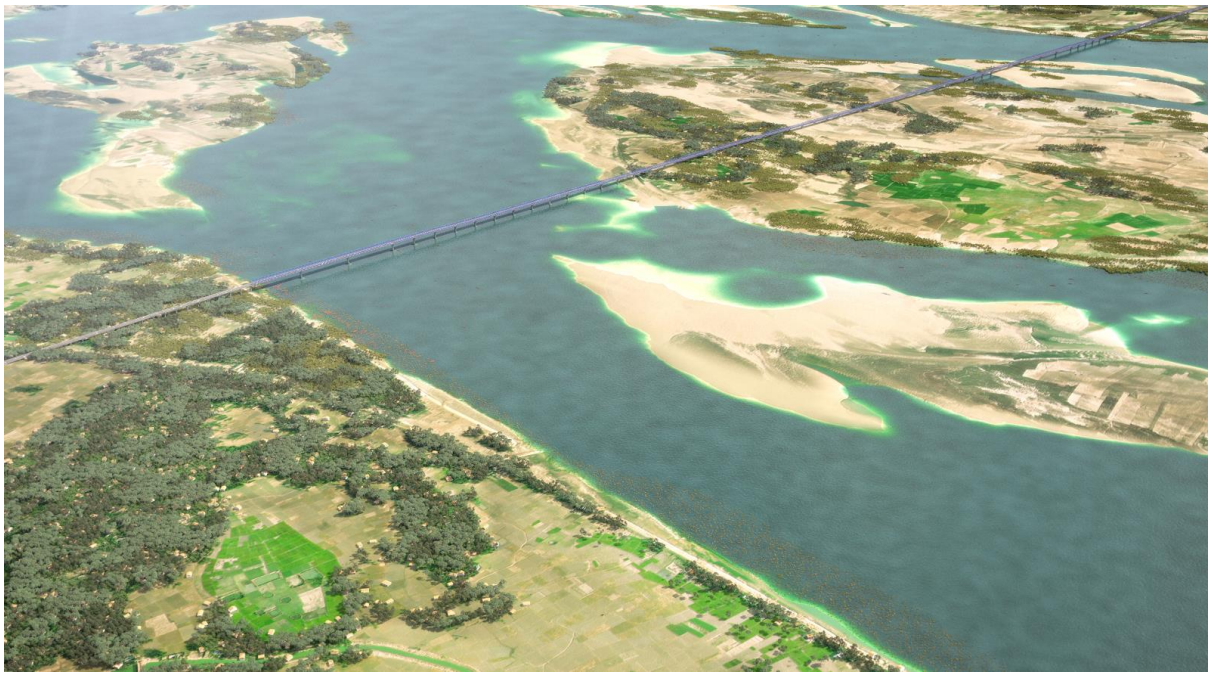


Figure 16. General view of the bridge area and char lands

4.2. Technical design

The Consultant has carried out the assignment in accordance with international practice and procedures. However, reference was made to practices followed in Bangladesh and the established standards and procedures of Roads and Highways Department (RHD). The principal International and RHD Standards adopted are:

- 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 (Edition 2021)".

Road Geometry and Design Standard

The geometric design of the approach roads conforms to the following requirements:

Table 7. Summary of roads and highways parameters

DESIGN STANDARDS			
Design Elements	Unit	Design Parameters	Reference (AASHTO, RH, Roade Notes, IRC
Design Speed	KM	80	RHD Table 2.2 page-05
Minimum Stopping Sight Distance for Crest & Sag Vertical Curves	m	120	RHD Table 2.3 page-06
Cross-Sectional Elements			
Lane Width	m	3.65	RHD Table2.1 page-04
Outer Shoulder Width	m	1.5	RHD Table 2.1 page-04
Minimum Inner Shoulder Width	m	0.5	RHD Table 4.13 pages-72
Minimum Median Width with Barrier	m	3.5	RHD Table 4.12 pages-70
Cross fall of Shoulder	%	3%	RHD Table 4.7 pages-17
Cross fall of Shoulder soft	%	5%	RHD Table 4.7 pages-17
Horizontal Alignment			
Minimum Radius	m	500	RHD Table 5.1 pages-75
Maximum Super Elevation	%	5%	RHD Table 5.2 pages-75
Length of Tangent Runout	m	55	RHD Table 5.3 page-76
Vertical Alignment			
Crest Vertical curve	m	35	RHD Table 6.1 page-82
Sag Vertical curve	m	26	AASHTO

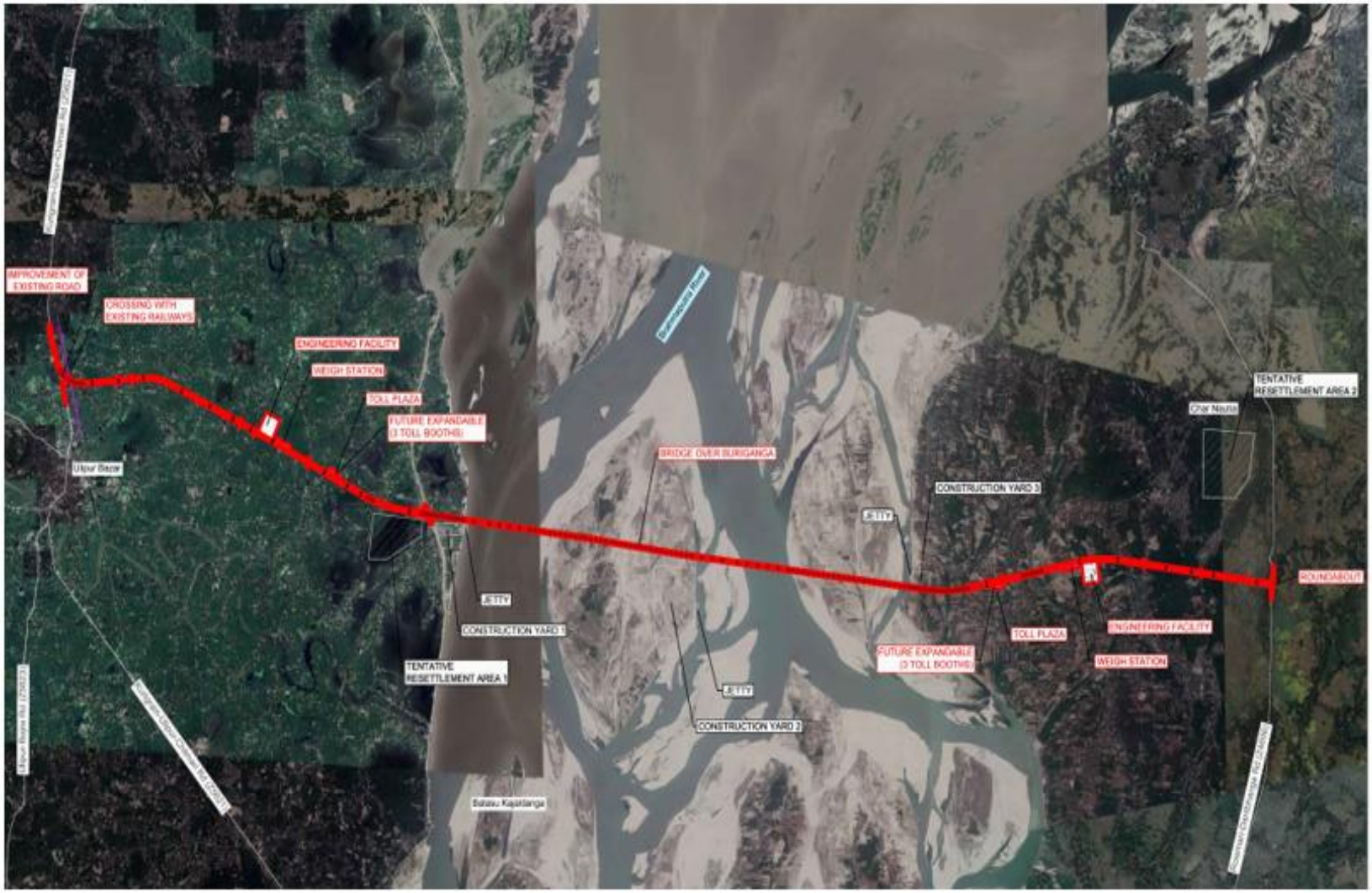


Figure 17 Complete Alignment of the proposed project

4.3. Proposed Engineering Solution

As shown in Volume 5, the optimum and preferred proposed alignment option in terms of total project estimate is **Alignment Option D**. Also, among the different technical bridge solutions that were analysed for the Alignment Option D, when considering the construction period and all factors, was the one called D.1-I: Truss bridge with typical spans of 100 m and 200 m and access bridges of precast I beams with 40 m spans and a total bridge length of 10,780 m (8,900 m of Truss Bridge plus 1,880 m of Approach Viaducts).

Figure 18 Aerial image of the proposed Bridge at Chilmari-Rowmari.

The foundation of the piers for the main bridge, which are planned to be executed mainly in the dry area for the 100 m spans but in wet conditions for the 200 m spans, are planned with 6 steel driven piles Ø2.5 m of 80 m in length for the 100 m spans and 12 steel driven piles Ø2.5 m of 80 m in length for the 200 m. 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 back approach viaducts, the foundations include Ø1.8 m bored reinforced concrete piles.

The approach viaducts for the solution which deemed most suitable according to the described criteria, include precast beams I beams. From a feasibility study point of view, the difference in cost and programme between the two precast solutions considered for the access spans ("I" beams and "U" beams) is small. This could lead to the U beams being the preferred option during detail design or construction stage.

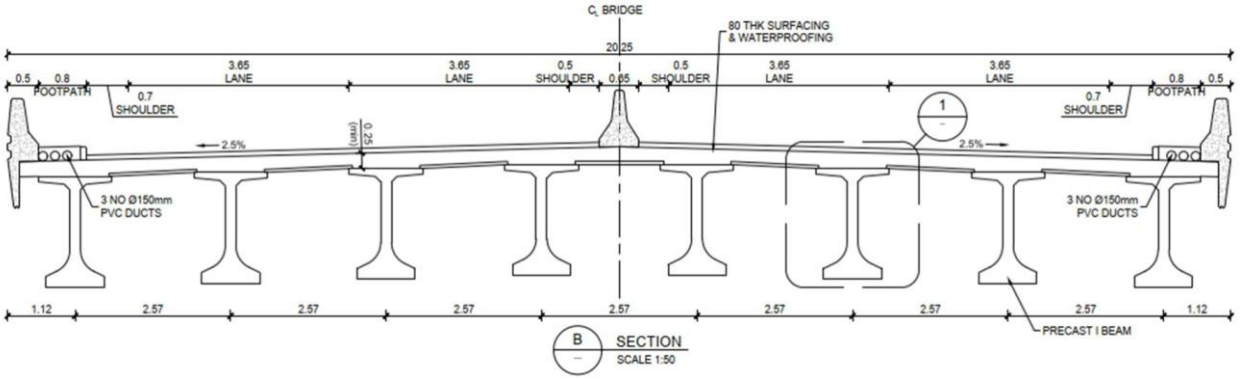


Figure 19 Typical cross section of access spans for the bridge.

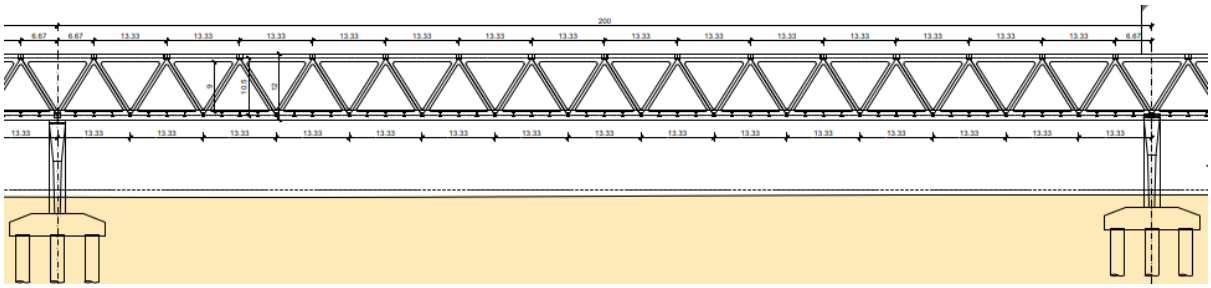


Figure 20 Elevation of the 200m span trusses for Chilmari-Rowmari.

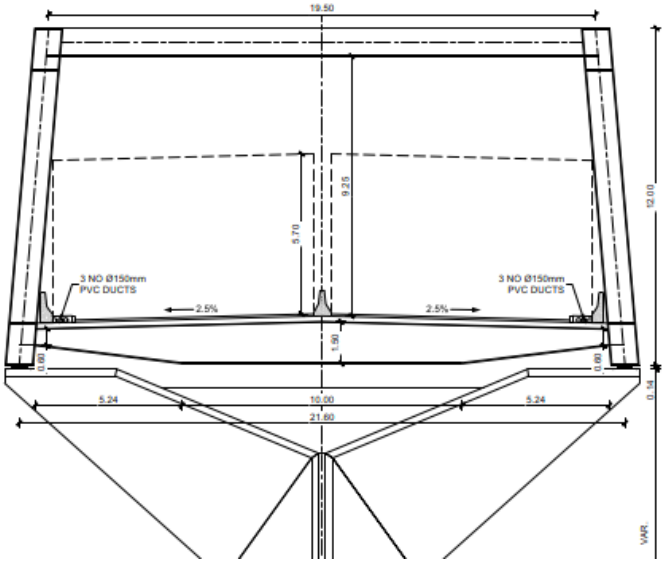


Figure 21 Typical cross section of the 200m span trusses for Chilmari-Rowmari.

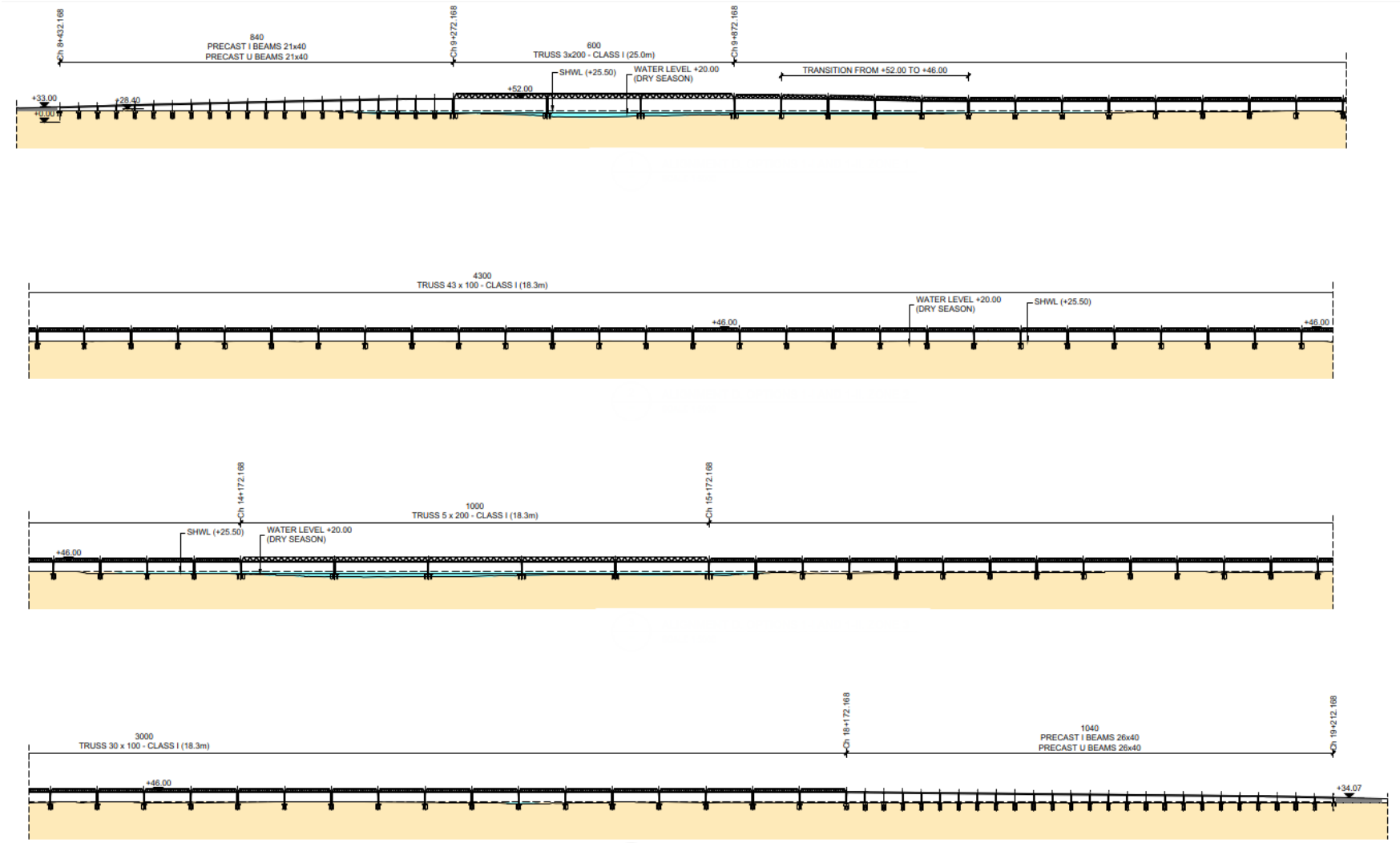


Figure 22. Elevation of the bridge

Table 8. Stretches of the bridge

	Stretch	Navigation class	Type	Spans (No x length)	Length (m)
1	Stretch	Navigation class	Type	Spans (No x length)	Length (m)
2	Approach bridge		Precast I-Beams	21 x 40	840
3	**Main Span**	**Class I**	**Steel truss**	**3 x 200**	**600**
4	Intermediate Spans	Class I	Steel truss	43 x 100	4,300
5	**Main Span**	**Class I**	**Steel truss**	**5 x 200**	**1,000**
7	Lateral Spans	Class I	Steel truss	30 x 100	3,000
				TOTAL LENGTH (m)	10,780

Figure 23. General view of the proposed bridge at Chilmari-Rowmari

Figure 24. Image of the proposed bridge from the vehicle's perspective

4.4. Hydro-morphological study summary

Bangladesh is a riverine country with enriched natural resources. People are directly or indirectly dependent on the rivers of this country. River plays a vital role in the livelihood pattern of the people who are mostly influenced by the rivers. So, morphological characteristics of these rivers are very important issues for the life and livelihood of people. The most influential single phenomenon to have deep impacts on its culture and economy is the river system. Ironically, these rivers bring along the perennial threat of floods and riverbank erosion. Riverbank erosion is an endemic and recurrent natural hazard in Bangladesh. In a typical year, about 2,400 km of bank line experience major erosion.

Due to flat terrain and dense population, the Bengal Delta is highly vulnerable to sea level rise. At present the delta building process is active in the Meghna estuary. Each year the rivers of Ganges, Jamuna (lower reach of the Brahmaputra) and Meghna transport more than one billion tonnes of sediment from their catchments in India, China, Nepal, and Bhutan to the delta region.

The hydro-morphological assessment of this project, involving the selection of the optimum alignment, has been carried out by the Institute of Water Modelling (IWM).

To achieve the goals in relation to the hydraulic design of the Chilmari Bridge following steps have been taken.

- Collection and Compilation of data and information from different sources mainly from IWM Archive, BWDB, BIWTA. These data included:
    - Bathymetry data of the Brahmaputra-Jamuna River.
    - Water level data at Noonkhawa, Chilmari, Kamarjani.
    - Historical Cross-sectional data of the Jamuna River.
- Primary data collection including bathymetry survey, char survey, water level and discharge and sediment measurement.
- Frequency analysis of the flow data corresponding to different intensity and desk analysis of water level data to determine 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.
- Development of two-dimensional (2D) model covers 35 Km long stretches of the Brahmaputra-Jamuna River, starting at the immediate downstream of Dharla River outfall and ended at 12 Km downstream of Teesta River outfall.
- 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.
- Results from with and without bridge condition has been used in calculating local scour around the bridge pier using different empirical formula. Brahmaputra-Jamuna River is characterized with general scour, found from model, varies in the order of maximum **30.23 m.**
- 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. In light of past experience and observing the historical bank erosion pattern, it has been recommended to use two guide bundhs 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 Left Guide Bund (LGB) is considered about 8 Km, and the length of Right Guide Bund (RGB) is about 6 Km. The location of these guide bunds is shown in Figure 25.

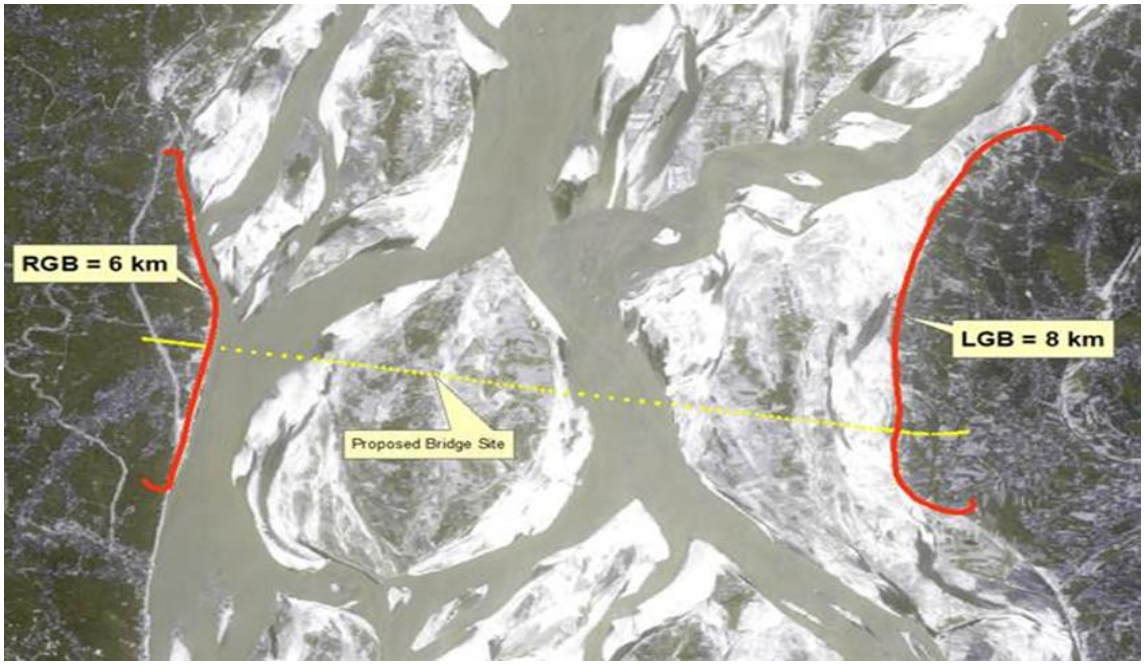


Figure 25. Bank Protection Works along both banks of Brahmaputra-Jamuna River

Table 9. Summary of hydraulic variables

Hydraulic Parameters	Magnitude	Source
Design Discharge, m3/sec	105,429	Generated from rating curve
Observed High Flood level, mPWD	25.85	Sloped from observed WL of Chilmari station
SHWL, mPWD		
Observed Low water surface level, mPWD	17.38	Sloped from observed WL of Chilmari station
SLWL, mPWD	17.44	
Lowest Bed Level, mPWD (1998)	-19.46	2D Model Simulated
Observed lowest bed level (2022),mPWD	10.77	Surveyed data (2022)
General Scour level, mPWD	30.23 m	2D Model Simulated
Constriction Scour, m	4.03 m	2D Model Simulated
Local Scour, m	16.98	Using FHWA equation using variables from 2D model and observed data
Design Scour, m	51.24	

4.5. Geotechnical study summary

A geotechnical investigation provides a baseline to understand the physical soil conditions of a site will enable the predesign approach and construction recommendations for future phases of a project. Information gathered during geotechnical investigations is vital for making the optimum technical decisions on the type of foundations and on the entire structural analysis.

The purpose of carrying out this geotechnical investigation carried out, has been to obtain soil and sub-surface ground data for the design of the Chilmari-Rowmari Bridge and have been undertaken along the bridge alignment and the nearby banks.

The main objectives of the geotechnical investigations were to determine:

- The presence of soft silts and clays on the riverbed.
- The geological stratification along the alignment.
- The thickness and distribution of the various riverbed sediment layers.
- The engineering properties of each soil type for the purpose of designing works of the bridge.

The Geotechnical Investigation of this study was completed by subcontractor, DCL including 10 boreholes (RBH-1 to RBH-10) and the excavation of 17 trial pits (CRTP-1 to CRTP-17) during the period between February 24th, 2022, to June 8th, 2022.

