

Table 5.2 Comparison of the road alignment at Meghna Bridge site

Meghna Bridge	Route A	Route B	Route C	
Route				
Summary	Next to existing bridge(up stream)	Secure distance of 250m upstream near old ferry route	Secure distance of 250m upstream of shifted ferry route Minimize resettlement issue (Ctg. side) on Alignment B	
① Convenient to road user	No specific problem	No specific problem	No specific problem	
Impact on Socio-environment	② Resettlement	10 structure (5 houses, 5 shops)	250 structure (90 houses, 150 shops, 10 stalls)	60 structure (10 houses, 50 shops)
	③ Public facility	No	Mosque relocation	No
	④ Land acquisition (area, landowner)	15m from Holcim Cement boundary (RHD will agree with Holcim Cement)	0 m2	0 m2
	⑤ Traffic safety for vessels	Negligible (one foundation combined with both bridge)	Slightly (two foundations are separated)	Slightly (two foundations are separated)
	⑥ Economic activities (sand unloading, ferry terminal operation, factory etc)	5 shops Fishery	150 shops 50 Sand loading/unloading workers Fishery	50 shops 30 Sand loading/inloading workers Fishery
Impact on natural environment	⑦ Ecosystem	Small Plantation Some impacts to natural fauna and flora during construction Slightly	Many roadside trees shall be cut	Many roadside trees shall be cut
	⑧ Hydrological conditions	(enlarge scoring if some foundation in main channel will be combined, but bank erosion will be little)	Slightly (new bridge impact is small, but scoring around existing bridge will be large by protection)	Worst (new bridge scoring will be large because new route is on the deepest river bed, and existing bridge is needed)
	⑨ noise / air pollution	Negligible impact since few houses remain along new access on Chittagon side	Severe impact since many houses remain along new accesses A school is located near the new access	Severe impact since many houses remain along new accesses A school is located near the new access
	⑩ River flow	Negligible (one foundation combined with both bridge)	Slightly (two foundations are separated)	Slightly (two foundations are separated)
	⑪ Landscape	Negligible (two bridges are close)	Slightly (two bridges are separated (loss of road side trees)	Slightly (two bridges are separated (loss of road side trees)
⑫ Obstacle Object (steel towers, water pipe, gas pipe)	No specific problem	No specific problem	No specific problem	
⑬ Construction condition	Construction period is the shortest Bridge Length: 930m Earthwork : 39,000m3	Construction period is the longest Bridge Length: 1,100m Earthwork : 84,000m3	Construction period is shorter comparing to Route B Bridge Length: 980m Earthwork : 128,000m3	
⑭ Project cost	Cheap	Expensive	Expensive	
Evaluation	⊙	△	○	

Legend ⊙ : Excellent, ○ : Good, △ : Poor

Note: Number of structure within the proposed alignment were counted and rounded up based on the number of roofs identified through Google maps and site reconnaissance made
In the Census survey, number of actual affected households of Route A is 19 households, which include one household with several renters per one structure. It is estimated 1.9 households per one structure on an average. Based on such estimation, that of Route B and C is both 475 households and 114 households, respectively. It is therefore Route A is the most feasible due that number affected households is the smallest compared with the other plans.

Table 5.3 Comparison of the road alignment at Gumti Bridge site

Gumti Bridge		Route A	Route B	Route C	
Route					
Summary		Next to existing bridge(down stream)	Route that secures distance from existing bridge(down stream)	Next to existing bridge(up stream)	
① Convenient to road user		No specific problem	⊙	No specific problem	
Impact on Socio-environment	② Resettlement	20 structure (5 houses, 15 shops)	⊙	80 structure (40 houses, 40 shops)	△
	③ Public facility	No	⊙	No	⊙
	④ Land acquisition (area, landowner)	0 m2	⊙	0 m2	⊙
	⑤ Traffic safety for vessels	Negligible (one foundation combined with both bridge)	⊙	Slightly (two foundations are separated)	○
	⑥ Economic activities (sand unloading, ferry terminal operation, factory etc)	15 shops 100 sand loading/unloading workers cultivating farm on sand bars Fishery	⊙	40 shops 100 sand loading/unloading workers Fishery	△
Impact on natural environment	⑦ Ecosystem	Some impacts to natural fauna and flora during construction	○	Some impacts to natural fauna and flora during construction	○
	⑧ Hydrological conditions	Slightly (enlarge scoring if some foundation will be combined)	○	Negligible (scoring will be same around existing bridge)	⊙
	⑨ noise / air pollution	No impact since no house remained along new access	⊙	Moderate impact since several houses remained along new access	○
	⑩ River flow	Negligible (one foundation combined with both bridge)	⊙	Slightly (two foundations are separated)	○
	⑪ Landscape	Negligible (two bridges are close)	⊙	Slightly (two bridges are separated)	○
⑫ Obstacle Object (steel towers, water pipe, gas pipe)		No specific problem	⊙	No specific problem	⊙
⑬ Construction condition		Construction period is shorter comparing to Route B Bridge Length: 1,410m Earthwork : 33,000m3	⊙	Construction period is the longest Bridge Length: 1,390m Earthwork : 41,000m3	○
⑭ Project cost		Cheap	⊙	Slightly expensive	○
Evaluation		⊙	△	○	
Legend ⊙: Excellent, ○: Good, △: Poor					
Note: Number of structure within the proposed alignment were counted and rounded up based on the number of roofs identified through Google maps and site reconnaissance made					
In the Census survey, number of actual affected households of Route A is 24 households, which include one household with several renters per one structure. It is estimated 1.2 households per one structure on an average. Based on such estimation, that of Route B and C is both 96 households and 24 households, respectively. It is therefore Route A is the most feasible due that number affected households is the smallest compared with the other plans.					

