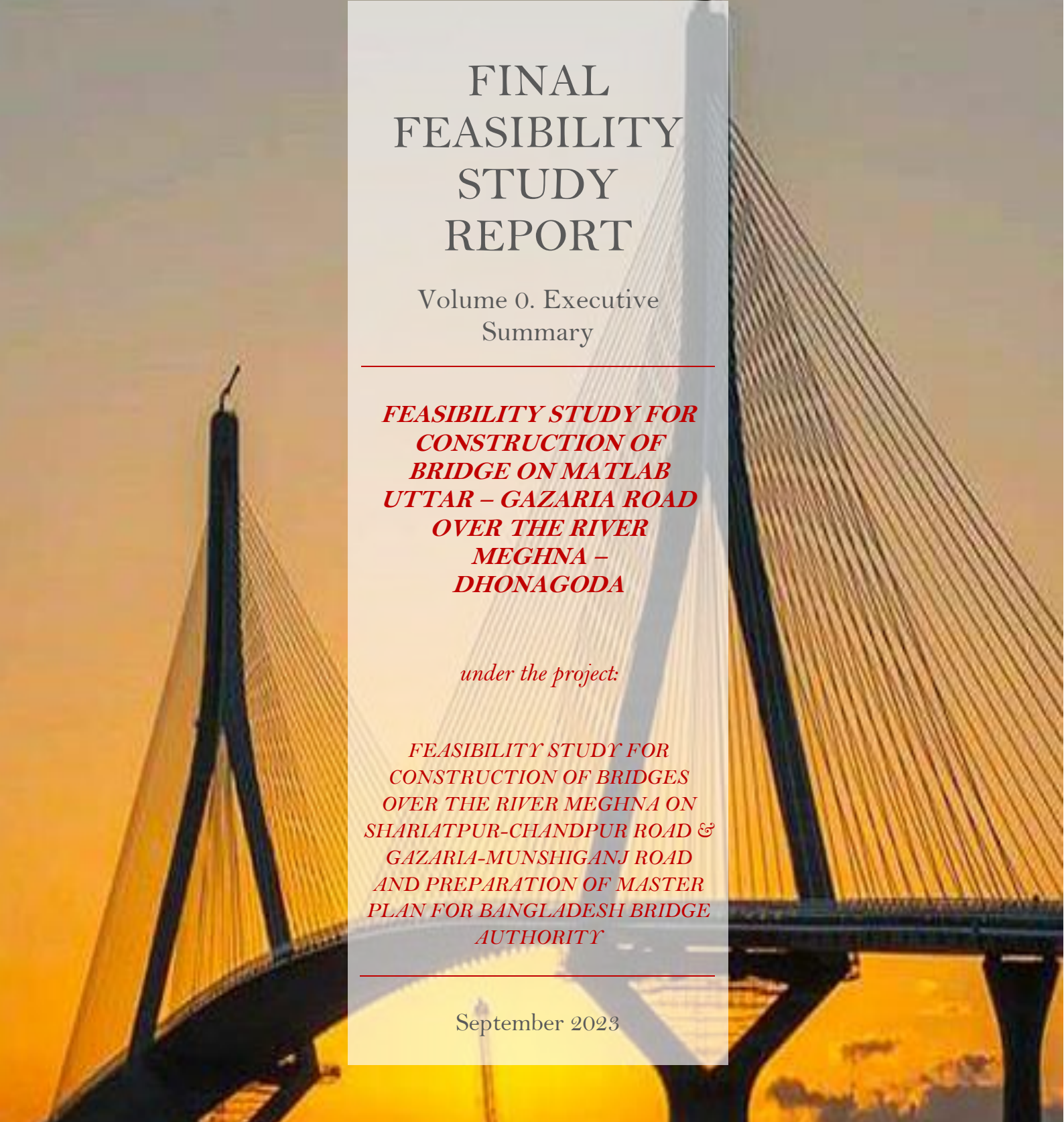

FINAL FEASIBILITY STUDY REPORT

Volume 0. Executive Summary

FEASIBILITY STUDY FOR CONSTRUCTION OF BRIDGE ON MATLAB UTTAR – GAZARIA ROAD OVER THE RIVER MEGHNA – DHONAGODA

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

September 2023

TYPSA

DOHWA

NIPPON KOEI

ddc BCL DevCon

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

BANGLADESH BRIDGE AUTHORITY বাংলাদেশ সেতু কর্তৃপক্ষ

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

FEASIBILITY STUDY OF MATLAB UTTAR-GAZARIA BRIDGE

VOLUME 0
EXECUTIVE SUMMARY

VOLUME 1
MAIN REPORT

VOLUME 2
HYDROLOGICAL & MORPHOLOGICAL MATHEMATICAL MODELLING STUDY

VOLUME 3
GEOTECHNICAL INVESTIGATION

VOLUME 4
TRAFFIC STUDY REPORT

VOLUME 5
TECHNICAL REPORT

VOLUME 6
PRELIMINARY DESIGN DRAWINGS

VOLUME 7
LAND ACQUISITION PLAN

VOLUME 8
RESETTLEMENT ACTION PLAN

VOLUME 9
ENVIRONMENTAL IMPACT ASSESSMENT PLAN

VOLUME 10
MISCELLANEOUS

VOLUME 11
COST ESTIMATION

VOLUME 12
ECONOMIC AND FINANCIAL ANALYSIS

THIS PAGE HAS BEEN LEFT INTENTIONALLY BLANK

Quality Control sheet

DOCUMENT	**FINAL FEASIBILITY STUDY REPORT OF MATLAB UTTAR-GAZARIA BRIDGE. VOLUME 0. EXECUTIVE SUMMARY**	
PROJECT	TR8138-MASTER PLAN BBA	
CODE	TR8138-JV-FS-G001-RP-000001-FFS_Vol0-D04	
AUTHORS	Signed:	MCP
	Date:	12/09/2023
VERIFIED	Signed:	JLY
	Date:	13/09/2023
RECIPIENT	Bangladesh Bridge Authority (BBA)	
NOTES	Document created by the Joint Venture formed by TYPSA-DOHWA-NIPPON KOEI-DDC-BCL-DEVCON	

Control of Versions

VERSION	CONTROL OF CHANGES
1	First Submission
2	Submision March 2023
3	Submission August 2023
4	Submission September 2023

THIS PAGE HAS BEEN LEFT INTENTIONALLY BLANK

Contents

List of Volumes

VOLUME 0: Executive Summary
VOLUME 1: Main Report
VOLUME 2: Hydrological and Morphological Mathematical Modelling Study
VOLUME 3: Geotechnical Investigation along Proposed Bridge Alignment
VOLUME 4: Traffic Survey Report
VOLUME 5: Preliminary Technical Report (Two Volumes: Volume I and Volume II)
VOLUME 6: Preliminary Design Drawings
VOLUME 7: Land Acquisition Plan
VOLUME 8: Resettlement Action Plan
VOLUME 9: Environmental Impact Assessment
VOLUME 10: Miscellaneous
VOLUME 11: Cost Estimate (BOQ)
VOLUME 12 Economic and Financial Analysis

List of Figures

List of Tables

List of Abbreviations

1D	One Dimensional
2D	Two Dimensional
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)
BWDB	Bangladesh Water Development Board
CAPEX	Capital Expenditure
CBA	Cost Benefit Analysis
CC	Cement Concrete
CCB	Control Centre Building
CEGIS	Centre for Environmental and Geographic Information Services
CL	Lean Clay
CPR	Common Property Resources
DBFOT	Design-Build-Finance-Operate-Transfer
DC	Deputy Commissioner
DoE	Department of Environment
DSCR	Debt Service Coverage Ratio
EBITDA	Earnings before Interest, Taxes, Depreciation and Amortization,
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
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)

IWM	Institute of Water Modelling
JV	Joint Venture
Ke	Cost of equity
Km	Kilometre
LAP	Land Acquisition and Resettlement
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
PCM	Public Consultation Meeting
PM	Prime Minister
PPP	Public and Private Partnership
PWD	Public Works Datum
PWD	Public Works Department
RAP	Resettlement Action Plan
RC	Replacement Cost
RHD	Roads and Highways Department
RoW	Right of Way
RTW	River Training Work
SCP	Sand Compaction Pile
SHWL	Standard High-Water Level
SM	Silty Sand
SP	Poorly Graded Sand
SRD	Social Rate of Discount
TAC	Technical Advisory Committee
ToR	Terms of Reference
USD	United States Dollar
VAT	Value Added Tax
VGF	Viability Gap Financing
WACC	Weighted average cost of capital
WB	World Bank
WL	Water Level

Executive Summary

1. PROJECT BACKGROUND

The feasibility study project is located in between Matlab Uttar and Gazaria upazilas and at circa 50 km distance from the capital Dhaka. Matlab Uttar, covering an area of 260 km2 and with a population of 2.9 lakh, is an upazila of the Chandpur District belonging to the Chattogram Division. Gazaria, covering a total area of 131 km2 and with a population of 1.6 lakh, is an upazila of the Munshiganj District belonging to the Dhaka Division. Dhonagoda river is one of the Meghna River tributary branches, which separates both territories, now only connected by boat from Maya Ferry Ghat to Kalipur Terminal or by road driving a long way through the Srirayerchar bridge and connecting to the N1 road near Shahidnagar Bazar. The proposed Matlab Uttar - Gazaria bridge project would connect both Matlab Uttar and Gazaria upazilas, providing a clear benefit at a local scale transport network between those upazilas but it also would help to generate a new route for the population from Matlab Uttar traveling to and from Dhaka city saving a considerable amount of time. This project shall relevantly be deemed to be embedded as a component of a broader transportation enhancement approach, together with other connectivity initiatives under study as the bridge connecting Gazaria to Munshiganj, the one connecting Shariatpur to Chandpur or the whole South-North transportation corridor under assessment that would improve the current connectivity of the whole Chandpur region with Dhaka city.

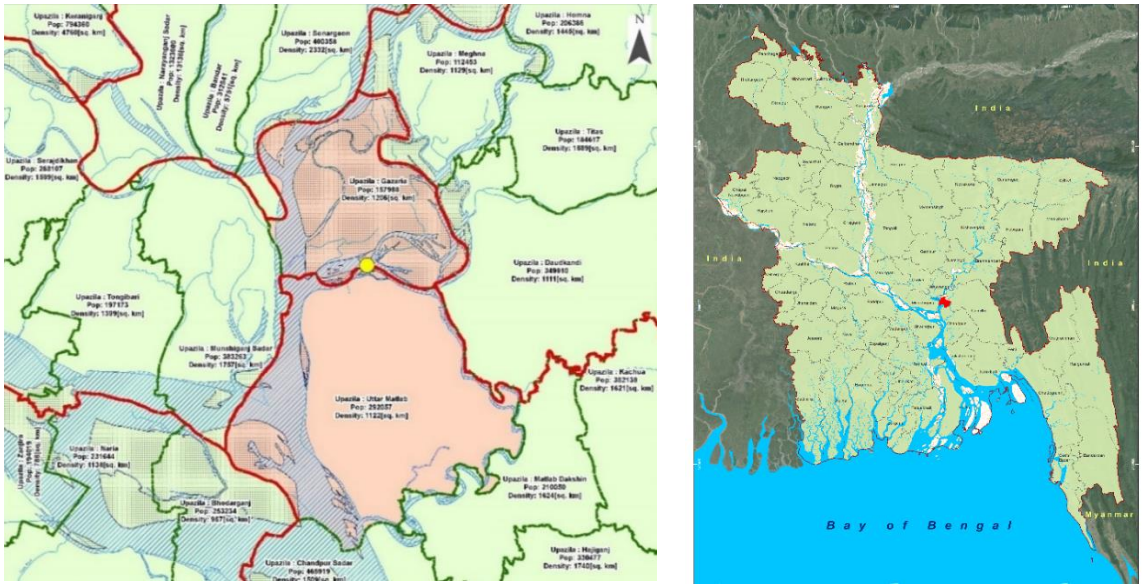

Figure 1. Matlab Uttar-Gazaria Bridge Location

2. GENERAL CONSIDERATIONS

The Bangladesh Bridge Authority (BBA) assigned in June 2021, a series of four Feasibility Studies to be undertaken by the Consultant JV under the project "Construction of Bridges over the river Meghna and Preparation of Transport Master Plan for Bangladesh". Later in December 2021, the assignment from the BBA was increased in scope, by means of adding three new bridges to be implemented at FS level. One of those new assigned bridge feasibility study was the one connecting Matlab Uttar with Gazaria upazilas.

This assignment has been carried out following the initial contract Terms of Reference (TOR), including a thorough selection of the preferred selected alignment, out of a manifold of location options, and a selection of the optimum technical solution out of a considerable number of outlined options. The feasibility study outcome is based on an in-depth analysis from several standpoints, site conditions, technical aspects, social and environmental appraisal and finally economic and financial study and conclusions. So, technical aspects and site conditions (soil investigation, topography, and hydro-morphological studies) have determined the technical viability of the proposed solution and have driven to determining the construction cost of the bridge and other components as additional structures and accessing roads. Similarly, the social and environmental studies have determined the project's viability from other critical points of view, driven also to a critical cost in some cases, land acquisition and resettlement action plan (LAP and RAP). Lastly and based on the estimated CAPEX, the economic and financial analysis have provided a sound conclusion regarding the economic and financial performance rates during the life of the project.

It is the purpose of this Executive Summary, to provide the key and summarized information of each one of the matters and disciplines that have been considered at this Feasibility Study, which are further developed in detail in the Main Report (Volume 01) and on each one of its respective volumes included in this assignment.

3. SALIENT FEATURES

Table 1. Main salient features

Main salient features of Matlab Uttar-Gazaria Bridge		
Total bridge length		1,850 m
Cable stayed bridge	Length	700 m
	Main span	400 m (1 x 400)
	Back spans	150 + 150 = 300 m [2 x (1 x 54 + 1 x 96)]
	Width of cable stayed section	23 m
Approach bridge	Length	1,150 m
	Matlab Uttar side	590 m (1 x 39 + 6 x 38.5) + (1 x 60 + 2 x 100 + 1 x 60)
	Gazaria side	560 m (14 x 40)

Main salient features of Matlab Uttar-Gazaria Bridge		
	Width of approach bridge	20.25 m
Approach road	Total length	5,530 m
	Matlab Uttar side	360 m
	Gazaria side	5,170 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	2895 m
	Matlab Uttar end	1,695 m
	Gazaria end	1200 m
Interchange with N1	Total Length of Ramp for Dhaka to Matlab Uttar direction	750 m
	Bridge for Dhaka to Matlab Uttar ramp	340 m
	Road and RE wall for Dhaka to Matlab Uttar ramp	410 m
	Total Length of Ramp for Matlab Uttar to Chattgram direction	1350 m
	Bridge for Dhaka to Matlab Uttar ramp	900 m
	Road and RE wall for Dhaka to Matlab Uttar ramp	450 m
Other features in approach road		
	Small bridges	3 bridges (120 + 60 + 305) Total = 485 m
	Culverts	3 nos – 2 Vent each
	Toll Plaza	7 nos booth each side = Total 14 nos (+ Future extendable 3 nos each side)
	Weighing scale	1 no each side = Total 2 nos 4 nos Weigh bridge each side (+ Future extendable 2 nos each side)
	Engineer's Facilities and Service Area	27.98 acres
	Contractor's Construction Yard	1 no on each side = Total 2 nos 8.18 + 11.10 = 19.28 acres
River training works	Total length	2,200 m

Main salient features of Matlab Uttar-Gazaria Bridge		
	Matlab Uttar side	1,200 m
	Gazaria side	1,000 m
Land Acquisition		
	Width of right of way (ROW)	69.5 m
	Total land to be acquired	200.22 acres
	Total number of project affected units	115 nos
	Total number of persons affected	381 nos

4. SITE CONDITIONS AND FIELD SURVEYS

Field surveys and site conditions studies are undoubtedly one of the primordial tasks of any Feasibility Study. Hence, the Consultant initiated as soon as the assignment was communicated, a thorough reconnaissance of the site and a comprehensive campaign for the study of the current site conditions.

The Consultant conducted the following field works investigation activities, in some cases, with the support and collaboration of third party specialized subconsultants.

1. **Extensive Reconnaissance trips and survey** by the Consultants numerous teams of experts, to identify the most suitable alignment of the bridge as well as the preferred option for approach roads and connectivity points to the existing network. These included field trips, collection and study of available secondary data, consultation with local officials and public.
2. Detailed **Hydrological and Morphological Investigation** by a specialized agency. Institute of Water Modelling (IWM) carried out field investigation including discharge, velocity, and water level measurement. Additionally supported by historical satellite images, IWM studied the potential stability of riverbanks at the proposed alignment. IWM also established the hydraulic design parameters by Mathematical Modelling. Finally, IWM collaboratively with the consultant experts provided a recommendation for the adopted solution for river training and protection of structures, as well a cost estimate for this discipline.
3. **Topographic Survey** of the proposed bridge and the approach road alignments have been carried out by the specialized firm BSO in collaboration with the Consultant Road and Highways team of experts. The topographical report, that was implemented utilizing traditional methods and total station, is included in the Volume 10 providing a detailed mapping and profile sections at each 20 m interval.
4. **Geotechnical Investigation** at the proposed bridge location and approach roads alignment has been carried out by the firm AMIN and is included in Vol.03 providing sound conclusions on the quality and current conditions of the soil at the area under study and enabling to calculate bearing capacity and a preliminary assessment of the different type of deep foundations included in the project.

5. **Traffic Survey** was undertaken on the surrounding roads and water ports around Matlab Uttar to carry out **Traffic Forecast Study.** Traffic counts, Origin-Destination Interviews, and Axle Load Surveys have been undertaken by the local firms DevCon, BCL & DDC.
6. **Environmental Impact Study**. The project environmental considerations and analysis, falling under RED category, have been carried out by the team of experts in-house, which had to carry out several site visits to assess the site current conditions.
7. **Social Survey and study** have been undertaken for the preparation of the **Land Acquisition and Resettlement Action Plan,** by the specialized subconsultant together with the team of experts in-house. A number of visits and meetings, including several Public Consultation Meetings (PCM) were carried out during the implementation of this study, as it is further developed within each section.

5. FINDINGS

5.1. Bridge Location and Alignment

The Consultant has selected the proposed bridge location and approach roads alignment based on a multi-criteria iterative methodology and after a thorough reconnaissance task and current site conditions assessment. Four crossing locations were considered on a planform of the Meghna branch channel throughout the area under study. All four sites were subject to initial screening, based on multiple reconnaissance surveys, hydrological and morphological studies, public consultations, geotechnical investigation. This matter was overtly discussed with BBA officials aiming to find consensus through a collaborative dialogue. Finally, the “preferred” site (option D) was fixed at about a few 500 m upstream Maya Ferry Ghat on Gazaria side and at a mid-point location between Kalipur and Beltoli Bazar (Z1069 Road) on Matlab Uttar side.

The total width of the crossing is 1.85 km including some char land spans. A comprehensive study and all the details about the selection of final bridge alignment can be found in the Annexure 1 of the Volume 01.