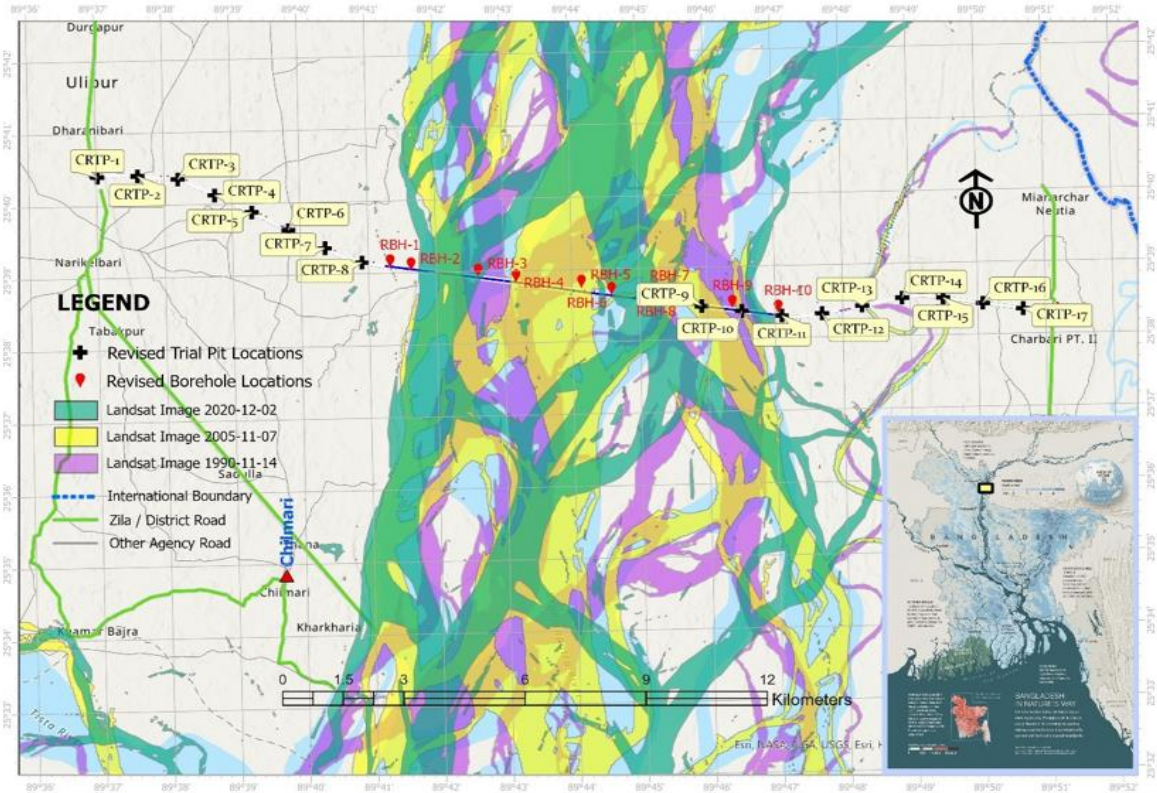


Figure 26. The location of soil investigation campaign

Table 10. Summary of soil investigations

Type of Investigation	Quantities	Depth (m)
Boring	10	80-120
Trial Pit	17	2

The sub soil deposits comprise of cohesionless layers from existing ground surface up to the end of borehole (max. 120m depth) as encountered in all ten boreholes. The soils are non-plastic from very loose to loose sand near the surface (layer 1) & strengthen in deeper depths to very dense soil (layer 4). Furthermore, comparatively high content of mica was observed; it was evaluated to range from 5.71% to 10.72 %. The layers of cohesionless soil (Layer 1, 2, 3 and 4) consist of various types of sand with some silt (SM)/ SP/(SP-SM) including mica content.

Pile bearing capacity of Chilmari-Rowmari has been estimated according to the guidelines of AASHTO-2020 LRFD specifications. The pile bearing capacity have been calculated with depth and various pile diameter depend on the pile type of large diameter cast in situ bored and large diameter steel pipes driven piles.

Engineering characteristics of the surface ground were identified loose sand based on the geotechnical investigations and laboratory test results. The settlement analysis of typical embankment section carried out using Plaxis-2D. The immediate maximum settlement was calculated as 210 mm. It was recommended that the ground improvement treatment method has been selected as the excavation and replacement method with compacted acceptable fill.

4.6. Approach Road and Structures

The four-lane approach road has been designed primarily as per RHD standard supplemented by AASHTO.
specifications where needed. The design envisages a four-lane dual carriageway with an unpaved median of 3.5 m. The approximate length of the project is 25.236 Km, including the bridge, the viaducts and the connecting roads. The geometric design has been developed for a speed of 80 kph. 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.

Salient elements of the project are as follows:

- **General data:**
    - **Bridge**
        - Total bridge Length:10,780 m.
        - Truss Bridge length:8,900 m.
    - **Approach road length**
        - At Chilmari end: 8,432 m.
        - At Rowmari end: 6,004 m.
    - Improvement of existing roads
        - Kurigram-Ulipur-Chilmari (R562): 450 m.

        - Jamalpur-Rowmari Road (R464): 570 m.
    - Total project length including the existing improvement length: 26.26 Km.

- **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 (3.5 m wide).
    - 2-Service Road Lanes 5.5 m, plus 1.5 m outer soft shoulder and 0.50m 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.
    - Intersections at Chilmari-Rowmari ends for connection with existing roads (elevated structure crossing over the existing railways track and a direct at grade junction at connection with Kurigram-Ulipur Road (R562) and a roundabout at connection with Rowmari-Rajibpur (R464).
    - 2 Toll Plazas at both ends (7 toll booths plus the reserved areas for 3 future ones).
    - 2 Axle Load Stations and Service Yards at both Chilmari-Rowmari ends.
    - 2 Service Area and Engineering Facilities.
    - Overpass on the existing rail track at Chilmari end.
    - Underpass of the existing local roads.
    - Box culverts at locations as drainage structures.

- **Cross section for the Bridge**

    - Total width of Bridge: 20.25 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.

4.7. Cost estimate

The cost estimate for the preferred solution has been estimated as follows:

The project cost is based on several sources, mainly RHD Schedule of Rates (2023), Public Works Department (PWD) (June 2022) and Bangladesh Water Development Board (BWDB) (September 2022), but also by benchmarking from current market rates analysis and from previous feasibility studies implemented by the BBA in recent years. The total Estimated Project Cost (Construction) has been estimated as 23,699.08 Cr BDT as detailed below.

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

Table 11. Summary of Preliminary Cost Estimation

No.	Item	Amount (BDT)	Amount (Cr BDT)	Amount (Million USD)
1	General and Site Facilities	4,186,622,852	418.66	41.87
2	Main Span	109,855,970,020	10,985.60	1,098.56
3	Approach Spans	7,361,811,985	736.18	73.62
4	Approach Road including small structures	15,809,621,408	1,580.96	158.10
5	Toll Plaza & Engineering Facilities	5,403,147,481	540.31	54.03
6	Bank Protection Work	55,032,607,384	5,503.26	550.33
(A)	**Subtotal**	**197,649,781,130**	**19,764.98**	**1,976.50**
(B)	Provisional Sum for Physical Contingency = 3% of (A)	5,929,493,434	592.95	59.29
(C)	**Sub Total (A+B)**	**203,579,274,563**	**20,357.93**	**2,035.79**
(D)	Provisional Sum for Price Contingency = 6% of (C)	12,214,756,474	1,221.48	122.15
(E)	Engineer's Estimate = (C+D)	215,794,031,037	21,579.40	2,157.94
(F)	**Land Acquisition and Resettlement Costs**	**7,361,277,829**	**736.13**	**73.61**
(G)	Design Cost = 2% of (A)	3,952,995,623	395.30	39.53
(H)	Construction Supervision = 5% of (A)	9,882,489,056	988.25	98.82
(I)	Project Estimate = (E+F+G+H)	236,990,793,545	23,699.08	2,369.91

(Based on 1 USD = 100 BDT according to selling rate of Bangladesh Bank on 2nd November 2022)

4.8. Implementation timeline

The considered implementation timeline for the project, in accordance with the criteria based on other recent studies undertaken by the Consultant and after conversations held with BBA officials has been estimated as follows:

PRE-CONSTRUCTION PHASE

- FS process and GOB's Approval of the Project (Years 2023 - 2024)

INVESTMENT PERIOD (BEFORE OPERATION): 5Y

- Starting year of investment: Y1 = January 2025.
- Financial Arrangement.
- Project Detailed Design Phase: **9 months.**
- RAP and LAP implementation phase: **12 months.**
- Main Contractor Tender Process: **3 months.**
- **Construction period** including Testing and commissioning: **54 months**.
  Starting of construction: Y1 + 1/2 Y2 = July 2025.
  Finishing year of construction (54 months) including T&C: Y5 = December 2029.
- Defects Notification Period (DNP 1 year) January 2030 to December 2030.
  OPERATION PERIOD: 30 Y = January 2030 to December 2059.
- **TOTAL PROJECT PERIOD: 30 + 5 = 35 Y**

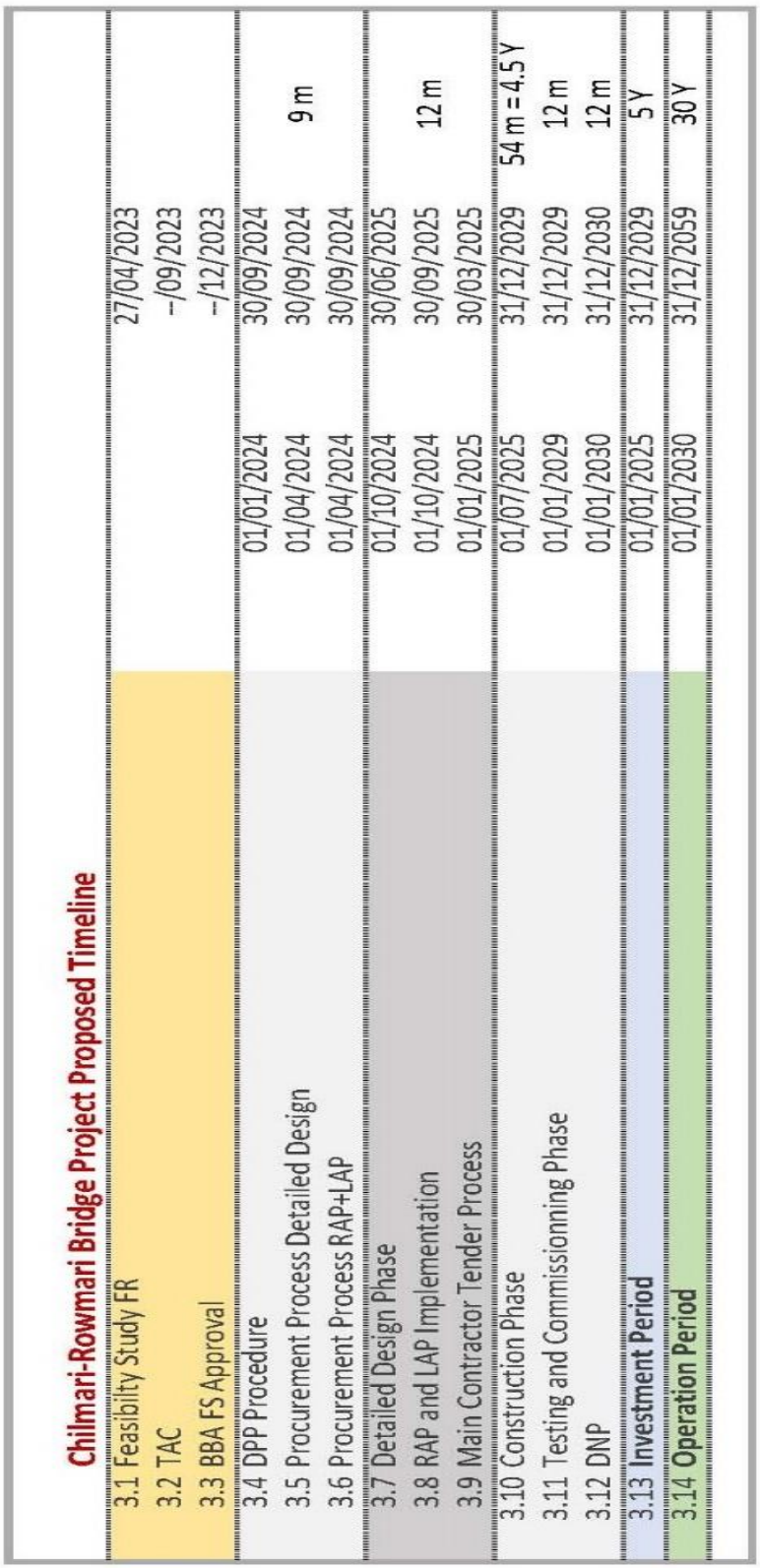


Figure 27. Project proposed implementation timeline.

5. ENVIRONMENTAL SUSTAINABILITY, CLIMATE RESILIENCE AND DISASTER RISK ANALYSIS

5.1. Environmental Assessment Considerations

The Chilmari-Rowmari Bridge has been proposed to be constructed over the river Brahmaputra in between Chilmari-Ulipur and Rowmari of Kurigram District. The project comprises three major components: a bridge with total length of 10.80 Km with a four-lane approach road of 8.43 km toward Chilmari-Ulipur and 6.00 km towards Rowmari side. The project also would require the improvement of existing roads Kurigram-Ulipur-Chilmari (R562) 450 m, Jamalpur-Rowmari Road (R464) 570 m, being the total project length including the existing Improvement length 26.26 km.

The environmental issues pertaining to the project have been incorporated properly in the design and assessed to incur benefits from the project by enhancing the environmental positive impacts and offsetting the negative impacts.

The Initial Environment Examination (IEE) / assessment for the proposed project has been carried out through the following methodologies: screening of the significant environmental impacts, assessing them, enhancing the positive impacts, and recommending the mitigation measures for the negative impacts. These have been done based on available secondary data, field data and discussion with the project affected peoples (PAPs). On the basis of the impact assessment, it is observed that the project has positive impacts mainly on commercial facilities, industrial activities, job opportunities, landscape and professional diversity, and some negative impacts mainly on noise, erosion and siltation, housing and commercial structures loss as well as community split. Environmental Management Plan (EMP) has been proposed to minimize the negative impacts and achieve sustainable bridge project.

Asian Development Bank (ADB), World Bank (WB), Department of Environment (DoE), Roads and Highway Department (RHD) and Local Government Engineering Department (LGED) guidelines have been followed for IEE preparation of the proposed Bridge Projects. Checklists for IEE have been completed and found no significant negative environmental impacts due to the project.

It should be mentioned that as per Environment Conservation Rules (ECR), 1997 of DoE, GoB, construction / reconstruction / extension of bridges with length of 100-m or more is included (under item 68) in the list of Red Category of projects. The proposed bridge would be having length of more than 100-m in each instance, so is in red category as per DoE, GoB and require environmental Clearance from DoE.

It has been estimated that circa 2,042 acres of land would be required for the project. Of the total land, 401.3 acre would be required for Right of Way. Additional 1,641.13-acre land would be required for other Project relevant interventions. It was estimated that, 390.72-acre land would be required for two resettlement areas, 271.40-acre land would be required for three construction yards and 979.00-acre land would be required for River Training Work on both side of the river. total 492 project affected units including 481 HHs and 11 CPRs would be affected by losing their immoveable assets. Apart from the primary structures a significant quantity of secondary structures would also be affected. The

assessment was also identified that 158 business premises including running business would be affected by the project interventions.

A total of 32,466 nos. of trees including new plantation as saplings are going to be affected due to the project. This loss can be mitigated by plantation of 192,541 tree saplings and 1,154,880 Vetiver roots on embankment slopes and other vacant lands which would enhance the environmental condition of the area.

No highly significant negative environmental impacts are expected during the construction period of 54 months except the normal construction hazards. However, during construction close monitoring would be ensured over the following issues: interruption of traffic, contamination of surface and ground water, disruption of drainage, pollution of air, noise and soil, disturbance of wildlife mainly water birds and reptiles, aquatic life, health and sanitation hazards and social disruption including split of communities.

The impacts during construction can easily be mitigated by taking advance adequate precautions and some additional measures appropriate to the construction. An Environment Management Plan (EMP) has been formulated to control/mitigate the negative impacts arising from construction related activities. Contractors would be directed to follow the suggestions mentioned in Chapter 7 and 8 of the Environmental Assessment Plan (Initial Environmental Examination) Report. Supervision consultants would check and ensure that EMP is working well according to the plan.

The impacts associated with the change in landscape after the construction of the project can be negative unless proper landscape plan is formulated by the government and adhered to. The impact on housing and commercial structures can be compensated by providing adequate compensations and alternative job opportunities as proposed in Resettlement Action Plan (RAP) of the project.

Environmental risk and disaster assessment has been conducted for the Chilmari-Rowmari Bridge Project. It was found that, all the measures needed to protect the bridge and approach road from the impact of Climate change and disaster has been incorporated in design hence the impact of the environmental risk and disasters were found to be low in nature.

The impacts after construction of the project, unless regulatory measures are taken in time, would be uncontrolled settlement, environmental pollution from industries and innumerable places of possible access to the road leading to traffic congestion and hazard. It would, therefore, be desirable to institutionalize some form of effective control on the growth of settlements on the Right of Way (RoW) land. One of the measures could be to have an exclusion zone up to a certain distance, say 100 m on each side of the road where no structure would be allowed to be erected and no access from any individual property would be allowed directly on the land considering future expansion of road.

It may, therefore, be concluded that the proposed Chilmari-Rowmari Bridge Project would be environmentally sound and sustainable. Furthermore, in the context of the Project, aggregated positive impacts would outweigh the negative impacts through the recommended mitigation measures.

5.2. Environmental and Social Risk Assessment

Environmental & 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 of internal risk assessment documentation, guided the risk assessment.[2]

Individual risks are identified through:

- Considering proposed project elements in relation to the project setting
- Making use of the expert's knowledge and experience from the operation of the existing bridge, as well as the experience of the study team with other similar projects
- Feedback from stakeholder consultation and
- Considering the preliminary risks identified in the Environmental Impact Assessment (EIA) as well as Social Impact Assessment (SIA).

Risks are systematically identified considering the full range of project activities in relation to individual aspects of the existing environment and socio - economics. The following social and environmental studies conducted under the Project are used for scoping analysis:

- Social and Resettlement
- Environmental quality (water, noise, air, riverbed material)
- Aquatic life and fish
- Flora and fauna
- Wildlife
- Land use.
- Char land.
- Topography, geology, and hydrological modelling
- Climate change.

[2] 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.

5.3. Risk/Impact Matrix for Proposed Infrastructures

Table 12. Risk Matrix Assessment

Sl. No.	Activities	Impacts	Negative		Mitigation Measures
			Short Term	Long Term	
A	**Pre-Construction Phase**				
i	Land Acquisition for site, access road and utility. supply system	Change in land use pattern		√	A Land Acquisition plan (LAP) will have to be prepared for proper compensation for land loss and rehabilitation of the Project Affected Persons (PAPs) according to GoB rules and regulations as well as other relevant guidelines. A Resettlement Action Plan (RAP) will be prepared for proper resettlement of the affected people. About 461 households will be involuntarily resettled. However, there will also be a high positive impact since all the affected people will be shifted to 'Resettlement Sites' that will cater to all infrastructure facilities including environmental sanitation and health
		Impact on livelihood		√	All direct income loss must be adequately compensated within the RAP. Moreso, income loss can be mitigated by providing alternative job opportunities for PAPs. Due to the nature of their profession, the fishermen should be rehabilitated as near as possible to the riverbank. A fish landing site should be incorporated in the design of the RTW. Alternative job opportunities should be arranged specially for the affected persons during the construction of the project.
		Shifting of utilities	√		Adequate protection (vertical clearance) for electric transmission line as per EE Rules 20203 and for telecommunication line culvert to be constructed for insulation of the pipelines.
ii	Site Preparation	Removal of vegetation.		√	This is a permanent ecological loss. Steps should be taken to convert the unplanted/unused lands in the vicinity into agricultural land

[3] *Bangladesh Gazette: November 4, 2020; page 11246*

Sl. No.	Activities	Impacts	Negative Impact		Mitigation Measures
			Short Term	Long Term	
		Impact on aesthetic aspects		√	Alternative locations and facilities should be provided for the cultural infrastructure such as family graves/graveyards, educational institutes, mosques/ temples, burning yard. However, if the relocation takes place before the establishments are broken down, then this will help to reverse many negative impacts.
		Impact on ecosystem		√	To compensate for the loss of trees, the project will provide opportunities for new plantation. A buffer strip of 20-meter width for RTW has be planned for tree plantation. There will be opportunities for plantation on the roadside slopes of the approach roads and in the service area. As compensation for the loss of wildlife biotopes and biodiversity conservation through project activities a protected sanctuary or nature reserve is necessary to be established on a suitable location close to the project site, where the main biodiversity
B	**Construction Phase**				
i	Development of the Bridge, Service Areas including Facilities and Construction of Boundary Wall, Guide Bandh, Approach Road, Electrical & Water Supply System	Loss of topsoil		√	Topsoil is a very good alternative to organic fertilizer. With this topsoil Adjacent agricultural lands are to be fertilized for more production.
		Soil contamination due to spillage of	√		Handling and storage of the potential contaminants must be organized under strict conditions to avoid water pollution during construction of the bridge.
		Surface water contamination	√		
		Air pollution	√		To keep the pollution level within an acceptable limit, construction-related emissions should be regulated. Regular water spray on dry surfaces to reduce dust generation must be practiced.

Sl. No.	Activities	Impacts	Negative Impact		Mitigation Measures
			Short Term	Long Term	
		Noise pollution	√		Since noise pollution exceeds the standard, strict measures for noise pollution control need to be undertaken during construction activities. Implementation of these measures may be expensive and difficult. The Contractor should be asked for consideration of these aspects and should apply optimum site activities and site layout so as not to exacerbate existing noise levels at sensitive receptor sites (e.g., mosques, schools).
		Increase in traffic	√		Proper traffic management needs to be put in place to minimize the disruption/risk of accidents during the construction stage.
		Impact on health & safety	√		During Construction: Adequate facilities should be provided for quality water supply, hygienic toilets. in the construction camps and in the resettlement area of PAPs to ensure good health. Drinking Water: Excellent quality drinking water is of paramount importance for maintaining good health of construction laborers. Drinking water should meet the WHO guideline values (1984) or Bangladesh Standards (DoE, 1997). As no public drinking water supply system is available at the project area, contractors must provide their own facilities. Drainage and Sewerage: Toilets for the construction workers must be fitted with water seals and connected to a septic tank. Care should be taken that the effluent from the septic tank is not discharged into open drains but is treated by subsurface infiltration through absorption trenches or soak pits without contaminating ground water. Septic tanks must be inspected regularly and de-slugged, if necessary. Wastewater from washing, bathing, kitchen. to be discharged directly into the river via sewer pipe. Solid Wastes: As a mitigation measure, regular collection of the solid wastes and proper disposal is essential. Transmission of Diseases: Awareness building, and education must be conducted regularly.

Sl. No.	Activities	Impacts	Negative Impact: Short Term	Negative Impact: Long Term	Mitigation Measures
					Regular health inspection and a vaccination program is also necessary.
C	**Operational Phase**				
i	Development of Infrastructure, i.e. Bridge, Service Areas including Facilities and Construction of Boundary wall, Guide Bandh, Approach Road, Electrical & Water Supply System	Impact on the Air Quality		√	Air quality should be monitored regularly after the opening of the bridge. During the operation period, if the air quality deteriorates, several mitigation measures can be conceived.
		Noise Pollution		√	In the detail design stage, the sections of the approach road will be identified where cumulative noise would exceed the standard. After opening of the bridge continuous monitoring should be conducted in the location and whenever a section's noise level crosses the standard, BBA may also place noise barriers at that section.
		Potential surface water pollution due to sewage		√	Sewerage Treatment Plant (STP) to be constructed to avoid possible surface water
		Groundwater abstraction		√	Treat and use of surface water setting. treatment plant is the best possible way to keep the ground water intact in the vicinity of the project site. Another way is Rainwater Harvesting.
		Traffic growth		√	BRTA rules and regulations will need to be strictly followed to minimize the risk of traffic accidents.

5.4. Impact related to natural disaster and climate change.

The proposed project site is in a tropical region where the summer season is much rainier than winter. Though no change in the macro-climatic setting (precipitation, temperature, and wind) is envisaged due to the project, the microclimate is likely to be temporarily modified by vegetation removal, and due to the addition of increased paved surface and operation of air-conditioning facilities, etc. which in turn might lead to rise of temperature.