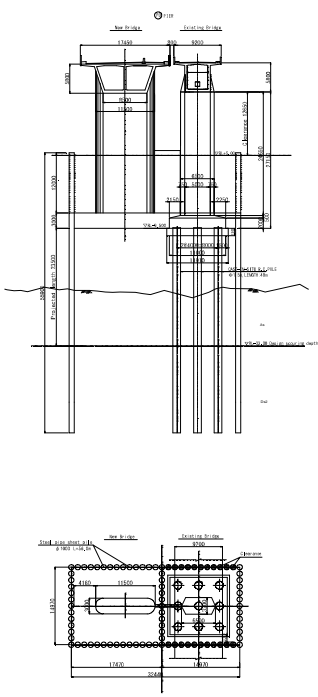
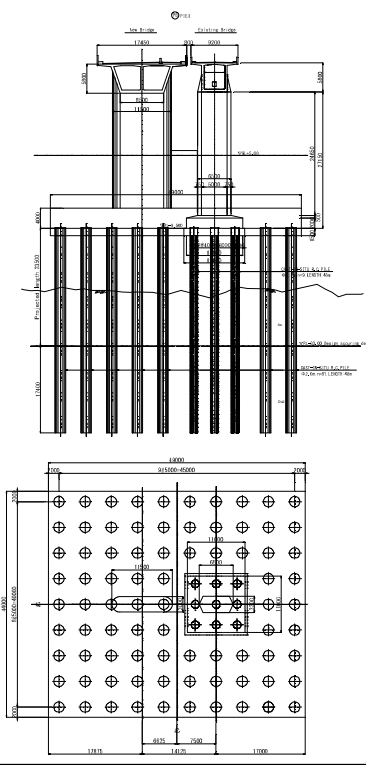
AP17-147

5.3 Selection of Foundation type and Bridge type of the 2nd bridges

5.3.1 Selection of Steel Pipe Sheet Pile Foundation

The comparison of the Steel Pipe Sheet Pile Foundation (SPSP) and concrete pile foundation in case of Meghna Bridge, both of which are capable of resisting new seismic forces after scouring of design depth was conducted regarding the necessity of cofferdams, construction period, foundation size and construction cost. The SPSP foundation was then selected based on the comparison results shown in Table 5.4.

Table 5.4 Foundation retrofitting

	Steel pipe sheet pile foundation (SPSP)		Concrete pile foundation	
Image				
Structural aspect				
Record	A little	△	A little	△
Foundation scale	Small in size	⊙	Large in size	△
Construction aspect				
Cofferdam	Not required	⊙	Required (cofferdam by Steel pipe sheet pile)	△
Navigation clearance	Adequate	△	Adequate	△
Construction period	Six months (Only Steel pipe sheet pile)	⊙	Over one year (RC pile + Steel pipe sheet pile)	△
Natural environment				
Effect on aquatic environment	Small (foundation is small)	⊙	Large (foundation is large)	△
River bed scouring	Small (foundation is small)	⊙	Large (foundation is large)	△
Cost	1.00	⊙	2.56	△
Evaluation	⊙		△	

Legend: ⊙excellent, ○good, △poor

Consequently, SPSP foundations have been adopted for most of the foundations in the 3 bridges. In general the SPSP has less impact on the environment compared to the other types of foundation because the amount of the excavated soil to be disposed is much less than in the conventional piled foundation.