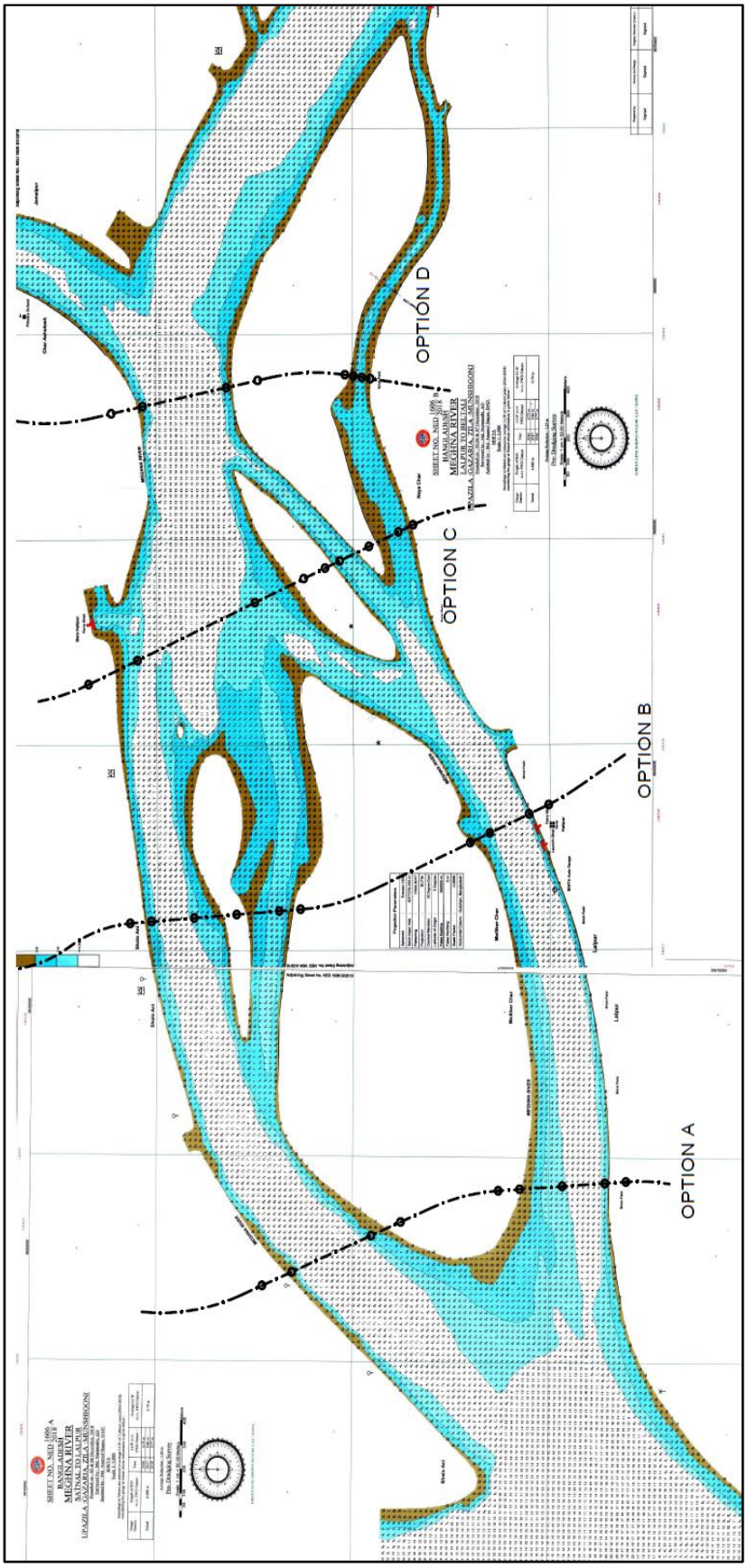

Figure 2. Options A, B, C, D assessed in detail for the river crossing

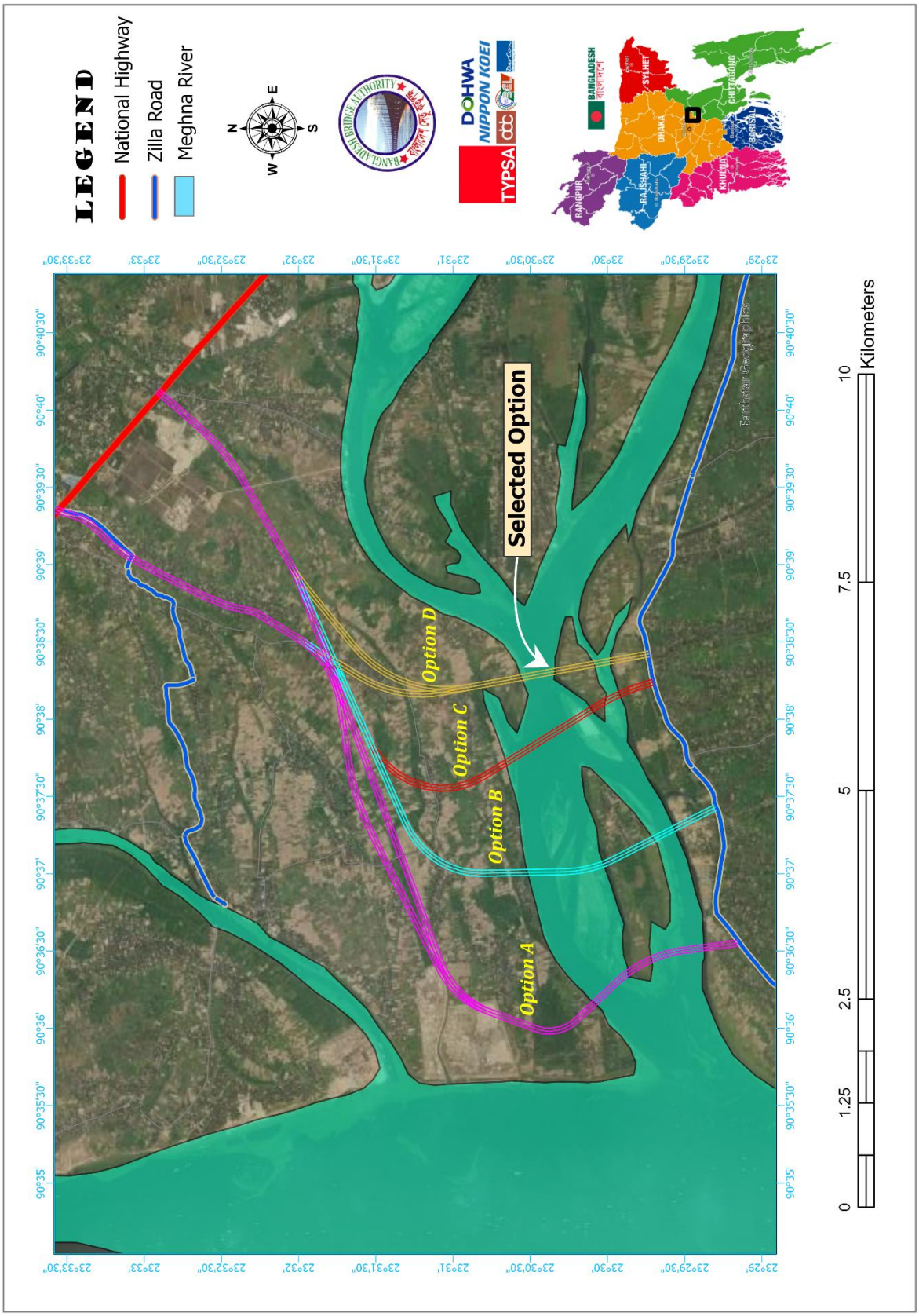

Figure 3. Four different alignment option under study

5.2. Main Crossing Bridge

Several options have been analysed and compared for the main crossing over the river. As described, the alignment assessment considered four alternatives. For each one of these alternatives, three solutions for the main bridge were considered, based on diverse bridge typologies: balanced cantilever, extradosed bridges, cable stayed bridges.

Thus, a total of **33 different alignment and structural combinations** of main bridges, approach spans, and connection bridges were studied.

For every alignment alternative, the detailed cost estimation of each bridge was developed, to select the most cost-efficient solution for each alignment. Then, those best solutions have been also compared based on other aspects and criteria, to determine the most suitable alignment option and associated structure, both for the main bridge and for the access/connection spans.

In our case study, and after implementing this comparison exercise, the solution that has proved to be the optimum both in terms of cost, construction process duration, aesthetics and constriction of the river section was the one called D.1-I: Cable stayed bridge with span arrangement 150 – 400 – 150 and access bridges of precast I beams with 40 m spans at Gazaria side, and 39 m and 38.5 m at Matlab side. This solution includes also two 100 m spans to cross two channels in the south connection, for which a balanced cantilever bridge with span distribution 60 – 100 – 100 – 60 has been considered as the best option.

Figure 4. Image of the Cable Stayed Bridge proposed at Matlab Uttar-Gazaria

One of the key advantages of the selected alignment and main bridge option is the fact that the foundation of the pylons of the main bridge have been projected to be executed mainly in the dry area, which is very beneficial in terms of construction cost and time for execution. This fact would minimize the foundations

construction related risks very considerably. The preliminary design of the foundations resolves each pylon with 24 number steel Ø3.0 m driven piles of 90 m in length. Further development of the current calculations during detail design may allow for the use of Ø2.5 m steel driven piles. For the back spans and the approach spans, the foundations include Ø1.8 m bored reinforced concrete piles.

The approach bridges for the solution which have been deemed most suitable according to the described criteria, include precast I beam. A sound difference between the precast solution and the box girder is the consideration of an eventual foundation settlement and the need for additional operations during construction.

Salient elements of the bridge component of project are as follows:

- Total width of bridge: 23.00 m in the cable stayed bridge and 20.25 in the access bridges.
- 2-lane carriageway width 7.30 m plus 0.7 m wide outer shoulder and 0.50 inner shoulder.
- 1 footpath of 0.80 m width beside each carriageway.
- Central safety barrier width 0.65 m.
- Side safety barrier width (each side) 0.50 m.

Figure 5. Cable Stayed and the balance cantilever bridges at Matlab Uttar-Gazaria

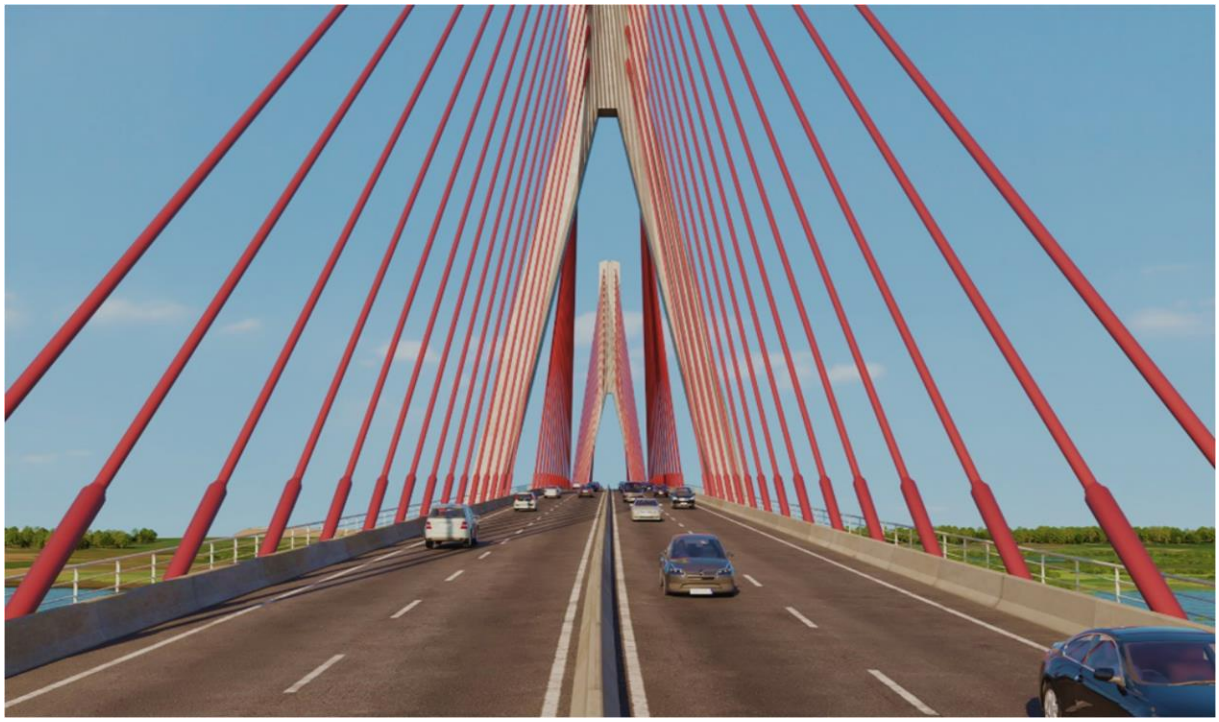

Figure 6. Cable Stayed bridge at Matlab Uttar-Gazaria. Road view

Figure 7. Cable Stayed bridge at Matlab Uttar-Gazaria. View from riverbank.

Figure 8. Cable Stayed bridges at Matlab Uttar-Gazaria. General view

Figure 9. Image of the Cable Stayed Bridge proposed at Matlab Uttar-Gazaria

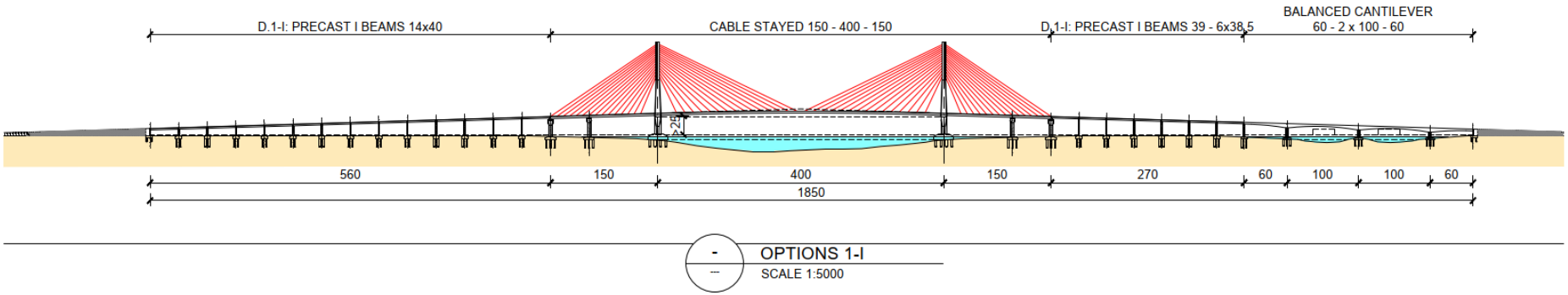

Figure 10. Elevation of the whole bridge from abutment to abutment

Table 2. Stretches of the bridge

	Stretch	Type	Spans (No x length)	Length (m)
1	Approach bridge	Precast I-Beams	14 x 40	560
2	Back Span	Cable stayed bridge	1 x 54 + 1 x 96	150
3	**Main Span**	**Cable stayed bridge**	**1 x 400**	**400**
4	Back Span	Cable stayed bridge	1 x 96 + 1 x 56	150
5	Approach bridge	Precast I-Beams	1 x 39 + 6 x 38.5	270
6	Approach bridge	Balanced cantilever	1 x 60 + 2 x 100 + 1 x 60	320
			TOTAL LENGTH (m)	1,850

5.3. Hydro-morphological Study

The hydro-morphological study and the River Training proposed solution has been carried out by the Institute of Water Modelling (IWM) following the standards of BWDB.

The study has comprised two major components: a) hydrological assessment and b) morphological assessment. Both one - and two - dimensional (1D and 2D) models have been used in the study, 1D model for determining general hydraulics of the river systems under the study area as well as for generating boundary information used for 2D model developed for the selected stretches of the Meghna Branch River covering the main channel from Meghna Bridge and branch channel from Daudkandi bridge towards downstream of Satnal.

Historical data has been collected from secondary sources (BWDB, CEGIS etc.) and IWM database for this study. Primary data have also been collected by IWM survey team for development of morphological model. The collected data includes water level, discharge, river bathymetry, banklines, bed and suspended sediments and satellite images etc.

Four potential alignment options (A, B, C & D) have been meticulously investigated by analyzing observed hydro-morphological characteristics of the Meghna branch channel to find the best suitable site for the proposed bridge. Morphological modelling has supplemented the analysis. The following criteria has been considered for selecting the best option among the selected four potential options.

Considering minimum width, orientation, bank stability, Option D appears to be the most suitable alignment for the proposed Matlab Uttar-Gazaria bridge over the Meghna Branch Channel.

Design Flood Event: 1988 flood event has been considered as design flood event which corresponds to 1 in 100-year flood for the study area.

Hydraulic Design Parameters: One of the major outputs of the present hydro-morphological study is the evaluation of hydraulic parameters to be used for the design of mainly substructure of the bridge and required river training works. To obtain these variables including maximum water level, minimum bed level, bank erosion, maximum flow, velocity etc., analysis of observed data as well as the model generated are carried out. The design hydrological parameters for Matlab Uttar-Gazaria bridge are given in the following table.

The bridges geometry parameters have been designed for the following vertical clearance: 25 m at the main cable-stayed bridge and 8 m for the secondary channel balance cantilever bridge.

Table 3. Hydraulic design parameters

Sl. No.	Features	Values	Source
1	Design Discharge (m^3/sec)	4594 m^3/s	1D Model
2	Design High water Level (m PWD)	6.89 m MSL/7.35 mPWD	1 in 100yr sloped from Daudkandi WL
3	Standard High-Water Level (SHWL)	6.58 mPWD	
4	Design Low water Level (m PWD)	-0.35 m MSL/0.11 mPWD	Sloped from Daudkandi WL
5	Maximum average Velocity (m/sec)	1.23 m/s	Empirical equation
6	Average bank level (m PWD)	1.54 m MSL/2 mPWD	Survey data
7	Lowest bed level (m PWD)	-18.59 m MSL -18.13 m PWD	BWDB 2008
8	Maximum depth of flow at u/s of pier (200m)	23.49 m	2D model simulated
9	Maximum depth of flow at u/s of pier (400m)	11.74 m	2D model simulated
10	General scour from existing bed level	1.57 m	2D model simulated
11	Local scour from existing bed level	35.59 m	2D model simulated
12	Design scour level for RTW	-22.60 m PWD	BWDB 2008
13	Design scour level for piles	-42.54 m PWD	2D model simulated
14	Angle of attack for 200m span	40.73 degree	
15	Angle of attack for 400m span	30.70 degree	
16	Average bed material size (mm)	0.10 mm	Survey data

River Training Works (RTWs) have been designed and recommended as necessary to protect the abutments against failure due to scour and maintain channel navigability, and for bank protection purposes. The layout of the protective works is shown in the following image.

Figure 11. Lay-out of the proposed river training

As a summary, the following recommendations have been made based on the hydro-morphological study:

- Proposed Matlab Uttar-Gazaria bridge should be constructed at the recommended site, alignment D.
- Collecting river data including the bed level, bank line and velocity should be continued until the bridge is constructed.
- Monitoring of hydro-morphological conditions of the river at upstream, downstream and along the axis of the bridge is suggested to arrest any unaccountable situation after construction of the bridge.
- Performance of proposed Guide Bunds must be monitored closely so that any damage to it can be repaired immediately taking emergency measures. In this respect, regular monitoring of this protective work must be done through bathymetric survey of an area of at least 1.00 km on both U/S and D/S of bridge.
- From June to October bathymetric survey should be done on 30 days' interval and shall be kept as record for further use.
- Dredging adjacent or in front of protective work shall not be allowed.
- 5 % extra CC block/geo-bag, additional to dumping volume shall be kept reserved as stockpile to meet up the emergency need.
- Safety drainage throughout the embankment requires 3 culverts of 2 vent each and 3 small bridges of 120, 30 and 305 m length.