Table 13. Natural Disaster Risk Matrix

District / Risk Area	Kurigram (Chilmari- Rowmari)		
	Risk Index	Impact	Mitigation Measures for Risk Hedge
Cyclone	Very Low	No Impact	No strategy is required
Drought (Kharif)	Moderate	No impact	No strategy is required.
Drought (Pre Kharif)	Very Low	No impact	No strategy is required.
Earthquake	High	High negative impact. Seismic intensity is severe. As per BNBC, Kurigram falls under Seismic Zone 4(Coefficient Z: 0.36)	To follow Bangladesh National Building Code (BNBC) 2020, Indian Roads Congress Standard (IRC) code for urban roads, American Association of State Highway and Transportation Officials (AASHTO) specifications and manual for design.
Erosion	High	High negative impact	Guide Bandth (DAM) would be the proposed solution for mitigation of erosion.
Flood	High	High negative impact	Vertical clearance for Class -I navigation must be maintained for the bridge and maximum flood level for approach road considering return periods,
Flash flood	Very Low	No impact	No strategy is required.
Salinity	Very Low	No impact	No strategy is required
Sea-level rise	Very Low	No impact	No strategy is required
Landslide	Very Low	No impact	No strategy is required
Storm Surge	Very Low	No impact	No strategy is required

6. SOCIAL SAFEGUARD ASSESMENT

Social considerations and community-driven aspects of the project have been assessed accordingly: the river Brahmaputra separates Rowmari and Ulipur/Chilmari upazilas of Kurigram district from and from other northern districts. This fact has caused the sense of isolation and deprivation among the people living in Kurigram. The construction of a bridge in the crossing point would integrate the outlaying upazilas with the mainland districts. Moreover, the people of Kurigram, Lalmonirhat and some parts of Rangpur and Gaibandha use the river route to cross the river and travel to Dhaka, Mymensingh, and Gazipur in search of livelihood and employment. The bridge would provide a cheaper, faster, and safer alternative for this journey.

Therefore, the construction of a river bridge over the river Brahmahputra at Chilmari-Rowmari crossing link has been identified as a High Priority Project by BBA, and this fact is completely supported by our social aspects assessment being carried out in this assignment.

Chilmari Rowmari Bridge as well is considered within the Economic Corridor EC4 (Dhaka-Rangpur-India), focusing on regional integration and elimination of regional disparity, providing at the same time employment opportunities in Kurigram as a whole.

- **Displacement and impact of the project**

It is estimated that around 623.57 acres land would require acquisition for the project. Of the total land, 400.39 acre would be required for Right of Way. Additional 223.17-acre land would be required for other project relevant interventions. It was estimated that, 10-acre land would be required for two-resettlement area, 50.141-acre land would be required for three construction yard and 163.03-acre land would be required for River Training Work on both side of the river. It is identified that the land acquisition for ROW would require from 1,518 plots of 15 administrative Mouzas. According to the detailed census and IOL survey, total 492 project affected units including 481 HHs and 11 CPRs would be affected by losing their immoveable assets. Apart from the primary structures a significant quantity of secondary structures would also be affected. The assessment was also identified that 158 business premises including running business would be affected by the project interventions. Table below shows summary of land acquisition impacts by Interventions.

Table 14. Summary of project impact on land acquisition

Sl. No.	Project Impacts	Chilmari	Rowmari	Ulipur	Total
A.1	Affected Land for RoW	30.64	180.37	189.37	400.39
A.1.1	Amount of affected private land (acre)	30.12	160.29	180.20	370.62
A.1.2	Amount of affected Govt land (acre)	0.52	20.07	9.16	29.76
A.2	Affected Land for Resentment area, Construction Area and River Training Activities	33.23	113.03	76.91	223.17
A	Amount of affected land (acre)	**63.87**	**293.40**	**266.28**	**623.57**
	Number of Mouza for RoW	1	5	9	15

Sl. No.	Project Impacts	Chilmari	Rowmari	Ulipur	Total
	Number of plots affected for RoW	178	497	843	1518
	Number of affected Landowners	174	345	568	1087
B	Number of total HHs affected by structure	92	230	154	476
B.1	Total number of households requiring relocation	92	228	141	461
B.1.1	Number of titled HHs losing res/com requiring relocation	92	226	138	456
B.1.2	Number of Non-title losing res/com and structures requiring relocation	0	2	3	5
B.2	Number of titled HHs losing res/com and other structures requiring No-relocation	0	2	13	15
B.3	Number of Non-title losing structures requiring No relocation	0	0	5	5
	Number of Household	**92**	**230**	**159**	**481**
D	Number of CPRs affected	1	3	7	11
E	Total number of Project Affected Units (B+C+D)	93	233	166	492
K	Number of business affected	2	110	46	158
L	Number of Vendors affected	0	0	0	0
M	Number of trees affected	4,401	10,294	17,771	32,466
N	Total number of persons affected	312	989	663	1964
O	Total affected primary structure from HHs and CPRs (sft)	46,758	168,154	147,254	362,166

Table 15. Land ownership status by intervention

	Affected land	Chilmari	Rowmari	Ulipur	Total
A	Amount of affected private land (acre)	30.64	180.39	189.37	400.39
B	Amount of affected Govt land (acre)	0.52	20.17	9.16	29.76
C(A+B)	Affected Land for RoW (acre)	30.12	160.29	180.20	370.62
D	Affected Land for Resentment area, Construction Area and River Training Activities	33.23	113.03	76.91	223.17
E(C+D)	**Amount of affected land (acre)**	**63.87**	**293.40**	**266.28**	**623.57**

- **Socio-economic profile**

The total project that would be affected HHs is 481 including 461 HHs that would be physically displaced. The total number of projects affected persons would be 1964. Of the total PAPs 52.50% are male (1033.) and 47.50% are female (933). The education level in the project-affected area is about 72%. Business and other profession dominated by male while 38.76% of total female are only housewife. The survey identified about 33.89 % (139 male, and 24 female) 163 HHs are of the affected people are living below the national poverty line (BDT 12000 per month) based on the Bangladesh Bureau of Statistics (BBS). Survey also identified that about 52.18% (1025) household's income is below BDT 30,000 and 47.82% (939) households earn more than BDT 30,000/month. Considering of the income and expenditure level among the very poor and poor people it is found that expenditure is higher than income level and it is common scenario among the low-income group in Bangladesh.

- **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.

- **Legal and Policy Framework**

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. BBA aims to promote environmentally sound, socially acceptable, and economically viable projects. It believes that each of its projects would improve the living standards of populations affected by the projects. BBA recognizes the importance of addressing environmental and social issues and seeks to promote stakeholder involvement in the pursuit of sustainable projects. Compensation of the affected land and other assets would be paid following the GoB law and policy. It also recognizes that displacement of households from private and government land along the project design and disruption of their livelihood is likely to occur. Where such displacement and disruption are inevitable, BBA aims to ensure that affected households are appropriately relocated by their own, and their livelihoods are restored in a fair and transparent manner, and to link mitigation measures with project development opportunities (civil works of the project).

- **Grievance Redress Mechanism**

A two-tier bottom up GRC system would be established in this Project. First, there would be GRCs at the local level, hereafter called Local GRC upazila level); and second, GRC at the project level to give room for grievances to be reviewed. The APs would be informed through public consultation that they have the right to have their grievances redressed by the local committees as well as by the project management. The APs can also call upon the support of the implementing NGO (INGO) engaged to implement the RAP to assist them in presenting their grievances or queries to the GRC. Other than disputes relating to ownership right under the court of law, the GRC would review grievances involving

all resettlement assistance, relocation, and other support. The local GRCs (at the upazila/municipal level) would hear the grievances first. Only unresolved cases would be forwarded to the next tier – Project level GRC for further review and resolution. Grievances would be redressed within a month of the date of lodging the complaints. GRC decisions would be on a majority basis and would be disclosed and available for review by the stakeholders. If any disputant is unhappy or unsatisfied with the outcome of the Project level GRC, he/she may file cases in court.

- **Cost and Budget**

The preliminary estimation of Land acquisition and Resettlement budget for the project is BDT 7,361,277,829. Of the total budget, the estimated DC budget is 3,354,025,829 to be provided by DC office and additional top up budget for LAP and RAP is BDT 4,007,253480 to be provided by BBA as additional budget and resettlement benefits.

Table 16. Summary of cost estimate

Category of loss	Chilmari	Rowmari	Ulipur	Total
Land for RoW	69,735,308	478,746,359	959,774,322	1,508,255,990
Additional Land for Resentment area, Construction Area and River Training Activities	97,039,998	560,532,078	361,608,012	1,019,180,087
Compensation for structure	49,810,334	180,326,742	337,805,516	567,942,592
Compensation for Trees	33,637,320	80,825,720	144,184,120	258,647,160
Impact Budget (Paid by DC)	**250,222,960**	**1,300,430,899**	**1,803,371,970**	**3,354,025,829**
Top up for land	182,739,214	1,613,317,610	462,928,789	2,258,985,613
Other Resettlement Benefits	79,405,078	478,799,222	422,240,198	980,444,498
Operation cost for RAP Implementing Agency/ INGO	12,000,000	36,000,000	72,000,000	120,000,000
Operation cost for External Monitoring Agency	10,000,000	10,000,000	10,000,000	30,000,000
Administrative cost @5 % on the DC budget	21,648,109	145,687,425	113,315,038	280,650,572
Contingency @5% of the Sub-total	26,718,363	171,927,387	138,527,048	337,172,797
Total additional top up budget	**332,510,764**	**2,455,731,643**	**1,219,011,073**	**4,007,253,480**
Grand Total	582,733,724	3,756,162,542	3,022,383,043	7,361,277,829

7. COST-BENEFIT ANALYSIS

7.1. Economic Analysis

The socio-economic analysis methodology is based on assessing economic values during the life of the project, since the initial investment period plus the subsequent operation period. The assessment includes the implementation of standard conversion factors; costs and benefits are appraised from the point of view of the entire country's economy.

(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, etc.
- 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 based (capitalized accordingly) on year 2025, when the estimation was carried out:

Table 17. Basic elements that compose total project Capex (2025 monetary units)

Number	Item	Cr BDT
1	General and Site Facilities	408.15
2	Main Bridge (Truss and Arch)	10,709.68
3	Approach Bridges	717.69
4	Approach Road including small structures	1,541.25
5	Toll Plaza & Engineering Facilities	526.74
6	Bank Protection Work	5,365.04
7	Provisional Sum for Physical Contingency	578.06
8	Provisional Sum for Price Contingency	1,190.80
9	Land Acquisition and Resettlement Costs	771.46
10	Design Cost	360.24
11	Construction Supervision	900.60
	TOTAL	23,069.70

(b) Adjust them where necessary.

Capex costs are adjusted considering the inflation from 2022 to 2025 (starting year of investments) and the split by years following the following deployment:

Table 18. Capital expenses deployment with project.

	2025	2026	2027	2028	2029
Split by year of the CAPEX	15%	13%	16%	36%	21%

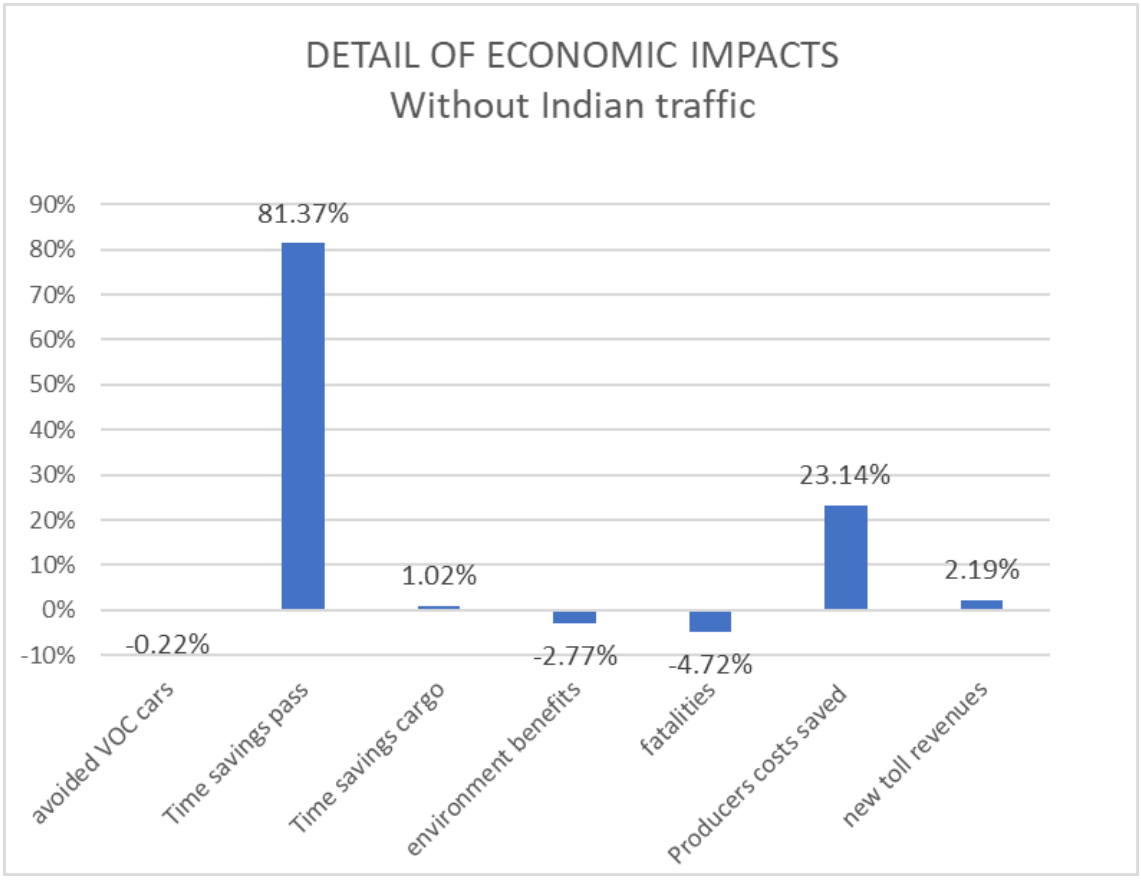
Table 19. Maintenance expenses with and without project. Values per year (Cr BDT)

	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	107.10	856.77 (Y15, Y25)	-	-
Approaching viaducts	7.18	28.71 (Y10, Y20, Y30)	-	-
Approaching roads	15.41	92.48 (Y10, Y20, Y30)	10.07	60.45 (Y10, Y20, Y30)
Bank protection and river training	107.30	321.90 (every 3Y)	42.92	128.76 (every 3Y)
Toll Plaza & Facilities	10.53	42.14 (Y15, Y25)	-	-
Ferry-ghat terminal	-	-	19.52	-
TOTAL (sum during Operation period (30Y)	**7,818.66**	**5,287.92**	**2,283.58**	**1,408.51**

The following figures show the split of main positive impacts (in terms of present values), showing that in all scenarios the variation in Consumer Surplus for transport users is by far the element with the highest impact: around 82%.

More precisely, passenger time savings represents 81% of positive impacts. The effects from freight activities are irrelevant in terms of net economic impacts.

On the other side, the variation in Producer surplus is relevant but much more modest (in terms of share of positive impacts) than time savings effects, the main source of potential impacts. This is mainly due to the savings on vehicle operation costs of the ferries and the reduction of distance for the diverted traffic is very limited.



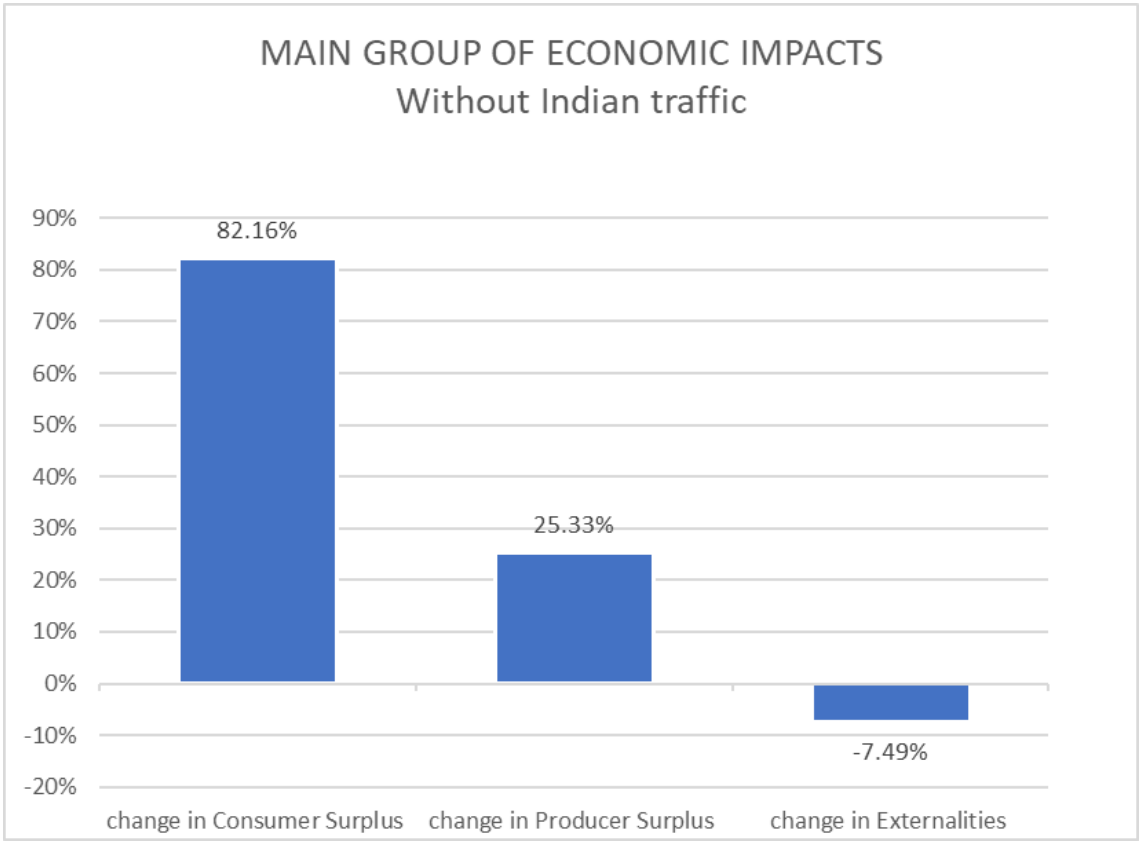
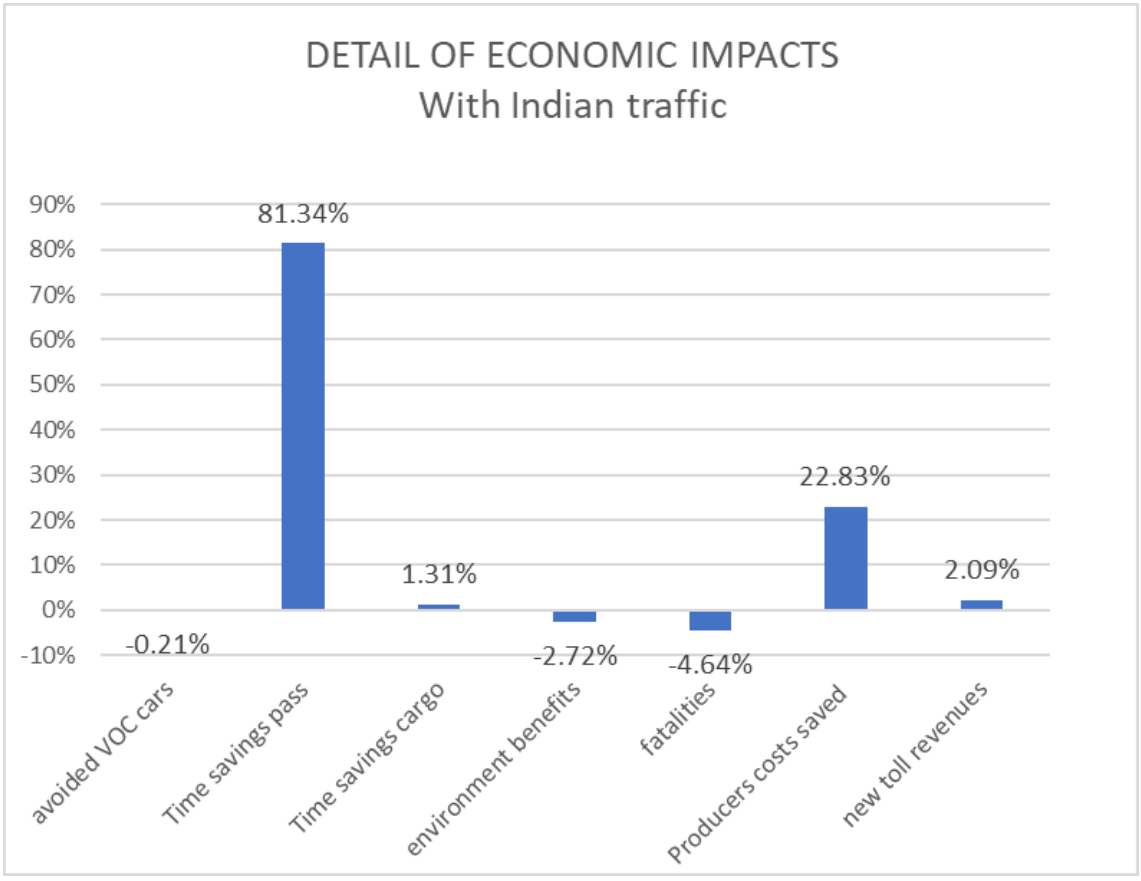


Figure 28: Main groups of economic impacts without Indian Traffic



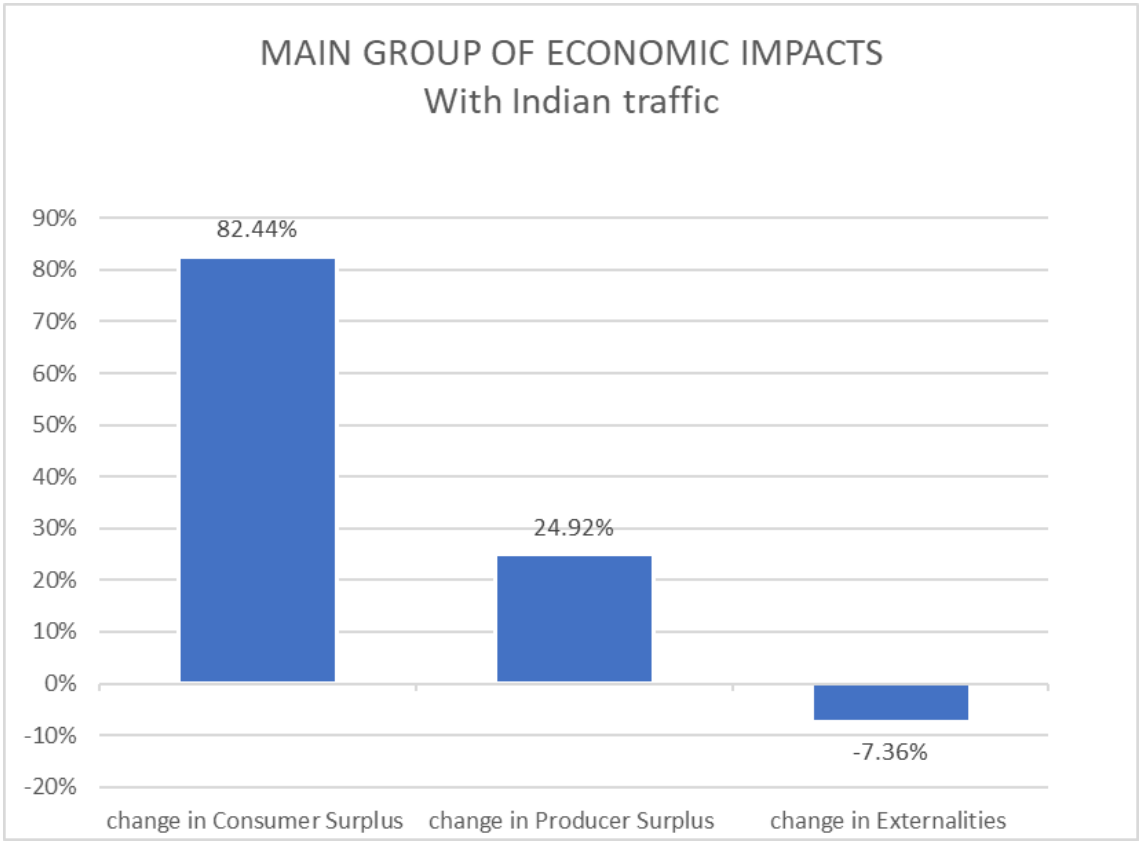


Figure 29: Main group of economic impacts. With Indian traffic

(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[4] have been applied for some of the outflows in this socioeconomic analysis. In particular:

Table 20. Considered Conversion factors.

Item	CF
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).

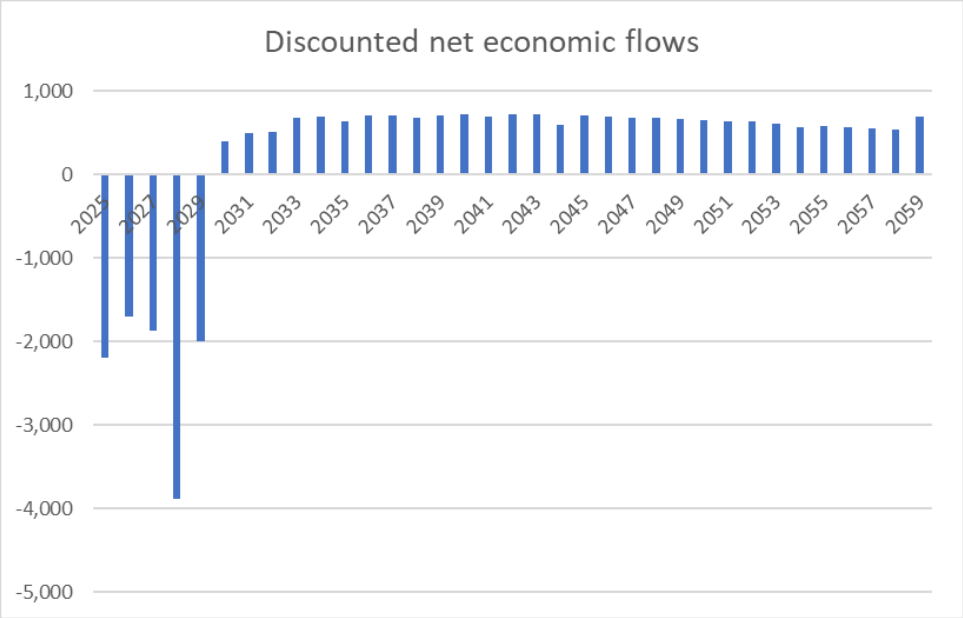


Figure 30: Discounted eco flows (Cr BDT) With indian traffic

[4] *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)*

(e) Mention the Assumption.