5.3.2 Selection of Continuous Steel Narrow Box Girder with Weathering Steel

For Kanchpur bridge, the comparison of PC box girder, continuous steel narrow box girder with weathering steel and PC extradosed type was conducted regarding structural performance, constructability, maintenance, landscape, environmental impact and lifecycle cost, while for Meghna and Gumti bridges, the PC box girder with corrugated steel web was added to the comparison. The continuous steel narrow box girder with weathering steel was selected for 2nd Kanchpur, Meghna and Gumti Bridges based on the comparison results shown in Table 5.5 to 5.7.

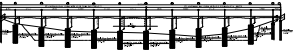
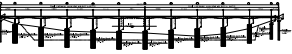


In general, the weathering steel adopted for the steel narrow box girder type in the 3 bridges has less negative impact on the environment compared to the conventional steel for the reasons listed below:

- As the corrosion protective coating is not required, no paint will be used.
- There will be no negative impact on the environment arising from scattered paint.
- There will be no repainting works which otherwise are required every 25 years.

Bridge type		Option-1	Option-2	Option-3	Option-4	
		PC T-beam bridge + PC box girder bridge	Continuous PC box girder bridge	Continuous steel narrow box girder bridge with weathering steel	PC extradosed bridge	
Bridge shape						
Structural performance	Record of usage	Many	Many	Not many	Many	
	Durability	Enough	Enough	Enough	Enough	
	Durability of floor slab	Enough (PC floor slab)	Enough (PC floor slab)	Enough (PC floor slab)	Enough (PC floor slab)	
Constructability	Earthquake resistance	moderate	moderate	advantageous	moderate	
	Construction method	normal	normal	normal	slightly difficult	
	Quality control	normal	normal	normal	slightly difficult (Camber adjustemnt)	
Maintenance	Construction period	3.0 years	3.0 years	2.5 years	3.5 years	
	Painting / Carbonation	Necessity of painting / Surface treatment	Painting once in 30 years	Painting once in 30 years	Surface treatment once in 50 years	Painting once in 30 years
	Maintenance	Intermediate joint numbers	1 point	Nothing	Nothing	Nothing
		Pier with bearings	5 points	Nothing	5 points	1 point
Cable	replacement of cable sheath	Not required	Not required	Not required	replacement once in 75 years	
Landscape	Aesthetic view	Straight + Slender arch shape	Slender arch shape	Straight	Monumental appearance	
Environmental impact	River Hydrology	Depends on no. of bridge piers in riverbed	7 piers	5 piers	5 piers	3 piers
	Scouring	number of piers in main stream	2 piers	2 piers	2 piers	1 pier
	Periodic maintenance	No. and conditions of expansion joints	3 points	2 points	2 points	2 points
Life cycle cost (Construction cost, Maintenance cost)		1.01	1.04	1.00	1.32	
Evaluation		2	3	1	4	

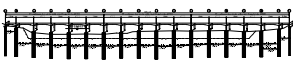



Legend: ⊙ Excellent, ○ Good, △ Poor

Table 5.5 Bridge type evaluation for 2nd Kanchpur Bridge

Bridge type		Option-1		Option-2		Option-3		Option-4		
		PC box girder bridge		PC box girder bridge with corrugated steel web		Continuous steel narrow box girder bridge with weathering steel		PC extradosed bridge + PC box girder bridge		
Bridge shape										
Structural performance	Record of usage		Many	⊙	Few	○	Not many	△	Many	⊙
	Durability	Durability of floor slab	Enough (PC floor slab)	⊙	Enough (PC floor slab)	⊙	Enough (PC floor slab)	⊙	Enough (PC floor slab)	⊙
	Earthquake resistance	Weight of superstructure	moderate	○	slightly advantageous	○	advantage	⊙	moderate	○
Constructability	Construction method	Difficulty level of construction	normal	○	slightly difficult	△	normal	○	slightly difficult	△
	Quality control	Difficulty level of quality control	normal	○	normal	○	normal	○	slightly difficult (Camber adjustemnt)	△
	Construction period		4 years	○	4 years	○	3 years	⊙	4 years	○
Maintenance	Painting / Carbonation	Necessity of painting / Surface treatment	Painting once in 30 years	○	Painting once in 30 years	○	Surface treatment once in 50 years	⊙	Painting once in 30 years	○
	Maintenance	Intermediate joint numbers	1 points	○	1 points	○	Nothing	⊙	1 points	○
		Pier with bearings	2 points	○	2 points	○	11 points	△	3 points	○
Cable	replacement of cable sheath	Not required	⊙	Not required	⊙	Not required	⊙	replacement once in 75 years	△	
Landscape	Aesthetic view		Slender arch shape	○	Slender arch shape	○	Straight	○	Monumental appearance	⊙
Environmental impact	River Hydrology	Depends on no. of bridge piers in riverbed	11 piers	○	11 piers	○	11 piers	○	10 piers	⊙
	Scouring	number of pier in main stream	5 piers	○	5 piers	○	5 piers	○	4 piers	⊙
	Periodic maintenance	No. and conditions of expansion joints	3 Points	○	3 Points	○	2 Points	⊙	3 Points	○
Life cycle cost (Construction cost, Maintenance cost)			1.01	⊙	1.00	⊙	1.00	⊙	1.15	△
Evaluation			2		3		1		4	