5.4. Geotechnical Study

The soil Investigation works, including 5 boreholes up to 150 m deep and 5 trial pits, were carried out during the period between February 18th to April 9th, 2022. The main objectives were to identify:

- 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.

During the soil field investigation and samples testing at laboratory, it was found that sub soil deposits comprise some cohesive and cohesionless layers. The cohesive layers are mostly consisting of low plastic to high plastic, lean inorganic clay and silt (CL/ML). The layers of cohesionless soil consist of various types of sand with some silt (SM)/ (SP-SM).

Pile bearing capacity was estimated according to the guidelines of AASHTO-2020 LRFD specifications. Two types of piles have been proposed: large diameter cast in situ bored piles for abutment and bridge portion and large diameter steel pipes driven piles for the main portion of the bridge suggested due to the huge vertical loads and low vertical settlement design parameter.

5.5. Approach Road and Structures

The approach roads, connecting the main crossing of Meghna branch river and the existing network roads have been designed as per RHD standards for a 2+2 lane highway plus one service road on each direction. Total length of accessing roads is 7,515 m that is divided into both sides of the bridge as follows:

Table 4. Proposed roads characteristics

	Matlab Uttar side connecting to Z1069	Gazaria side connecting to N1
Approach road	360 m	5,170 m
Improvement of existing roads	1,695 m	290 m
RoW	69.5 m	
Lanes	2-lane carriageway width 2 x 3.65 m 1.5 m outer shoulder 0.50 m inner shoulder	
Central Median	3.50 m width	
Service roads	2-Service Road Lane 5.50 m, plus 1.50 m outer soft shoulder and 0.50 m inner side safety	

The designed roads include the following elements:

- An at-grade junction to connect with N1 road at Bhoberchar was the solution initially conceived and the one detailed within the feasibility study technical report. However, after the coordination meeting held with RHD on September 10th, 2023, it was decided to include a provision for a multilevel directional interchange to connect with Dhaka-Chattogram Highways (N1) at Bhoberchar. This solution will be further developed according and in coordination with the ongoing improvement project of N1 being carried out by RHD.
- Intersection at Matlab Uttar end for connection with existing embankment. This junction will need to be further developed and duly coordinated with the concerned roads agencies. In addition, it is assumed that a 35 km new corridor will connect the bridge area with Chandpur, to comply with the traffic demand and roads capacity that have been considered in the de feasibility study.
- Toll Plaza and service area at Gazaria end and Engineers' facilities at Matlab side.
- Axle Load Stations and Service Yards at both Gazaria and Matlab Uttar sides.

One toll plaza has been planned, located before at Gazaria side. Concerning the toll fares, four categories or vehicle classes have been considered: 2-3 wheelers, light vehicles, buses and trucks. Also, two weighing stations have been included, one at each end. A specific and dedicated area has been included to allocate a compound for Engineers' facilities at Matlab Uttar side, including administrative and residential buildings as well as some leisure facilities.

5.5.1. Road Geometry and Design Standard

Table 5. Road Design Requirements

DESIGN STANDARDS			
Design Elements	Unit	Design Parameters	Reference (AASHTO, RHD, Road Notes, IRC)
Design Speed	Km/h	80	RHD Table 2.2 page-5
Minimum Stopping Sight Distance SSD for Crest & Sag Vertical Curves	m	120	RHD Table 2.3 Page-5
Minimum Intermediate Sight Distance ISD	m	250	RHD Table 2.3 Page-5
Minimum Overtaking Sight Distance OSD	m	500	RHD Table 2.3 Page-5
Cross-Sectional Elements			
Lane Width	m	3.65	RHD Table 2.1 page-4
Outer Shoulder Width	m	1.5	RHD Table 2.1 page-4
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

DESIGN STANDARDS			
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

For the selection of the adopted solution, construction of a new road connecting N1 with the Northern side of the bridge near Maya Ferry Ghat, a thorough analysis has been made in terms of analysing the optimum solution, considering the economic cost and the road safety parameters as the main drivers. On the other hand, a preliminary analysis of the possible interfaces with existing utilities network has been carried out, based on multiple site visits and interviews with the key utilities' providers representatives.

The associated minor bridges and culverts needed along the proposed alignment have been designed based on the detailed (20 m interval profile). The design according to the AASHTO LRFD 2014 specification in compliance with RHD standards for Bridges.

The road-drainage system consists of:

- Culverts and small bridges that take water across the road body.
- Side ditches / U-drain that channel the water along the road.
- Subgrade drains every 15 m along the road length.

Summarizing, the accessing roads adopted alignment and proposed solution derive from various undertaken analysis, safety parameters, economic appraisal, land acquisition, environmental impact, and existing utilities conflict preliminary assessment. The concluded proposed alignment is shown in the following figure.

5.5.2. Connection to N1 road network, RHD coordination

As mentioned above, an at-grade junction to connect with N1 road at Bhoberchar was the solution initially conceived and the one detailed within the feasibility study technical report. However, after the coordination meetings held with RHD on August 31st and September 10th, 2023, it was decided to include a provision for a multilevel directional interchange to connect with Dhaka-Chattogram Highways (N1) at Bhoberchar. This solution will be further developed according and in coordination with the ongoing improvement project of N1 being carried out by RHD.

The Alternative that is recommended by the Consultant is a multi-level grade separated interchange, enabling high capacity and ease of turning movements. It also poses a higher investment cost compared with the At-grade one but lower cost in terms of land acquisition.

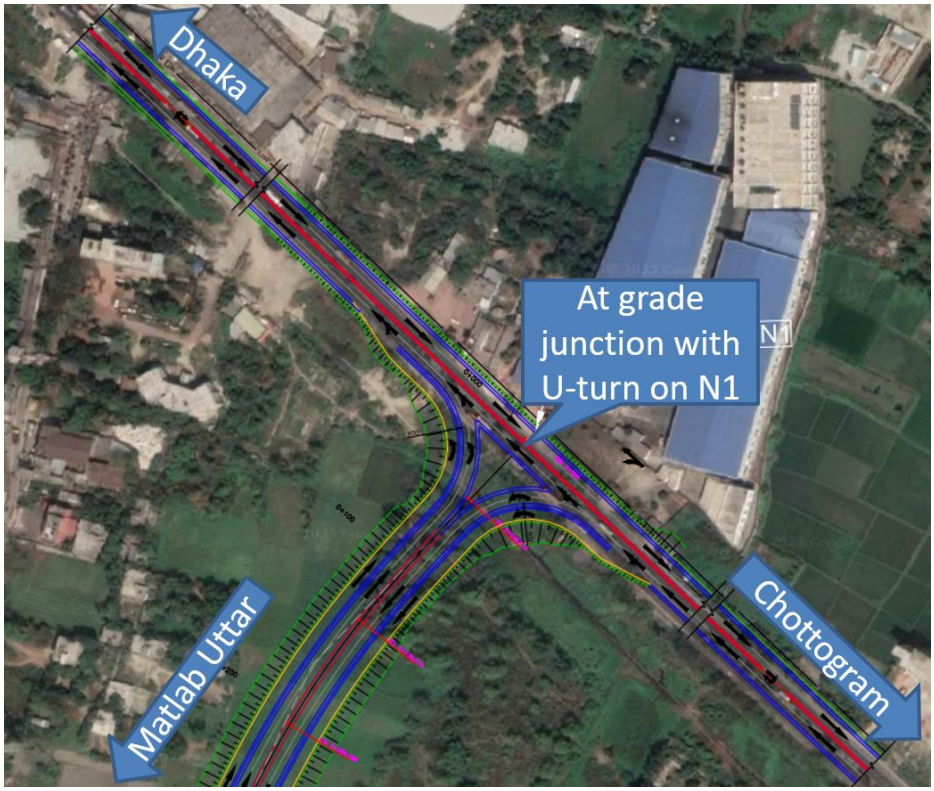

Figure 12. At-Grade connection option at N1 junction

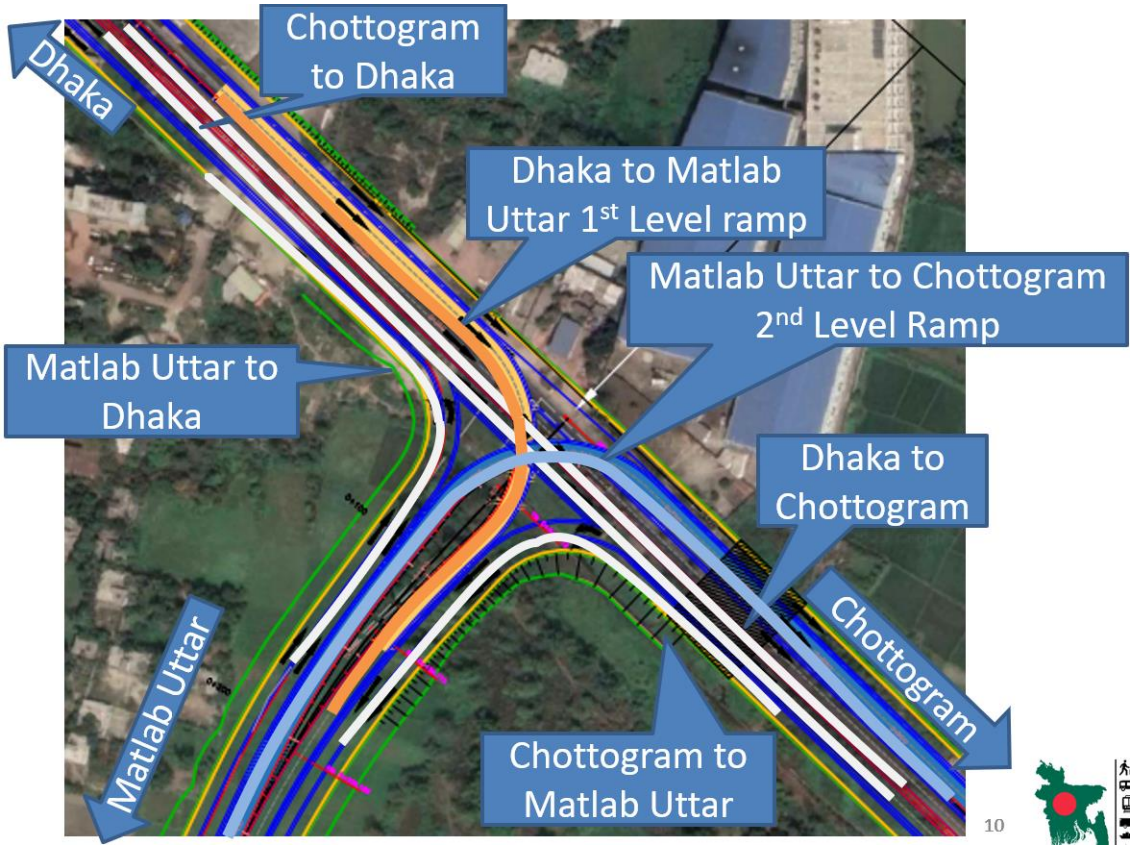

Figure 13. Multi-level interchange at N1 junction (recommended)

5.5.3. Connection to existing road network at Matlab Uttar side

On the other side of the bridge, at Matlab side, the assumption of a new road network, including a 34 km long corridor up to Chandpur city, is also recommended as a mandatory assumption for the proper viability of the project. Coordination with concerned agencies, RHD and LGED with this regard must be taken as of capital relevancy for the success of the project.

As stated above in the item **Error! Reference source not found. Error! Reference source not found.**, the co nstruction of a corridor to connect N1 with R140 is must for the viability of the construction of Matlab Uttar – Gazaria bridge.

"The scenarios that have been considered include the situation with project (Matlab Uttar-Gazaria Bridge) and the situation without project. For both scenarios, ongoing, future and potential (including a corridor connecting the N1 with R140) transport infrastructure developments are considered".

- Corridor from Matlab Uttar-Gazaria bridge (south end) to Shariatpur-Chandpur bridge (east end) (dotted line in white)
- Approximate length of the corridor 34 km
- 18 km new alignment
- 16 km Enhancement and double platform for Z1402 & R140 roads

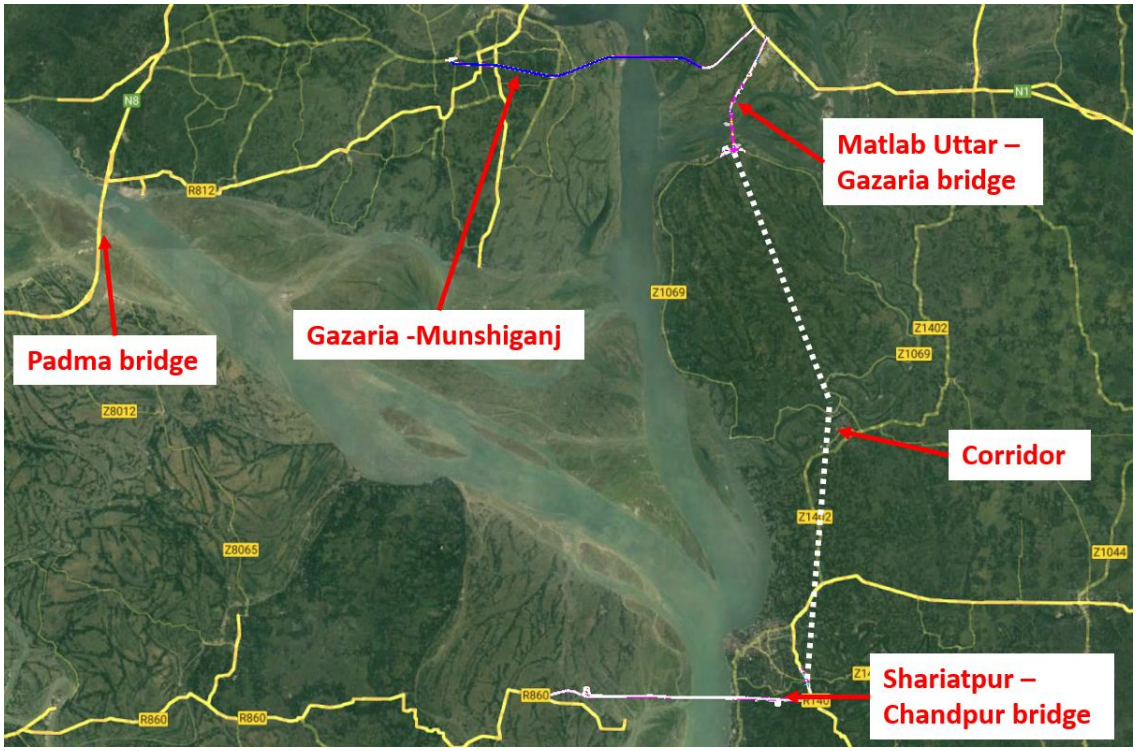

Figure 14. Gazaria-Chandpur South corridor

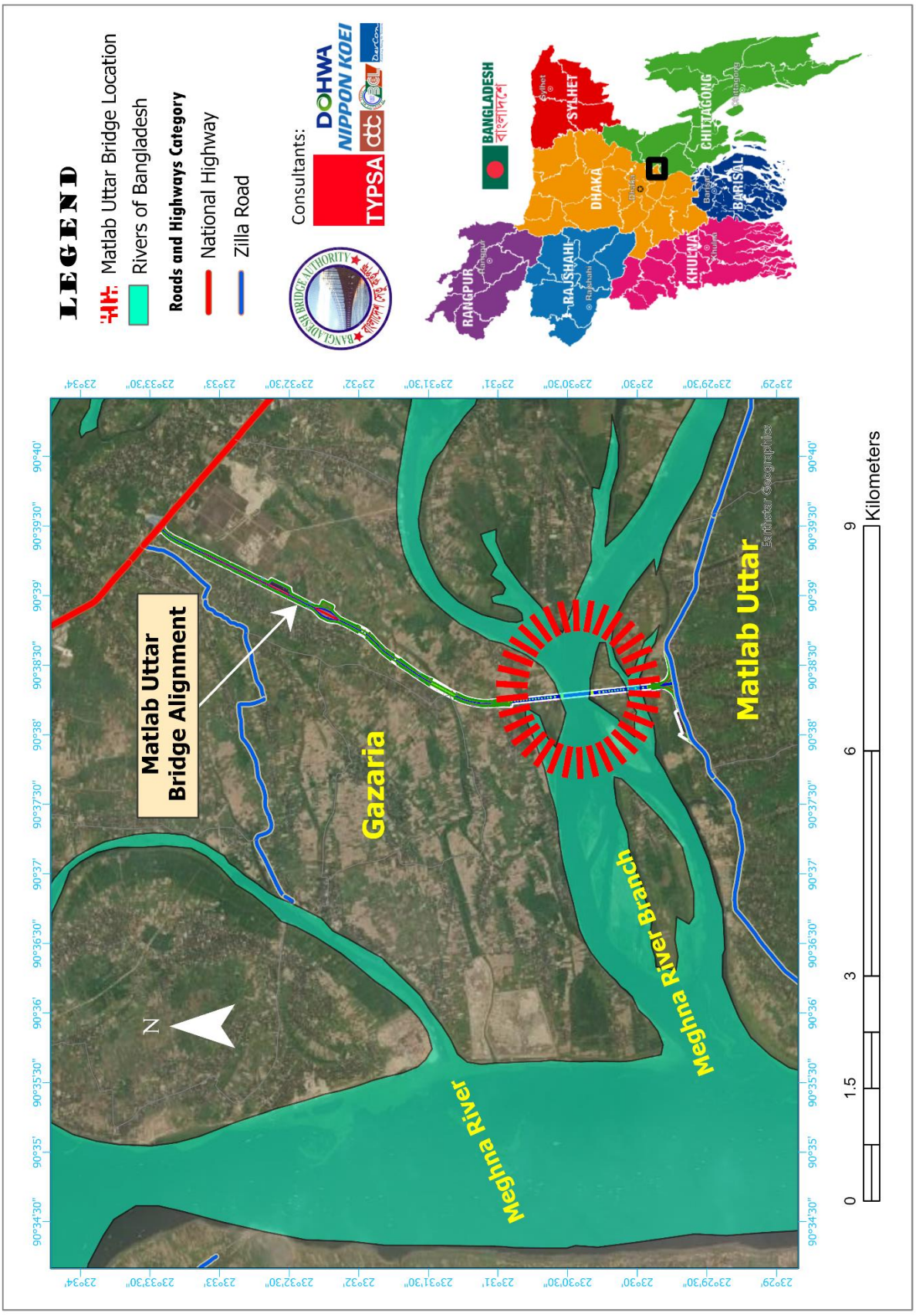

Figure 15. Matlab Uttar – Gazaria Bridge alignment

5.6. Environmental Considerations

The Matlab Uttar-Gazaria Bridge has been proposed to be constructed over the Meghna River Branch at 750 m upstream from the existing Maya Ferry Ghat. The project comprises three major components:

- A bridge with total length of 1.85 Km.
- Approach road of 5,170 m (with a ROW of 69.5 m) and road improvement of 290 m toward Gazaria.
- Approach road of 360 m (with a ROW of 69.5 m) and road improvement of 1,695 m toward Matlab.

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.

Environmental aspects have been incorporated in the design of the project. A cable stayed bridge has been proposed over the river to minimize the impact on the aquatic ecosystem. Proper navigational clearance has been adopted for movement of ships and to avoid water transport hazards. Piles with improved soil stabilization chemicals adopted in the design will generate minimum noise and vibrations which will create minimum disturbance to the aquatic animals including Dolphin and Hilsa fish. As the bridge is located 7 km away from the nearest government notified Hilsa sanctuary hence bridge will not impact the Hilsa breeding.