The base year has been set in 2025 and the horizon year in 2059.

- Total Investments period: 5 years (2025 – 2029)
- Total operations period: 30 years (2030 - 2059)

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 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 21. Values for VoT

Mode	VoT BDT/pass-h (2022)	VoT BDT/pass-h (2025)
Motorcycles	85 BDT/pass-h	92.59 BDT/pass-h
Light vehicles	95 BDT/pass-h	103.48 BDT/pass-h
Buses	75 BDT/pass-h	81.7 BDT/pass-h
Truck	3.5BDT/ton-h	3.81BDT/ton-h

Value of time is escalated by 4.64% yearly. The value is obtained by applying some conservative real GDP per capita long run growth rate and assuming elasticity of 70%.

This is the result of applying 70% to 6.63% that is the real GDP pc growth foreseen in 2025 according to data provided by Bangladesh bank to International Monetary Fund.

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, it has been adopted (likewise the adoption of figures for Value of Time) a quite conservative approach when selecting VOC values. The figures adopted are:

Table 22. Vehicle operating costs by mode

Mode	BDT / veh – km (2022)	BDT / veh – km (2025)
Motorcycles	10.00	11.65
Light vehicles	14.00	16.31
Buses	30.00	34.94
Truck	40.00	46.59

It has been considered a reference 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 a standard approach of estimating the amount of depreciation not computed in the analysis period (*net book value or remaining depreciation costs method) was adopted*. In general, the "Net Book Value" approach[5] is a less distorting approach compared with the alternatives.

(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. For illustrative purposes it can be highlighted that **ENPV estimated in real terms would reach: 6,624.16 Cr BDT for the "Without Indian traffic" scenario. It is a lower economic result than scenario "With Indian Traffic" which reaches ENPV of 7,469.57 Cr BDT**

The Economic Net Present Value obtained in all cases 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 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.**

(ii) Economic Benefit Cost Ratio (EBCR)

Project benefit cost ratio reaches 1.77 (without Indian case) and 1.89 (with Indian case) 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 15.08% for the "Without Indian traffic" scenario and 15.45% for the "With Indian traffic" scenario.** This data is higher than the considered social rate of discount (12%) or opportunity cost of capital, so the project can be considered as feasible (IRR > SRD and E-NPV positive).

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

7.2. Financial Analysis

A financial analysis has been implemented to evaluate whether Chilmari-Rowmari 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.

Regarding traffic projections, there are wo scenarios: with Indian traffic and without Indian traffic.

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:

- 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

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

Table 23. Investment budget

Investment budget (VAT included)	Cr BDT (2023)	Cr BDT (2025)
General and Site facilities	418.7	484.7
Approach Road including small structures	1,581.0	1,830.2
Toll plaza & CCB	540.3	625.5
Main bridge (s)	10,985.6	12,717.2
Approach Bridges and Connection Bridge	736.2	852.2
Bank protection work	5,503.3	6,370.7
Land acquisition and Resettlement costs	736.1	852.2
Design costs	395.30	457.61
Supervision costs	988.25	1,144.02
Contingencies	1,814.42	2,100.42
CAPEX	23,699.1	27,434.6

(NOTE: CAPEX amount is in constant BDT and VAT included, i.e., it does not include inflation)

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

Table 24. Sources and application of funds year by year. PPP contract structure

Sources & Application of Funds (Cr BDT)	2025	2026	2027	2028	2029
Government grants	33,603	28,771	35,484	82,260	47,261
Private equity	2,755	1,443	2,365	6,773	4,991
Long term financing resources (debt)	8,266	4,329	7,094	20,319	14,973
Investments	38,033	34,192	44,278	107,780	65,019
Other initial costs (capitalized interests)	6,592	351	664	1,573	2,206
Total	44,624	34,543	44,942	109,353	67,225

Table 25. Operating expenses

Operating expenses (VAT included)	Cr BDT / year
Operation	13.12
Overall expenses. Company structure	5.00

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

Table 26. Maintenance expenses. Amount per year

Maintenance (Cr BDT. VAT included)	Investment	Maintenance / year
Main bridge	12,717	195.0
Approaching viaducts	852	11.9
Approaching roads	1,830	29.3
Bank protection and river training	6,371	254.8
Toll Plaza	625	15.8
Total		506.88

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 for both scenarios (with Indian traffic and without Indian traffic), respectively:

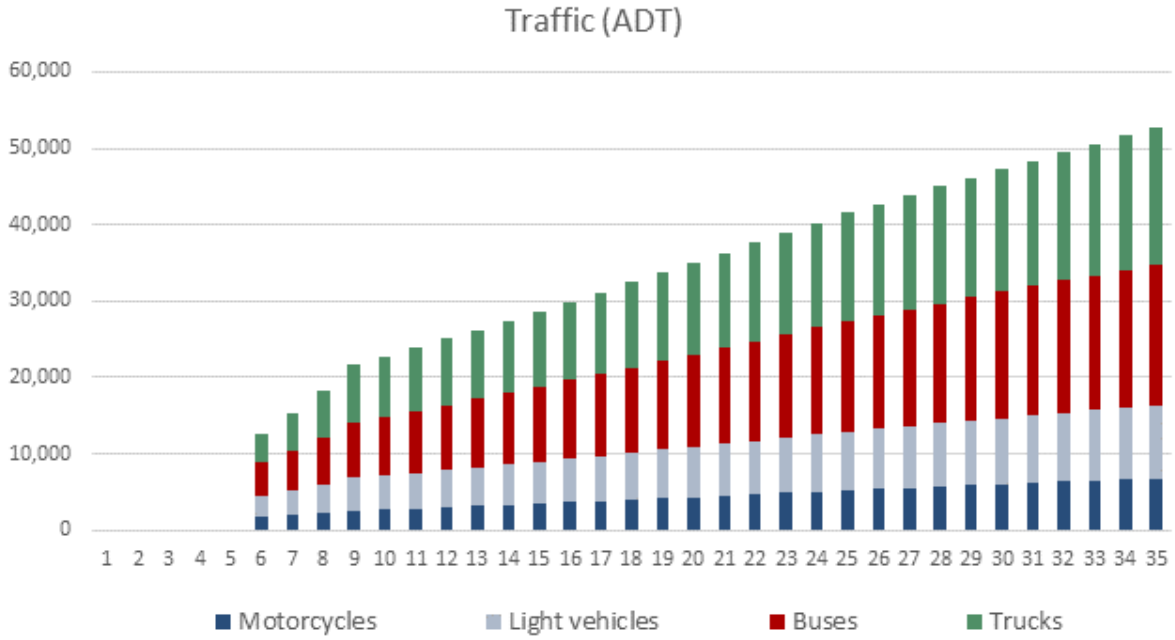


Figure 31. Toll revenues. With Indian traffic

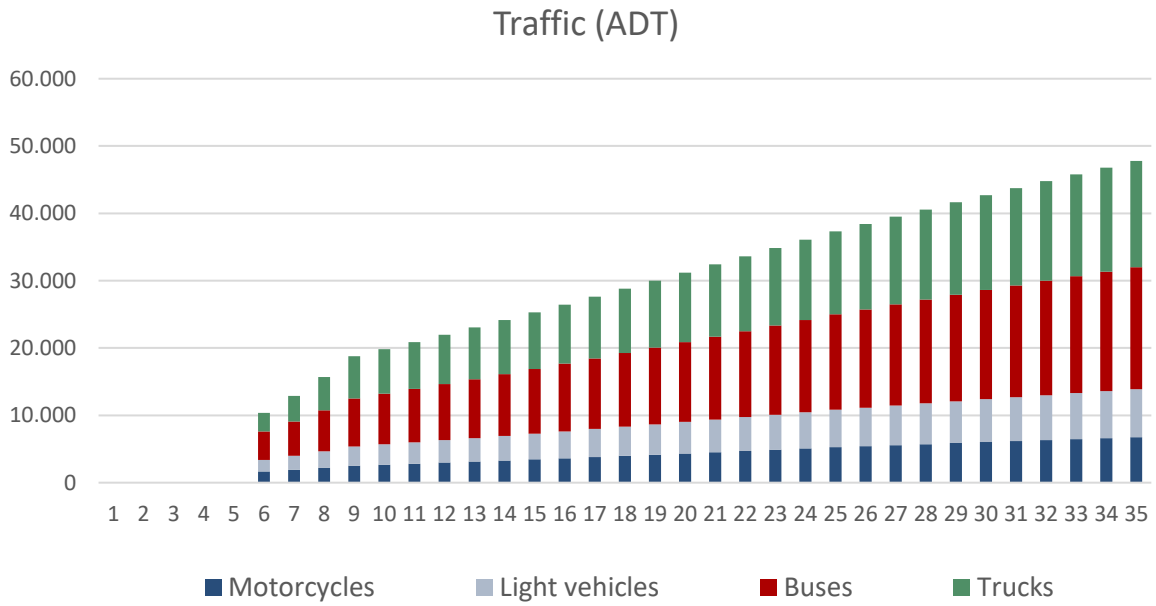


Figure 32: Demand forecasts. Without Indian traffic

The most important classes in number of vehicles are buses (35% of total vehicles) and trucks (34%).

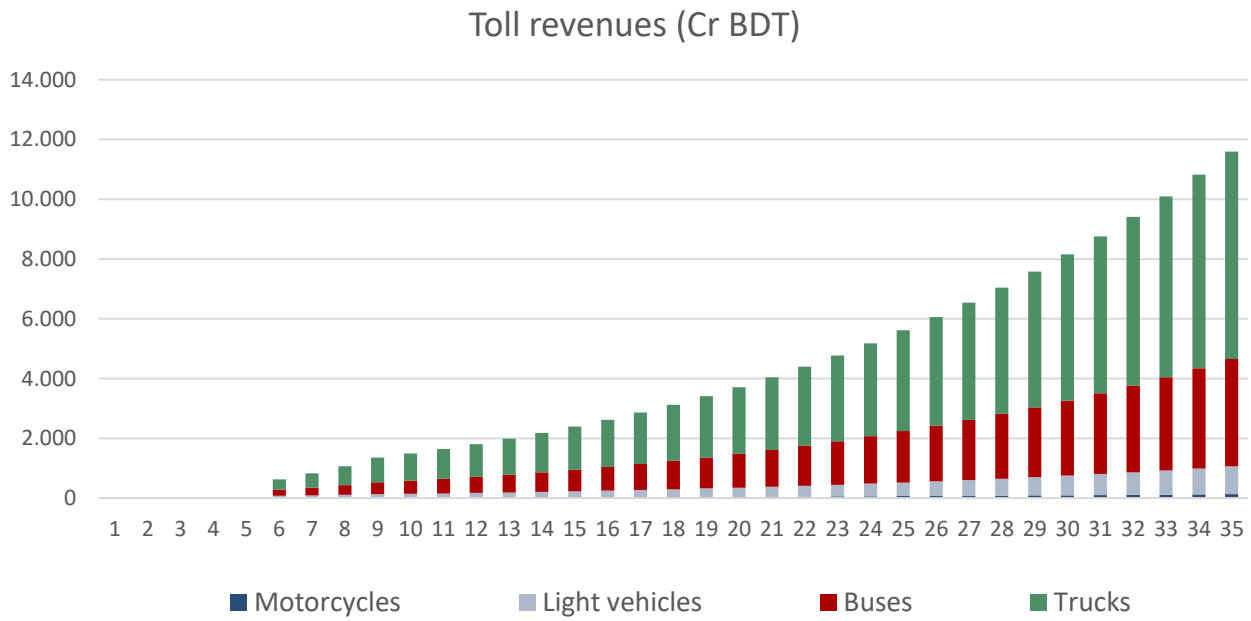


Figure 33. Toll revenues. With Indian traffic

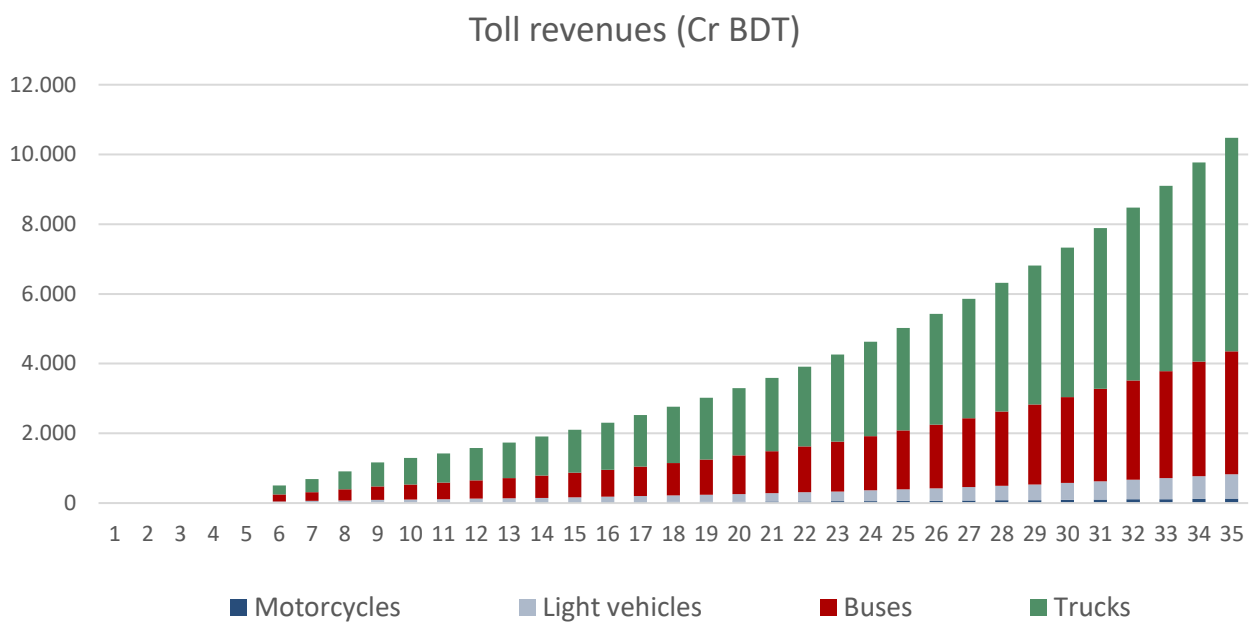


Figure 34: Toll revenues. Without Indian traffic

Despite of the number of vehicles projected, the toll revenues have different impacts on the Project cash flows: both buses and trucks are the most important classes, representing together almost 91% of total revenues, being trucks 60%, in the scenario with Indian traffic. In the scenario without Indian traffic, buses and trucks represent almost 71%, being buses 38%.

Additional commercial revenues are expected to be produced from the lease of the infrastructure to cross service telecommunication lines and other services. For conservative reasons, no commercial revenues have been considered in the financial analysis.

(c) Cash flow

The following two tables show the 35 years of projected cash flows during the period of analysis for both contract alternatives: Public Project and PPP Contract, respectively, as well as for both the scenario with Indian traffic and the scenario without Indian traffic, 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 27. Project cash flows. Public Project or Traditional procurement. With Indian traffic

CASH FLOWS (Million BDT)	2023 Year 1	2024 Year 2	2025 Year 3	2026 Year 4	2027 Year 5	2028 Year 6	2032 Year 10	2037 Year 15	2042 Year 20	2047 Year 25	2052 Year 30	2057 Year 35
Operating revenues	**0**	**0**	**0**	**0**	**0**	**6,296**	**14,891**	**23,914**	**37,154**	**56,130**	**81,513**	**115,956**
Toll revenues	0	0	0	0	0	6,296	14,891	23,914	37,154	56,130	81,513	115,956
Other commercial revenues	0	0	0	0	0	0	0	0	0	0	0	0
Operation & Maintenance expenses	**0**	**0**	**0**	**0**	**0**	**-3,919**	**-4,763**	**-8,928**	**-44,391**	**-14,543**	**-56,575**	**-43,770**
Maintenance & Overhaul	0	0	0	0	0	-3,751	-4,560	-8,669	-44,059	-14,120	-56,034	-43,081
Operation	0	0	0	0	0	-168	-204	-260	-332	-423	-540	-690
Net Cash Flows due to Operations	**0**	**0**	**0**	**0**	**0**	**2,377**	**10,127**	**14,986**	**-7,237**	**41,586**	**24,939**	**72,186**
Cash Flows due to Investments	**-43,460**	**-37,858**	**-49,495**	**-119,374**	**-75,126**	**0**	**0**	**0**	**0**	**0**	**0**	**79,274**
Initial CAPEX	-43,460	-37,858	-49,495	-119,374	-75,126	0	0	0	0	0	0	0
Other CAPEX	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	79,274
Project cash flows	**-43,460**	**-37,858**	**-49,495**	**-119,374**	**-75,126**	**2,377**	**10,127**	**14,986**	**-7,237**	**41,586**	**24,939**	**151,460**

	2023 Year 1	2024 Year 2	2025 Year 3	2026 Year 4	2027 Year 5	2028 Year 6	2032 Year 10	2037 Year 15	2042 Year 20	2047 Year 25	2052 Year 30	2057 Year 35
Outflows	**-43,460**	**-37,858**	**-49,495**	**-119,374**	**-75,126**	**-17,345**	**-16,142**	**-14,638**	**-13,135**	**-11,631**	**-10,128**	**-8,624**
Project Development (Initial CAPEX)	-40,544	-36,450	-47,202	-114,896	-69,312	0	0	0	0	0	0	0
Financing Fees	-2,916	-1,409	-2,293	-4,478	-5,814	0	0	0	0	0	0	0
Loan Repayments												
Interest	0	0	0	0	0	-8,871	-7,668	-6,164	-4,661	-3,157	-1,654	-150
Principal Repayments	0	0	0	0	0	-8,474	-8,474	-8,474	-8,474	-8,474	-8,474	-8,474
Inflows	**43,460**	**37,858**	**49,495**	**119,374**	**75,126**	**944**	**2,234**	**3,587**	**5,573**	**8,419**	**12,227**	**17,393**
GoB Equity / Budgets	10,507	8,996	11,095	25,721	14,778	0	0	0	0	0	0	0
Multilateral grants	0	0	0	0	0	0	0	0	0	0	0	0
Borrowings	32,953	28,862	38,400	93,653	60,348	0	0	0	0	0	0	0
VAT on toll fares	0	0	0	0	0	944	2,234	3,587	5,573	8,419	12,227	17,393
Future Developments	0	0	0	0	0	0	0	0	0	0	0	0
GoB net cashflows	**0**	**0**	**0**	**0**	**0**	**-14,023**	**-3,781**	**3,934**	**-14,798**	**38,374**	**27,038**	**160,229**

Table 28. Project cash flows. Public Project (Cr BDT). Without Indian traffic

CASH FLOWS (Million BDT)	2023 Year 1	2024 Year 2	2025 Year 3	2026 Year 4	2027 Year 5	2028 Year 6	2032 Year 10	2037 Year 15	2042 Year 20	2047 Year 25	2052 Year 30	2057 Year 35
Operating revenues	**0**	**0**	**0**	**0**	**0**	**5,070**	**12,900**	**20,990**	**32,955**	**50,213**	**73,309**	**104,731**
Toll revenues	0	0	0	0	0	5,070	12,900	20,990	32,955	50,213	73,309	104,731
Other commercial revenues	0	0	0	0	0	0	0	0	0	0	0	0
Operation & Maintenance expenses	**0**	**0**	**0**	**0**	**0**	**-3,919**	**-4,763**	**-8,928**	**-44,391**	**-14,543**	**-56,575**	**-43,770**
Maintenance & Overhaul	0	0	0	0	0	-3,751	-4,560	-8,669	-44,059	-14,120	-56,034	-43,081
Operation	0	0	0	0	0	-168	-204	-260	-332	-423	-540	-690
Net Cash Flows due to Operations	**0**	**0**	**0**	**0**	**0**	**1,151**	**8,137**	**12,062**	**-11,436**	**35,669**	**16,734**	**60,961**
Cash Flows due to Investments	**-43,460**	**-37,858**	**-49,495**	**-119,374**	**-75,126**	**0**	**0**	**0**	**0**	**0**	**0**	**79,274**
Initial CAPEX	-43,460	-37,858	-49,495	-119,374	-75,126	0	0	0	0	0	0	0
Other CAPEX	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	79,274
Project cash flows	**-43,460**	**-37,858**	**-49,495**	**-119,374**	**-75,126**	**1,151**	**8,137**	**12,062**	**-11,436**	**35,669**	**16,734**	**140,235**

	2023 Year 1	2024 Year 2	2025 Year 3	2026 Year 4	2027 Year 5	2028 Year 6	2032 Year 10	2037 Year 15	2042 Year 20	2047 Year 25	2052 Year 30	2057 Year 35
Outflows	**-43,460**	**-37,858**	**-49,495**	**-119,374**	**-75,126**	**-17,345**	**-16,142**	**-14,638**	**-13,135**	**-11,631**	**-10,128**	**-8,624**
Project Development (Initial CAPEX)	-40,544	-36,450	-47,202	-114,896	-69,312	0	0	0	0	0	0	0
Financing Fees	-2,916	-1,409	-2,293	-4,478	-5,814	0	0	0	0	0	0	0
Loan Repayments												
Interest	0	0	0	0	0	-8,871	-7,668	-6,164	-4,661	-3,157	-1,654	-150
Principal Repayments	0	0	0	0	0	-8,474	-8,474	-8,474	-8,474	-8,474	-8,474	-8,474
Inflows	**43,460**	**37,858**	**49,495**	**119,374**	**75,126**	**761**	**1,935**	**3,148**	**4,943**	**7,532**	**10,996**	**15,710**
GoB Equity / Budgets	10,507	8,996	11,095	25,721	14,778	0	0	0	0	0	0	0
Multilateral grants	0	0	0	0	0	0	0	0	0	0	0	0
Borrowings	32,953	28,862	38,400	93,653	60,348	0	0	0	0	0	0	0
VAT on toll fares	0	0	0	0	0	761	1,935	3,148	4,943	7,532	10,996	15,710
Future Developments	0	0	0	0	0	0	0	0	0	0	0	0
GoB net cashflows	**0**	**0**	**0**	**0**	**0**	**-15,433**	**-6,070**	**572**	**-19,628**	**31,570**	**17,603**	**147,320**