Legend: ⊙ Excellent, ○ Good, △ Poor

Table 5.6 Bridge type evaluation for 2nd Meghna Bridge

Bridge type		Option-1		Option-2		Option-3		Option-4		
		PC box girder bridge		PC box girder bridge with corrugated steel web		Steel narrow box girder bridge with weathering steel		PC extradosed bridge + PC box girder bridge		
Bridge shape										
Structural performance	Record of usage	Many	⊙	Few	○	Not many	△	Many	⊙	
	Durability	Durability of floor slab	Enough (PC floor slab)	⊙	⊙	Enough (PC floor slab)	⊙	⊙	⊙	
	Earthquake resistance	Weight of superstructure	moderate	○	slightly advantageous	○	advantageous	⊙	○	
Constructability	Construction method	Difficulty level of construction	normal	○	slightly difficult	△	normal	○	slightly difficult	△
	Quality control	Difficulty level of quality control	normal	○	○	normal	○	⊙	slightly difficult (Camber adjustment)	△
	Construction period		4 years	○	4 years	○	3 years	⊙	4 years	○
Maintenance	Painting / Carbonation	Necessity of painting / Surface treatment	Painting once in 30 years	○	Painting once in 30 years	○	Surface treatment once in a 50 years	⊙	Painting once in 30 years	○
	Maintenance	Intermediate joint numbers	2 points	○	⊙	2 points	○	⊙	2 points	○
		Pier with bearings	2 points	⊙	⊙	2 points	⊙	△	4 points	○
	Cable	replacement of cable sheath	Not required	⊙	⊙	Not required	⊙	⊙	replacement once in 75years.	△
Landscape	Aesthetic view	Slende arch shape	○	○	Slende arch shape	○	○	Straight	○	
Environmental impact	River Hydrology	Depends on no. of bridge pier in riverbed	16 piers	○	16 piers	○	16 piers	○	15 piers	⊙
	Scouring	number of piers in main stream	6 piers	○	6 piers	○	6 piers	○	5 piers	⊙
	Periodic maintenance	No. and conditions of expansion joints	4 points	⊙	4 points	⊙	4 points	⊙	4 points	⊙
Life cycle cost (Construction cost, Maintenance cost)			1.00	⊙	1.01	⊙	1.00	⊙	1.06	△
Evaluation		2		3		1		4		

Legend: ⊙ Excellent, ○ Good, △ Poor

Table 5.7 Bridge type evaluation for 2nd Gunthi Bridge

CHAPTER 6 INITIAL ENVIRONMENTAL EXAMINATION

6.1 Screening

Screening is the step to categorize projects/activities based on degree of environmental impacts caused by the project.

The Project was classified as “Red” under regulation of Bangladesh and “A” according to the JICA Environmental Guidelines, and thus EIA is necessary to be conducted.

6.2 Scoping

The aim of scoping is to find out possible ecological/environmental and social impact caused by the implementation of proposed project and to determine Terms of Reference (TOR) for EIA.

The results of screening are shown in Table 5.1. Impacts are rated in A, B, C and D. The definition of the rating is as follows.