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 on the basis of available secondary data, field data and discussion with the 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. EMP has been proposed to minimize the negative impacts and achieve sustainable bridge project.

ADB, WB, DoE, RHD and 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.

No highly significant negative environmental impacts are expected during the construction period of 3 years except the normal construction hazards. However, during construction close monitoring is required 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.

About 200.22 acres of agriculture land acquisition is required for the proposed project. A total of 34 nos. of residential, 17 commercial structures and 03 CPRs will be affected by the project who will be compensated as per provisions of the RAP of this project. A total of 674 nos. of trees including new plantation as saplings are going to be affected due to the project. This loss can be mitigated by planting 13,000 nos. of tree saplings

and 100,000 nos. of Vetiver saplings on embankment slopes and other vacant lands which will enhance the environmental condition of the area.

It should be mentioned that as per Environment Conservation Rule, 1997 of Department of Environment, Government of Bangladesh, 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 will 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, GoB. Which require various documents – IEE is one of them.

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 will be directed to follow the suggestions mentioned in Chapter 7 and 8 of the Environmental Assessment Plan (Initial Environmental Examination) Report (Volume 9). Supervision consultants will 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 Matlab Uttar-Gazaria 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, will be uncontrolled settlement, environmental pollution from industries and innumerable places of possible access to the road leading to traffic congestion and hazard. It will, therefore, be desirable to institutionalize some form of effective control on the growth of settlements on the ROW land. One of the measures could be to have an exclusion zone up to a certain distance, say 100m on each side of the road where no structure would be allowed to be erected and no access from any individual property will be allowed directly on the land considering future expansion of road.

It can, therefore, be concluded that the proposed Matlab Uttar-Gazaria Bridge Project would be environmentally sound and sustainable. It can be said in the context of Matlab Uttar-Gazaria Bridge Project that aggregated positive impacts would outweigh the negative impacts through the recommended mitigation measures.

5.7. Land Acquisition and Resettlement (LAP and RAP)

After carrying out the LAP by the specialized subconsultant and the Consultant in-house team of experts, it has been estimated that around 200.22 acres land will require acquisition for the project. (745 plots of 11 administrative Mouzas). According to the detailed census and IOL (inventory of loss) survey, a total of 115 units would be affected including 112 households and 3 CPR (common property resources). Due to acquisition of land 26,739 sqft residential and commercial structures would need to be dismantled. Apart from the primary structures a significant quantity of secondary structures would also be affected. The assessment has also identified that 17 businesses would be affected by the project interventions. Table below shows summary of land acquisition impacts by Interventions.

Table 6. Summary of project impact

Sl. No.	Project Impacts	Gazaria	Matlab Uttar	Total
A.1	Amount of affected land (acre)	138.88	61.34	200.22
A.1.1	Amount of affected private land (acre)	119.42	33.47	152.90
A.1.2	Amount of affected government land (acre)	19.45	27.86	47.32
A.2	Number of Mouza affected	7	4	11
B	Number of total HHs affected by structure	32	2	34
B.1	Total number of households requiring relocation	27	2	29
B.1.1	Number of titled HHs losing res/com requiring relocation	14	2	16
B.1.2	Number of Non-title losing res/com and structures requiring relocation	13	0	13
B.2	Number of titled HHs losing res/com and other structures requiring No-relocation	3	0	3
B.3	Number of Non-title losing structures requiring No relocation	2	0	2
C	Only Land	59	19	78
D	Number of CPRs affected	3	0	3
E	Total number of Project Affected Units (B+C+D)	94	21	115
K	Number of businesses affected	16	1	17

Sl. No.	Project Impacts	Gazaria	Matlab Uttar	Total
L	Number of Vendors affected	13	0	13
M	Number of trees affected	625	49	674
N	Total number of persons affected	285	96	381
O	Total affected primary structure from HHs and CPRs (sqft)	25,307	1432	26,739

Table 7. Summary of land impact by agency

Upazila	Private	DC	BWDB	RHD	Total
Gazaria	119.42	16.01		3.44	138.88
Matlab Uttar	33.47	2.47	25.38		61.34
Grand Total	152.90	18.49	25.38	3.44	200.22

5.7.1. Consultation and participation

During the public consultation meetings (**PCM**), 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. Upon disseminating information by the consultant/project authority, stakeholders identified some pertinent issues relating to the compensation, displacement, resettlement, livelihood restoration, etc.

5.7.2. 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.

5.7.3. Grievance Redress Mechanism

This project would follow specific grievance redress mechanism to ensure that the voices of the APs merge with implementation decisions.

5.7.4. Cost and Budget

Preliminary identified that Land acquisition and Resettlement budget for the project: **BDT 4,777,157,658** (51.37 million USD @93 BDT per dollar). Of the total budget, the estimated DC budget is BDT 4,386,977,458 to be provided by DC office and additional top up budget for LAP and RAP is BDT 390,180,200 to be provided by BBA as additional budget and resettlement benefits.

Table 8. Summary of cost estimate (LAP and RAP)

Category of Loss	DC		BBA		Estimated RC amount in BDT	Million USD (93/$)
	Gazaria	Matlab	Gazaria	Matlab		
Compensation For Land	4,019,071,254	325,219,891	3,436,289	6,904,489	4,354,631,923	46.82
Compensation for structure	28,379,489	1,200,434			29,579,923	0.32
Compensation for Trees	2,427,967	337,645			2,765,612	0.03
Impact Budget (A+B+C)	**4,049,878,710**	**326,757,970**	**3,436,289**	**6,904,489**	**4,386,977,458**	**47.17**
Other Resettlement Benefits			33,001,766	5,133,260	38,135,026	0.41
Operation cost for RAP Implementing Agency/ INGO			10,000,000	30,000,000	40,000,000	0.43
Operation cost for External Monitoring Agency			500,000	500,000	1,000,000	0.01
Sub Total (DC budget + Other RC + Operation Cost)	4,049,878,710	326,757,970	46,938,055	42,537,749	**4,466,112,484**	48.02
Contingency @2 % of the Sub-total			204,840,838	18,464,786	223,305,624	2.40
Administrative cost @ 5 % on the DC budget			81,066,300	6,673,249	87,739,549	0.94
Grand Total	4,049,878,710	326,757,970	332,845,193	67,675,785	4,777,157,658	**51.37**

5.8. Traffic Forecast

The calculation of the potential traffic of the Matlab Uttar-Gazaria bridge has been carried out based on traffic counts and O/D surveys. The prognosis of the traffic was estimated based on a GDP growth study, considering the future economic developments in the area.

The base scenario considered has been built by applying trending forecast and the observed data from the field survey.

In addition, with and without Matlab Uttar-Gazaria bridge project scenarios – future and potential transport infrastructure developments are considered, including a road corridor across Matlab Uttar connecting N1 with R140 (see *Traffic Study and Forecast* Section in Volume 1).

The traffic projection outputs of total motorized traffic (including 2-3 wheelers, light vehicles, buses, and trucks) for scenario with Matlab Uttar-Gazaria bridge project show that the ADT forecast for the first operation year (2028) is around 21,000 vehicles per day and for the 30th year (2057) is close to 61,000 veh/day.

Table 9. Total Daily Traffic (vehicles)

Operation year	Base case
2028	21,038
2029	22,272
2030	24,893
2031	26,183
2032	27,496
2033	28,831
2034	30,185
2035	31,555
2036	32,940
2037	34,337
2038	35,742
2039	37,155
2040	38,573
2041	39,993
2042	41,414
2043	42,833
2044	44,249
2045	45,660

Operation year	Base case
2046	47,064
2047	48,397
2048	49,715
2049	51,018
2050	52,304
2051	53,571
2052	54,821
2053	56,048
2054	57,256
2055	58,442
2056	59,606
2057	60,745

This traffic estimation was carried out considering the following toll fees:

Table 10. Toll fares structure

Toll rates	BDT/veh
2-3 wheelers	30.00
Light vehicles	100.00
Buses	300.00
Trucks	350.00

These toll fees were established as the optimal for trucks, and based on this toll fee for trucks were established the others considering the usual relation applied in other toll roads or bridges in the country.

To estimate the traffic, it was considered the travel time savings due to the introduction of a new improved connection between the N1 road and the area of Chandpur as observed in the figure below which shows the travelling time for each one of the four existing routes without the project and the one with the proposed bridge and new road corridor once implemented.

	Path Alternative	Dist. (km)	Avg. Travel Time (h:min)	Avg. Saved Time (h:min)
A	With project	35.6	0:35	-
E1	Z1062 + Z1069 + Z1402	52.0	1:30	0:55
E2	Z1402	57.4	1:41	1:06
E3	Z1044	71.3	1:53	1:18
E4	N1 + R140	118.8	2:47	2:12

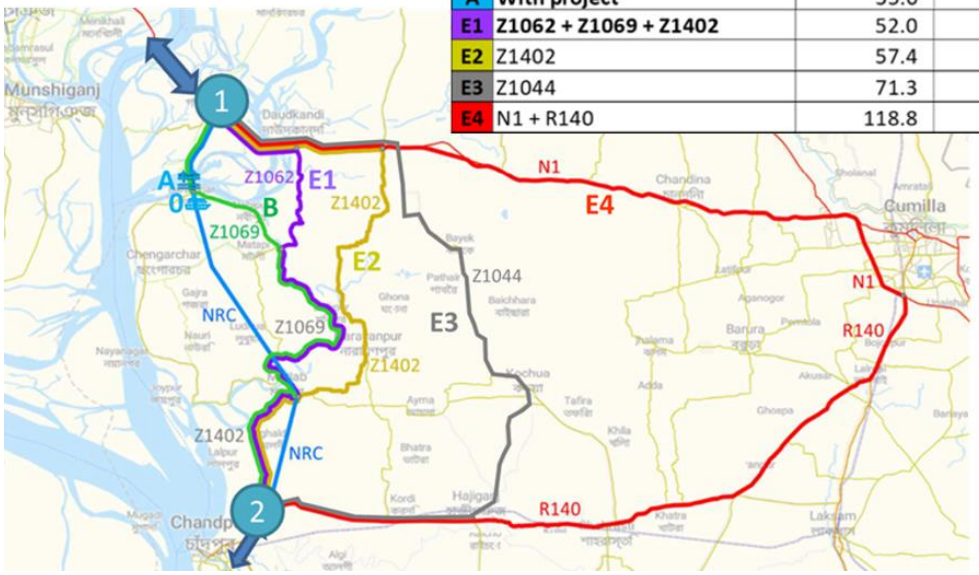

Figure 16. Travel time comparison – existing alternatives and with project alternative

Following table shows the summary of the daily savings for the existing vehicles:

Table 11. Average daily total time, distance and fuel saved by existing traffic

	Without bridge	With bridge	Difference	% Difference
Time [hours]	3,805	1,416	-2,389	-63 %
Distance [kms]	132,510	86,435	-46,075	-35 %
Fuel [litres]	14,829	9,432	-5,397	-36 %

The time savings are due to the introduction of an improved road corridor and the bridge and the reduction of distance. As a result of the time reduction, the traffic through the bridge would come from:

- Diverted from existing roads.
- Generated due to time reduction.
- Diverted from other modes (mainly launch services).
- Traffic for employees commuting to the new economic zones from Matlab.

5.9. Estimated Project Cost

The project cost has been estimated based on several sources, mainly RHD Schedule of Rates (August 2022), 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 has been estimated as

4,073.48 Cr BDT. This total amount needs to be increased by a provision for administrative costs, 68.63 Cr BDT, related to the project implementation that is not considered for the economic and financial analysis purposes as it is shown in the following sections of the report.

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

Table 12. Summary of Preliminary Cost Estimation

No.	Item	Amount (BDT)	Amount (Cr BDT)	Amount (Million USD)
1	General and Site Facilities	722,605,597	72.26	7.77
2	Main Span	13,840,121,854	1,384.01	148.82
3	Approach Bridges and Connection Bridge	5,189,946,301	518.99	55.81
4	Approach Road including small structures	4,833,101,312	483.31	51.97
5	Toll Plaza & Engineering Facilities	1,127,330,848	112.73	12.12
6	Bank Protection Work	2,236,870,060	223.69	24.05
7	Interchange with N1	3,000,000,000	300.00	32.26
(A)	**Subtotal**	**30,949,975,972**	**3,095.00**	**332.80**
(B)	Provisional Sum for Physical Contingency = 3% of (A)	928,499,279	92.85	9.98
(C)	**Sub Total (A+B)**	**31,878,475,251**	**3,187.85**	**342.78**
(D)	Provisional Sum for Price Contingency = 6% of (C)	1,912,708,515	191.27	20.57
(E)	Engineer's Estimate = (C+D)	33,791,183,766	3,379.12	363.35
(F)	**Land Acquisition and Resettlement Costs**	4,777,157,658	**477.72**	**51.37**
(G)	Design Cost = 2% of (A)	618,999,519	61.90	6.66
(H)	Construction Supervision = 5% of (A)	1,547,498,799	154.75	16.64
(I)	**Project Estimate = (E+F+G+H)**	**40,734,839,742**	**4,073.48**	**438.01**

Based on 1 USD = 93 BDT according to selling rate of Bangladesh Bank on 13th July 2022).

5.10. Implementation timeline

The considered implementation project timeline, according to the criteria based on other recent studies undertaken by the Consultant and after conversations held with BBA officials was estimated as follows:

PRE-CONSTRUCTION PHASE

- GOB's Approval of the Project – 2023
- Y0 Jan 2023 to Dec 2024 – DPP implementation – Detailed Design and RAP+LAP implementation - **24 months**.

INVESTMENT PERIOD (BEFORE OPERATION): 5 Y

- Starting year of investment: Y1 = Jan 2023. / Financial Arrangement.
- Project Detailed Design Phase - **18 months.**
- RAP and LAP implementation phase - **12 months.**
- Main Contractor Tender Process - **6 months.**
- **Construction period** including Testing and commissioning - **36 months**.

  Starting: Jul 2024. Finish: Dec 2027.
- Defects Notification Period (DNP 1 year) Jan 2028 to Dec 2028.

OPERATION PERIOD: 30 Y = Jan 2028 to Dec 2058.

- **TOTAL PROJECT PERIOD: 30 + 5 = 35 Y**

5.11. Economic Analysis

The aim of economic analysis is to measure the change in the total social surplus created by a project, which is in turn the sum of the changes in producer surplus, consumer surplus and external effects.

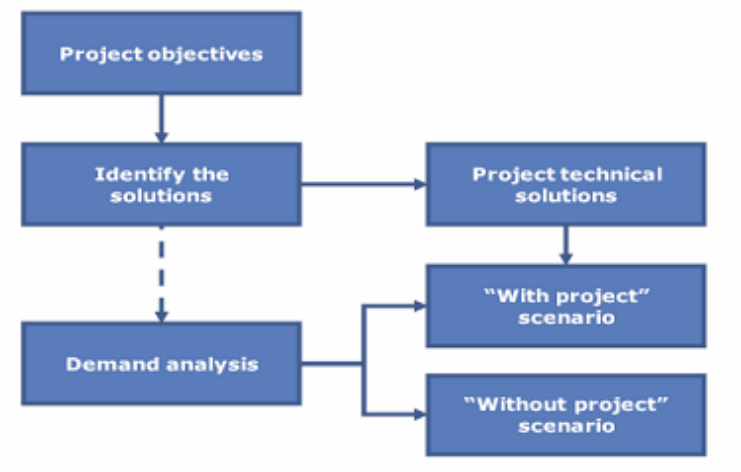

Figure 17. Framework of with / without scenario identification

In our case Project Net Present Value was estimated taking as reference the first year of the considered period– when the investments would start. ENPV estimated in real terms (2023 terms) reaches: 93.90 MUSD (873.3 Cr BDT), as shown in the following table.

Project Economic IRR was obtained from the economic flows estimated for each year. The result is an E-IRR equal to 15.43 %.

This data is clearly higher than the considered social rate of discount (12 %) or opportunity cost of capital, so it can be concluded that the project is feasible (IRR > SRD and E-NPV >0).

Table 13. Economic Appraisal Indicators

Economic appraisal indicators	
Economic Net Present Value (M USD):	93.90
Economic Net Present Value (Cr BDT):	873.30
Economic Internal Rate of Return (EIRR):	15.43%
Benefit / Cost ratio	1.84
Pay back (year)	2043

Basis of appraisal

This executive summary includes the key elements of the **economic evaluation of the Matlab Uttar–Gazaria Bridge project.** Economic analysis or Cost-Benefit Analysis (CBA) is a method used to calculate the profitability of a project from a social point of view, by quantifying costs and benefits of an investment project in monetary terms to allocate society resources in an efficient way.

Prior to any economic estimation on a project requiring investments or benefits it is needed to identify and describe the potential impacts considering the expected effects in an incremental way. That is, estimating those effects when carrying out the project with respect to a reference scenario ("without project" scenario, or counterfactual scenario of not implementing the bridge program):

- ***"Without project" scenario***, or reference scenario (or also, BAU scenario): no bridge project is implemented in the area. Instead, existing traffic structures and travel times to be projected will follow current conditions. In other words, existing transport operating features will be maintained.
- ***"With project" scenario*** (or project scenario): the bridge program is implemented. Traffic analysis undertaken in this report will prevail and a new infrastructure section (the bridge) will add transport capacity to the system.

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 be 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.)

Socioeconomic analysis was carried out considering 5 years of investments and 30 years of operation. Traffic applied to this analysis is the obtained in the Traffic forecast.

Project economic flows

Project economic flows shown in the following figure have been projected for the period of analysis (in Million USD in real terms):

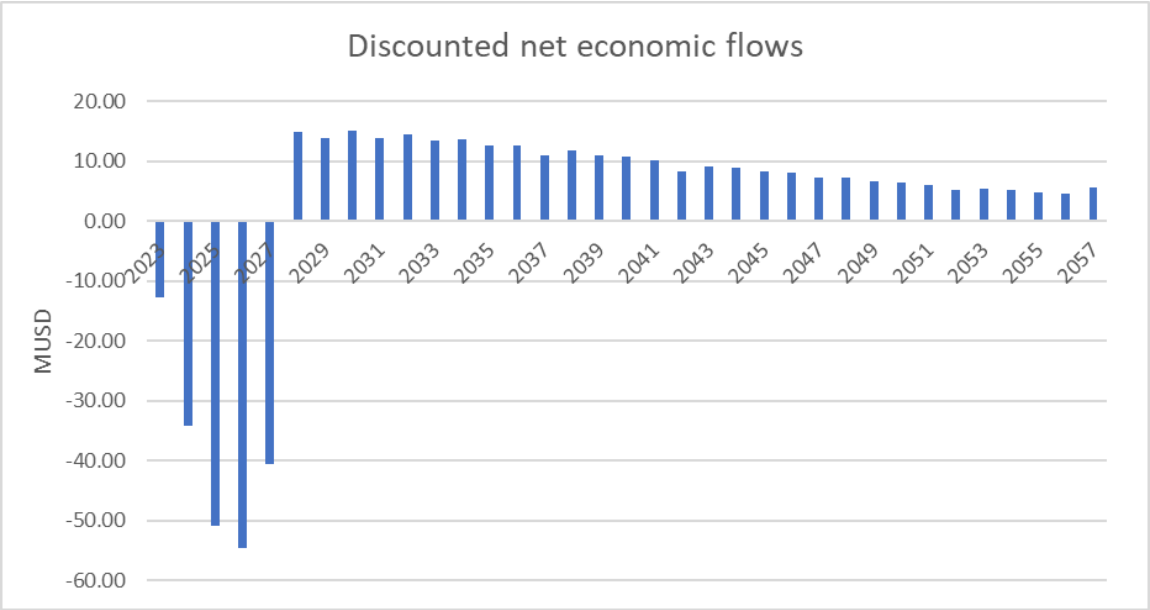

Figure 18. Discounted net economic flows

As observed, the main net costs arise during the construction period (2023 - 2027). Then, during the first operations years flows apparently could start to become positive and grow yearly. It must be noted that operational economic flows (economic flows after the phases of investments) have a certain declining timeframe due to the application of a social rate of discount.