Table 29. Project cash flows. PPP Contract. With Indian traffic

CASH FLOWS (Million BDT)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 10	Year 15	Year 20	Year 25	Year 30	Year 35
Operating revenues	**0**	**0**	**0**	**0**	**0**	**6,296**	**14,891**	**23,914**	**37,154**	**56,130**	**81,513**	**115,956**
Toll revenues	0	0	0	0	0	6,296	14,891	23,914	37,154	56,130	81,513	115,956
Other revenues	0	0	0	0	0	0	0	0	0	0	0	0
Operating expenses	**0**	**0**	**0**	**0**	**0**	**-8,308**	**-12,187**	**-25,584**	**-19,852**	**-41,674**	**-32,337**	**-67,882**
Maintenance	0	0	0	0	0	-8,076	-11,906	-25,225	-19,394	-41,089	-31,590	-66,930
Operation	0	0	0	0	0	-168	-204	-260	-332	-423	-540	-690
SPV Structure	0	0	0	0	0	-64	-78	-99	-126	-161	-206	-263
Corporate tax	0	0	0	0	0	0	0	0	-3,368	-2,585	-12,280	-12,193
EBITDA	**0**	**0**	**0**	**0**	**0**	**-2,012**	**2,703**	**-1,670**	**17,303**	**14,456**	**49,177**	**48,074**
Investments	**-44,624**	**-34,543**	**-44,942**	**-109,353**	**-67,225**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	-44,624	-34,543	-44,942	-109,353	-67,225	0	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0	0	0	0	0	0	0
Project cash flows	**-44,624**	**-34,543**	**-44,942**	**-109,353**	**-67,225**	**-2,012**	**2,703**	**-1,670**	**13,935**	**11,871**	**36,896**	**35,881**
Public Contributions	**33,603**	**28,771**	**35,484**	**82,260**	**47,261**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Government capital contributions	16,802	14,386	17,742	41,130	23,631	0	0	0	0	0	0	0
Multilateral capital contributions	16,802	14,386	17,742	41,130	23,631	0	0	0	0	0	0	0
Project cash flows (after contributions)	**-11,021**	**-5,772**	**-9,458**	**-27,093**	**-19,964**	**-2,012**	**2,703**	**-1,670**	**13,935**	**11,871**	**36,896**	**35,881**
Funding	**11,021**	**5,772**	**9,458**	**27,093**	**19,964**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Equity	2,755	1,443	2,365	6,773	4,991	0	0	0	0	0	0	0
Multilateral term loan	8,266	4,329	7,094	20,319	14,973	0	0	0	0	0	0	0
Cash flow before debt service (multilateral)	**0**	**0**	**0**	**0**	**0**	**-2,012**	**2,703**	**-1,670**	**13,935**	**11,871**	**36,896**	**35,881**
Debt service. Multilateral term loan	**0**	**0**	**0**	**0**	**0**	**-3,345**	**-3,111**	**-1,706**	**0**	**0**	**0**	**0**
Interest	0	0	0	0	0	-3,345	-3,111	-1,706	0	0	0	0
Debt repayment	0	0	0	0	0	0	0	0	0	0	0	0
Cash flow after debt service (multilateral)	**0**	**0**	**0**	**0**	**0**	**-5,356**	**-408**	**-3,376**	**13,935**	**11,871**	**36,896**	**35,881**
Commercial banks credit line. Drawdowns	0	0	0	0	0	5,356	408	3,376	0	0	0	0
Cash flow before debt service (commercial)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**13,935**	**11,871**	**36,896**	**35,881**
Debt service. Commercial term loan	**0**	**0**	**0**	**0**	**0**	**0**	**-334**	**0**	**0**	**0**	**0**	**0**
Interest	0	0	0	0	0	0	-334	0	0	0	0	0
Debt repayment	0	0	0	0	0	0	0	0	0	0	0	0
Free cash flows	**0**	**0**	**0**	**0**	**0**	**0**	**-334**	**0**	**13,935**	**11,871**	**36,896**	**35,881**
Dividends	0	0	0	0	0	0	0	0	-8,879	-6,815	-32,376	-32,146
Annual cash	**0**	**0**	**0**	**0**	**0**	**0**	**-334**	**0**	**5,056**	**5,056**	**4,520**	**3,734**
Initial cash balance	**0**	**0**	**0**	**0**	**0**	**0**	**423**	**3,186**	**24,009**	**49,288**	**72,425**	**91,882**
Cash movements of the year	0	0	0	0	0	0	-334	0	5,056	5,056	4,520	3,734
Ending cash balance	**0**	**0**	**0**	**0**	**0**	**0**	**88**	**3,186**	**29,065**	**54,344**	**76,946**	**95,617**

Table 30. Project cash flows. PPP Contract (Cr BDT). Without Indian traffic

CASH FLOWS (Million BDT)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 10	Year 15	Year 20	Year 25	Year 30	Year 35
Operating revenues	**0**	**0**	**0**	**0**	**0**	**5,070**	**12,900**	**20,990**	**32,955**	**50,213**	**73,309**	**104,731**
Toll revenues	0	0	0	0	0	5,070	12,900	20,990	32,955	50,213	73,309	104,731
Other revenues	0	0	0	0	0	0	0	0	0	0	0	0
Operating expenses	**0**	**0**	**0**	**0**	**0**	**-8,308**	**-12,187**	**-25,584**	**-19,852**	**-41,674**	**-32,337**	**-67,882**
Maintenance	0	0	0	0	0	-8,076	-11,906	-25,225	-19,394	-41,089	-31,590	-66,930
Operation	0	0	0	0	0	-168	-204	-260	-332	-423	-540	-690
SPV Structure	0	0	0	0	0	-64	-78	-99	-126	-161	-206	-263
Corporate tax	0	0	0	0	0	0	0	0	-933	-958	-10,024	-9,107
EBITDA	**0**	**0**	**0**	**0**	**0**	**-3,238**	**713**	**-4,594**	**13,103**	**8,539**	**40,972**	**36,849**
Investments	**-44,550**	**-34,405**	**-44,726**	**-108,954**	**-66,721**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	-44,550	-34,405	-44,726	-108,954	-66,721	0	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0	0	0	0	0	0	0
Project cash flows	**-44,550**	**-34,405**	**-44,726**	**-108,954**	**-66,721**	**-3,238**	**713**	**-4,594**	**12,170**	**7,581**	**30,948**	**27,742**
Public Contributions	**35,693**	**30,561**	**37,691**	**87,377**	**50,201**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Government capital contributions	17,847	15,280	18,846	43,689	25,100	0	0	0	0	0	0	0
Multilateral capital contributions	17,847	15,280	18,846	43,689	25,100	0	0	0	0	0	0	0
Project cash flows (after contributions)	**-8,857**	**-3,844**	**-7,034**	**-21,577**	**-16,520**	**-3,238**	**713**	**-4,594**	**12,170**	**7,581**	**30,948**	**27,742**
Funding	**8,857**	**3,844**	**7,034**	**21,577**	**16,520**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Equity	2,214	961	1,759	5,394	4,130	0	0	0	0	0	0	0
Multilateral term loan	6,643	2,883	5,276	16,183	12,390	0	0	0	0	0	0	0
Cash flow before debt service (multilateral)	**0**	**0**	**0**	**0**	**0**	**-3,238**	**713**	**-4,594**	**12,170**	**7,581**	**30,948**	**27,742**
Debt service. Multilateral term loan	**0**	**0**	**0**	**0**	**0**	**-2,639**	**-2,451**	**-1,376**	**0**	**0**	**0**	**0**
Interest	0	0	0	0	0	-2,639	-2,451	-1,376	0	0	0	0
Debt repayment	0	0	0	0	0	0	0	0	0	0	0	0
Cash flow after debt service (multilateral)	**0**	**0**	**0**	**0**	**0**	**-5,876**	**-1,738**	**-5,970**	**12,170**	**7,581**	**30,948**	**27,742**
Commercial banks credit line. Drawdowns	0	0	0	0	0	5,876	1,738	5,970	0	0	0	0
Cash flow before debt service (commercial)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**12,170**	**7,581**	**30,948**	**27,742**
Debt service. Commercial term loan	**0**	**0**	**0**	**0**	**0**	**0**	**-482**	**-353**	**0**	**0**	**0**	**0**
Interest	0	0	0	0	0	0	-482	-353	0	0	0	0
Debt repayment	0	0	0	0	0	0	0	0	0	0	0	0
Free cash flows	**0**	**0**	**0**	**0**	**0**	**0**	**-482**	**-353**	**12,170**	**7,581**	**30,948**	**27,742**
Dividends	0	0	0	0	0	0	0	0	0	-2,525	-26,427	-24,008
Annual cash	**0**	**0**	**0**	**0**	**0**	**0**	**-482**	**-353**	**12,170**	**5,056**	**4,520**	**3,734**
Initial cash balance	**0**	**0**	**0**	**0**	**0**	**0**	**104**	**1,381**	**27,034**	**59,427**	**82,565**	**102,022**
Cash movements of the year	0	0	0	0	0	0	-482	-353	12,170	5,056	4,520	3,734
Ending cash balance	**0**	**0**	**0**	**0**	**0**	**0**	**-378**	**1,027**	**39,204**	**64,483**	**87,085**	**105,756**

The Project cash flows 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:

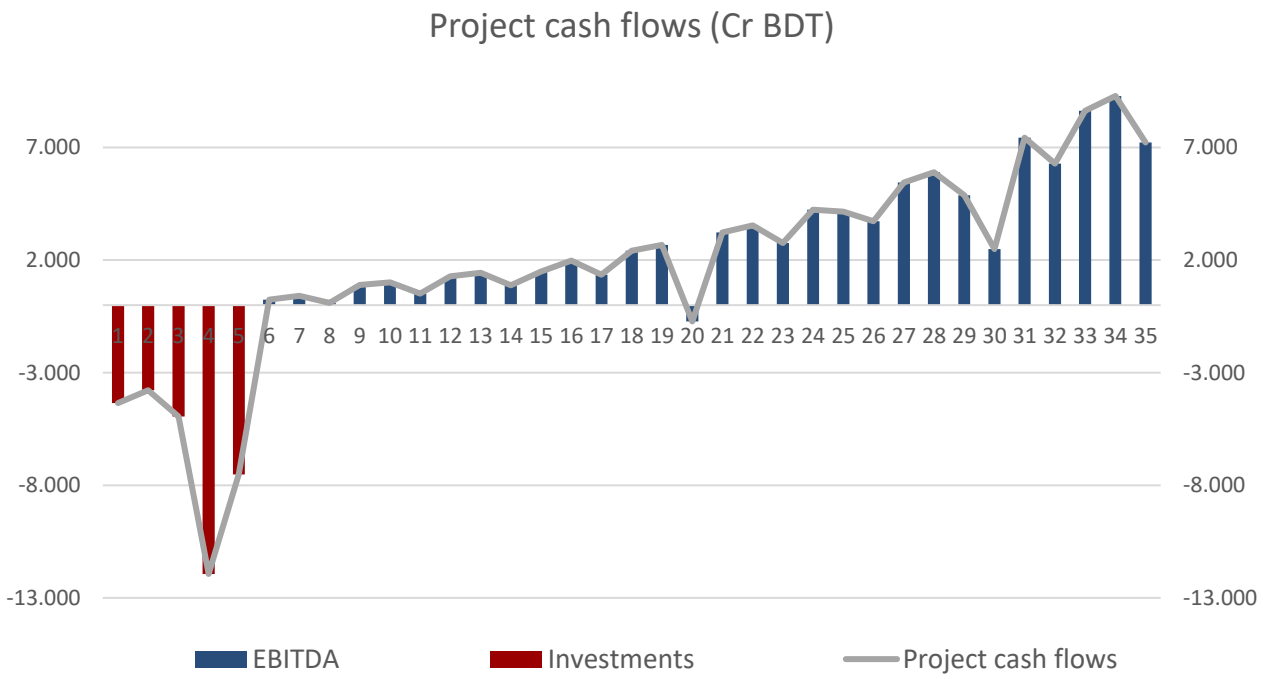


Figure 35. Projected cash flows. With Indian traffic

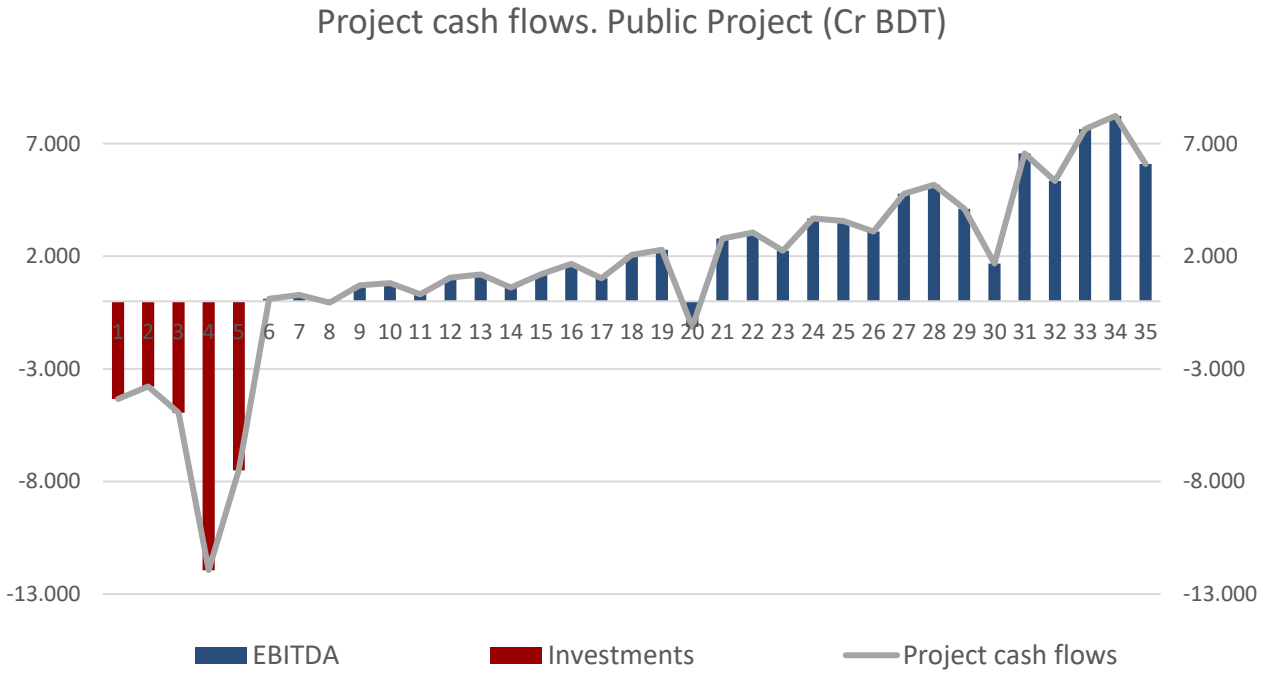


Figure 36: Projected cash flows. Public project. Without Indian traffic

As above mentioned, in both scenarios first years represent the investment period, with cash outflows and negative project cash flows; these cash outflows represent the amount of investments. Since year 6, EBITDA becomes positive for the whole operating period, except in year 15 of operation (year 20 of analysis) due to high extraordinary maintenance costs, with operating revenues higher than operating expenses, generating positive project cash flows (right-hand vertical axel of the above figure) with additional sharp reduction in years 25 and 30 of operation (years 30 and 35 of analysis, respectively), also due to high extraordinary maintenance costs, reducing project cash flows although remaining positive.

(d) Key Assumptions considered.

Table 31. General assumptions. Macroeconomic assumptions

General assumptions	
Inflation rate	5.00%
Financial Discount Rate (Project). WACC	12.0% [6]
Exchange rate USD / BDT	100

Following Government regulation[7], 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 32. General assumptions. Terms related assumptions.

Terms	Years
Analysis	35
Construction period (including Detail design)	5
Operation	30
Base year for analysis	2025
Starting year of operations	2030

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:

[6] 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).
7 Memo no 20.804.014.00.00.014.027.18-177, dated 04/09/2018.

Table 33. Maintenance expenses. Assumptions

Maintenance expenses	Over CAPEX
Main bridge	
Ordinary	1.0 %
Extraordinary (years 15, 25, 35, 45)	8.0 %
Approaching viaducts	
Ordinary	1.0 %
Extraordinary (years 10, 20, 30, 40)	4.0 %
Approaching roads	
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 34. Toll fares structure

Toll rates (BDT)	BDT (with VAT 2022)	BDT (w/o VAT 2022)	BDT (w/o VAT 2025)
Motorcycles	100.00	86.96	101.27
Light vehicles	500.00	434.78	506.37
Buses	1,000.00	869.57	1,012.74
Trucks	2,000.00	1,739.13	2,025.49

Toll fares will be annually increased based on the CPI rate during the operation period. Since original toll values are as of 2022, they have been increased with the corresponding CPI from 2023 to 2025.

In the alternative of PPP Contract, GoB would 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,

(i) Public Project or Traditional procurement

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

Table 35. Financial outcomes. Traditional procurement

FINANCIAL RESULTS	With Indian trafffic	Without Indian trafffic
Project F-IRR. Unlevered	5.21%	4.35%
Project NPV (@ 12%). Cr BDT	-17,449.2	-18,912.9
GoB F-IRR. Levered	6.90%	5.37%
GoB net contributions. Cr BDT	-5,770.2	-7,233.8
Financial Benefit/Cost ratio	41.02%	36.07%
Term of ADB loan (repayment)	30 years	30 years

As detailed in the table above, in the scenario with Indian traffic the Project cash flows after GoB contributions generate a positive Project F-IRR of 5.21%, not reaching the FDR of 12.00%, generating a negative FNPV (-17,449.2 Cr BDT). Total net GoB revenues from the Project, in discounted BDT, are estimated in 5,770.2 Cr BDT, representing a leveraged F-IRR of 6.90% (below FDR of 12%). Furthermore, F-BCR reaches 0.41x, lower than 1.0x. As a conclusion, the Project is not feasible from the financial point of view since the Project F-IRR is lower than 12% provided by law. In the scenario without Indian traffic financial results are lower, even with positive F-IRR.

(ii) PPP Contract

The following tables show the financial indicators for the PPP Contract structure in both traffic scenarios:

Table 36. Financial outcomes. PPP Contract. With Indian traffic

FINANCIAL RESULTS	Bf Grants	After Grants
F-IRR. Project	3.90%	12.00%
NPV (@ 12.0%). Cr BDT	-15,729.1	0.0
GoB Grants required. Cr BDT		22,738.0
VGF (% over total Project costs)		39.33%
F-IRR. Investors		15.88%
NPV (@ Ke%). Cr BDT		-24.6
Term of multilateral loan (drawdown + repayment)		13 years
DSCR. Minimum		1.30 x
DSCR. Average		1.63 x

As shown in the above table, results before and after grants have different values because of the capital grants. Results before grants are not sustainable. Both F-IRR and F-NPV for the project after capital grants are positive and they show that the feasibility of the Project is reached with 22,738 Cr BDT of GoB grants, which represent a VGF of 39.3%.

Table 37. Financial indicators. PPP contract. Without Indian traffic

FINANCIAL RESULTS	Before Grants	After Grants
F-IRR. Project	3.04%	12.00%
NPV (@ 12.0%). Cr BDT	-16,707.4	0.0
GoB Grants required. Cr BDT		24,152.3
VGF (% over total Project costs)		43.06%
F-IRR. Investors		15.43%
NPV (@ Ke%). Cr BDT		-94.8
Term of multilateral loan (drawdown + repayment)		13 years
DSCR. Minimum		1.30 x
DSCR. Average		1.73 x

As shown in the above table, results before and after grants have different values because of the capital grants. Results before grants are not sustainable. Both F-IRR and F-NPV for the project after capital grants are positive and they show that the feasibility of the Project is reached with 24,152 Cr BDT of GoB grants, which represent a VGF of 43.1%.

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

- The projected demand is mainly coming from the trucks (34%) and their revenues would be higher (60%) due to the bigger toll rates.
- Operating expenses come mainly from maintenance of the infrastructure and installations, 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, 25 and 35 of operation).
- The Project, in the scenario with Indian traffic, requires GoB grants to reach the target FDR of 12.00% in case of PPP Contract, amounting 22,738 Cr BDT, which represents 39.3% of total project costs. In the scenario without Indian traffic, VGF generated of 43.1% exceeds maximum limit of 40% provided by law.
- Financial indicators, with the Public Project contract structure, show a Project with a positive F-IRR of 5.21% (unlevered), which is lower the FDR (12.00%), representing a negative F-IRR of -17,449.2 Cr BDT and F-BCR reaches 0.41x, lower than 1.0x. Levered F-IRR is 6.90%, higher than 12%, which means that the total net GoB contributions to the Project during the period analysed are 5,770.2 Cr BDT. In the scenario without Indian traffic financial results are lower, even with positive F-IRR.

The financial analysis with the PPP Contract structure, including the GoB grant, shows positive financial indicators in the scenario with Indian traffic. 12.00% F-IRR of the project (unlevered) and 15.9% F-IRR for investors, being slightly lower 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 22,738 Cr BDT, which represents 39.3% of total project costs. In the scenario without Indian traffic, VGF generated is 43.1%, exceeding maximum limit of 40%.

- Such estimated VGF in the scenario with Indian traffic is lower than the maximum of 40% set up by law for PPP Contract structures and so, the PPP Contract structure could be implemented according to the VGF regulations. In the scenario without Indian traffic, VGF generated is higher than 40% and so, the PPP Contract structure could not be implemented according to the VGF regulations.

8. INSTITUTIONAL AND LEGAL 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 abnormal level of prices increases.
- 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.

The economic analysis states the break-even year is around 2047, depending on the scenarios adopted.

Nevertheless, in financial terms the project cannot reach by itself operating or financial sustainability, which leads to a strong problem of credit solvency, requiring therefore an important support from GoB. Albeit the high level of required grant (VGF of 39.3% of project costs), this figure could lead to the possibility (legally) of recommending a toll-based PPP Concession Agreement.

A simple Government Contract following open international bidding process for construction and a year of maintenance is recommended to be adopted. After the completion of works, mandatory maintenance period of 1-2 years. BBA to decide. Demand risk should be retained by the Government to avoid that this relevant risk implies a high additional cost in case it is transferred to a private operator.

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

Table 30. Risk sharing format.

BBA-Government	EPC-Contractor
Arrange for funding	Design review and proof checking
Land Acquisition	Construction and timely completion
Open bidding process and contract award for Construction and Long-term maintenance and toll collection	Maintenance for a period of 1-2 years

It is recommended that BBA may opt for a FIDIC Multilateral Development Bank Harmonized (MDB) Edition (June 2010) for General and Particular Conditions of Contract as it opts for open bidding and Contract Award process.

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. This cost is covered in above table/graph.

9. CONCLUSION AND RECOMMENDATION

As a summarizing and sound conclusion derived from this Feasibility Study, considering all Technical, Social, Environmental, Economic and Financial standpoints, and after carrying a comprehensive a thorough analysis, it may be concluded that the project, located at Kurigram district, consisting of the 10.78 km long bridge, crossing the Brahmaputra/Jamuna River at the selected alignment D, through the designed steel-truss bridge and a series of other needed associated components would be viable.

The Consultant recommends this project to be constructed, as it would provide relevant social and economic progress and benefits to the population living in the directly related upazilas Ulipur, Chilmari and Rowmari, to the whole Kurigram district, and to the entire north-west region of Bangladesh. It would also promote and enhance potential connectivity corridors, as the transborder India-Bangladesh and the East-West one through the northern part of the country.

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 Resettlement Action Plan. Consultation to the community of the affected area was carried out with a positive response from both local authorities and population.

The completion of this project construction has been estimated in 54 months, including 12 months of testing and commissioning. It is estimated to start operation in 2030 and to end in 2059 (35 years including 5 years of investment phase and 30 years of operation). The estimated cost investment is **23,699.08 Cr BDT**.

The Economic Cost-Benefit Analysis (CBA) has been assessed running two scenarios (considering or not the passing traffic from India). The results in the **case with Indian traffic** are as follows:

EIRR 15.45 %, Cost-Benefit Ratio 1.89, E-NPV 7,469.58 Cr BDT, Pay-back year 2047.

The project shows economic viability in both scenarios considering the traffic passing from India or without it. The consideration of the three wheelers vehicles has been precluded.

The Financial indicators, in the case of **Public Project contract** structure, for the **scenario with Indian traffic** show that the Project cash flows (unlevered scenario) generate a positive Project **F-IRR** of **5.21%,** not reaching the FDR of 12.00%, generating a negative F-NPV (-17,449.2 Cr BDT). In the levered scenario, F-IRR reaches **6.90%,** and the total net GoB contribution to the Project, in discounted BDT, is estimated in -5,770.2 Cr BDT. F-BCR reaches 0.41x.

The project implementation structure shows feasibility under a **PPP model**, for the **scenario with Indian traffic**. Although the results before grants are not sustainable, both F-IRR and F-NPV for the project after capital grants are positive showing that the feasibility of the Project is reached with 22,738

Cr BDT of GoB grants, which represent a VGF of 39.3%, which falls under the limit of 40% set up by law for PPP in Bangladesh.

As a conclusion, the Project is estimated to generate large socio-economic benefits, and could be financially feasible considering the abovementioned conditions both under a traditional Public Government model, or a PPP contract scheme.

The Calculations sheets compilation including the studied scenarios outcome from the socio-economic (CBA) analysis and financial analysis are presented below.