Definition of the Rating:

- A: Severe negative impact is predicted
- B: Limited negative impacts can be predicted
- C: Impact is unknown
- D: Almost no negative impact is predicted

Table 6.1 Results of Scoping at Kanchpur Bridge Site

	Item	Rating			Potential impact description		Study methodology
		Overall	Before / During Construction	During Operation	Before / During Construction	During Operation	
1	Involuntary resettlement	A	A	D	Loss of approximately 40 residential houses and small shops	-	Preparation of RAP Census Asset inventory
2	Local economics, such as employment, livelihood, etc.	A	A	D	Loss of approximately 20 small shops Some restrictions to sand carrying work	- (Local economy can be activated)	Socio-economical survey and group discussion
3	Land use and utilization of local resources	B	B	D	Impact on part of fishing place	-	Study of current land use
4	Social institutions such as social infrastructure and local decision-making institutions	D	D	D	-	-	-
5	Existing social infrastructures and services	D	D	D	-	-	-
6	Poor, indigenous, or ethnic people	A	A	D	Relocation of approximately 40 poor and landless families and small shops	-	Group discussion
7	Misdistribution of benefits and damages	B	B	B	Relocated families may become poorer while the remaining families can have the project benefit		Socio-economical survey and group discussion
8	Local conflicts of interest	B	B	B	Local conflicts may take place by the misdistribution of benefits and damages		Socio-economical survey and group discussion
9	Cultural heritage	D	D	D	Appeared to be no cultural heritage around	-	-
10	Accident	B	B	B	Construction accident during construction	Traffic accident	Study and analysis of construction accident during construction and traffic accident
11	Infectious diseases such as HIV/AIDS	B	B	C	Inflow of workers with HIV into camp	-	Study of present condition of HIV
12	Gender	B	B	C	Female laborers may be discriminated in wage at construction site	-	Study of present condition of gender gaps
13	Children's rights	B	B	C	Children's labor	-	Study of present condition of children's labor

	Item	Rating			Potential impact description		Study methodology
		Overall	Before / During Construction	During Operation	Before / During Construction	During Operation	
14	Erosion and scouring	C	C	C	River bank erosion may be caused by installation of embankment road for construction and abutments		literature study and hearing study
15	River transportation	B	B	B	Construction vessels may obstacle passing vessels	New pier foundations may obstacle passing vessels	Study of the number of passing vessels and their passing direction Study of present condition of river traffic accident
16	Hydrology	B	B	B	Flood can be caused by installation of embankment road for construction and abutments		Hydrological analysis
17	Biota and Ecosystem	B	B	C	Impact on precious species	-	Hearing study
18	Global Warming	C	C	C	CO2 emission from construction equipment	An increase in CO2 emission from passing vehicles	Estimation of the amount of emission Prediction of the amount of emission
19	Air Pollution	B	B	C	Emission of air pollutant from construction equipment	An increase in emission of air pollutant from passing vehicles	Chemical analysis of air pollution Prediction of future density
20	Water Contamination	B	B	D	Release of construction turbid water without treatment into river Disturbance of river bottom by installation of pier foundation	-	Chemical analysis of present water quality Estimation and prediction of amount of suspended solid by installation of pier foundation
21	Soil Pollution	B	B	D	Leakage of asphalt and gasoline	-	Soil sampling and analysis for pollution Prediction of leakage in construction
22	Waste	B	B	D	Illegal dumping of construction solid waste	-	Prediction of amount of generated construction waste
23	Noise and Vibration	B	B	C	Noise and vibration of construction equipment	Noise and vibration of passing vehicles	Measurement of noise and vibration Prediction of future noise and vibration

	Item	Rating			Potential impact description		Study methodology
		Overall	Before / During Construction	During Operation	Before / During Construction	During Operation	
24	Ground Subsidence	C	D	C		Ground subsidence of buildings and surrounding facilities	Study of current condition of soft ground distribution by boring
25	Offensive Odor	C	C	C	Odor from emitted gases by construction equipment and open burning of waste		Study of a cause and a resource of offensive odor
26	Bottom Sediment	C	C	D	-	-	Sampling and chemical analysis of bottom sediments
27	Landscape	C	C	C	View of bridges and embankments during construction	View of bridges and embankments during operation	Hearing from local residents

Table 6.2 Results of scoping at Meghna Bridge Site

No.	Item	Rating			Potential impact description		Study methodology
		Overall	Before / During Construction	During Operation	Before / During Construction	During Operation	
1	Involuntary resettlement	A	A	D	Loss of approximately 400 residential houses and small shops	-	Census Asset inventory -
2	Local economics, such as employment, livelihood, etc.	A	A	D	Loss of approximately 200 small shops Some restrictions to sand carrying work	- (Local economy can be activated)	Socio-economical survey and group discussion
3	Land use and utilization of local resources	B	B	D	Impact on part of fishing place and timber industry	-	Study of current land use
4	Social institutions such as social infrastructure and local decision-making institutions	B	B	D	Construction impact on school	-	Study of location, influence and so forth