The following figures show the split of the main positive NPV flows, showing that the variation in Consumer Surplus for transport users is by very far the element with the highest impact: around 72% (more precisely, passenger time savings represents 63% of positive impacts).

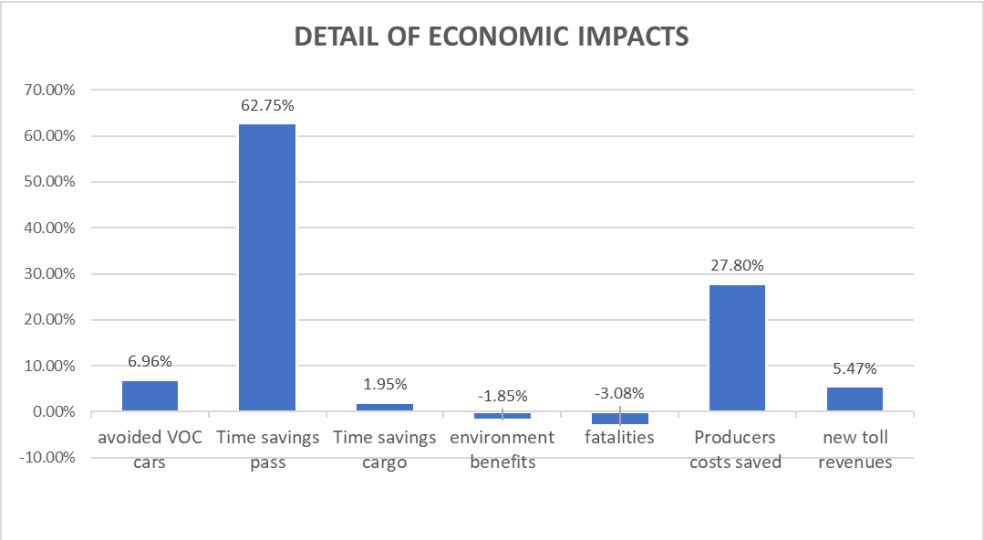

Figure 19. Detail of economic impacts

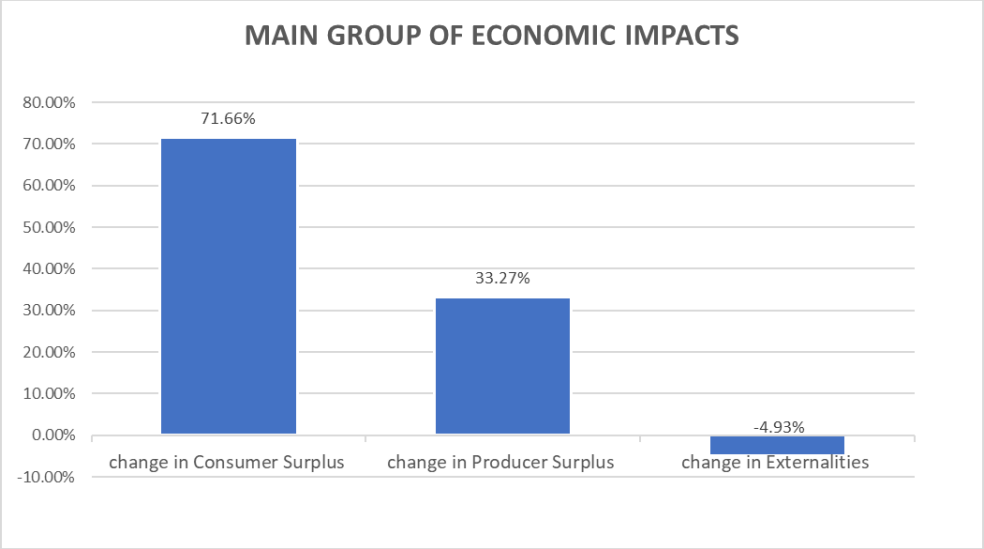

Figure 20. Main group of economic impacts

With the assumptions and the results computed it can be concluded that **the Matlab Uttar - Gazaria bridge would be, taking everything into account, a feasible project from a socio-economic point of view**.

All economic indicators show a positive potential impact in economic terms (under all scenarios, especially for base case scenario, with or without 2/3 wheelers). The project is essentially intended to save time for road and ferry users since that is the main positive impact derived from project implementation, although newly generated economic activities (among them traffic) could bring some diseconomies in terms of incremental external effects.

5.12. Financial Analysis

Introduction

A financial analysis has been implemented in order to evaluate whether Matlab Uttar-Gazaria bridge project can generate enough operating income above operating expenses, repay easily external funding (debt) and remunerate equity investors accordingly, under market conditions.

A simulation model (Financial Model) has been developed, generating project operating and financial flows during the period of analysis; it represents the Economic-Financial Plan ("EFP") of the Project. This EFP develops the projections of the investments of the Project Company and the financial resources used, as well as the operation and maintenance plan, from which it is intended to analyse the financial viability of the Project Company.

Tolling system approach

From the point of view of the payment contract structure, the implementation of a user toll system is planned to minimize the budgetary resources from the Government of Bangladesh. 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:

- 2-3 wheelers.
- Light vehicles.
- Buses.
- Trucks.

The base case traffic scenario described in the Traffic Forecast subsection has been considered in the Financial Analysis.

Procurement alternatives considered.

The procurement alternatives considered are the following ones:

- Traditional procurement or Public Project (the Government implements and operates the Project)
- PPP procurement:
    - Classic PPP Contract (the private partner is in charge of the construction, implementation and operation of the Project as a whole).
    - *Hybrid* PPP Contract (the Government is in charge of the construction/implementation of the Project, whist the private partner is in charge of the operation and maintenance).

Traditional procurement or Public Project

The Government of Bangladesh ("GoB") is in charge of 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. This contractual structure is represented in the following chart:

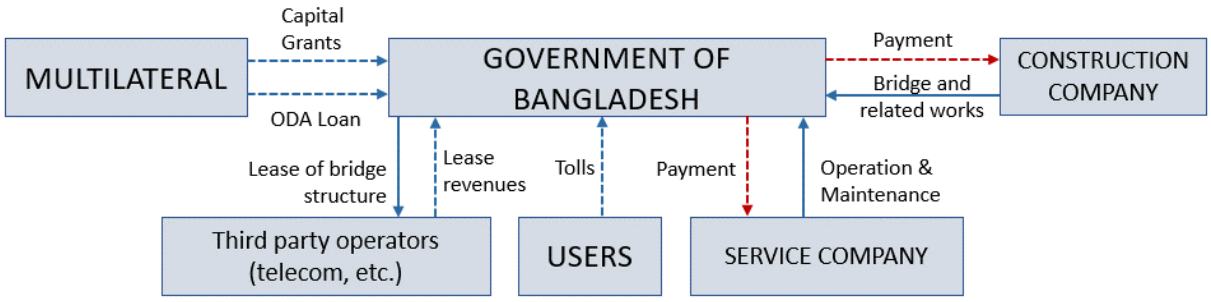

Figure 21. Traditional procurement or Public Project contract structure

PPP Contract

A private PPP company is in charge of the construction, operation and maintenance of the Bridge and collects tolls from users. Should expected revenues be insufficient 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.

This structure is shown in the following chart:

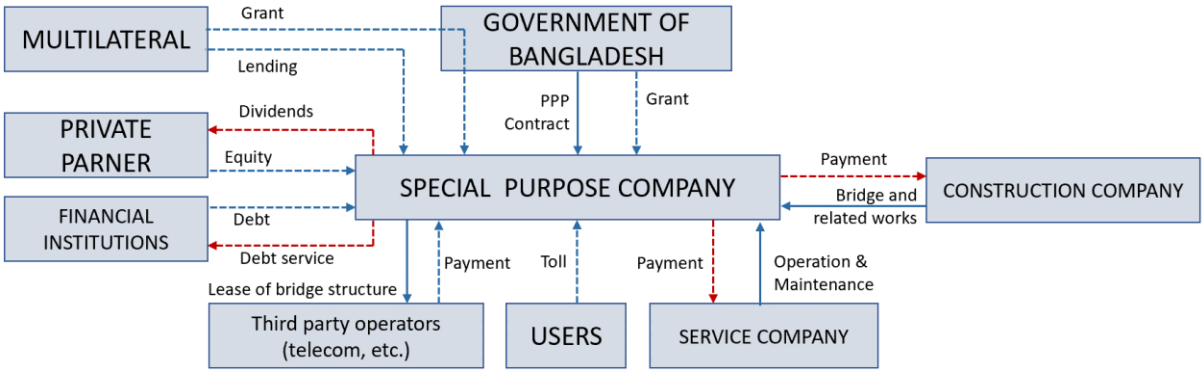

Figure 22. PPP contract structure

Hybrid PPP Contract

Hybrid PPP refers to an arrangement to develop the project whereby all – or most of – investments are taken on by GoB, while other part of the CAPEX and OPEX are done through a normal PPP contract. The typical reason for this PPP structure is to lower cost of financing, thanks to an adequate risk assignment, and faster project implementation. Since design and construction is implemented by GoB with government funds, this fact reduces the risks for the private involvement in the project, being a positive factor for the market appetite and its bankability. This structure is shown in the following chart:

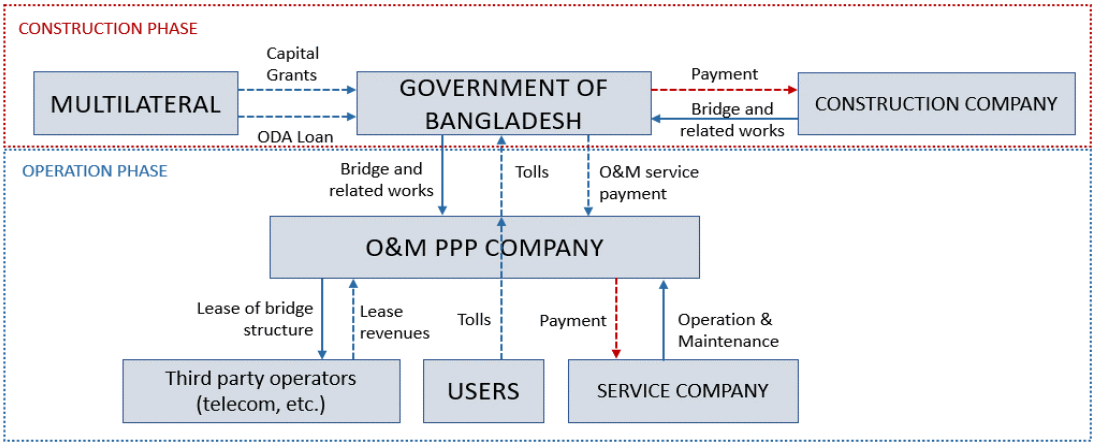

Figure 23. Hybrid PPP contract structure

In the case of the PPP contracts, the government has fixed a *viability gap funding* (VGF). This VGF designated the required grant to support projects that are economically feasible but relatively financially weak.

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 capital cost.

Approach to contract structure

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

- First, the classic PPP scheme is analysed as it allows to alleviate the use of public resources, and to shorten construction schedule. If financial viability is reached without public support (grant), this contract scheme should be the preferred alternative.
- If PPP contract is not financially viable, a VGF mechanism (required for viability) is activated and required support is estimated. If VGF < 40 %, the PPP structure is recommended.
- But if required VGF > 40 %, then a public contract procurement will be recommended, and the analysis will be carried out according to the Traditional Public procurement project structure.

General assumptions for financial appraisal

Total period of analysis is 35 years, including 5 years of investment (design/construction) and 30 years of operation.

Table 14. General assumptions. Terms related assumptions

Terms	Years
Analysis	35
Investment period (including Detail Design and construction)	5
Operation	30

Terms	Years
Base year for analysis	2023

Following Government regulation[1], financial discount rate ("FDR") is fixed at 12 % in nominal terms. It represents a financial hurdle rate and hence it will be used for all contractual scenarios, regardless of the different perceived risks among structures. Therefore, it is being applied as financial discount rate to estimate the financial indicators in the financial analysis of all contract structures:

Table 15. General assumptions. Macroeconomic assumptions

General assumptions	
Inflation rate	5.00 %
Financial Discount Rate	12.0 %
Exchange rate USD / BDT	93

Other assumptions are as follows:

Table 16. Toll fares structure

Toll rates	BDT/veh
2-3 wheelers	30.00
Light vehicles	100.00
Buses	300.00
Trucks	350.00

Table 17. CAPEX of the new scenario

Investment budget (VAT included)	Cr BDT
General and Site facilities	72.26
Approach Road including small structures	783.31
Toll plaza & CCB	112.73
Main bridge (s)	1,384.01
Approach Bridges and Connection Bridge	518.99
Bank protection work	223.69
Land acquisition and Resettlement costs	477.72
Design costs	61.90

1 Memo no 20.804.014.00.00.014.027.18-177, dated 04/09/2018.

Investment budget (VAT included)	Cr BDT
Supervision costs	154.75
Contingencies	284.12
CAPEX	4,073.48

Financial outcomes for PPP structures

The financial indicators are presented in the following table, based on debt sculpting repayment with DSCR:

Table 18. Financial indicators. PPP contract structure

FINANCIAL RESULTS. BASE CASE	Before grants	After grants
F-IRR. Project	4.2%	12.0%
NPV (@WACC %). Million BDT	-21,904.7	0.0
GoB grants required. Million BDT		32,467
VGF (@ constant BDT)		39.2%
F-IRR. Investors		16.2%
NPV (@ Ke [2] %). Million BDT		82.4
Debt repayment based on DSCR (minimum: 1.30x)		14 years

It can be seen in the previous table that results before and after grants have different values due to grant injection financial impact. Outcomes without grant are clearly not sustainable, with both FIRR and project FNPV insufficient to reach financial feasibility. Project viability (minimum accepted project FIRR = 12 %) is reached with a VGF of 39.2 % in constant BDT (3,246.7 Cr BDT), lower than maximum of 40 %, generating a FIRR for Equity investors of 16.2 %, higher than an opportunity cost of capital for investors of around 16 %.

The following chart shows that Project cash flows are positive during the complete operation period, with some years (particularly, years 20 and 30) with lower project cash flows due to certain extraordinary maintenance costs:

[2] *Ke = Cost of equity. Taking into account that the average FDR being used in this analysis is 12 %, a reasonable estimation of the cost of equity for investors could be around 16 %.*

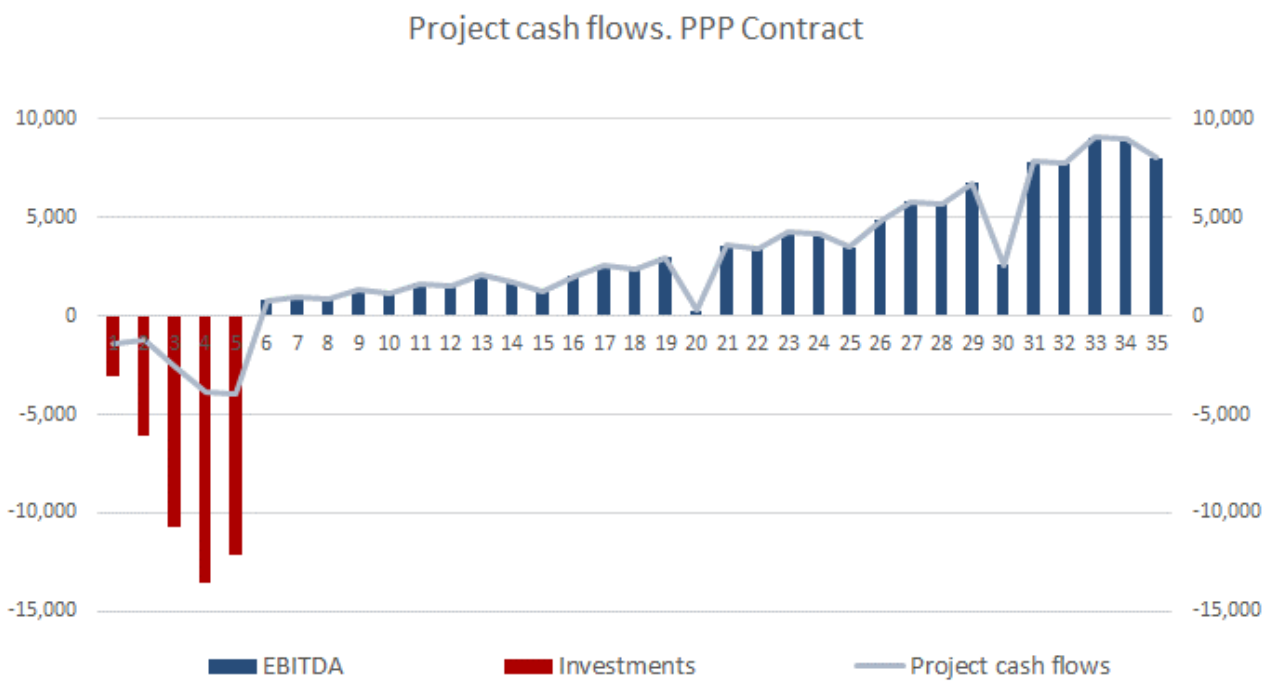

Figure 24. Projected cash flows. PPP Contract structure

Hence the Project could be implemented under a pure PPP scheme and contract structure (according to VGF regulation). But the theoretically intermediate option (the hybrid contractual scheme) is not really much more relevant in these specific circumstances. Indeed, the high investment means that high (public) funds must be allocated to debt repayment, so any possible additional cash generation from the operations is not worth transferring to a private agent. For this reason, the hybrid scenario is not presented.

Results for Traditional procurement or Public Project

The Traditional procurement contract structure, in which the Project is implemented and operated by the GoB, combines the following financial outcomes:

Table 19. Financial results for public procurement

	Base Case
FIRR (unlevered)	5.5 %
FIRR (levered)	9.2 %
FNPV (@12 %) (M BDT)	-3,716.4 MM BDT
FNPV/CAPEX	≈ 9 %

We see that Project (unlevered) FIRR reaches 5.5 % while levered FIRR reaches 9.2 %, which are lower than the established FDR (12.0 %), and therefore the financial feasibility cannot be reached.[3]

The resulting GoB net Cash Flows are negative during the construction period, while positive during the operation period, from year 12 inclusive, except in years 15 and 20 due to particularly high extraordinary maintenance costs. GoB net cash flows are particularly high once the debt is fully amortized (year 30).

The following figure shows the resulting GoB cash flows during the 35 years of the period of analysis:

[3] *1) Unlevered: its calculation includes the financial cash flows of the Project (toll revenues and other operating revenues, O&M expenses and investments). It is equivalent to the project FIRR in a PPP Contract structure.*

2) Levered: its calculation includes the financial flows of the GOB (investment flows, operating revenues and expenses, multilateral loan and debt service). It is the equivalent of the investor's FIRR in PPP Contract structure.