Annexure 01 – Economic and Financial Model Calculation Sheets

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Economic Analysis (Excluding Indian Traffic)

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CBA

Without Indian traffic

FEASIBILITY STUDY OF CHILMARI-ROWMARI BRIDGE		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	**16,418.12**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Existing traffic	**12,553.59**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
User passenger time savings	12,433.89	0.00	0.00	0.00	0.00	0.00
User freight time savings	151.16	0.00	0.00	0.00	0.00	0.00
Vehicle Operating Costs (VOC) savings	-31.47	0.00	0.00	0.00	0.00	0.00
Diverted traffic	**2,777.87**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
User passenger time savings	2,039.60	0.00	0.00	0.00	0.00	0.00
User freight time savings	233.96	0.00	0.00	0.00	0.00	0.00
Vehicle Operating Costs (VOC) savings	504.31	0.00	0.00	0.00	0.00	0.00
Generated traffic	**1,086.66**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
User time costs savings	1,073.85	0.00	0.00	0.00	0.00	0.00
User freight time savings	17.41	0.00	0.00	0.00	0.00	0.00
Additional Vehicle Operating Costs (VOC)	-4.60	0.00	0.00	0.00	0.00	0.00
Variation in Externalities	**-1,243.93**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Accidents	-784.39	0.00	0.00	0.00	0.00	0.00
Emissions	-402.11	0.00	0.00	0.00	0.00	0.00
Air polution	-242.00	0.00	0.00	0.00	0.00	0.00
Climate change	-160.10	0.00	0.00	0.00	0.00	0.00
Well to tank	-57.43	0.00	0.00	0.00	0.00	0.00
TOTAL ECONOMIC BENEFITS (Cr BDT)	**15,174.19**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-11,710.57**	**-2,205.25**	**-1,918.31**	**-2,365.88**	**-5,484.68**	**-3,151.11**
Residual value	**185.71**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-1,230.05**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Change in Producer Surplus:	**4,204.87**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Producers costs savings for the system	3,936.52	0.00	0.00	0.00	0.00	0.00
Existing traffic	413.31	0.00	0.00	0.00	0.00	0.00
Diverted traffic	3,523.21	0.00	0.00	0.00	0.00	0.00
Toll revenues (generated traffic)	363.96	0.00	0.00	0.00	0.00	0.00
Vehicle Op costs (generated traffic)	-95.61	0.00	0.00	0.00	0.00	0.00
TOTAL ECONOMIC COSTS (Cr BDT)	**-8,550.03**	**-2,205.25**	**-1,918.31**	**-2,365.88**	**-5,484.68**	**-3,151.11**
NET BENEFITS (Cr BDT)	**6,624.16**	**-2,205.25**	**-1,918.31**	**-2,365.88**	**-5,484.68**	**-3,151.11**

IRR (%)	**15.08%**
NPV (Cr BDT)	**6,624.16**
Pay Back	**2,048**
Benefit / Cost	**1.77**

CBA

Without Indian traffic

FEASIBILITY STUDY OF CHILMARI-ROWMARI BRIDGE		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	**16,418.12**	**736.98**	**924.27**	**1,144.30**	**1,401.50**	**1,593.21**
Existing traffic	**12,553.59**	**668.73**	**771.03**	**886.55**	**1,016.64**	**1,162.73**
User passenger time savings	12,433.89	663.53	764.84	879.24	1,008.05	1,152.68
User freight time savings	151.16	7.81	9.07	10.50	12.11	13.92
Vehicle Operating Costs (VOC) savings	-31.47	-2.61	-2.89	-3.19	-3.51	-3.87
Diverted traffic	**2,777.87**	**59.75**	**132.59**	**220.27**	**324.68**	**358.31**
User passenger time savings	2,039.60	45.40	100.49	166.49	244.75	269.35
User freight time savings	233.96	3.12	7.25	12.61	19.42	22.36
Vehicle Operating Costs (VOC) savings	504.31	11.23	24.85	41.17	60.52	66.60
Generated traffic	**1,086.66**	**8.50**	**20.65**	**37.48**	**60.18**	**72.17**
User time costs savings	1,073.85	8.44	20.52	37.21	59.71	71.56
User freight time savings	17.41	0.12	0.30	0.55	0.90	1.08
Additional Vehicle Operating Costs (VOC)	-4.60	-0.07	-0.16	-0.28	-0.42	-0.48
Variation in Externalities	**-1,243.93**	**-51.27**	**-78.26**	**-112.08**	**-153.54**	**-170.72**
Accidents	-784.39	-32.50	-50.86	-73.43	-100.67	-111.17
Emissions	-402.11	-16.40	-23.95	-33.79	-46.21	-52.06
Air polution	-242.00	-9.73	-14.28	-20.21	-27.71	-31.24
Climate change	-160.10	-6.67	-9.67	-13.58	-18.50	-20.82
Well to tank	-57.43	-2.36	-3.45	-4.87	-6.65	-7.49
TOTAL ECONOMIC BENEFITS (Cr BDT)	**15,174.19**	**685.71**	**846.01**	**1,032.22**	**1,247.97**	**1,422.49**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-11,710.57**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**185.71**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-1,230.05**	**-163.06**	**-163.06**	**-333.02**	**-163.06**	**-163.06**
Change in Producer Surplus:	**4,204.87**	**120.13**	**228.02**	**356.81**	**508.96**	**559.84**
Producers costs savings for the system	3,936.52	112.66	211.47	329.44	468.90	516.05
Existing traffic	413.31	34.23	37.88	41.84	46.13	50.77
Diverted traffic	3,523.21	78.43	173.59	287.60	422.77	465.28
Toll revenues (generated traffic)	363.96	8.71	19.44	32.42	47.87	52.82
Vehicle Op costs (generated traffic)	-95.61	-1.24	-2.89	-5.05	-7.81	-9.02
TOTAL ECONOMIC COSTS (Cr BDT)	**-8,550.03**	**-42.93**	**64.96**	**23.78**	**345.90**	**396.78**
NET BENEFITS (Cr BDT)	**6,624.16**	**642.78**	**910.97**	**1,056.00**	**1,593.87**	**1,819.27**

IRR (%)	**15.08%**
NPV (Cr BDT)	**6,624.16**
Pay Back	**2,048**
Benefit / Cost	**1.77**

CBA

Without Indian traffic

FEASIBILITY STUDY OF CHILMARI-ROWMARI BRIDGE		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	**16,418.12**	**1,807.29**	**2,045.83**	**2,311.05**	**2,605.32**	**2,931.16**
Existing traffic	**12,553.59**	**1,326.36**	**1,509.14**	**1,712.82**	**1,939.20**	**2,190.24**
User passenger time savings	12,433.89	1,314.65	1,495.57	1,697.13	1,921.16	2,169.55
User freight time savings	151.16	15.96	18.24	20.78	23.62	26.77
Vehicle Operating Costs (VOC) savings	-31.47	-4.25	-4.66	-5.10	-5.58	-6.09
Diverted traffic	**2,777.87**	**394.76**	**434.20**	**476.83**	**522.83**	**572.42**
User passenger time savings	2,039.60	295.92	324.57	355.43	388.61	424.25
User freight time savings	233.96	25.67	29.37	33.52	38.14	43.27
Vehicle Operating Costs (VOC) savings	504.31	73.17	80.25	87.88	96.09	104.90
Generated traffic	**1,086.66**	**86.17**	**102.48**	**121.40**	**143.29**	**168.51**
User time costs savings	1,073.85	85.41	101.53	120.23	141.85	166.77
User freight time savings	17.41	1.31	1.57	1.87	2.22	2.63
Additional Vehicle Operating Costs (VOC)	-4.60	-0.55	-0.62	-0.70	-0.78	-0.88
Variation in Externalities	**-1,243.93**	**-189.06**	**-208.58**	**-229.31**	**-251.26**	**-274.45**
Accidents	-784.39	-122.34	-134.19	-146.74	-160.00	-173.97
Emissions	-402.11	-58.35	-65.06	-72.23	-79.84	-87.91
Air polution	-242.00	-35.04	-39.10	-43.43	-48.03	-52.92
Climate change	-160.10	-23.31	-25.96	-28.80	-31.81	-35.00
Well to tank	-57.43	-8.38	-9.33	-10.34	-11.42	-12.56
TOTAL ECONOMIC BENEFITS (Cr BDT)	**15,174.19**	**1,618.23**	**1,837.24**	**2,081.74**	**2,354.06**	**2,656.72**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-11,710.57**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**185.71**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-1,230.05**	**-333.02**	**-163.06**	**-163.06**	**-333.02**	**-220.43**
Change in Producer Surplus:	**4,204.87**	**614.65**	**673.59**	**736.90**	**804.79**	**877.51**
Producers costs savings for the system	3,936.52	566.95	621.85	680.95	744.52	812.81
Existing traffic	413.31	55.78	61.18	66.99	73.24	79.96
Diverted traffic	3,523.21	511.18	560.67	613.96	671.28	732.85
Toll revenues (generated traffic)	363.96	58.08	63.67	69.58	75.82	82.40
Vehicle Op costs (generated traffic)	-95.61	-10.39	-11.92	-13.64	-15.56	-17.70
TOTAL ECONOMIC COSTS (Cr BDT)	**-8,550.03**	**281.62**	**510.53**	**573.84**	**471.77**	**657.08**
NET BENEFITS (Cr BDT)	**6,624.16**	**1,899.85**	**2,347.78**	**2,655.57**	**2,825.83**	**3,313.80**

IRR (%)	**15.08%**
NPV (Cr BDT)	**6,624.16**
Pay Back	**2,048**
Benefit / Cost	**1.77**

CBA

Without Indian traffic

FEASIBILITY STUDY OF CHILMARI-ROWMARI BRIDGE		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	**16,418.12**	**3,291.25**	**3,688.39**	**4,125.60**	**4,606.03**	**5,133.02**
Existing traffic	**12,553.59**	**2,467.95**	**2,774.51**	**3,112.15**	**3,483.27**	**3,890.34**
User passenger time savings	12,433.89	2,444.32	2,747.60	3,081.62	3,448.71	3,851.35
User freight time savings	151.16	30.27	34.13	38.39	43.08	48.23
Vehicle Operating Costs (VOC) savings	-31.47	-6.64	-7.23	-7.85	-8.53	-9.25
Diverted traffic	**2,777.87**	**625.80**	**683.20**	**744.86**	**811.02**	**881.93**
User passenger time savings	2,039.60	462.48	503.46	547.32	594.23	644.33
User freight time savings	233.96	48.96	55.26	62.21	69.87	78.28
Vehicle Operating Costs (VOC) savings	504.31	114.35	124.48	135.33	146.93	159.32
Generated traffic	**1,086.66**	**197.49**	**230.68**	**268.58**	**311.74**	**360.76**
User time costs savings	1,073.85	195.38	228.15	265.56	308.16	356.52
User freight time savings	17.41	3.10	3.64	4.26	4.97	5.77
Additional Vehicle Operating Costs (VOC)	-4.60	-0.99	-1.11	-1.23	-1.38	-1.53
Variation in Externalities	**-1,243.93**	**-298.89**	**-324.60**	**-351.58**	**-379.85**	**-409.40**
Accidents	-784.39	-188.66	-204.09	-220.24	-237.13	-254.77
Emissions	-402.11	-96.45	-105.46	-114.95	-124.91	-135.36
Air polution	-242.00	-58.08	-63.53	-69.27	-75.30	-81.63
Climate change	-160.10	-38.37	-41.93	-45.68	-49.61	-53.74
Well to tank	-57.43	-13.77	-15.05	-16.39	-17.80	-19.27
TOTAL ECONOMIC BENEFITS (Cr BDT)	**15,174.19**	**2,992.36**	**3,363.80**	**3,774.02**	**4,226.19**	**4,723.62**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-11,710.57**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**185.71**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-1,230.05**	**-163.06**	**-333.02**	**-163.06**	**-163.06**	**-1,124.07**
Change in Producer Surplus:	**4,204.87**	**955.30**	**1,038.41**	**1,127.11**	**1,221.67**	**1,322.37**
Producers costs savings for the system	3,936.52	886.06	964.57	1,048.60	1,138.46	1,234.46
Existing traffic	413.31	87.17	94.89	103.16	112.00	121.44
Diverted traffic	3,523.21	798.89	869.68	945.44	1,026.47	1,113.02
Toll revenues (generated traffic)	363.96	89.31	96.57	104.17	112.11	120.39
Vehicle Op costs (generated traffic)	-95.61	-20.08	-22.72	-25.66	-28.90	-32.49
TOTAL ECONOMIC COSTS (Cr BDT)	**-8,550.03**	**792.24**	**705.39**	**964.05**	**1,058.61**	**198.30**
NET BENEFITS (Cr BDT)	**6,624.16**	**3,784.60**	**4,069.19**	**4,738.08**	**5,284.80**	**4,921.92**

IRR (%)	**15.08%**
NPV (Cr BDT)	**6,624.16**
Pay Back	**2,048**
Benefit / Cost	**1.77**

CBA

Without Indian traffic

FEASIBILITY STUDY OF CHILMARI-ROWMARI BRIDGE		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	**16,418.12**	**5,710.09**	**6,340.94**	**7,029.49**	**7,779.84**	**8,596.31**
Existing traffic	**12,553.59**	**4,335.98**	**4,822.91**	**5,354.00**	**5,932.22**	**6,560.71**
User passenger time savings	12,433.89	4,292.11	4,773.69	5,298.91	5,870.72	6,492.20
User freight time savings	151.16	53.88	60.05	66.79	74.14	82.13
Vehicle Operating Costs (VOC) savings	-31.47	-10.01	-10.83	-11.70	-12.63	-13.62
Diverted traffic	**2,777.87**	**957.85**	**1,039.06**	**1,125.85**	**1,218.52**	**1,317.38**
User passenger time savings	2,039.60	697.81	754.84	815.59	880.26	949.04
User freight time savings	233.96	87.50	97.58	108.60	120.61	133.68
Vehicle Operating Costs (VOC) savings	504.31	172.54	186.64	201.66	217.65	234.66
Generated traffic	**1,086.66**	**416.27**	**478.97**	**549.64**	**629.10**	**718.22**
User time costs savings	1,073.85	411.28	473.14	542.84	621.20	709.08
User freight time savings	17.41	6.69	7.73	8.90	10.22	11.71
Additional Vehicle Operating Costs (VOC)	-4.60	-1.71	-1.89	-2.10	-2.32	-2.57
Variation in Externalities	**-1,243.93**	**-440.25**	**-472.40**	**-505.84**	**-540.57**	**-576.59**
Accidents	-784.39	-273.14	-292.25	-312.10	-332.69	-354.02
Emissions	-402.11	-146.30	-157.71	-169.62	-182.01	-194.89
Air polution	-242.00	-88.24	-95.16	-102.37	-109.87	-117.67
Climate change	-160.10	-58.05	-62.56	-67.25	-72.14	-77.22
Well to tank	-57.43	-20.82	-22.43	-24.11	-25.86	-27.68
TOTAL ECONOMIC BENEFITS (Cr BDT)	**15,174.19**	**5,269.84**	**5,868.55**	**6,523.66**	**7,239.27**	**8,019.72**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-11,710.57**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**185.71**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-1,230.05**	**-163.06**	**-163.06**	**-333.02**	**-163.06**	**-220.43**
Change in Producer Surplus:	**4,204.87**	**1,429.51**	**1,543.38**	**1,664.31**	**1,792.62**	**1,928.66**
Producers costs savings for the system	3,936.52	1,336.92	1,446.17	1,562.57	1,686.47	1,818.25
Existing traffic	413.31	131.52	142.27	153.72	165.90	178.87
Diverted traffic	3,523.21	1,205.40	1,303.91	1,408.85	1,520.56	1,639.38
Toll revenues (generated traffic)	363.96	129.03	138.00	147.33	157.00	167.01
Vehicle Op costs (generated traffic)	-95.61	-36.44	-40.79	-45.58	-50.84	-56.60
TOTAL ECONOMIC COSTS (Cr BDT)	**-8,550.03**	**1,266.45**	**1,380.32**	**1,331.29**	**1,629.57**	**1,708.23**
NET BENEFITS (Cr BDT)	**6,624.16**	**6,536.29**	**7,248.87**	**7,854.95**	**8,868.84**	**9,727.95**

IRR (%)	**15.08%**
NPV (Cr BDT)	**6,624.16**
Pay Back	**2,048**
Benefit / Cost	**1.77**

CBA

Without Indian traffic

FEASIBILITY STUDY OF CHILMARI-ROWMARI BRIDGE		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	**16,418.12**	**9,458.46**	**10,390.62**	**11,397.06**	**12,482.26**	**13,650.86**
Existing traffic	**12,553.59**	**7,242.70**	**7,981.60**	**8,780.94**	**9,644.41**	**10,575.86**
User passenger time savings	12,433.89	7,166.57	7,897.18	8,687.52	9,541.24	10,462.14
User freight time savings	151.16	90.80	100.21	110.39	121.39	133.26
Vehicle Operating Costs (VOC) savings	-31.47	-14.67	-15.78	-16.96	-18.22	-19.54
Diverted traffic	**2,777.87**	**1,422.76**	**1,535.00**	**1,654.44**	**1,781.47**	**1,916.47**
User passenger time savings	2,039.60	1,022.15	1,099.80	1,182.20	1,269.60	1,362.24
User freight time savings	233.96	147.87	163.27	179.93	197.95	217.40
Vehicle Operating Costs (VOC) savings	504.31	252.74	271.93	292.31	313.92	336.83
Generated traffic	**1,086.66**	**793.00**	**874.02**	**961.68**	**1,056.38**	**1,158.54**
User time costs savings	1,073.85	782.80	862.68	949.09	1,042.44	1,143.14
User freight time savings	17.41	12.96	14.31	15.78	17.37	19.08
Additional Vehicle Operating Costs (VOC)	-4.60	-2.76	-2.97	-3.20	-3.43	-3.68
Variation in Externalities	**-1,243.93**	**-593.44**	**-610.16**	**-626.76**	**-643.22**	**-659.51**
Accidents	-784.39	-364.36	-374.63	-384.82	-394.92	-404.92
Emissions	-402.11	-200.59	-206.24	-211.85	-217.42	-222.93
Air polution	-242.00	-121.11	-124.52	-127.91	-131.27	-134.60
Climate change	-160.10	-79.48	-81.72	-83.94	-86.15	-88.33
Well to tank	-57.43	-28.49	-29.29	-30.09	-30.88	-31.66
TOTAL ECONOMIC BENEFITS (Cr BDT)	**15,174.19**	**8,865.03**	**9,780.45**	**10,770.30**	**11,839.05**	**12,991.35**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-11,710.57**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**185.71**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-1,230.05**	**-333.02**	**-163.06**	**-163.06**	**-333.02**	**-954.10**
Change in Producer Surplus:	**4,204.87**	**2,069.24**	**2,218.22**	**2,375.99**	**2,543.00**	**2,719.68**
Producers costs savings for the system	3,936.52	1,958.31	2,107.07	2,264.95	2,432.40	2,609.89
Existing traffic	413.31	192.65	207.28	222.81	239.28	256.74
Diverted traffic	3,523.21	1,765.67	1,899.79	2,042.14	2,193.11	2,353.14
Toll revenues (generated traffic)	363.96	171.89	176.74	181.55	186.32	191.04
Vehicle Op costs (generated traffic)	-95.61	-60.96	-65.59	-70.50	-75.72	-81.24
TOTAL ECONOMIC COSTS (Cr BDT)	**-8,550.03**	**1,736.22**	**2,055.16**	**2,212.93**	**2,209.97**	**1,765.58**
NET BENEFITS (Cr BDT)	**6,624.16**	**10,601.24**	**11,835.61**	**12,983.23**	**14,049.02**	**14,756.93**

IRR (%)	**15.08%**
NPV (Cr BDT)	**6,624.16**
Pay Back	**2,048**
Benefit / Cost	**1.77**

CBA

Without Indian traffic

FEASIBILITY STUDY OF CHILMARI-ROWMARI BRIDGE		2055	2056	2057	2058	2059
		Year 31	Year 32	Year 33	Year 34	Year 35
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**					
Change in Consumer Surplus	**16,418.12**	**14,907.72**	**16,257.86**	**17,706.56**	**19,259.29**	**20,467.16**
Existing traffic	**12,553.59**	**11,579.28**	**12,658.84**	**13,818.89**	**15,063.95**	**16,227.78**
User passenger time savings	12,433.89	11,454.17	12,521.45	13,668.27	14,899.10	16,218.59
User freight time savings	151.16	146.06	159.84	174.64	190.54	36.64
Vehicle Operating Costs (VOC) savings	-31.47	-20.95	-22.44	-24.02	-25.69	-27.45
Diverted traffic	**2,777.87**	**2,059.84**	**2,212.00**	**2,373.38**	**2,544.46**	**2,442.05**
User passenger time savings	2,039.60	1,460.38	1,564.28	1,674.21	1,790.48	1,913.38
User freight time savings	233.96	238.37	260.94	285.21	311.27	55.58
Vehicle Operating Costs (VOC) savings	504.31	361.09	386.78	413.96	442.71	473.10
Generated traffic	**1,086.66**	**1,268.60**	**1,387.02**	**1,514.28**	**1,650.88**	**1,797.32**
User time costs savings	1,073.85	1,251.62	1,368.33	1,493.74	1,628.35	1,772.66
User freight time savings	17.41	20.93	22.92	25.07	27.37	29.83
Additional Vehicle Operating Costs (VOC)	-4.60	-3.95	-4.23	-4.53	-4.84	-5.17
Variation in Externalities	**-1,243.93**	**-675.64**	**-691.58**	**-707.32**	**-722.86**	**-738.19**
Accidents	-784.39	-414.82	-424.61	-434.27	-443.81	-453.22
Emissions	-402.11	-228.38	-233.76	-239.09	-244.34	-249.52
Air polution	-242.00	-137.89	-141.14	-144.35	-147.53	-150.65
Climate change	-160.10	-90.49	-92.62	-94.73	-96.82	-98.87
Well to tank	-57.43	-32.44	-33.20	-33.96	-34.71	-35.44
TOTAL ECONOMIC BENEFITS (Cr BDT)	**15,174.19**	**14,232.08**	**15,566.29**	**16,999.24**	**18,536.43**	**19,728.97**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-11,710.57**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**185.71**	**0.00**	**0.00**	**0.00**	**0.00**	**8,755.04**
Renovation works	**-1,230.05**	**-163.06**	**-333.02**	**-163.06**	**-163.06**	**-358.29**
Change in Producer Surplus:	**4,204.87**	**2,906.52**	**3,104.00**	**3,312.63**	**3,532.95**	**3,765.52**
Producers costs savings for the system	3,936.52	2,797.90	2,996.96	3,207.58	3,430.33	3,665.78
Existing traffic	413.31	275.24	294.82	315.54	337.45	360.61
Diverted traffic	3,523.21	2,522.66	2,702.14	2,892.04	3,092.88	3,305.17
Toll revenues (generated traffic)	363.96	195.71	200.33	204.89	209.40	213.84
Vehicle Op costs (generated traffic)	-95.61	-87.09	-93.29	-99.84	-106.78	-114.10
TOTAL ECONOMIC COSTS (Cr BDT)	**-8,550.03**	**2,743.46**	**2,770.98**	**3,149.57**	**3,369.89**	**12,162.28**
NET BENEFITS (Cr BDT)	**6,624.16**	**16,975.54**	**18,337.26**	**20,148.81**	**21,906.32**	**31,891.24**

IRR (%)	**15.08%**
NPV (Cr BDT)	**6,624.16**
Pay Back	**2,048**
Benefit / Cost	**1.77**

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Economic Analysis (Including Indian Traffic)

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CBA

With Indian traffic

FEASIBILITY STUDY OF CHILMARI-ROWMARI BRIDGE		2025 Year 1	2026 Year 2	2027 Year 3	2028 Year 4	2029 Year 5
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**					
Change in Consumer Surplus	**17,109.64**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Existing traffic	**13,242.99**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
User passenger time savings	13,064.94	0.00	0.00	0.00	0.00	0.00
User freight time savings	210.04	0.00	0.00	0.00	0.00	0.00
Vehicle Operating Costs (VOC) savings	-31.99	0.00	0.00	0.00	0.00	0.00
Diverted traffic	**2,779.31**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
User passenger time savings	2,039.60	0.00	0.00	0.00	0.00	0.00
User freight time savings	235.41	0.00	0.00	0.00	0.00	0.00
Vehicle Operating Costs (VOC) savings	504.31	0.00	0.00	0.00	0.00	0.00
Generated traffic	**1,087.33**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
User time costs savings	1,074.42	0.00	0.00	0.00	0.00	0.00
User freight time savings	17.51	0.00	0.00	0.00	0.00	0.00
Additional Vehicle Operating Costs (VOC)	-4.60	0.00	0.00	0.00	0.00	0.00
Variation in Externalities	**-1,279.52**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Accidents	-806.41	0.00	0.00	0.00	0.00	0.00
Emissions	-413.71	0.00	0.00	0.00	0.00	0.00
Air polution	-248.10	0.00	0.00	0.00	0.00	0.00
Climate change	-165.61	0.00	0.00	0.00	0.00	0.00
Well to tank	-59.40	0.00	0.00	0.00	0.00	0.00
TOTAL ECONOMIC BENEFITS (Cr BDT)	**15,830.12**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-11,651.48**	**-2,192.74**	**-1,908.91**	**-2,354.28**	**-5,457.80**	**-3,135.67**
Residual value	**184.74**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-1,225.43**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Change in Producer Surplus:	**4,331.62**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Producers costs savings for the system	4,063.27	0.00	0.00	0.00	0.00	0.00
Existing traffic	540.06	0.00	0.00	0.00	0.00	0.00
Diverted traffic	3,523.21	0.00	0.00	0.00	0.00	0.00
Toll revenues (generated traffic)	363.96	0.00	0.00	0.00	0.00	0.00
Vehicle Op costs (generated traffic)	-95.61	0.00	0.00	0.00	0.00	0.00
TOTAL ECONOMIC COSTS (Cr BDT)	**-8,360.55**	**-2,192.74**	**-1,908.91**	**-2,354.28**	**-5,457.80**	**-3,135.67**
NET BENEFITS (Cr BDT)	**7,469.57**	**-2,192.74**	**-1,908.91**	**-2,354.28**	**-5,457.80**	**-3,135.67**

IRR (%)	**15.45%**
NPV (Cr BDT)	**7,469.57**
Pay Back	**2,047**
Benefit / Cost	**1.89**