No.	Item	Rating			Potential impact description		Study methodology
		Overall	Before / During Construction	During Operation	Before / During Construction	During Operation	
5	Existing social infrastructures and services	B	B	D	Relocation of ferry terminal	-	Study of current condition of ferry use
6	Poor, indigenous, or ethnic people	A	A	D	Relocation of approximately 40 poor and landless families and small shops	-	Group discussion
7	Misdistribution of benefits and damages	B	B	B	Relocated families may become poorer while the remaining families can have the project benefit		Socio-economical survey and group discussion
8	Local conflicts of interest	B	B	B	Local conflicts may take place by the misdistribution of benefits and damages		Socio-economical survey and group discussion
9	Cultural heritage	D	D	D	Appeared to be no cultural heritage around	-	Appeared to be no cultural heritage around
10	Accident	B	B	B	Construction accident during construction	Traffic accident	Study and analysis of construction accident during construction and traffic accident
11	Infectious diseases such as HIV/AIDS	B	B	C	Inflow of workers with HIV into camp	-	Study of present condition of HIV
12	Gender	B	B	C	Female laborers may be discriminated in wage at construction site	-	Study of present condition of gender gaps
13	Children's rights	B	B	C	Children's labor	-	Study of present condition of children's labor
14	Erosion and scouring	A	C	A	Deep scour of river bottom around pier's foundations and river bank erosion may be caused by installation of embankment road for construction and abutments		Hydrological analysis
15	River transportation	B	B	B	Construction vessels may obstacle passing vessels	New pier foundations may obstacle passing vessels	Construction vessels may obstacle passing vessels
16	Hydrology	B	B	B	Flood can be caused by installation of embankment road for construction and abutments		Hydrological analysis for erosion and scouring
17	Biota and Ecosystem	B	B	C	Impact on precious species	-	Hearing study

No.	Item	Rating			Potential impact description			Study methodology
		Overall	Before / During Construction	During Operation	Before / During Construction	During Operation	During Operation	
18	Global Warming	C	C	C	CO2 emission from construction equipment	An increase in CO2 emission from passing vehicles	Estimation of the amount of emission Prediction of the amount of emission	
19	Air Pollution	B	B	C	Emission of air pollutant from construction equipment	An increase in emission of air pollutant from passing vehicles	Chemical analysis of air pollution Prediction of future density	
20	Water Contamination	B	B	D	Release of construction turbid water without treatment into river Disturbance of river bottom by installation of pier foundation	-	Chemical analysis of present water quality Estimation and prediction of amount of suspended solid by installation of pier foundation	
21	Soil Pollution	B	B	D	Leakage of asphalt and gasoline	-	Soil sampling and analysis for pollution Prediction of leakage in construction	
22	Waste	B	B	D	Illegal dumping of construction solid waste	-	Prediction of amount of generated construction waste	
23	Noise and Vibration	B	B	C	Noise and vibration of construction equipment	Noise and vibration of passing vehicles	Measurement of noise and vibration Prediction of future noise and vibration	
24	Ground Subsidence	C	D	C		Ground subsidence of buildings and surrounding facilities	Study of current condition of soft ground distribution by boring	
25	Odor	C	C	C	Odor from emitted gases by construction equipment and open burning of waste		Study of a cause and a resource of offensive odor	
26	Bottom Sediment	C	C	D	-	-	Sampling and chemical analysis of bottom sediments	
27	Landscape	C	C	C	View of bridges and embankments during construction	View of bridges and embankments during operation	Hearing from local residents	

Table 6.3 Results of scoping at Gumti Bridge Site

No.	Item	Rating			Potential impact description			Study methodology
		Overall	Before / During Construction	During Operation	Before / During Construction	During Operation	During Operation	
1	Involuntary resettlement	A	A	D	Loss of approximately 40 residential houses and small shops	-	Census Asset inventory -	
2	Local economics, such as employment, livelihood, etc.	A	A	D	Loss of approximately 20 small shops Some restrictions to sand carrying work	-	Socio-economical survey and group discussion	
3	Land use and utilization of local resources	D	D	D	Impact on part of fishing place, timber industry and agriculture	-	Study of current land use	
4	Social institutions such as social infrastructure and local decision-making institutions	B	B	D	-		-	
5	Existing social infrastructures and services	D	D	D				
6	Poor, indigenous, or ethnic people	A	A	D	Relocation of approximately 40 poor and landless families and small shops	-	Group discussion	
7	Misdistribution of benefits and damages	B	B	B	Relocated families may become poorer while the remaining families can have the project benefit		Socio-economical survey and group discussion	
8	Local conflicts of interest	B	B	B	Local conflicts may take place by the misdistribution of benefits and damages		Socio-economical survey and group discussion	
9	Cultural heritage	D	D	D	Appeared to be no cultural heritage around	-	Appeared to be no cultural heritage around	
10	Accident	B	B	B	Construction accident during construction	Traffic accident	Study and analysis of construction accident during construction and traffic accident	
11	Infectious diseases such as HIV/AIDS	B	B	C	Inflow of workers with HIV into camp	-	Study of present condition of HIV	
12	Gender	B	B	C	Female laborers may be discriminated in wage at construction site	-	Study of present condition of gender gaps	