In the case of the Public Project alternative, the Levered FIRR may be more reasonable since it is a country project and sovereign financing, so the flows to be analysed are those of the GOB.

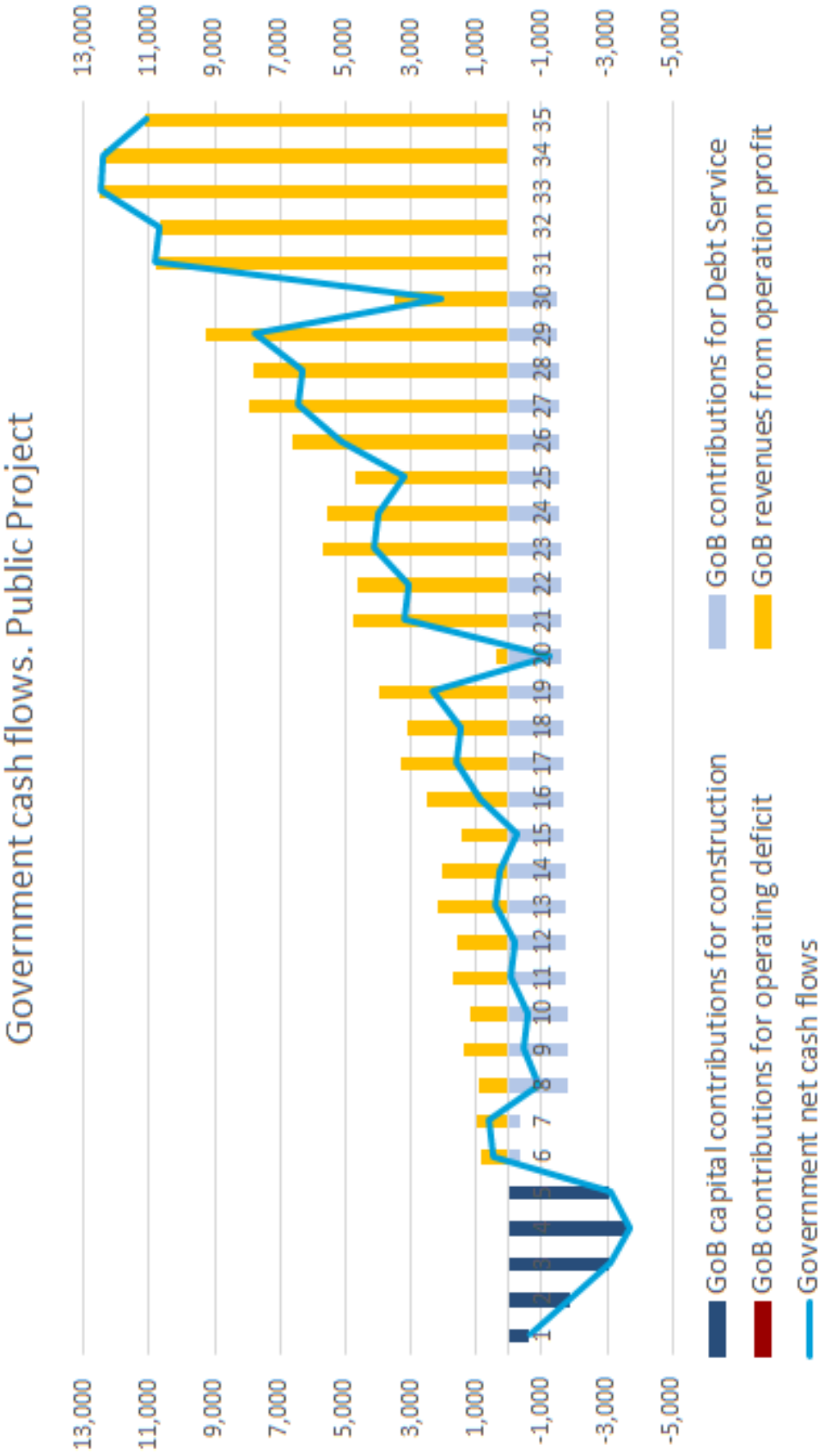

Figure 25. Projected GoB cash flows. Public Project contract structure

Value for Money analysis

The VfM involves estimating the net cost to the GOB of implementing and operating the project in two alternative processes (PPP Contract and Traditional Procurement).

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

Net cost to BBA under PPP (Cr BDT)	=	P.V. of CAPEX by BBA	+	P.V. of OPEX by BBA	-	P.V. of Revenue to BBA	+	VGF	+	P.V. of risks retained by BBA
25,189	=	0	+	0	-	0	+	24,533	+	656

Net cost to BBA for not doing PPP (Cr BDT)	=	P.V. of CAPEX by BBA	+	P.V. of OPEX by BBA	-	P.V. of Revenue to BBA	+	P.V. of risks retained by BBA
26,954	=	34,951	+	6,325	-	17,906	+	3,584

Net benefit of BBA in case of PPP (Cr BDT)	=	Net cost to BBA for not doing PPP (Cr BDT)	-	Net cost to BBA under PPP (Cr BDT)
177	=	2,695	-	2,519

Figure 26: Value for Money process of calculation

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

Table 20. Net cost difference excluding cost of risks.

Total costs (NOT including cost of risks)	Cr BDT
[1] 'Net costs to BBA (Traditional procurement)	2,337
[2] Net costs to BBA (PPP Contract)	2,453
Higher cost of PPP (NOT including cost of risks) (= [1] - [2])	116

The above table shows that PPP Contract represent a higher net cost for the BBA since it includes a more complex structuring as well as the participation of the private sector. The difference is 116 Cr BDT.

Table 21. Value for Money results

Total costs (NOT including cost of risks)	Cr BDT
[1] 'Net costs to BBA (Traditional procurement)	2,695
[2] Net costs to BBA (PPP Contract)	2,519
Net benefit of BBA in case of PPP ([3] = [1] - [2])	177
Net benefit of BBA / Total CAPEX (= [3] / CAPEX)	0.51%

The table above shows that there is a potential benefit for the GoB in case the Project is implemented through a PPP contract, estimated in 177 Cr BDT (equivalent to 0.51% of CAPEX). This difference means that, in case

the Project is implemented as a PPP Contract, it could be more convenient for the GoB with a potential net benefit of BDT Cr 177.

Conclusions for financial analysis

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

- Project financial feasibility under a PPP structure would require a grant of 3,246.7 Cr BDT, which represents 39.2 % of project costs in the most favorable case. This grant injection could guarantee an unlevered project FIRR of 12.0 % (with FNPV = 0 since SRD = 12 %) and an Investors FIRR of 16.2 %.
- But this level of required grant, VGF does not reach the maximum of 40 % set up by law for PPP contract structures and therefore the PPP Contract structure could be legally implemented according to VGF regulation.
- The Project has also been analyzed under a traditional Public Procurement Structure, allowing for a project FIRR (levered) of 9.2 %, which is lower than the established FDR (12.0 %).
- The results of VfM analysis show that in case the Project is implemented as a PPP Contract, it could be more convenient for the GoB with a potential net benefit of BDT Cr 177 (equivalent to 0.51 % of CAPEX).

Calculations sheets compilation from the socio-economic (CBA) analysis and financial analysis are included at the end of this Executive Summary and also at the end of Volume 0 (Annexure).

5.13. Procurement Considerations

When addressing the initial approach considerations for this specific procurement strategy plan, the following aspects need to be carefully examined:

- Expediting the procurement process is a key aspect as per the prioritization given to this of this FS.
- Cost: rates and construction cost estimate pose medium-high uncertainty being a challenge in today's current global macro-economic environment of high inflation and raw materials scarcity. The procurement process shall cover this risk appropriately within the construction contract.
- Time for completion of the project (Client and the Contractor/Concessionaire). Minimum time over-run should be one of the key facts 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 IFC set at pre-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: the client may involve a specific innovative component to be executed. The option of awarding the project to a joint venture, led by a top worldwide international contractor joining with domestic subcontractors for some specifics section of the project is highly recommended.
- Quality Assurance: the 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.

A simple Government Contract following an open international bidding process for construction and a year or two of maintenance period is recommended to be adopted. The classic risk sharing format for such a contract shall be as follows.

Table 22. 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 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.

One main factor must not be overlooked while preparing the bidding documents.

1. The successful bidder shall carry out his own Geotechnical 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.

5.14. Need and Justification of the Project

This section encloses a description of the identified benefits and the considerations corresponding to the assessed need and justification to implement the project:

- At present there is only a waterway communication system between Matlab Uttar and Gazaria Upazila using engine boats, barges and launches. This system is time-consuming, slow, inadequate and risky. The proposed bridge would facilitate and drastically improve the local connectivity between the directly affected Upazilas and the access to the main road network (N1) and the capital Dhaka.

- The proposed project Matlab Uttar-Gazaria bridge would not only benefit the directly connected Matlab Uttar Upazila under Chandpur District with Gazaria Upazila under Munshiganj District. This bridge would also, by means of implementing the recommended N-S corridor, improve the connectivity of Chandpur, Noakhali, Feni, Comilla, Lakshmipur, Bhola districts with Munshiganj, Narayanganj, and the capital Dhaka. It is estimated that nearly 1.8 Cr inhabitants of the region will be benefited and influenced by this infrastructure.

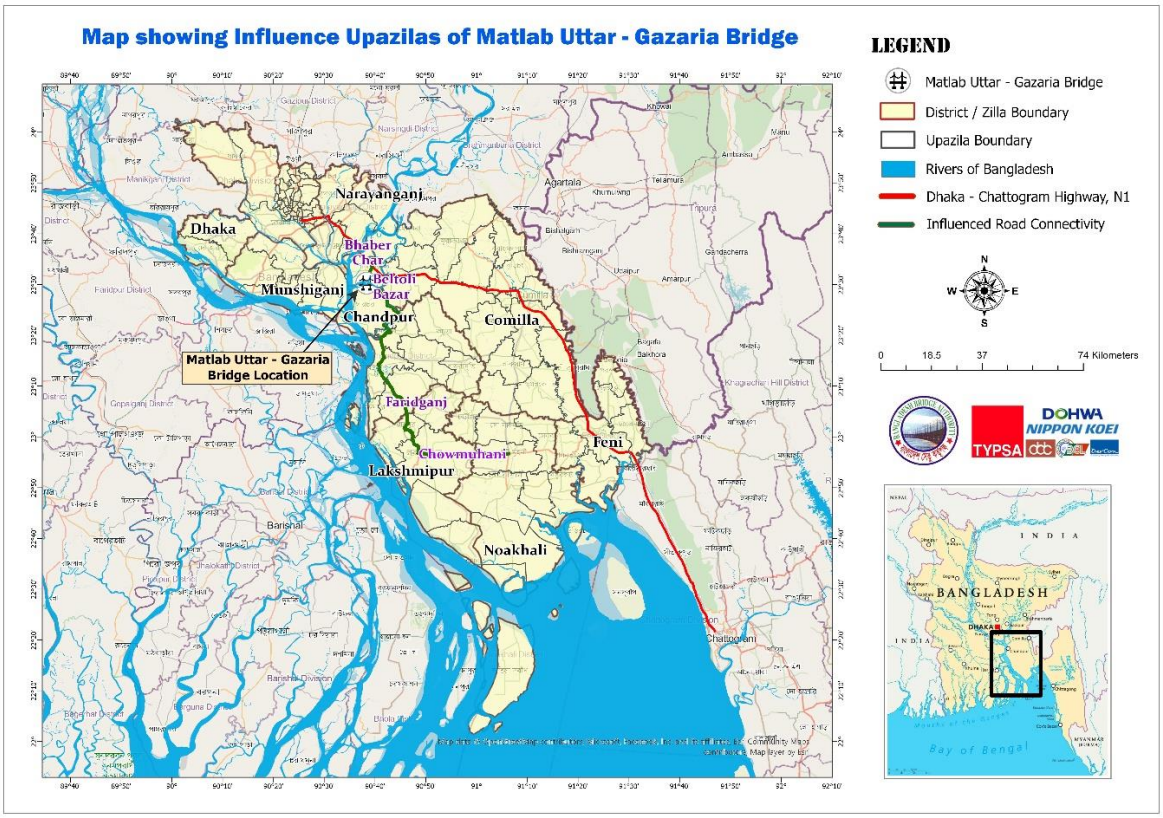

Figure 27. Image of area of influence of the Bridge proposed at Matlab Uttar-Gazaria

Table 23. Estimated influenced by the bridge population.

	District Name	Area (sq km)	Population
1	Bhola (Part)	256	271,349
2	Chandpur	1,469	2,398,531
3	Comilla	3,088	4,501,155
4	Feni	907	1,236,672
5	Lakshmipur	1,244	1,453,583
6	Noakhali (Part)	2,678	2,718,939
7	Dhaka (Part)	1,315	2,550,209
8	Munshiganj	933	1,154,047
9	Narayanganj (Part)	522	1,756,283
			18,040,768

- Connectivity improvements are proved based on the traffic study as follows: in the base traffic scenario, it is estimated to circulate around 21,000 motorized vehicles in the opening year, which will increase up to about 61,000 in the next 30 years. For the other scenarios, the traffic is as follows:

Table 24. Daily traffic volumes

Year	Base case	Conservative case
1st year	21,038	16,195
30th year	60,745	42,206

- In the current existing traffic system, the heavy vehicles (buses and heavy trucks) travelling from Chandpur and nearby areas must travel to the capital city Dhaka via Hajiganj, Cumilla and Daudkandi, taking a long itinerary through R140 by reaching N1 at Cumilla. Through the construction of the proposed bridge, this heavy traffic would save circa 83 km equivalent to nearly 2 hours of time.

- Regarding the non-heavy traffic (rest of vehicles), the distance in road communication between the Chandpur city and the capital Dhaka compared with the current traffic through different possible routes: 1) Z1062+Z1069+Z1402 2) Z1402 3) Z1044, would be shortened by 1) 16.4 km 2) 21.8 km 3) 35.7 km by taking the proposed bridge route, resulting in time-savings of 1) 55 min 2) 66 min 3) 78 min in each itinerary case.

- Non-heavy traffic (rest of vehicles), the distance in road communication between the Bhola and the capital Dhaka would be shortened by 1) 16 km 2) 1 hour 10 min.
  Non-heavy traffic (rest of vehicles), the distance in road communication between the Noakhali and the capital Dhaka would be shortened by 1) 16 km 2) 1 hour.
  Non-heavy traffic (rest of vehicles), the distance in road communication between Lakshmipur and the capital Dhaka would be shortened by 1) 10 km 2) 1 hour 20 min.

- The bridge and adjacent road network would also connect the greater Chandpur, Lakshmipur, and parts of Noakhali and Bhola districts and will serve as an alternative route to Dhaka-Chattogram (N-1) highway and will facilitate the development of project influence area.

- In addition to facilitating the movement of workers and employees of industrial areas along with transportation of goods, extensive socio-economic development will take place within the catchment area of the project bridge in the years to come.

- The Matlab-Uttar bridge has estimated its traffic, taking into consideration also that part of the increase will be due to the construction of the future Shariatpur-Chandpur bridge.

- As an item also to take into consideration, the project is foreseen to generate a relevant increase in the tourism visiting the area, due to the construction of an iconic bridge which would be the first cable stayed bridge in the whole Bangladesh.

- The project would improve considerably the transportation of fishery and agriculture goods between the region and Dhaka.

Benefits of the project:

The project would contribute to achieve the following benefits:

- Improvement of the connection by road between Dhaka and Chandpur, Lakshmipur, Noakhali and the districts within the area of influence (estimated nearly 1.8 Cr population).
- Decentralization improvement: increase in the people that will do their daily activity near this proposed area from the capital. Thus, the thrust of capital will decrease.
- Considerable vehicle travel time, distance, and fuel savings between these districts. As a daily average, considering the average during the 30 years of operation and comparing with the current situation.
    - Time savings 2,389 h.
    - Distance savings 46,075 km.
    - Fuel savings 5,397 litres
- Ease of heavy vehicles' traffic, improving freight transport and commerce.
- Creation of a new transport alternative to current boat trips between Chandpur and Dhaka.
- Urban and economic development of Upazilas of Chandpur District, such as: Chandpur Sadar, Faridganj, Haim Char, Hajiganj, Kachua, Matlab Dakshin, Matlab Uttar, and Shahrasti.
- Proper connection between new economic zones, e.g., EZ of Gazaria and Matlab Uttar.
- Catalyst for economic development, increasing the national **GDP** at an estimated rate of **0.23%** during the entire period of invstement plus operation of the project (see justification in Annexure No. 02).
- Employment creation. For example, around 7,500 workers would cross the bridge every day from Matlab Upazila to work in the proposed new EZ in Gazaria.
- Relief of traffic congestion in N1.
- Mohonpur tourist spot will become more attractive to the tourist due to easy mobility.

- Growth in tourism due to new iconic bridge.

SWOT Analysis the project:

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

Table 25. SWOT matrix

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

Opportunities	Threats
▪ To establish connectivity with the national transport network, particularly in areas that are directly influenced, but also to a broader area affecting several districts and an estimated population of nearly 1.8 Cr. ▪ To facilitate smooth inter- and intra-town movement of people, goods, and services, thereby enhancing overall transportation efficiency and accessibility. ▪ To increase trade at both the local and regional levels, fostering economic growth and development in the area. ▪ To bring about improvements to the environment and public health, ensuring a sustainable and healthier living environment for the local communities. ▪ To foster sustainable decentralization, regional development, and resilient climate-adaptive practices, promoting long-term growth and resilience in the face of climate change challenges. ▪ To contribute significantly to local economic development, creating employment opportunities for the people in the region.	▪ Occurrence of climate change-related and other natural hazards. ▪ The construction process could face hindrance in the event of a sudden natural disaster, impacting its continuity and progress. ▪ Excavation may result in sediments reaching watercourses. ▪ Land acquisition and rehabilitation processes can indeed be time-consuming. Furthermore, social and political obstacles can further complicate and prolong these procedures, potentially impacting the overall progress of the project. ▪ Due to various reasons, there is a possibility of not completing the work on time and increasing the cost of the project.

Source: Consultant Team

6. CONCLUSION

As a summarizing and sound conclusion derived from all the developed sections enclosed within this Feasibility Study and after carrying a comprehensive a thorough analysis, the Consultant has reached the following conclusion: the project consisting of the crossing over the Meghna-Dhonagoda River branch connecting Matlab Uttar and Gazaria, at the selected site and considering all the assumptions taken, is assessed to be technically, environmentally, economically and socially feasible.

The project, overcoming the 1.85 km long crossing through the designed infrastructure, based on a cable-stayed bridge (central span of 400 m) for the main bridge and the other associated infrastructure components, would provide sound social and economic progress and benefits to the population living in the directly connected upazilas Matlab Uttar and Gazaria, to the whole Chandpur, Comilla, and part of Feni, Lakhsmipur, Noakhali districts, and in sum, to 1.8 Cr of estimated population of the surrounding area that would be benefited by the bridge.

The completion of this project construction has been estimated in 36 months, with an estimated start of tendering and construction phase in 2024. The initial investment period has been considered 5 years (2023-2024-2025-2026-2027), considering 30 years of operation period (2028-2058) for the socioeconomic and financial analysis.