CBA

With Indian traffic

FEASIBILITY STUDY OF CHILMARI-ROWMARI BRIDGE		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	**17,109.64**	**787.32**	**980.66**	**1,207.35**	**1,471.89**	**1,671.60**
Existing traffic	**13,242.99**	**719.07**	**827.38**	**949.51**	**1,086.86**	**1,240.89**
User passenger time savings	13,064.94	710.18	816.98	937.40	1,072.81	1,224.67
User freight time savings	210.04	11.55	13.34	15.36	17.63	20.17
Vehicle Operating Costs (VOC) savings	-31.99	-2.66	-2.94	-3.25	-3.58	-3.94
Diverted traffic	**2,779.31**	**59.75**	**132.62**	**220.34**	**324.81**	**358.49**
User passenger time savings	2,039.60	45.40	100.49	166.49	244.75	269.35
User freight time savings	235.41	3.13	7.28	12.68	19.55	22.54
Vehicle Operating Costs (VOC) savings	504.31	11.23	24.85	41.17	60.52	66.60
Generated traffic	**1,087.33**	**8.50**	**20.66**	**37.50**	**60.22**	**72.21**
User time costs savings	1,074.42	8.44	20.52	37.22	59.74	71.60
User freight time savings	17.51	0.12	0.30	0.55	0.90	1.09
Additional Vehicle Operating Costs (VOC)	-4.60	-0.07	-0.16	-0.28	-0.42	-0.48
Variation in Externalities	**-1,279.52**	**-56.84**	**-84.03**	**-118.05**	**-159.70**	**-177.08**
Accidents	-806.41	-35.95	-54.43	-77.11	-104.49	-115.10
Emissions	-413.71	-18.22	-25.83	-35.73	-48.22	-54.14
Air polution	-248.10	-10.68	-15.26	-21.23	-28.76	-32.33
Climate change	-165.61	-7.53	-10.57	-14.50	-19.45	-21.80
Well to tank	-59.40	-2.67	-3.77	-5.20	-7.00	-7.84
TOTAL ECONOMIC BENEFITS (Cr BDT)	**15,830.12**	**730.48**	**896.63**	**1,089.30**	**1,312.19**	**1,494.52**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-11,651.48**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**184.74**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-1,225.43**	**-162.36**	**-162.36**	**-332.33**	**-162.36**	**-162.36**
Change in Producer Surplus:	**4,331.62**	**132.85**	**241.79**	**371.71**	**525.07**	**577.23**
Producers costs savings for the system	4,063.27	125.38	225.25	344.35	485.02	533.44
Existing traffic	540.06	46.95	51.66	56.75	62.24	68.16
Diverted traffic	3,523.21	78.43	173.59	287.60	422.77	465.28
Toll revenues (generated traffic)	363.96	8.71	19.44	32.42	47.87	52.82
Vehicle Op costs (generated traffic)	-95.61	-1.24	-2.89	-5.05	-7.81	-9.02
TOTAL ECONOMIC COSTS (Cr BDT)	**-8,360.55**	**-29.51**	**79.43**	**39.39**	**362.71**	**414.87**
NET BENEFITS (Cr BDT)	**7,469.57**	**700.97**	**976.06**	**1,128.69**	**1,674.90**	**1,909.39**

IRR (%)	**15.45%**
NPV (Cr BDT)	**7,469.57**
Pay Back	**2,047**
Benefit / Cost	**1.89**

CBA

With Indian traffic

FEASIBILITY STUDY OF CHILMARI-ROWMARI BRIDGE		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	**17,109.64**	**1,894.42**	**2,142.50**	**2,418.12**	**2,723.69**	**3,061.79**
Existing traffic	**13,242.99**	**1,413.21**	**1,605.47**	**1,819.47**	**2,057.08**	**2,320.29**
User passenger time savings	13,064.94	1,394.53	1,584.05	1,794.98	2,029.18	2,288.61
User freight time savings	210.04	23.00	26.16	29.68	33.57	37.87
Vehicle Operating Costs (VOC) savings	-31.99	-4.32	-4.74	-5.19	-5.67	-6.19
Diverted traffic	**2,779.31**	**394.98**	**434.47**	**477.14**	**523.19**	**572.83**
User passenger time savings	2,039.60	295.92	324.57	355.43	388.61	424.25
User freight time savings	235.41	25.89	29.64	33.83	38.50	43.68
Vehicle Operating Costs (VOC) savings	504.31	73.17	80.25	87.88	96.09	104.90
Generated traffic	**1,087.33**	**86.24**	**102.57**	**121.51**	**143.42**	**168.68**
User time costs savings	1,074.42	85.47	101.60	120.33	141.97	166.90
User freight time savings	17.51	1.32	1.58	1.88	2.24	2.65
Additional Vehicle Operating Costs (VOC)	-4.60	-0.55	-0.62	-0.70	-0.78	-0.88
Variation in Externalities	**-1,279.52**	**-195.61**	**-215.33**	**-236.25**	**-258.39**	**-281.76**
Accidents	-806.41	-126.39	-138.36	-151.03	-164.41	-178.49
Emissions	-413.71	-60.48	-67.26	-74.49	-82.16	-90.30
Air polution	-248.10	-36.16	-40.26	-44.62	-49.25	-54.17
Climate change	-165.61	-24.32	-27.01	-29.87	-32.91	-36.13
Well to tank	-59.40	-8.74	-9.70	-10.73	-11.82	-12.97
TOTAL ECONOMIC BENEFITS (Cr BDT)	**15,830.12**	**1,698.81**	**1,927.18**	**2,181.87**	**2,465.30**	**2,780.03**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-11,651.48**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**184.74**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-1,225.43**	**-332.33**	**-162.36**	**-162.36**	**-332.33**	**-215.81**
Change in Producer Surplus:	**4,331.62**	**633.41**	**693.80**	**758.65**	**828.18**	**902.63**
Producers costs savings for the system	4,063.27	585.71	642.06	702.71	767.91	837.93
Existing traffic	540.06	74.54	81.39	88.74	96.63	105.08
Diverted traffic	3,523.21	511.18	560.67	613.96	671.28	732.85
Toll revenues (generated traffic)	363.96	58.08	63.67	69.58	75.82	82.40
Vehicle Op costs (generated traffic)	-95.61	-10.39	-11.92	-13.64	-15.56	-17.70
TOTAL ECONOMIC COSTS (Cr BDT)	**-8,360.55**	**301.08**	**531.44**	**596.29**	**495.85**	**686.82**
NET BENEFITS (Cr BDT)	**7,469.57**	**1,999.89**	**2,458.62**	**2,778.16**	**2,961.16**	**3,466.85**

IRR (%)	**15.45%**
NPV (Cr BDT)	**7,469.57**
Pay Back	**2,047**
Benefit / Cost	**1.89**

CBA

With Indian traffic

FEASIBILITY STUDY OF CHILMARI-ROWMARI BRIDGE		2040 Year 16	2041 Year 17	2042 Year 18	2043 Year 19	2044 Year 20
SOCIO ECONOMIC BENEFITS (Cr BDT)	**NPV**					
Change in Consumer Surplus	**17,109.64**	**3,435.15**	**3,846.67**	**4,299.38**	**4,796.53**	**5,341.52**
Existing traffic	**13,242.99**	**2,611.21**	**2,932.05**	**3,285.12**	**3,672.88**	**4,097.87**
User passenger time savings	13,064.94	2,575.34	2,891.54	3,239.51	3,621.65	4,040.50
User freight time savings	210.04	42.62	47.85	53.59	59.89	66.77
Vehicle Operating Costs (VOC) savings	-31.99	-6.75	-7.34	-7.98	-8.66	-9.39
Diverted traffic	**2,779.31**	**626.26**	**683.71**	**745.42**	**811.62**	**882.56**
User passenger time savings	2,039.60	462.48	503.46	547.32	594.23	644.33
User freight time savings	235.41	49.42	55.77	62.77	70.46	78.91
Vehicle Operating Costs (VOC) savings	504.31	114.35	124.48	135.33	146.93	159.32
Generated traffic	**1,087.33**	**197.68**	**230.91**	**268.84**	**312.04**	**361.08**
User time costs savings	1,074.42	195.55	228.34	265.78	308.40	356.79
User freight time savings	17.51	3.13	3.67	4.30	5.01	5.82
Additional Vehicle Operating Costs (VOC)	-4.60	-0.99	-1.11	-1.23	-1.38	-1.53
Variation in Externalities	**-1,279.52**	**-306.39**	**-332.29**	**-359.45**	**-387.90**	**-417.64**
Accidents	-806.41	-193.30	-208.84	-225.11	-242.12	-259.86
Emissions	-413.71	-98.90	-107.97	-117.52	-127.54	-138.05
Air polution	-248.10	-59.37	-64.85	-70.62	-76.68	-83.04
Climate change	-165.61	-39.53	-43.12	-46.90	-50.86	-55.01
Well to tank	-59.40	-14.19	-15.47	-16.83	-18.24	-19.73
TOTAL ECONOMIC BENEFITS (Cr BDT)	**15,830.12**	**3,128.76**	**3,514.38**	**3,939.93**	**4,408.63**	**4,923.89**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-11,651.48**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**184.74**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-1,225.43**	**-162.36**	**-332.33**	**-162.36**	**-162.36**	**-1,123.37**
Change in Producer Surplus:	**4,331.62**	**982.26**	**1,067.32**	**1,158.09**	**1,254.83**	**1,357.84**
Producers costs savings for the system	4,063.27	913.03	993.48	1,079.58	1,171.63	1,269.94
Existing traffic	540.06	114.13	123.80	134.13	145.16	156.91
Diverted traffic	3,523.21	798.89	869.68	945.44	1,026.47	1,113.02
Toll revenues (generated traffic)	363.96	89.31	96.57	104.17	112.11	120.39
Vehicle Op costs (generated traffic)	-95.61	-20.08	-22.72	-25.66	-28.90	-32.49
TOTAL ECONOMIC COSTS (Cr BDT)	**-8,360.55**	**819.90**	**735.00**	**995.73**	**1,092.47**	**234.47**
NET BENEFITS (Cr BDT)	**7,469.57**	**3,948.66**	**4,249.38**	**4,935.65**	**5,501.10**	**5,158.36**

IRR (%)	**15.45%**
NPV (Cr BDT)	**7,469.57**
Pay Back	**2,047**
Benefit / Cost	**1.89**

CBA

With Indian traffic

FEASIBILITY STUDY OF CHILMARI-ROWMARI BRIDGE		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	**17,109.64**	**5,937.94**	**6,589.58**	**7,300.41**	**8,074.62**	**8,916.62**
Existing traffic	**13,242.99**	**4,562.80**	**5,070.45**	**5,623.77**	**6,225.82**	**6,879.81**
User passenger time savings	13,064.94	4,498.68	4,998.97	5,544.26	6,137.57	6,782.06
User freight time savings	210.04	74.29	82.48	91.39	101.07	111.56
Vehicle Operating Costs (VOC) savings	-31.99	-10.17	-11.00	-11.88	-12.82	-13.82
Diverted traffic	**2,779.31**	**958.52**	**1,039.76**	**1,126.58**	**1,219.26**	**1,318.12**
User passenger time savings	2,039.60	697.81	754.84	815.59	880.26	949.04
User freight time savings	235.41	88.17	98.29	109.33	121.35	134.42
Vehicle Operating Costs (VOC) savings	504.31	172.54	186.64	201.66	217.65	234.66
Generated traffic	**1,087.33**	**416.62**	**479.37**	**550.07**	**629.54**	**718.69**
User time costs savings	1,074.42	411.59	473.47	543.20	621.58	709.48
User freight time savings	17.51	6.74	7.79	8.96	10.29	11.78
Additional Vehicle Operating Costs (VOC)	-4.60	-1.71	-1.89	-2.10	-2.32	-2.57
Variation in Externalities	**-1,279.52**	**-448.66**	**-480.98**	**-514.59**	**-549.49**	**-585.68**
Accidents	-806.41	-278.34	-297.56	-317.52	-338.21	-359.64
Emissions	-413.71	-149.04	-160.51	-172.47	-184.92	-197.86
Air polution	-248.10	-89.68	-96.63	-103.87	-111.40	-119.23
Climate change	-165.61	-59.35	-63.89	-68.61	-73.52	-78.63
Well to tank	-59.40	-21.29	-22.91	-24.60	-26.36	-28.19
TOTAL ECONOMIC BENEFITS (Cr BDT)	**15,830.12**	**5,489.28**	**6,108.60**	**6,785.82**	**7,525.13**	**8,330.94**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-11,651.48**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**184.74**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-1,225.43**	**-162.36**	**-162.36**	**-332.33**	**-162.36**	**-215.81**
Change in Producer Surplus:	**4,331.62**	**1,467.42**	**1,583.88**	**1,707.54**	**1,838.73**	**1,977.79**
Producers costs savings for the system	4,063.27	1,374.84	1,486.67	1,605.79	1,732.57	1,867.39
Existing traffic	540.06	169.44	182.76	196.94	212.01	228.01
Diverted traffic	3,523.21	1,205.40	1,303.91	1,408.85	1,520.56	1,639.38
Toll revenues (generated traffic)	363.96	129.03	138.00	147.33	157.00	167.01
Vehicle Op costs (generated traffic)	-95.61	-36.44	-40.79	-45.58	-50.84	-56.60
TOTAL ECONOMIC COSTS (Cr BDT)	**-8,360.55**	**1,305.06**	**1,421.52**	**1,375.21**	**1,676.36**	**1,761.99**
NET BENEFITS (Cr BDT)	**7,469.57**	**6,794.34**	**7,530.11**	**8,161.03**	**9,201.49**	**10,092.92**

IRR (%)	**15.45%**
NPV (Cr BDT)	**7,469.57**
Pay Back	**2,047**
Benefit / Cost	**1.89**

CBA

With Indian traffic

FEASIBILITY STUDY OF CHILMARI-ROWMARI BRIDGE		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	**17,109.64**	**9,806.03**	**10,767.29**	**11,804.77**	**12,923.04**	**14,126.83**
Existing traffic	**13,242.99**	**7,589.07**	**8,357.10**	**9,187.53**	**10,084.15**	**11,050.90**
User passenger time savings	13,064.94	7,481.03	8,237.91	9,056.28	9,939.87	10,892.59
User freight time savings	210.04	122.93	135.21	148.46	162.75	178.13
Vehicle Operating Costs (VOC) savings	-31.99	-14.88	-16.01	-17.21	-18.47	-19.82
Diverted traffic	**2,779.31**	**1,423.49**	**1,535.70**	**1,655.11**	**1,782.08**	**1,917.01**
User passenger time savings	2,039.60	1,022.15	1,099.80	1,182.20	1,269.60	1,362.24
User freight time savings	235.41	148.60	163.97	180.60	198.56	217.94
Vehicle Operating Costs (VOC) savings	504.31	252.74	271.93	292.31	313.92	336.83
Generated traffic	**1,087.33**	**793.47**	**874.48**	**962.13**	**1,056.80**	**1,158.92**
User time costs savings	1,074.42	783.20	863.07	949.47	1,042.80	1,143.47
User freight time savings	17.51	13.03	14.38	15.85	17.43	19.14
Additional Vehicle Operating Costs (VOC)	-4.60	-2.76	-2.97	-3.20	-3.43	-3.68
Variation in Externalities	**-1,279.52**	**-602.69**	**-619.58**	**-636.33**	**-652.94**	**-669.39**
Accidents	-806.41	-370.08	-380.45	-390.74	-400.93	-411.03
Emissions	-413.71	-203.60	-209.31	-214.97	-220.59	-226.15
Air polution	-248.10	-122.69	-126.14	-129.55	-132.94	-136.29
Climate change	-165.61	-80.91	-83.18	-85.42	-87.65	-89.86
Well to tank	-59.40	-29.00	-29.82	-30.62	-31.42	-32.21
TOTAL ECONOMIC BENEFITS (Cr BDT)	**15,830.12**	**9,203.34**	**10,147.71**	**11,168.44**	**12,270.10**	**13,457.45**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-11,651.48**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**184.74**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-1,225.43**	**-332.33**	**-162.36**	**-162.36**	**-332.33**	**-953.41**
Change in Producer Surplus:	**4,331.62**	**2,121.58**	**2,273.94**	**2,435.27**	**2,606.03**	**2,786.67**
Producers costs savings for the system	4,063.27	2,010.66	2,162.79	2,324.23	2,495.43	2,676.88
Existing traffic	540.06	244.99	263.00	282.09	302.32	323.73
Diverted traffic	3,523.21	1,765.67	1,899.79	2,042.14	2,193.11	2,353.14
Toll revenues (generated traffic)	363.96	171.89	176.74	181.55	186.32	191.04
Vehicle Op costs (generated traffic)	-95.61	-60.96	-65.59	-70.50	-75.72	-81.24
TOTAL ECONOMIC COSTS (Cr BDT)	**-8,360.55**	**1,789.26**	**2,111.58**	**2,272.91**	**2,273.71**	**1,833.27**
NET BENEFITS (Cr BDT)	**7,469.57**	**10,992.60**	**12,259.29**	**13,441.35**	**14,543.80**	**15,290.71**

IRR (%)	**15.45%**
NPV (Cr BDT)	**7,469.57**
Pay Back	**2,047**
Benefit / Cost	**1.89**

CBA

With Indian traffic

FEASIBILITY STUDY OF CHILMARI-ROWMARI BRIDGE		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	**17,109.64**	**15,421.12**	**16,811.04**	**18,301.97**	**19,899.51**	**21,100.67**
Existing traffic	**13,242.99**	**12,091.90**	**13,211.42**	**14,413.93**	**15,704.07**	**16,861.29**
User passenger time savings	13,064.94	11,918.47	13,021.75	14,206.80	15,478.23	16,840.78
User freight time savings	210.04	194.67	212.43	231.48	251.88	48.34
Vehicle Operating Costs (VOC) savings	-31.99	-21.24	-22.75	-24.35	-26.04	-27.82
Diverted traffic	**2,779.31**	**2,060.28**	**2,212.32**	**2,373.56**	**2,544.46**	**2,442.05**
User passenger time savings	2,039.60	1,460.38	1,564.28	1,674.21	1,790.48	1,913.38
User freight time savings	235.41	238.81	261.26	285.38	311.27	55.58
Vehicle Operating Costs (VOC) savings	504.31	361.09	386.78	413.96	442.71	473.10
Generated traffic	**1,087.33**	**1,268.94**	**1,387.30**	**1,514.49**	**1,650.99**	**1,797.32**
User time costs savings	1,074.42	1,251.90	1,368.57	1,493.92	1,628.45	1,772.66
User freight time savings	17.51	20.98	22.97	25.10	27.38	29.83
Additional Vehicle Operating Costs (VOC)	-4.60	-3.95	-4.23	-4.53	-4.84	-5.17
Variation in Externalities	**-1,279.52**	**-685.66**	**-701.74**	**-717.63**	**-733.31**	**-748.77**
Accidents	-806.41	-421.02	-430.90	-440.65	-450.28	-459.77
Emissions	-413.71	-231.64	-237.08	-242.45	-247.75	-252.97
Air polution	-248.10	-139.60	-142.88	-146.12	-149.32	-152.47
Climate change	-165.61	-92.04	-94.20	-96.33	-98.43	-100.51
Well to tank	-59.40	-32.99	-33.77	-34.53	-35.28	-36.03
TOTAL ECONOMIC BENEFITS (Cr BDT)	**15,830.12**	**14,735.46**	**16,109.29**	**17,584.34**	**19,166.20**	**20,351.90**
SOCIO ECONOMIC COSTS (Cr BDT)						
Project initial investments	**-11,651.48**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**184.74**	**0.00**	**0.00**	**0.00**	**0.00**	**8,709.05**
Renovation works	**-1,225.43**	**-162.36**	**-332.33**	**-162.36**	**-162.36**	**-357.59**
Change in Producer Surplus:	**4,331.62**	**2,977.67**	**3,179.53**	**3,392.78**	**3,617.95**	**3,855.62**
Producers costs savings for the system	4,063.27	2,869.06	3,072.49	3,287.73	3,515.33	3,755.89
Existing traffic	540.06	346.39	370.36	395.69	422.45	450.72
Diverted traffic	3,523.21	2,522.66	2,702.14	2,892.04	3,092.88	3,305.17
Toll revenues (generated traffic)	363.96	195.71	200.33	204.89	209.40	213.84
Vehicle Op costs (generated traffic)	-95.61	-87.09	-93.29	-99.84	-106.78	-114.10
TOTAL ECONOMIC COSTS (Cr BDT)	**-8,360.55**	**2,815.31**	**2,847.21**	**3,230.41**	**3,455.59**	**12,207.09**
NET BENEFITS (Cr BDT)	**7,469.57**	**17,550.77**	**18,956.50**	**20,814.76**	**22,621.79**	**32,558.98**

IRR (%)	**15.45%**
NPV (Cr BDT)	**7,469.57**
Pay Back	**2,047**
Benefit / Cost	**1.89**

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Financial Analysis - Public Project Scheme - Cash Flow

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	2023 Year 1	2024 Year 2	2025 Year 3	2026 Year 4	2027 Year 5	2028 Year 6
Construction period	1	1	1	1	1	0
Operation period	0	0	0	0	0	1
Term of analysis	1	1	1	1	1	1
Price indexation	1.00	1.05	1.10	1.16	1.22	1.28

CASH FLOWS (Million BDT)	2023 Year 1	2024 Year 2	2025 Year 3	2026 Year 4	2027 Year 5	2028 Year 6
Operating revenues	**0**	**0**	**0**	**0**	**0**	**6,296**
Toll revenues	0	0	0	0	0	6,296
Other commercial revenues	0	0	0	0	0	0
Operation & Maintenance expenses	**0**	**0**	**0**	**0**	**0**	**-3,919**
Maintenance & Overhaul	0	0	0	0	0	-3,751
Operation	0	0	0	0	0	-168
Net Cash Flows due to Operations	**0**	**0**	**0**	**0**	**0**	**2,377**
Cash Flows due to Investments	**-43,460**	**-37,858**	**-49,495**	**-119,374**	**-75,126**	**0**
Initial CAPEX	-43,460	-37,858	-49,495	-119,374	-75,126	0
Other CAPEX	0	0	0	0	0	0
Residual Value of Investments	0	0	0	0	0	0
Project cash flows	**-43,460**	**-37,858**	**-49,495**	**-119,374**	**-75,126**	**2,377**

	2023 Year 1	2024 Year 2	2025 Year 3	2026 Year 4	2027 Year 5	2028 Year 6
Outflows	**-43,460**	**-37,858**	**-49,495**	**-119,374**	**-75,126**	**-17,345**
Project Development (Initial CAPEX)	-40,544	-36,450	-47,202	-114,896	-69,312	0
Financing Fees	-2,916	-1,409	-2,293	-4,478	-5,814	0
Loan Repayments						
Interest	0	0	0	0	0	-8,871
Principal Repayments	0	0	0	0	0	-8,474
Inflows	**43,460**	**37,858**	**49,495**	**119,374**	**75,126**	**944**
GoB Equity / Budgets	10,507	8,996	11,095	25,721	14,778	0
Multilateral grants	0	0	0	0	0	0
Borrowings	32,953	28,862	38,400	93,653	60,348	0
VAT on toll fares	0	0	0	0	0	944
Future Developments	0	0	0	0	0	0
GoB net cashflows	**0**	**0**	**0**	**0**	**0**	**-14,023**

	2029 Year 7	2030 Year 8	2031 Year 9	2032 Year 10	2033 Year 11	2034 Year 12
Construction period	0	0	0	0	0	0
Operation period	1	1	1	1	1	1
Term of analysis	1	1	1	1	1	1
Price indexation	1.34	1.41	1.48	1.55	1.63	1.71

CASH FLOWS (Million BDT)	2029 Year 7	2030 Year 8	2031 Year 9	2032 Year 10	2033 Year 11	2034 Year 12
Operating revenues	**8,314**	**10,694**	**13,484**	**14,891**	**16,418**	**18,075**
Toll revenues	8,314	10,694	13,484	14,891	16,418	18,075
Other commercial revenues	0	0	0	0	0	0
Operation & Maintenance expenses	**-4,115**	**-9,699**	**-4,536**	**-4,763**	**-11,228**	**-5,252**
Maintenance & Overhaul	-3,939	-9,514	-4,343	-4,560	-11,014	-5,027
Operation	-176	-185	-194	-204	-214	-224
Net Cash Flows due to Operations	**4,199**	**995**	**8,948**	**10,127**	**5,190**	**12,824**
Cash Flows due to Investments	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0
Residual Value of Investments	0	0	0	0	0	0
Project cash flows	**4,199**	**995**	**8,948**	**10,127**	**5,190**	**12,824**

	2029 Year 7	2030 Year 8	2031 Year 9	2032 Year 10	2033 Year 11	2034 Year 12
Outflows	**-17,044**	**-16,743**	**-16,443**	**-16,142**	**-15,841**	**-15,540**
Project Development (Initial CAPEX)	0	0	0	0	0	0
Financing Fees	0	0	0	0	0	0
Loan Repayments						
Interest	-8,570	-8,269	-7,969	-7,668	-7,367	-7,067
Principal Repayments	-8,474	-8,474	-8,474	-8,474	-8,474	-8,474
Inflows	**1,247**	**1,604**	**2,023**	**2,234**	**2,463**	**2,711**
GoB Equity / Budgets	0	0	0	0	0	0
Multilateral grants	0	0	0	0	0	0
Borrowings	0	0	0	0	0	0
VAT on toll fares	1,247	1,604	2,023	2,234	2,463	2,711
Future Developments	0	0	0	0	0	0
GoB net cashflows	**-11,598**	**-14,144**	**-5,472**	**-3,781**	**-8,188**	**-5**