No.	Item	Rating			Potential impact description		Study methodology
		Overall	Before / During Construction	During Operation	Before / During Construction	During Operation	
13	Children's rights	B	B	C	Children's labor	-	Study of present condition of children's labor
14	Erosion and scouring	A	C	A	Deep scour of river bottom around pier's foundations and river bank erosion may be caused by installation of embankment road for construction and abutments		Hydrological analysis
15	River transportation	B	B	B	Construction vessels may obstacle passing vessels	New pier foundations may obstacle passing vessels	Construction vessels may obstacle passing vessels
16	Hydrology	B	B	B	Flood can be caused by installation of embankment road for construction and abutments		Hydrological analysis
17	Biota and Ecosystem	B	B	C	Impact on precious species	-	Hearing study
18	Global Warming	C	C	C	CO2 emission from construction equipment	An increase in CO2 emission from passing vehicles	Estimation of the amount of emission Prediction of the amount of emission
19	Air Pollution	B	B	C	Emission of air pollutant from construction equipment	An increase in emission of air pollutant from passing vehicles	Chemical analysis of air pollution Prediction of future density
20	Water Contamination	B	B	D	Release of construction turbid water without treatment into river Disturbance of river bottom by installation of pier foundation	-	Chemical analysis of present water quality Estimation and prediction of amount of suspended solid by installation of pier foundation
21	Soil Pollution	B	B	D	Leakage of asphalt and gasoline	-	Soil sampling and analysis for pollution Prediction of leakage in construction
22	Waste	B	B	D	Illegal dumping of construction solid waste	-	Prediction of amount of generated construction waste
23	Noise and Vibration	B	B	C	Noise and vibration of construction equipment	Noise and vibration of passing vehicles	Measurement of noise and vibration Prediction of future noise and vibration

No.	Item	Rating			Potential impact description		Study methodology
		Overall	Before / During Construction	During Operation	Before / During Construction	During Operation	
24	Ground Subsidence	C	D	C		Ground subsidence of buildings and surrounding facilities	Study of current condition of soft ground distribution by boring
25	Odor	C	C	C	Odor from emitted gases by construction equipment and open burning of waste		Study of a cause and a resource of offensive odor
26	Bottom Sediment	C	C	D	-	-	Sampling and chemical analysis of bottom sediments
27	Landscape	C	C	C	View of bridges and embankments during construction	View of bridges and embankments during operation	Hearing from local residents

6.3 Study Approach Proposed

Study approaches employed, where applicable, are:

- Existing data collection
- Discussion with expert
- Site reconnaissance
- Monitoring/ sampling/ laboratory analysis
- Numerical analysis (Formula presented in Annex 2)

Policy, Legal, and Administrative Framework:

This is to clarify the roles, limits and challenges of environmental rules and organization related. For this purpose, it is required to collect information and analyze legal framework, such as a National Environmental policy, National Environmental Management Plan, Environmental Conservation Act and Rule etc and institutional framework related to environment, such as Department of Environment, a Social and Environmental Circle of RHD.

Alternative Study and feasible route selection:

This is to clarify the necessity/priority of the project and, then, to propose the most feasible routes for three bridges respectively. For that purpose, a national master plan, traffic policy master plan and road master plan available are studied and, in the view of national priority, economy and technique, the necessity of project is evaluated comparing with other modes of transportation, such as railway and water transport together with the case when project be not implemented (zero option). By this, benefits of the project are emphasized to understand the necessity of the project to get smooth approval from stakeholders. Once the project is found to be most prioritized, then, most feasible routes are studied, in the view of construction /maintenance costs, technical issues such as flood, bank erosion and river bed scouring, social and environmental issues such as number of relocated houses/ shops, present river transportation safety, fauna and flora, pollution etc whatever affected.

Baseline presentation, impact prediction and migration measures planning

This is to clarify the present environmental and social conditions of the Project sites, together before the construction be started, for the purpose to estimate the changes of environmental and social conditions by the implementation of the project. Then, to minimize impacts, mitigation measures shall be established. Table 6.2 summarizes indicators for to present the baseline information and the indicators predicted. Mitigation measures are planned to reduce the degree of impact predicted.