The project study has been carried out including several assumptions, scenario “with project”, that are included and detailed within the traffic studies, Vol 04, the socio-economic and financial studies, Vol 12, and the main report, Vol 01. In this regard, it is worthwhile to remark two components affecting the connectivity of the project with the existing road network. To connect at Gazaria side with the N1 Dhaka-Chattogram highway, an initial at-grade junction was pre-designed, but finally, a provision has been included based on a multilevel directional interchange. This proposed and recommended solution will need to be further detailed and coordinated with RHD, once the ongoing project of the improvement of the current N1 makes progress. On the other side of the bridge, at Matlab side, the analysis with project scenario includes the assumption of a new road network, including a 34 km long corridor up to Chandpur city. This corridor is not only recommended, but its implementation is considered mandatory for the proper viability of the project in terms of traffic demand and capacity. The coordination with the concerned agencies, RHD and LGED with this regard must be taken as of capital relevancy for the success of the project.

The total estimated project cost, CAPEX, including a provision of 300 Cr BDT for the abovementioned recommended solution for the connection with N1, is **4,073.48 Cr BDT**. Administrative cost of 68.63 Cr BDT shall be added to this amount.

The Socio-Economic Cost-Benefit and Financial Analysis have been assessed running several scenarios, traffic demand base and conservative cases, including or not 3-wheelers vehicles, toll rates options, and other variables affecting the study outcome. The results corresponding to the selected optimum case, are obtained by applying and considering the revised estimated cost including a N1 connection cost provision, include 3-wheelers, higher toll rates and the base traffic case. The socio-economic analysis (CBA) indicates an **EIRR** equal to **15.43 %.** This value is higher than the considered social rate of discount (12 %) or opportunity cost

of capital, so it can be concluded that the project would be economically viable. Other CBA results are **ENPV = 873.30 Cr BDT**, **payback year 2043** and **cost-benefit ratio = 1.84**.

The Financial study was carried also under the same assumptions and studying various scenarios. Initially, the approach was to check the feasibility of implementing the project under a PPP structure. In this case, GOB grants should be necessary in order to reach the minimum target Project FIRR 12 %, this would generate a **VGF** of around **39 %** of the investment in the base case. This value falls below the 40% limit by law. Secondly, the alternative of Public Project procurement was carried out, with the following financial assessment results: **FIRR** of **5.5%** (unlevered) and **FIRR** of **9.2%** (levered).

The financial indicators in the Public Project procurement structure do not reach the 12% ideally targeted financial rate of return, but the value is near 10% in the levered case, whereas the PPP Contract structure would be an option as it does not exceed the maximum VGF by law (40%).

Operation and maintenance can be fully recovered by the toll revenues as well as part of the investments, which means that the project should receive Government grants or equity contributions, depending on the type of procurement option that is finally selected.

The socioeconomic analysis outcome is clearly positive, the Matlab Uttar-Gazaria Bridge project would clearly provide a positive impact on the society and the Country of Bangladesh.

Annexure 01 – Economic and Financial Model Calculation Sheets

THIS PAGE HAS BEEN LEFT INTENTIONALLY BLANK

Economic Analysis

THIS PAGE HAS BEEN LEFT INTENTIONALLY BLANK

CBA

FEASIBILITY STUDY OF MATLAB UTTAR - GAZARIA BRIDGE		2023 Year 1	2024 Year 2	2025 Year 3	2026 Year 4	2027 Year 5
SOCIO ECONOMIC BENEFITS (IN MUSD)	**NPV**					
Change in Consumer Surplus	**220.60**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Diverted traffic	**187.42**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
User passenger time savings	160.37	0.00	0.00	0.00	0.00	0.00
User freight time savings	5.80	0.00	0.00	0.00	0.00	0.00
Vehicle Operating Costs (VOC) savings	21.25	0.00	0.00	0.00	0.00	0.00
Generated traffic	**33.18**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
User time costs savings	32.79	0.00	0.00	0.00	0.00	0.00
User freight time savings	0.22	0.00	0.00	0.00	0.00	0.00
Additional Vehicle Operating Costs (VOC)	0.17	0.00	0.00	0.00	0.00	0.00
Variation in Externalities	**-15.18**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Accidents	-9.49	0.00	0.00	0.00	0.00	0.00
Emissions	-4.91	0.00	0.00	0.00	0.00	0.00
Air polution	-2.76	0.00	0.00	0.00	0.00	0.00
Climate change	-2.16	0.00	0.00	0.00	0.00	0.00
Well to tank	-0.77	0.00	0.00	0.00	0.00	0.00
TOTAL ECONOMIC BENEFITS (IN MUSD)	**307.84**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
SOCIO ECONOMIC COSTS (IN MUSD)						
Project initial investments	**-193.06**	**-12.77**	**-38.32**	**-63.87**	**-76.65**	**-63.87**
Residual value	**1.32**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-22.19**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Change in Producer Surplus:	**102.41**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Producers costs savings for the system	124.53	0.00	0.00	0.00	0.00	0.00
Toll revenues (generated traffic)	16.83	0.00	0.00	0.00	0.00	0.00
Vehicle Op costs (generated traffic)	-38.95	0.00	0.00	0.00	0.00	0.00
TOTAL ECONOMIC COSTS (IN MUSD)	**-213.93**	**-12.77**	**-38.32**	**-63.87**	**-76.65**	**-63.87**
NET BENEFITS (IN MUSD)	**93.90**	**-12.77**	**-38.32**	**-63.87**	**-76.65**	**-63.87**

IRR (%)	**15.43%**
NPV (MUSD)	**93.90**
Pay Back	**2,043**
Benefit / Cost	**1.84**

CBA

FEASIBILITY STUDY OF MATLAB UTTAR - GAZARIA BRIDGE		2028	2029	2030	2031	2032
		Year 6	Year 7	Year 8	Year 9	Year 10
SOCIO ECONOMIC BENEFITS (IN MUSD)	**NPV**					
Change in Consumer Surplus	**220.60**	**20.69**	**22.64**	**26.10**	**28.34**	**30.73**
Diverted traffic	**187.42**	**17.67**	**19.32**	**22.35**	**24.25**	**26.27**
User passenger time savings	160.37	15.09	16.49	19.23	20.85	22.57
User freight time savings	5.80	0.55	0.60	0.67	0.73	0.80
Vehicle Operating Costs (VOC) savings	21.25	2.04	2.23	2.45	2.67	2.91
Generated traffic	**33.18**	**3.02**	**3.31**	**3.74**	**4.09**	**4.45**
User time costs savings	32.79	2.98	3.27	3.70	4.04	4.40
User freight time savings	0.22	0.02	0.02	0.02	0.03	0.03
Additional Vehicle Operating Costs (VOC)	0.17	0.02	0.02	0.02	0.02	0.03
Variation in Externalities	**-15.18**	**-1.90**	**-2.02**	**-2.29**	**-2.41**	**-2.54**
Accidents	-9.49	-1.20	-1.27	-1.44	-1.52	-1.59
Emissions	-4.91	-0.61	-0.65	-0.73	-0.77	-0.81
Air polution	-2.76	-0.34	-0.36	-0.41	-0.43	-0.46
Climate change	-2.16	-0.27	-0.29	-0.32	-0.34	-0.36
Well to tank	-0.77	-0.10	-0.10	-0.12	-0.12	-0.13
TOTAL ECONOMIC BENEFITS (IN MUSD)	**307.84**	**29.25**	**32.01**	**36.26**	**39.42**	**42.78**
SOCIO ECONOMIC COSTS (IN MUSD)						
Project initial investments	**-193.06**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**1.32**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-22.19**	**-2.81**	**-4.78**	**-2.81**	**-4.78**	**-2.81**
Change in Producer Surplus:	**102.41**	**10.45**	**11.39**	**12.45**	**13.49**	**14.59**
Producers costs savings for the system	124.53	11.88	13.03	14.34	15.65	17.03
Toll revenues (generated traffic)	16.83	2.09	2.23	2.45	2.60	2.74
Vehicle Op costs (generated traffic)	-38.95	-3.52	-3.87	-4.34	-4.75	-5.19
TOTAL ECONOMIC COSTS (IN MUSD)	**-213.93**	**-2.81**	**-4.78**	**-2.81**	**-4.78**	**-2.81**
NET BENEFITS (IN MUSD)	**93.90**	**26.43**	**27.22**	**33.44**	**34.64**	**39.96**

IRR (%)	**15.43%**
NPV (MUSD)	**93.90**
Pay Back	**2,043**
Benefit / Cost	**1.84**

CBA

FEASIBILITY STUDY OF MATLAB UTTAR - GAZARIA BRIDGE		2033 Year 11	2034 Year 12	2035 Year 13	2036 Year 14	2037 Year 15
SOCIO ECONOMIC BENEFITS (IN MUSD)	**NPV**					
Change in Consumer Surplus	**220.60**	**33.26**	**35.93**	**38.76**	**41.74**	**44.88**
Diverted traffic	**187.42**	**28.41**	**30.67**	**33.05**	**35.56**	**38.20**
User passenger time savings	160.37	24.39	26.31	28.34	30.47	32.72
User freight time savings	5.80	0.86	0.94	1.01	1.09	1.18
Vehicle Operating Costs (VOC) savings	21.25	3.16	3.42	3.70	3.99	4.30
Generated traffic	**33.18**	**4.84**	**5.26**	**5.71**	**6.18**	**6.68**
User time costs savings	32.79	4.79	5.20	5.64	6.11	6.60
User freight time savings	0.22	0.03	0.03	0.04	0.04	0.04
Additional Vehicle Operating Costs (VOC)	0.17	0.03	0.03	0.03	0.03	0.04
Variation in Externalities	**-15.18**	**-2.67**	**-2.80**	**-2.94**	**-3.08**	**-3.22**
Accidents	-9.49	-1.67	-1.76	-1.84	-1.93	-2.01
Emissions	-4.91	-0.86	-0.90	-0.95	-1.00	-1.04
Air polution	-2.76	-0.48	-0.51	-0.53	-0.56	-0.59
Climate change	-2.16	-0.38	-0.40	-0.42	-0.44	-0.46
Well to tank	-0.77	-0.14	-0.14	-0.15	-0.16	-0.16
TOTAL ECONOMIC BENEFITS (IN MUSD)	**307.84**	**46.33**	**50.08**	**54.04**	**58.21**	**62.60**
SOCIO ECONOMIC COSTS (IN MUSD)						
Project initial investments	**-193.06**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**1.32**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-22.19**	**-4.78**	**-2.81**	**-4.78**	**-2.81**	**-8.34**
Change in Producer Surplus:	**102.41**	**15.74**	**16.96**	**18.23**	**19.55**	**20.94**
Producers costs savings for the system	124.53	18.50	20.05	21.69	23.42	25.24
Toll revenues (generated traffic)	16.83	2.90	3.05	3.21	3.38	3.54
Vehicle Op costs (generated traffic)	-38.95	-5.65	-6.15	-6.68	-7.24	-7.84
TOTAL ECONOMIC COSTS (IN MUSD)	**-213.93**	**-4.78**	**-2.81**	**-4.78**	**-2.81**	**-8.34**
NET BENEFITS (IN MUSD)	**93.90**	**41.55**	**47.27**	**49.26**	**55.40**	**54.26**

IRR (%)	**15.43%**
NPV (MUSD)	**93.90**
Pay Back	**2,043**
Benefit / Cost	**1.84**

CBA

FEASIBILITY STUDY OF MATLAB UTTAR - GAZARIA BRIDGE		2038	2039	2040	2041	2042
		Year 16	Year 17	Year 18	Year 19	Year 20
SOCIO ECONOMIC BENEFITS (IN MUSD)	NPV					
Change in Consumer Surplus	**220.60**	**48.19**	**51.66**	**55.30**	**59.12**	**63.12**
Diverted traffic	**187.42**	**40.97**	**43.88**	**46.93**	**50.11**	**53.45**
User passenger time savings	160.37	35.08	37.55	40.14	42.85	45.69
User freight time savings	5.80	1.27	1.36	1.46	1.56	1.66
Vehicle Operating Costs (VOC) savings	21.25	4.63	4.97	5.33	5.70	6.10
Generated traffic	**33.18**	**7.21**	**7.78**	**8.37**	**9.00**	**9.67**
User time costs savings	32.79	7.13	7.69	8.28	8.90	9.56
User freight time savings	0.22	0.05	0.05	0.06	0.06	0.06
Additional Vehicle Operating Costs (VOC)	0.17	0.04	0.04	0.04	0.05	0.05
Variation in Externalities	**-15.18**	**-3.37**	**-3.52**	**-3.67**	**-3.82**	**-3.97**
Accidents	-9.49	-2.10	-2.19	-2.28	-2.38	-2.47
Emissions	-4.91	-1.09	-1.14	-1.19	-1.25	-1.30
Air polution	-2.76	-0.61	-0.64	-0.67	-0.70	-0.73
Climate change	-2.16	-0.48	-0.50	-0.52	-0.54	-0.57
Well to tank	-0.77	-0.17	-0.18	-0.19	-0.20	-0.20
TOTAL ECONOMIC BENEFITS (IN MUSD)	**307.84**	**67.21**	**72.04**	**77.10**	**82.39**	**87.92**
SOCIO ECONOMIC COSTS (IN MUSD)						
Project initial investments	**-193.06**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**1.32**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-22.19**	**-2.81**	**-4.78**	**-2.81**	**-4.78**	**-15.79**
Change in Producer Surplus:	**102.41**	**22.39**	**23.89**	**25.46**	**27.09**	**28.78**
Producers costs savings for the system	124.53	27.15	29.15	31.25	33.45	35.75
Toll revenues (generated traffic)	16.83	3.71	3.88	4.06	4.24	4.42
Vehicle Op costs (generated traffic)	-38.95	-8.47	-9.14	-9.85	-10.60	-11.39
TOTAL ECONOMIC COSTS (IN MUSD)	**-213.93**	**-2.81**	**-4.78**	**-2.81**	**-4.78**	**-15.79**
NET BENEFITS (IN MUSD)	**93.90**	**64.39**	**67.25**	**74.28**	**77.61**	**72.13**

IRR (%)	15.43%
NPV (MUSD)	93.90
Pay Back	2,043
Benefit / Cost	1.84

CBA

FEASIBILITY STUDY OF MATLAB UTTAR - GAZARIA BRIDGE		2043 Year 21	2044 Year 22	2045 Year 23	2046 Year 24	2047 Year 25
SOCIO ECONOMIC BENEFITS (IN MUSD)	**NPV**					
Change in Consumer Surplus	**220.60**	**67.30**	**71.67**	**76.23**	**80.98**	**85.84**
Diverted traffic	**187.42**	**56.93**	**60.56**	**64.34**	**68.28**	**72.37**
User passenger time savings	160.37	48.64	51.73	54.95	58.29	61.78
User freight time savings	5.80	1.78	1.89	2.01	2.14	2.27
Vehicle Operating Costs (VOC) savings	21.25	6.51	6.93	7.38	7.84	8.32
Generated traffic	**33.18**	**10.37**	**11.11**	**11.89**	**12.71**	**13.47**
User time costs savings	32.79	10.25	10.98	11.75	12.56	13.31
User freight time savings	0.22	0.07	0.07	0.08	0.09	0.09
Additional Vehicle Operating Costs (VOC)	0.17	0.05	0.05	0.06	0.06	0.06
Variation in Externalities	**-15.18**	**-4.13**	**-4.29**	**-4.44**	**-4.60**	**-4.73**
Accidents	-9.49	-2.57	-2.66	-2.76	-2.85	-2.93
Emissions	-4.91	-1.35	-1.41	-1.46	-1.51	-1.56
Air polution	-2.76	-0.76	-0.79	-0.82	-0.85	-0.88
Climate change	-2.16	-0.59	-0.61	-0.64	-0.66	-0.68
Well to tank	-0.77	-0.21	-0.22	-0.23	-0.24	-0.24
TOTAL ECONOMIC BENEFITS (IN MUSD)	**307.84**	**93.70**	**99.72**	**105.99**	**112.53**	**119.33**
SOCIO ECONOMIC COSTS (IN MUSD)						
Project initial investments	**-193.06**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**1.32**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-22.19**	**-4.78**	**-2.81**	**-4.78**	**-2.81**	**-8.34**
Change in Producer Surplus:	**102.41**	**30.53**	**32.34**	**34.21**	**36.15**	**38.22**
Producers costs savings for the system	124.53	38.16	40.67	43.28	46.00	48.84
Toll revenues (generated traffic)	16.83	4.60	4.78	4.97	5.15	5.30
Vehicle Op costs (generated traffic)	-38.95	-12.23	-13.11	-14.04	-15.01	-15.92
TOTAL ECONOMIC COSTS (IN MUSD)	**-213.93**	**-4.78**	**-2.81**	**-4.78**	**-2.81**	**-8.34**
NET BENEFITS (IN MUSD)	**93.90**	**88.91**	**96.91**	**101.21**	**109.71**	**111.00**

IRR (%)	**15.43%**
NPV (MUSD)	**93.90**
Pay Back	**2,043**
Benefit / Cost	**1.84**

CBA

FEASIBILITY STUDY OF MATLAB UTTAR - GAZARIA BRIDGE		2048 Year 26	2049 Year 27	2050 Year 28	2051 Year 29	2052 Year 30
SOCIO ECONOMIC BENEFITS (IN MUSD)	**NPV**					
Change in Consumer Surplus	**220.60**	**90.89**	**96.14**	**101.58**	**107.23**	**113.08**
Diverted traffic	**187.42**	**76.63**	**81.05**	**85.65**	**90.41**	**95.34**
User passenger time savings	160.37	65.40	69.16	73.06	77.11	81.30
User freight time savings	5.80	2.41	2.55	2.70	2.85	3.01
Vehicle Operating Costs (VOC) savings	21.25	8.83	9.35	9.89	10.45	11.03
Generated traffic	**33.18**	**14.26**	**15.08**	**15.94**	**16.82**	**17.74**
User time costs savings	32.79	14.10	14.91	15.75	16.63	17.53
User freight time savings	0.22	0.10	0.10	0.11	0.11	0.12
Additional Vehicle Operating Costs (VOC)	0.17	0.07	0.07	0.07	0.08	0.08
Variation in Externalities	**-15.18**	**-4.86**	**-4.98**	**-5.11**	**-5.23**	**-5.35**
Accidents	-9.49	-3.01	-3.09	-3.16	-3.24	-3.31
Emissions	-4.91	-1.60	-1.64	-1.68	-1.72	-1.76
Air polution	-2.76	-0.90	-0.93	-0.95	-0.97	-0.99
Climate change	-2.16	-0.70	-0.71	-0.73	-0.75	-0.77
Well to tank	-0.77	-0.25	-0.26	-0.26	-0.27	-0.27
TOTAL ECONOMIC BENEFITS (IN MUSD)	**307.84**	**126.40**	**133.75**	**141.38**	**149.28**	**157.48**
SOCIO ECONOMIC COSTS (IN MUSD)						
Project initial investments	**-193.06**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**1.32**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Renovation works	**-22.19**	**-2.81**	**-4.78**	**-2.81**	**-4.78**	**-15.79**
Change in Producer Surplus:	**102.41**	**40.37**	**42.60**	**44.90**	**47.28**	**49.75**
Producers costs savings for the system	124.53	51.78	54.84	58.02	61.32	64.73
Toll revenues (generated traffic)	16.83	5.45	5.59	5.74	5.88	6.02
Vehicle Op costs (generated traffic)	-38.95	-16.86	-17.84	-18.86	-19.91	-21.00
TOTAL ECONOMIC COSTS (IN MUSD)	**-213.93**	**-2.81**	**-4.78**	**-2.81**	**-4.78**	**-15.79**
NET BENEFITS (IN MUSD)	**93.90**	**123.59**	**128.97**	**138.56**	**144.50**	**141.69**