	2035 Year 13	2036 Year 14	2037 Year 15	2038 Year 16	2039 Year 17	2040 Year 18
Construction period	0	0	0	0	0	0
Operation period	1	1	1	1	1	1
Term of analysis	1	1	1	1	1	1
Price indexation	1.80	1.89	1.98	2.08	2.18	2.29

CASH FLOWS (Million BDT)	2035 Year 13	2036 Year 14	2037 Year 15	2038 Year 16	2039 Year 17	2040 Year 18
Operating revenues	**19,871**	**21,814**	**23,914**	**26,182**	**28,628**	**31,264**
Toll revenues	19,871	21,814	23,914	26,182	28,628	31,264
Other commercial revenues	0	0	0	0	0	0
Operation & Maintenance expenses	**-5,514**	**-12,998**	**-8,928**	**-6,383**	**-15,046**	**-7,038**
Maintenance & Overhaul	-5,278	-12,750	-8,669	-6,110	-14,760	-6,737
Operation	-236	-247	-260	-273	-287	-301
Net Cash Flows due to Operations	**14,357**	**8,816**	**14,986**	**19,799**	**13,582**	**24,226**
Cash Flows due to Investments	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0
Residual Value of Investments	0	0	0	0	0	0
Project cash flows	**14,357**	**8,816**	**14,986**	**19,799**	**13,582**	**24,226**

	2035 Year 13	2036 Year 14	2037 Year 15	2038 Year 16	2039 Year 17	2040 Year 18
Outflows	**-15,240**	**-14,939**	**-14,638**	**-14,338**	**-14,037**	**-13,736**
Project Development (Initial CAPEX)	0	0	0	0	0	0
Financing Fees	0	0	0	0	0	0
Loan Repayments						
Interest	-6,766	-6,465	-6,164	-5,864	-5,563	-5,262
Principal Repayments	-8,474	-8,474	-8,474	-8,474	-8,474	-8,474
Inflows	**2,981**	**3,272**	**3,587**	**3,927**	**4,294**	**4,690**
GoB Equity / Budgets	0	0	0	0	0	0
Multilateral grants	0	0	0	0	0	0
Borrowings	0	0	0	0	0	0
VAT on toll fares	2,981	3,272	3,587	3,927	4,294	4,690
Future Developments	0	0	0	0	0	0
GoB net cashflows	**2,098**	**-2,851**	**3,934**	**9,388**	**3,839**	**15,180**

	2041 Year 19	2042 Year 20	2043 Year 21	2044 Year 22	2045 Year 23	2046 Year 24
Construction period	0	0	0	0	0	0
Operation period	1	1	1	1	1	1
Term of analysis	1	1	1	1	1	1
Price indexation	2.41	2.53	2.65	2.79	2.93	3.07

CASH FLOWS (Million BDT)	2041 Year 19	2042 Year 20	2043 Year 21	2044 Year 22	2045 Year 23	2046 Year 24
Operating revenues	**34,102**	**37,154**	**40,435**	**43,957**	**47,737**	**51,789**
Toll revenues	34,102	37,154	40,435	43,957	47,737	51,789
Other commercial revenues	0	0	0	0	0	0
Operation & Maintenance expenses	**-7,389**	**-44,391**	**-8,147**	**-8,554**	**-20,163**	**-9,431**
Maintenance & Overhaul	-7,074	-44,059	-7,799	-8,188	-19,780	-9,028
Operation	-316	-332	-348	-366	-384	-403
Net Cash Flows due to Operations	**26,713**	**-7,237**	**32,288**	**35,403**	**27,573**	**42,358**
Cash Flows due to Investments	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0
Residual Value of Investments	0	0	0	0	0	0
Project cash flows	**26,713**	**-7,237**	**32,288**	**35,403**	**27,573**	**42,358**

	2041 Year 19	2042 Year 20	2043 Year 21	2044 Year 22	2045 Year 23	2046 Year 24
Outflows	**-13,436**	**-13,135**	**-12,834**	**-12,533**	**-12,233**	**-11,932**
Project Development (Initial CAPEX)	0	0	0	0	0	0
Financing Fees	0	0	0	0	0	0
Loan Repayments						
Interest	-4,962	-4,661	-4,360	-4,060	-3,759	-3,458
Principal Repayments	-8,474	-8,474	-8,474	-8,474	-8,474	-8,474
Inflows	**5,115**	**5,573**	**6,065**	**6,594**	**7,160**	**7,768**
GoB Equity / Budgets	0	0	0	0	0	0
Multilateral grants	0	0	0	0	0	0
Borrowings	0	0	0	0	0	0
VAT on toll fares	5,115	5,573	6,065	6,594	7,160	7,768
Future Developments	0	0	0	0	0	0
GoB net cashflows	**18,392**	**-14,798**	**25,519**	**29,463**	**22,501**	**38,194**

	2047 Year 25	2048 Year 26	2049 Year 27	2050 Year 28	2051 Year 29	2052 Year 30
Construction period	0	0	0	0	0	0
Operation period	1	1	1	1	1	1
Term of analysis	1	1	1	1	1	1
Price indexation	3.23	3.39	3.56	3.73	3.92	4.12

CASH FLOWS (Million BDT)	2047 Year 25	2048 Year 26	2049 Year 27	2050 Year 28	2051 Year 29	2052 Year 30
Operating revenues	**56,130**	**60,589**	**65,341**	**70,401**	**75,786**	**81,513**
Toll revenues	56,130	60,589	65,341	70,401	75,786	81,513
Other commercial revenues	0	0	0	0	0	0
Operation & Maintenance expenses	**-14,543**	**-23,342**	**-10,918**	**-11,463**	**-27,021**	**-56,575**
Maintenance & Overhaul	-14,120	-22,897	-10,451	-10,973	-26,506	-56,034
Operation	-423	-444	-467	-490	-515	-540
Net Cash Flows due to Operations	**41,586**	**37,247**	**54,423**	**58,937**	**48,765**	**24,939**
Cash Flows due to Investments	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0
Residual Value of Investments	0	0	0	0	0	0
Project cash flows	**41,586**	**37,247**	**54,423**	**58,937**	**48,765**	**24,939**

	2047 Year 25	2048 Year 26	2049 Year 27	2050 Year 28	2051 Year 29	2052 Year 30
Outflows	**-11,631**	**-11,331**	**-11,030**	**-10,729**	**-10,428**	**-10,128**
Project Development (Initial CAPEX)	0	0	0	0	0	0
Financing Fees	0	0	0	0	0	0
Loan Repayments						
Interest	-3,157	-2,857	-2,556	-2,255	-1,955	-1,654
Principal Repayments	-8,474	-8,474	-8,474	-8,474	-8,474	-8,474
Inflows	**8,419**	**9,088**	**9,801**	**10,560**	**11,368**	**12,227**
GoB Equity / Budgets	0	0	0	0	0	0
Multilateral grants	0	0	0	0	0	0
Borrowings	0	0	0	0	0	0
VAT on toll fares	8,419	9,088	9,801	10,560	11,368	12,227
Future Developments	0	0	0	0	0	0
GoB net cashflows	**38,374**	**35,005**	**53,194**	**58,768**	**49,704**	**27,038**

	2053 Year 31	2054 Year 32	2055 Year 33	2056 Year 34	2057 Year 35
Construction period	0	0	0	0	0
Operation period	1	1	1	1	1
Term of analysis	1	1	1	1	1
Price indexation	4.32	4.54	4.76	5.00	5.25

CASH FLOWS (Million BDT)	2053 Year 31	2054 Year 32	2055 Year 33	2056 Year 34	2057 Year 35
Operating revenues	**87,601**	**94,069**	**100,937**	**108,225**	**115,956**
Toll revenues	87,601	94,069	100,937	108,225	115,956
Other commercial revenues	0	0	0	0	0
Operation & Maintenance expenses	**-13,270**	**-31,280**	**-14,631**	**-15,362**	**-43,770**
Maintenance & Overhaul	-12,703	-30,685	-14,005	-14,705	-43,081
Operation	-567	-596	-625	-657	-690
Net Cash Flows due to Operations	**74,331**	**62,789**	**86,306**	**92,863**	**72,186**
Cash Flows due to Investments	**0**	**0**	**0**	**0**	**79,274**
Initial CAPEX	0	0	0	0	0
Other CAPEX	0	0	0	0	0
Residual Value of Investments	0	0	0	0	79,274
Project cash flows	**74,331**	**62,789**	**86,306**	**92,863**	**151,460**

	2053 Year 31	2054 Year 32	2055 Year 33	2056 Year 34	2057 Year 35
Outflows	**-9,827**	**-9,526**	**-9,226**	**-8,925**	**-8,624**
Project Development (Initial CAPEX)	0	0	0	0	0
Financing Fees	0	0	0	0	0
Loan Repayments					
Interest	-1,353	-1,052	-752	-451	-150
Principal Repayments	-8,474	-8,474	-8,474	-8,474	-8,474
Inflows	**13,140**	**14,110**	**15,141**	**16,234**	**17,393**
GoB Equity / Budgets	0	0	0	0	0
Multilateral grants	0	0	0	0	0
Borrowings	0	0	0	0	0
VAT on toll fares	13,140	14,110	15,141	16,234	17,393
Future Developments	0	0	0	0	0
GoB net cashflows	**77,644**	**67,373**	**92,221**	**100,172**	**160,229**

Financial Analysis-PPP scheme Cash Flows

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CASH FLOWS (Million BDT)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Operating revenues	**0**	**0**	**0**	**0**	**0**	**6,296**
Toll revenues	0	0	0	0	0	6,296
Other revenues	0	0	0	0	0	0
Operating expenses	**0**	**0**	**0**	**0**	**0**	**-8,308**
Maintenance	0	0	0	0	0	-8,076
Operation	0	0	0	0	0	-168
SPV Structure	0	0	0	0	0	-64
Corporate tax	0	0	0	0	0	0
EBITDA	**0**	**0**	**0**	**0**	**0**	**-2,012**
Investments	**-44,624**	**-34,543**	**-44,942**	**-109,353**	**-67,225**	**0**
Initial CAPEX	-44,624	-34,543	-44,942	-109,353	-67,225	0
Other CAPEX	0	0	0	0	0	0
Project cash flows	**-44,624**	**-34,543**	**-44,942**	**-109,353**	**-67,225**	**-2,012**
Public Contributions	**33,603**	**28,771**	**35,484**	**82,260**	**47,261**	**0**
Government capital contributions	16,802	14,386	17,742	41,130	23,631	0
Multilateral capital contributions	16,802	14,386	17,742	41,130	23,631	0
Project cash flows (after contributions)	**-11,021**	**-5,772**	**-9,458**	**-27,093**	**-19,964**	**-2,012**
Funding	**11,021**	**5,772**	**9,458**	**27,093**	**19,964**	**0**
Equity	2,755	1,443	2,365	6,773	4,991	0
Multilateral term loan	8,266	4,329	7,094	20,319	14,973	0
Cash flow before debt service (multilateral)	**0**	**0**	**0**	**0**	**0**	**-2,012**
Debt service. Multilateral term loan	**0**	**0**	**0**	**0**	**0**	**-3,345**
Interest	0	0	0	0	0	-3,345
Debt repayment	0	0	0	0	0	0
Cash flow after debt service (multilateral)	**0**	**0**	**0**	**0**	**0**	**-5,356**
Commercial banks credit line. Drawdowns	0	0	0	0	0	5,356
Cash flow before debt service (commercial)	**0**	**0**	**0**	**0**	**0**	**0**
Debt service. Commercial term loan	**0**	**0**	**0**	**0**	**0**	**0**
Interest	0	0	0	0	0	0
Debt repayment	0	0	0	0	0	0
Free cash flows	**0**	**0**	**0**	**0**	**0**	**0**
Dividends	0	0	0	0	0	0
Annual cash	**0**	**0**	**0**	**0**	**0**	**0**
Initial cash balance	**0**	**0**	**0**	**0**	**0**	**0**
Cash movements of the year	0	0	0	0	0	0
Ending cash balance	**0**	**0**	**0**	**0**	**0**	**0**

CASH FLOWS (Million BDT)	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Operating revenues	**8,314**	**10,694**	**13,484**	**14,891**	**16,418**	**18,075**
Toll revenues	8,314	10,694	13,484	14,891	16,418	18,075
Other revenues	0	0	0	0	0	0
Operating expenses	**-3,929**	**-9,159**	**-4,332**	**-12,187**	**-4,776**	**-11,133**
Maintenance	-3,686	-8,904	-4,064	-11,906	-4,481	-10,823
Operation	-176	-185	-194	-204	-214	-224
SPV Structure	-67	-70	-74	-78	-81	-86
Corporate tax	0	0	0	0	0	0
EBITDA	**4,385**	**1,535**	**9,152**	**2,703**	**11,642**	**6,942**
Investments	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0
Project cash flows	**4,385**	**1,535**	**9,152**	**2,703**	**11,642**	**6,942**
Public Contributions	**0**	**0**	**0**	**0**	**0**	**0**
Government capital contributions	0	0	0	0	0	0
Multilateral capital contributions	0	0	0	0	0	0
Project cash flows (after contributions)	**4,385**	**1,535**	**9,152**	**2,703**	**11,642**	**6,942**
Funding	**0**	**0**	**0**	**0**	**0**	**0**
Equity	0	0	0	0	0	0
Multilateral term loan	0	0	0	0	0	0
Cash flow before debt service (multilateral)	**4,385**	**1,535**	**9,152**	**2,703**	**11,642**	**6,942**
Debt service. Multilateral term loan	**-3,373**	**-3,343**	**-7,040**	**-3,111**	**-8,956**	**-5,340**
Interest	-3,344	-3,343	-3,227	-3,111	-2,928	-2,663
Debt repayment	-29	0	-3,813	0	-6,028	-2,677
Cash flow after debt service (multilateral)	**1,012**	**-1,808**	**2,112**	**-408**	**2,687**	**1,602**
Commercial banks credit line. Drawdowns	0	1,808	0	408	0	0
Cash flow before debt service (commercial)	**1,012**	**0**	**2,112**	**0**	**2,687**	**1,602**
Debt service. Commercial term loan	**-778**	**-298**	**-1,625**	**-334**	**-2,067**	**-1,232**
Interest	-326	-298	-408	-334	-359	-255
Debt repayment	-453	0	-1,216	0	-1,708	-977
Free cash flows	**234**	**-298**	**487**	**-334**	**620**	**370**
Dividends	0	0	0	0	0	0
Annual cash	**234**	**-298**	**487**	**-334**	**620**	**370**
Initial cash balance	**0**	**234**	**-65**	**423**	**88**	**708**
Cash movements of the year	234	-298	487	-334	620	370
Ending cash balance	**234**	**-65**	**423**	**88**	**708**	**1,078**

CASH FLOWS (Million BDT)	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18
Operating revenues	**19,871**	**21,814**	**23,914**	**26,182**	**28,628**	**31,264**
Toll revenues	19,871	21,814	23,914	26,182	28,628	31,264
Other revenues	0	0	0	0	0	0
Operating expenses	**-5,265**	**-12,274**	**-25,584**	**-13,532**	**-6,400**	**-14,919**
Maintenance	-4,940	-11,933	-25,225	-13,156	-6,005	-14,504
Operation	-236	-247	-260	-273	-287	-301
SPV Structure	-90	-94	-99	-104	-109	-115
Corporate tax	0	0	0	0	0	-1,489
EBITDA	**14,605**	**9,539**	**-1,670**	**12,649**	**22,228**	**16,345**
Investments	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0
Project cash flows	**14,605**	**9,539**	**-1,670**	**12,649**	**22,228**	**14,855**
Public Contributions	**0**	**0**	**0**	**0**	**0**	**0**
Government capital contributions	0	0	0	0	0	0
Multilateral capital contributions	0	0	0	0	0	0
Project cash flows (after contributions)	**14,605**	**9,539**	**-1,670**	**12,649**	**22,228**	**14,855**
Funding	**0**	**0**	**0**	**0**	**0**	**0**
Equity	0	0	0	0	0	0
Multilateral term loan	0	0	0	0	0	0
Cash flow before debt service (multilateral)	**14,605**	**9,539**	**-1,670**	**12,649**	**22,228**	**14,855**
Debt service. Multilateral term loan	**-11,235**	**-7,338**	**-1,706**	**-9,730**	**-17,098**	**-3,474**
Interest	-2,310	-1,872	-1,706	-1,454	-704	-103
Debt repayment	-8,925	-5,466	0	-8,276	-16,395	-3,371
Cash flow after debt service (multilateral)	**3,370**	**2,201**	**-3,376**	**2,919**	**5,129**	**11,381**
Commercial banks credit line. Drawdowns	0	0	3,376	0	0	0
Cash flow before debt service (commercial)	**3,370**	**2,201**	**0**	**2,919**	**5,129**	**11,381**
Debt service. Commercial term loan	**-2,593**	**-871**	**0**	**-2,245**	**-1,417**	**0**
Interest	-196	-50	0	-205	-81	0
Debt repayment	-2,397	-822	0	-2,040	-1,336	0
Free cash flows	**778**	**1,330**	**0**	**674**	**3,712**	**11,381**
Dividends	0	0	0	0	0	0
Annual cash	**778**	**1,330**	**0**	**674**	**3,712**	**11,381**
Initial cash balance	**1,078**	**1,856**	**3,186**	**3,186**	**3,859**	**7,572**
Cash movements of the year	778	1,330	0	674	3,712	11,381
Ending cash balance	**1,856**	**3,186**	**3,186**	**3,859**	**7,572**	**18,953**

CASH FLOWS (Million BDT)	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24
Operating revenues	**34,102**	**37,154**	**40,435**	**43,957**	**47,737**	**51,789**
Toll revenues	34,102	37,154	40,435	43,957	47,737	51,789
Other revenues	0	0	0	0	0	0
Operating expenses	**-7,056**	**-19,852**	**-7,779**	**-18,135**	**-8,577**	**-19,994**
Maintenance	-6,620	-19,394	-7,299	-17,630	-8,047	-19,437
Operation	-316	-332	-348	-366	-384	-403
SPV Structure	-120	-126	-133	-139	-146	-154
Corporate tax	-6,047	-3,368	-7,590	-5,711	-9,379	-7,353
EBITDA	**27,046**	**17,303**	**32,655**	**25,822**	**39,160**	**31,795**
Investments	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0
Project cash flows	**20,998**	**13,935**	**25,065**	**20,112**	**29,781**	**24,442**
Public Contributions	**0**	**0**	**0**	**0**	**0**	**0**
Government capital contributions	0	0	0	0	0	0
Multilateral capital contributions	0	0	0	0	0	0
Project cash flows (after contributions)	**20,998**	**13,935**	**25,065**	**20,112**	**29,781**	**24,442**
Funding	**0**	**0**	**0**	**0**	**0**	**0**
Equity	0	0	0	0	0	0
Multilateral term loan	0	0	0	0	0	0
Cash flow before debt service (multilateral)	**20,998**	**13,935**	**25,065**	**20,112**	**29,781**	**24,442**
Debt service. Multilateral term loan	**0**	**0**	**0**	**0**	**0**	**0**
Interest	0	0	0	0	0	0
Debt repayment	0	0	0	0	0	0
Cash flow after debt service (multilateral)	**20,998**	**13,935**	**25,065**	**20,112**	**29,781**	**24,442**
Commercial banks credit line. Drawdowns	0	0	0	0	0	0
Cash flow before debt service (commercial)	**20,998**	**13,935**	**25,065**	**20,112**	**29,781**	**24,442**
Debt service. Commercial term loan	**0**	**0**	**0**	**0**	**0**	**0**
Interest	0	0	0	0	0	0
Debt repayment	0	0	0	0	0	0
Free cash flows	**20,998**	**13,935**	**25,065**	**20,112**	**29,781**	**24,442**
Dividends	-15,943	-8,879	-20,010	-15,056	-24,725	-19,386
Annual cash	**5,056**	**5,056**	**5,056**	**5,056**	**5,056**	**5,056**
Initial cash balance	**18,953**	**24,009**	**29,065**	**34,120**	**39,176**	**44,232**
Cash movements of the year	5,056	5,056	5,056	5,056	5,056	5,056
Ending cash balance	**24,009**	**29,065**	**34,120**	**39,176**	**44,232**	**49,288**

CASH FLOWS (Million BDT)	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30
Operating revenues	**56,130**	**60,589**	**65,341**	**70,401**	**75,786**	**81,513**
Toll revenues	56,130	60,589	65,341	70,401	75,786	81,513
Other revenues	0	0	0	0	0	0
Operating expenses	**-41,674**	**-22,043**	**-10,425**	**-24,302**	**-11,494**	**-32,337**
Maintenance	-41,089	-21,429	-9,781	-23,626	-10,783	-31,590
Operation	-423	-444	-467	-490	-515	-540
SPV Structure	-161	-169	-178	-187	-196	-206
Corporate tax	-2,585	-9,357	-13,859	-11,434	-16,437	-12,280
EBITDA	**14,456**	**38,546**	**54,915**	**46,098**	**64,292**	**49,177**
Investments	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0
Project cash flows	**11,871**	**29,189**	**41,057**	**34,664**	**47,855**	**36,896**
Public Contributions	**0**	**0**	**0**	**0**	**0**	**0**
Government capital contributions	0	0	0	0	0	0
Multilateral capital contributions	0	0	0	0	0	0
Project cash flows (after contributions)	**11,871**	**29,189**	**41,057**	**34,664**	**47,855**	**36,896**
Funding	**0**	**0**	**0**	**0**	**0**	**0**
Equity	0	0	0	0	0	0
Multilateral term loan	0	0	0	0	0	0
Cash flow before debt service (multilateral)	**11,871**	**29,189**	**41,057**	**34,664**	**47,855**	**36,896**
Debt service. Multilateral term loan	**0**	**0**	**0**	**0**	**0**	**0**
Interest	0	0	0	0	0	0
Debt repayment	0	0	0	0	0	0
Cash flow after debt service (multilateral)	**11,871**	**29,189**	**41,057**	**34,664**	**47,855**	**36,896**
Commercial banks credit line. Drawdowns	0	0	0	0	0	0
Cash flow before debt service (commercial)	**11,871**	**29,189**	**41,057**	**34,664**	**47,855**	**36,896**
Debt service. Commercial term loan	**0**	**0**	**0**	**0**	**0**	**0**
Interest	0	0	0	0	0	0
Debt repayment	0	0	0	0	0	0
Free cash flows	**11,871**	**29,189**	**41,057**	**34,664**	**47,855**	**36,896**
Dividends	-6,815	-24,668	-36,536	-30,144	-43,334	-32,376
Annual cash	**5,056**	**4,520**	**4,520**	**4,520**	**4,520**	**4,520**
Initial cash balance	**49,288**	**54,344**	**58,864**	**63,384**	**67,905**	**72,425**
Cash movements of the year	5,056	4,520	4,520	4,520	4,520	4,520
Ending cash balance	**54,344**	**58,864**	**63,384**	**67,905**	**72,425**	**76,946**

CASH FLOWS (Million BDT)	Year 31	Year 32	Year 33	Year 34	Year 35
Operating revenues	**87,601**	**94,069**	**100,937**	**108,225**	**115,956**
Toll revenues	87,601	94,069	100,937	108,225	115,956
Other revenues	0	0	0	0	0
Operating expenses	**-12,672**	**-29,540**	**-13,971**	**-32,567**	**-67,882**
Maintenance	-11,889	-28,717	-13,107	-31,661	-66,930
Operation	-567	-596	-625	-657	-690
SPV Structure	-216	-227	-238	-250	-263
Corporate tax	-19,579	-16,719	-22,889	-19,779	-12,193
EBITDA	**74,929**	**64,530**	**86,966**	**75,658**	**48,074**
Investments	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0
Other CAPEX	0	0	0	0	0
Project cash flows	**55,351**	**47,811**	**64,077**	**55,879**	**35,881**
Public Contributions	**0**	**0**	**0**	**0**	**0**
Government capital contributions	0	0	0	0	0
Multilateral capital contributions	0	0	0	0	0
Project cash flows (after contributions)	**55,351**	**47,811**	**64,077**	**55,879**	**35,881**
Funding	**0**	**0**	**0**	**0**	**0**
Equity	0	0	0	0	0
Multilateral term loan	0	0	0	0	0
Cash flow before debt service (multilateral)	**55,351**	**47,811**	**64,077**	**55,879**	**35,881**
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)	**55,351**	**47,811**	**64,077**	**55,879**	**35,881**
Commercial banks credit line. Drawdowns	0	0	0	0	0
Cash flow before debt service (commercial)	**55,351**	**47,811**	**64,077**	**55,879**	**35,881**
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	**55,351**	**47,811**	**64,077**	**55,879**	**35,881**
Dividends	-51,617	-44,077	-60,343	-52,145	-32,146
Annual cash	**3,734**	**3,734**	**3,734**	**3,734**	**3,734**
Initial cash balance	**76,946**	**80,680**	**84,414**	**88,148**	**91,882**
Cash movements of the year	3,734	3,734	3,734	3,734	3,734
Ending cash balance	**80,680**	**84,414**	**88,148**	**91,882**	**95,617**