Table 6.4 Study items and methods

No.	Item	Baseline description based on	Study methods
1	Involuntary resettlement	- No of household and shops a the site	- Counting number of APs physically or economical whichever and their loss - Compensations/ assistances necessary
2	Local economics, such as employment, livelihood, etc.	- Economic activities (shop, fishery, agriculture, laboring work) as may be lost	- Income loss

No.	Item	Baseline description based on	Study methods
3	Land use and utilization of local resources	- Areas of agricultural land, plantation plot, sand stocking pile area as may be affected	- Change of land use during construction and after operation
4	Social institutions such as social infrastructure and local decision-making institutions	- Location from the NH-1 of public facilities such as school, mosque as may be affected	- Change of situation of public facilities such as school, mosque as may be affected
5	Existing social infrastructures and services	- Situation of ferry terminal etc as may be affected	- Change of situation of ferry terminal etc as may be affected
6	Poor, indigenous, or ethnic people	- Number of poor, indigenous and ethnic minority families	- Number of poor, indigenous and ethnic minority families in the APs
7	Misdistribution of benefits and damages	- Number of cases of misdistribution	- Increase of number of cases of misdistribution
8	Local conflicts of interest	- Number of cases of local conflict	- Increase of number of cases of local conflict
9	Cultural heritage	- Confirmation of cultural heritages nearby located if any - Distribution of heritages in the district	- No impact since there is no heritage as may be affected.
10	Accident	- Traffic volume (yearly) and number of traffic accidents	- Increase of number of traffic accidents - Generation of construction accident
11	Infectious diseases such as HIV/AIDS	- Number of HIV patients in the upazila/district - General situation of HIV in Bangladesh	- Possibility of increase of HIV patient
12	Gender	- Gender issues	- Enlargement of gender gap such as wage discrimination between man and woman
13	Children's rights	- Situation of children's labor in Bangladesh	- Exploit of children at the site as construction workers
14	Erosion and scouring	- Bank erosion - River bottom scouring	- Intensification of bank erosion and river bottom scouring
15	River transportation	- Types and volume of passing vessels	- Accidents of vessels
16	Hydrology	- Water level - Discharge - Velocity	- Increase of water level, velocity or change of flow direction
17	Biota and Ecosystem	- Important species -	- Possibility of threat to important species
18	Global Warming	- Emission of CO2 -	- Increased amount of emission of CO2
19	Air Pollution	- NO2, SO2 and SPM as Bangladesh standard, and PM10 and PM2.5 as world wide concerns sampled along the roadside	- Increase of pollutants emitted
20	Water Contamination	- Basic index (pH, DO), Turbidity, Eutrophication (BOD, COD, NH4), Sanitary (Coliform), Industrial effluent (oil and grease), sampled up and down streams during dry (low water) and wet (high water) seasons	- Increase of pollutants in effluence
21	Soil Pollution	- Heavy metals on the land where contamination is suspect	- Possibility of soil pollution during construction
22	Waste	- Present sanitary conditions	- Possibility of waste dumping during construction

No.	Item	Baseline description based on	Study methods
23	Noise and Vibration	- Noise at roadsides (10m away from car lane) where the houses is located for 24 hours	- Possibility of increase of noise
24	Ground Subsidence	- Presence of soft deposit	- Possibility of long term ground subsidence
25	Odor	- Present situation	- Possibility of increase of offensive odor especially during construction
26	Bottom Sediment	- Heavy metals sampled from river bed where vessels are being moored and contamination can be expected	- Possibility of contamination of bottom sediment
27	Landscape	- Opinion about the views	- Opinion about the views

Public Participation

Public participation includes:

- Socioeconomic survey
Socioeconomic survey is held including, usually 50-100% of directly affected (relocated) people and 20% of indirectly affected people around the site in the minimum. Livelihood, life level, income, martial status, education level etc are inquired door to door.
- Group discussion
Group discussion involves 8-10 participants at most to discuss about common issues among the “focus group” invited at the meeting. Focus groups cover vulnerable people (poor, landless, old and disabled), fishermen, sand loading/unloading labors etc.
- Stakeholders’ meeting
This is held two times(the phase of scoping and of draft report) for all stakeholders including affected people, project implementation agencies, environmental protection organization, local governors, universities, donors, mass media etc. The purposes are:
 - (1) Dissemination of project information
 - (2) Presentation of environmental impacts and mitigation measures
 - (3) Opinion, comment and recommendation collection