IRR (%)	**15.43%**
NPV (MUSD)	**93.90**
Pay Back	**2,043**
Benefit / Cost	**1.84**

CBA

FEASIBILITY STUDY OF MATLAB UTTAR - GAZARIA BRIDGE		2053 Year 31	2054 Year 32	2055 Year 33	2056 Year 34	2057 Year 35
SOCIO ECONOMIC BENEFITS (IN MUSD)	**NPV**					
Change in Consumer Surplus	**220.60**	**119.15**	**125.43**	**131.92**	**138.65**	**145.60**
Diverted traffic	**187.42**	**100.46**	**105.76**	**111.24**	**116.91**	**122.77**
User passenger time savings	160.37	85.65	90.15	94.81	99.63	104.61
User freight time savings	5.80	3.17	3.34	3.52	3.70	3.89
Vehicle Operating Costs (VOC) savings	21.25	11.64	12.26	12.91	13.58	14.27
Generated traffic	**33.18**	**18.69**	**19.67**	**20.69**	**21.74**	**22.83**
User time costs savings	32.79	18.47	19.45	20.45	21.49	22.57
User freight time savings	0.22	0.13	0.13	0.14	0.15	0.16
Additional Vehicle Operating Costs (VOC)	0.17	0.08	0.09	0.09	0.10	0.10
Variation in Externalities	**-15.18**	**-5.46**	**-5.58**	**-5.69**	**-5.80**	**0.00**
Accidents	-9.49	-3.38	-3.45	-3.52	-3.59	0.00
Emissions	-4.91	-1.80	-1.84	-1.88	-1.91	0.00
Air polution	-2.76	-1.02	-1.04	-1.06	-1.08	0.00
Climate change	-2.16	-0.78	-0.80	-0.82	-0.83	0.00
Well to tank	-0.77	-0.28	-0.29	-0.29	-0.30	0.00
TOTAL ECONOMIC BENEFITS (IN MUSD)	**307.84**	**165.97**	**174.77**	**183.87**	**193.28**	**208.92**
SOCIO ECONOMIC COSTS (IN MUSD)						
Project initial investments	**-193.06**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Residual value	**1.32**	**0.00**	**0.00**	**0.00**	**0.00**	**62.27**
Renovation works	**-22.19**	**-4.78**	**-2.81**	**-4.78**	**-2.81**	**-8.34**
Change in Producer Surplus:	**102.41**	**52.29**	**54.92**	**57.63**	**60.44**	**63.33**
Producers costs savings for the system	124.53	68.27	71.94	75.74	79.66	83.73
Toll revenues (generated traffic)	16.83	6.15	6.29	6.42	6.55	6.68
Vehicle Op costs (generated traffic)	-38.95	-22.14	-23.31	-24.52	-25.78	-27.08
TOTAL ECONOMIC COSTS (IN MUSD)	**-213.93**	**-4.78**	**-2.81**	**-4.78**	**-2.81**	**53.93**
NET BENEFITS (IN MUSD)	**93.90**	**161.19**	**171.95**	**179.08**	**190.47**	**262.86**

IRR (%)	**15.43%**
NPV (MUSD)	**93.90**
Pay Back	**2,043**
Benefit / Cost	**1.84**

THIS PAGE HAS BEEN LEFT INTENTIONALLY BLANK

Financial Analysis-Project and Government Cash Flows

THIS PAGE HAS BEEN LEFT INTENTIONALLY BLANK

UTTAR MATLAB BRIDGE

			2023 Year 1	2024 Year 2	2025 Year 3	2026 Year 4	2027 Year 5
Construction period	5 years		1	1	1	1	1
Operation period	30 years		0	0	0	0	0
Term of analysis	35 years		1	1	1	1	1
Price indexation	5.00%		1.00	1.05	1.10	1.16	1.22

PROJECT CASH FLOWS (Million BDT)			2023 Year 1	2024 Year 2	2025 Year 3	2026 Year 4	2027 Year 5
Operating revenues			**0**	**0**	**0**	**0**	**0**
Toll revenues			0	0	0	0	0
Other commercial revenues			0	0	0	0	0
Operation & Maintenance expenses			**0**	**0**	**0**	**0**	**0**
Maintenance & Overhaul			0	0	0	0	0
Operation			0	0	0	0	0
Net Cash Flows due to Operations		**10,782.5**	**0**	**0**	**0**	**0**	**0**
Cash Flows due to Investments			**-4,094**	**-6,038**	**-10,590**	**-13,387**	**-11,793**
Initial CAPEX		45,903	-4,094	-6,038	-10,590	-13,387	-11,793
Other CAPEX		0	0	0	0	0	0
Project cash flows (FIRR / FNPV)	**5.5%**	**-20,424.0**	**-4,094**	**-6,038**	**-10,590**	**-13,387**	**-11,793**

GOVERNMENT CASH FLOWS (Million BDT)			2023 Year 1	2024 Year 2	2025 Year 3	2026 Year 4	2027 Year 5
Outflows			**-4,094**	**-6,038**	**-10,590**	**-13,387**	**-11,793**
Project Development (Initial CAPEX)		-28,934	-1,905	-6,000	-10,500	-13,230	-11,576
Interest expenses and fees during construction		-2,273	-2,190	-38	-90	-157	-217
Operation & Maintenance expenses		-5,205	0	0	0	0	0
Loan Repayments							
Interest		-1,141	0	0	0	0	0
Principal Repayments		-5,113	0	0	0	0	0
Inflows			**3,483**	**4,205**	**7,535**	**9,721**	**8,738**
Borrowings		22,962	3,483	4,205	7,535	9,721	8,738
Operating revenues		15,987	0	0	0	0	0
Future Developments		0	0	0	0	0	0
GoB Net cashflows (FIRR / FNPV)	**9.2%**	**-3,716.4**	**-611**	**-1,833**	**-3,055**	**-3,666**	**-3,055**

UTTAR MATLAB BRIDGE

	2028 Year 6	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	0
Operation period	1	1	1	1	1	1	1
Term of analysis	1	1	1	1	1	1	1
Price indexation	1.28	1.34	1.41	1.48	1.55	1.63	1.71

PROJECT CASH FLOWS (Million BDT)	2028 Year 6	2029 Year 7	2030 Year 8	2031 Year 9	2032 Year 10	2033 Year 11	2034 Year 12
Operating revenues	**1,345**	**1,499**	**1,748**	**1,936**	**2,140**	**2,362**	**2,602**
Toll revenues	1,345	1,499	1,748	1,936	2,140	2,362	2,602
Other commercial revenues	0	0	0	0	0	0	0
Operation & Maintenance expenses	**-495**	**-519**	**-838**	**-572**	**-924**	**-631**	**-1,019**
Maintenance & Overhaul	-399	-419	-732	-462	-808	-509	-890
Operation	-96	-101	-106	-111	-116	-122	-128
Net Cash Flows due to Operations	**850**	**980**	**910**	**1,363**	**1,216**	**1,730**	**1,583**
Cash Flows due to Investments	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0	0
Project cash flows (FIRR / FNPV)	**850**	**980**	**910**	**1,363**	**1,216**	**1,730**	**1,583**

GOVERNMENT CASH FLOWS (Million BDT)	2028 Year 6	2029 Year 7	2030 Year 8	2031 Year 9	2032 Year 10	2033 Year 11	2034 Year 12
Outflows	**-831**	**-856**	**-2,632**	**-2,352**	**-2,689**	**-2,381**	**-2,754**
Project Development (Initial CAPEX)	0	0	0	0	0	0	0
Interest expenses and fees during constr	0	0	0	0	0	0	0
Operation & Maintenance expenses	-495	-519	-838	-572	-924	-631	-1,019
Loan Repayments							
Interest	-337	-337	-330	-315	-300	-286	-271
Principal Repayments	0	0	-1,464	-1,464	-1,464	-1,464	-1,464
Inflows	**1,345**	**1,499**	**1,748**	**1,936**	**2,140**	**2,362**	**2,602**
Borrowings	0	0	0	0	0	0	0
Operating revenues	1,345	1,499	1,748	1,936	2,140	2,362	2,602
Future Developments	0	0	0	0	0	0	0
GoB Net cashflows (FIRR / FNPV)	**514**	**643**	**-884**	**-416**	**-549**	**-20**	**-152**

UTTAR MATLAB BRIDGE

	2035 Year 13	2036 Year 14	2037 Year 15	2038 Year 16	2039 Year 17	2040 Year 18	2041 Year 19
Construction period	0	0	0	0	0	0	0
Operation period	1	1	1	1	1	1	1
Term of analysis	1	1	1	1	1	1	1
Price indexation	1.80	1.89	1.98	2.08	2.18	2.29	2.41

PROJECT CASH FLOWS (Million BDT)	2035 Year 13	2036 Year 14	2037 Year 15	2038 Year 16	2039 Year 17	2040 Year 18	2041 Year 19
Operating revenues	**2,862**	**3,143**	**3,446**	**3,772**	**4,124**	**4,502**	**4,908**
Toll revenues	2,862	3,143	3,446	3,772	4,124	4,502	4,908
Other commercial revenues	0	0	0	0	0	0	0
Operation & Maintenance expenses	**-696**	**-1,123**	**-2,015**	**-1,238**	**-846**	**-1,365**	**-933**
Maintenance & Overhaul	-561	-982	-1,867	-1,082	-682	-1,193	-752
Operation	-135	-141	-148	-156	-164	-172	-180
Net Cash Flows due to Operations	**2,166**	**2,020**	**1,431**	**2,534**	**3,278**	**3,137**	**3,975**
Cash Flows due to Investments	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0	0
Project cash flows (FIRR / FNPV)	**2,166**	**2,020**	**1,431**	**2,534**	**3,278**	**3,137**	**3,975**

GOVERNMENT CASH FLOWS (Million BDT)	2035 Year 13	2036 Year 14	2037 Year 15	2038 Year 16	2039 Year 17	2040 Year 18	2041 Year 19
Outflows	**-2,417**	**-2,829**	**-3,707**	**-2,915**	**-2,508**	**-3,013**	**-2,565**
Project Development (Initial CAPEX)	0	0	0	0	0	0	0
Interest expenses and fees during constr	0	0	0	0	0	0	0
Operation & Maintenance expenses	-696	-1,123	-2,015	-1,238	-846	-1,365	-933
Loan Repayments							
Interest	-256	-242	-227	-212	-198	-183	-168
Principal Repayments	-1,464	-1,464	-1,464	-1,464	-1,464	-1,464	-1,464
Inflows	**2,862**	**3,143**	**3,446**	**3,772**	**4,124**	**4,502**	**4,908**
Borrowings	0	0	0	0	0	0	0
Operating revenues	2,862	3,143	3,446	3,772	4,124	4,502	4,908
Future Developments	0	0	0	0	0	0	0
GoB Net cashflows (FIRR / FNPV)	**445**	**314**	**-261**	**857**	**1,616**	**1,489**	**2,342**

UTTAR MATLAB BRIDGE

	2042 Year 20	2043 Year 21	2044 Year 22	2045 Year 23	2046 Year 24	2047 Year 25	2048 Year 26
Construction period	0	0	0	0	0	0	0
Operation period	1	1	1	1	1	1	1
Term of analysis	1	1	1	1	1	1	1
Price indexation	2.53	2.65	2.79	2.93	3.07	3.23	3.39

PROJECT CASH FLOWS (Million BDT)	2042 Year 20	2043 Year 21	2044 Year 22	2045 Year 23	2046 Year 24	2047 Year 25	2048 Year 26
Operating revenues	**5,343**	**5,809**	**6,309**	**6,842**	**7,413**	**8,010**	**8,646**
Toll revenues	5,343	5,809	6,309	6,842	7,413	8,010	8,646
Other commercial revenues	0	0	0	0	0	0	0
Operation & Maintenance expenses	**-4,970**	**-1,028**	**-1,659**	**-1,133**	**-1,829**	**-3,282**	**-2,017**
Maintenance & Overhaul	-4,781	-829	-1,450	-914	-1,599	-3,041	-1,763
Operation	-190	-199	-209	-219	-230	-242	-254
Net Cash Flows due to Operations	**373**	**4,781**	**4,649**	**5,709**	**5,584**	**4,728**	**6,629**
Cash Flows due to Investments	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0	0
Project cash flows (FIRR / FNPV)	**373**	**4,781**	**4,649**	**5,709**	**5,584**	**4,728**	**6,629**

GOVERNMENT CASH FLOWS (Million BDT)	2042 Year 20	2043 Year 21	2044 Year 22	2045 Year 23	2046 Year 24	2047 Year 25	2048 Year 26
Outflows	**-6,588**	**-2,632**	**-3,248**	**-2,708**	**-3,389**	**-4,827**	**-3,547**
Project Development (Initial CAPEX)	0	0	0	0	0	0	0
Interest expenses and fees during constr	0	0	0	0	0	0	0
Operation & Maintenance expenses	-4,970	-1,028	-1,659	-1,133	-1,829	-3,282	-2,017
Loan Repayments							
Interest	-154	-139	-124	-110	-95	-81	-66
Principal Repayments	-1,464	-1,464	-1,464	-1,464	-1,464	-1,464	-1,464
Inflows	**5,343**	**5,809**	**6,309**	**6,842**	**7,413**	**8,010**	**8,646**
Borrowings	0	0	0	0	0	0	0
Operating revenues	5,343	5,809	6,309	6,842	7,413	8,010	8,646
Future Developments	0	0	0	0	0	0	0
GoB Net cashflows (FIRR / FNPV)	**-1,246**	**3,178**	**3,060**	**4,135**	**4,024**	**3,183**	**5,099**

UTTAR MATLAB BRIDGE

	2049 Year 27	2050 Year 28	2051 Year 29	2052 Year 30	2053 Year 31	2054 Year 32	2055 Year 33
Construction period	0	0	0	0	0	0	0
Operation period	1	1	1	1	1	1	1
Term of analysis	1	1	1	1	1	1	1
Price indexation	3.56	3.73	3.92	4.12	4.32	4.54	4.76

PROJECT CASH FLOWS (Million BDT)	2049 Year 27	2050 Year 28	2051 Year 29	2052 Year 30	2053 Year 31	2054 Year 32	2055 Year 33
Operating revenues	**9,322**	**10,041**	**10,805**	**11,616**	**12,477**	**13,389**	**14,357**
Toll revenues	9,322	10,041	10,805	11,616	12,477	13,389	14,357
Other commercial revenues	0	0	0	0	0	0	0
Operation & Maintenance expenses	**-1,378**	**-2,223**	**-1,519**	**-8,096**	**-1,675**	**-2,703**	**-1,846**
Maintenance & Overhaul	-1,111	-1,943	-1,225	-7,787	-1,351	-2,362	-1,489
Operation	-267	-280	-294	-309	-324	-340	-357
Net Cash Flows due to Operations	**7,944**	**7,818**	**9,286**	**3,520**	**10,802**	**10,687**	**12,510**
Cash Flows due to Investments	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Initial CAPEX	0	0	0	0	0	0	0
Other CAPEX	0	0	0	0	0	0	0
Project cash flows (FIRR / FNPV)	**7,944**	**7,818**	**9,286**	**3,520**	**10,802**	**10,687**	**12,510**

GOVERNMENT CASH FLOWS (Million BDT)	2049 Year 27	2050 Year 28	2051 Year 29	2052 Year 30	2053 Year 31	2054 Year 32	2055 Year 33
Outflows	**-2,893**	**-3,725**	**-3,005**	**-9,568**	**-1,675**	**-2,703**	**-1,846**
Project Development (Initial CAPEX)	0	0	0	0	0	0	0
Interest expenses and fees during constr	0	0	0	0	0	0	0
Operation & Maintenance expenses	-1,378	-2,223	-1,519	-8,096	-1,675	-2,703	-1,846
Loan Repayments							
Interest	-51	-37	-22	-7	0	0	0
Principal Repayments	-1,464	-1,464	-1,464	-1,464	0	0	0
Inflows	**9,322**	**10,041**	**10,805**	**11,616**	**12,477**	**13,389**	**14,357**
Borrowings	0	0	0	0	0	0	0
Operating revenues	9,322	10,041	10,805	11,616	12,477	13,389	14,357
Future Developments	0	0	0	0	0	0	0
GoB Net cashflows (FIRR / FNPV)	**6,429**	**6,317**	**7,800**	**2,048**	**10,802**	**10,687**	**12,510**

UTTAR MATLAB BRIDGE

	2056 Year 34	2057 Year 35
Construction period	0	0
Operation period	1	1
Term of analysis	1	1
Price indexation	5.00	5.25

PROJECT CASH FLOWS (Million BDT)	2056 Year 34	2057 Year 35
Operating revenues	**15,381**	**16,466**
Toll revenues	15,381	16,466
Other commercial revenues	0	0
Operation & Maintenance expenses	**-2,980**	**-5,347**
Maintenance & Overhaul	-2,604	-4,953
Operation	-375	-394
Net Cash Flows due to Operations	**12,401**	**11,119**
Cash Flows due to Investments	**0**	**0**
Initial CAPEX	0	0
Other CAPEX	0	0
Project cash flows (FIRR / FNPV)	**12,401**	**11,119**

GOVERNMENT CASH FLOWS (Million BDT)	2056 Year 34	2057 Year 35
Outflows	**-2,980**	**-5,347**
Project Development (Initial CAPEX)	0	0
Interest expenses and fees during constı	0	0
Operation & Maintenance expenses	-2,980	-5,347
Loan Repayments		
Interest	0	0
Principal Repayments	0	0
Inflows	**15,381**	**16,466**
Borrowings	0	0
Operating revenues	15,381	16,466
Future Developments	0	0
GoB Net cashflows (FIRR / FNPV)	**12,401**	**11,119**

Annexure 02 – GDP Impact Justification

THIS PAGE HAS BEEN LEFT INTENTIONALLY BLANK

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

GDP IMPACT CALCULATION		Million BDT
GDP economic impact. Direct Impact		**17,629**
Personnel expenses. Construction	22%	12,680
Personnel expenses. Operation	65%	0
EBITDA. Construction & Maintenance	8%	4,611
EBITDA. Operation	15%	338
GDP economic impact. Indirect Impact		**40,347**
Suppliers. Construction	70%	40,347
Suppliers. Operation	20%	0
GDP economic impact. Induced Impact		**38,906**
Bridge activity		12,680
Induced activity of the bridge		26,225

- Right-hand column is the addition of all the economic projections generated, in constant BDT (not considering inflation)

- Direct impact is the impact generated by the project itself and is similar to the Gross Added Value, which means the addition of personnel expenses and EBITDA both in the implementation phase and in the operation phase.

- Indirect impact is the impact generated by the suppliers of the project, also in both the implementation phase and the operation phase.

- Induced impact is the impact generated by all the personnel expenses with the money spent in any other activity in the region / country. It has been calculated as the induced impact of the bridge activity, based on the personnel expenses of the bridge itself (in construction and in operation), and the induced impact of the activity of the bridge, based on the personnel expenses of the indirect impact multiplied by the 65% estimated of personnel expenses of any service activity.

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

Total impact on GDP (million BDT 2022)	**96,881**
Direct impact	17,629
Indirect impact	40,347
Induced impact	38,906
GDP Bangladesh (million USD 2022)	453,852
GDP Bangladesh (million BDT 2022)	42,208,236
Project impact on GDP	**0.23%**