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ROADS & HIGHWAYS DEPARTMENT (RHD), ROADS DIVISION

MINISTRY OF COMMUNICATION (MOC), PEOPLE'S REPUBLIC OF BANGLADESH

PREPARATORY SURVEY FOR DHAKA-CHITTAGONG NATIONAL HIGHWAY NO.1 BRIDGE CONSTRUCTION AND REHABILITATION PROJECT

DRAFT FINAL REPORT

OF

ENVIRONMENTAL IMPACT ASSESSMENT

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＊PIU Officers who concurrently serve in charge of Resettlement & EMP will be conveniently and collectively called as "resettlement unit (RU) in this Report

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LIST OF ABBREVIATIONS

AADT	Annual Average Daily Traffic
ACE	Additional Chief Engineer
APD	Additional Project Director
ADB	Asian Development Bank
BRTA	Bangladesh Road Transport Authority
BMD	Bangladesh Meteorological Department
BWDB	Bangladesh Water Development Board
BNBC	Bangladesh National Building Code
BOD_5	Biochemical Oxygen Demand
CITES	Convention on International Trade in Endangered Species
COD	Chemical Oxygen Demand
DoE	Department of Environment
DPHE	Department of Public Health Engineering
dB	Decibel
DO	Dissolved Oxygen
EIA	Environmental Impact Assessment
ECC	Environmental Clearance Certificate
ECA	Ecologically Critical Areas
EMP	Environmental Management Plan
EC	Electric Conductivity
FAP	Flood Action Plan
FGD	Focus Group Discussion
GOB	Government of Bangladesh
GOJ	Government of Japan
HIV	Human Immunodeficiency Virus
HSMP	Health Safety Management Plan
IEE	Initial Environmental Examination
IUCN	International Union for Conservation of Nature
IARC	International Agency for Research on Cancer
JICA	Japan International Cooperation Agency
MOEF	Ministry of Environment and Forest
NEMAP	National Environmental Management Action Plan
NOx	Oxides of Nitrogen
OP	Operational Policy
ODA	Oversees Development Agency
PD	Project Director
PRA	Participatory Rapid Appraisal
Pb	Lead
PWD	Public Works Datum
PM	Particulate Matter
RAP	Resettlement Action Plan
RHD	Roads and Highways Department
SEC	Social Environment Circle
SPM	Suspended Particulate Matter
SO_2	Sulphur di Oxide
STI	Sexually Transmitted Infection
TSS	Total Suspended Solids
TDS	Total Dissolved Solids
WB	World Bank
WARPO	Water Resource Planning Organization
WQS	Water Quality Standards
WHO	World Health Organization

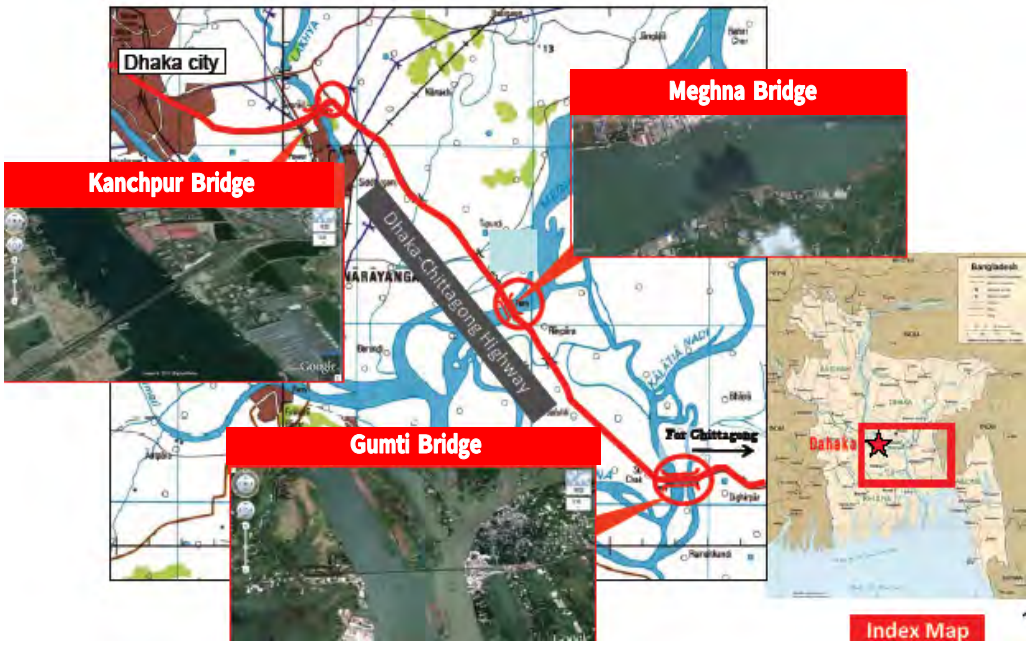
Executive Summary

Introduction

The Government of Bangladesh (GoB) has undertaken a project to construct three bridges on NH-1 (Dhaka-Chittagong Road) i.e. Kanchpur, Meghna and Gumti including rehabilitation of the existing bridges through the Roads and Highways Department (RHD) under the Ministry of Communications (MOC) with financial assistance from the Japan International Cooperation Agency (JICA). The project involves construction of new bridges parallel to the existing bridges with embankment and surrounding facilities. The length of the bridges are Kanchpur Bridge 400 m, Meghna Bridge 930 m and Gumti Bridge 1,410 m respectively. The overall objective of the Project is to mitigate the increasing traffic demand of National Highway No.1 (NH-1), which can be made by;

i. Construction of new 2nd Kanchpur Bridge, 2nd Meghna Bridge and 2nd Gumti Bridge together with approach road respectively.
ii. Rehabilitation of existing Kanchpur Bridge, Meghna Bridge and Gumti Bridge

The general description of those three bridges are as follow:



Locations of 3 bridges

The outline of project is summarized as:

		Kanchpur Bridge	Meghna Bridge	Gumti Bridge
Construction of new bridge	Length m	396.5	930	1,410
	Width m	18.4	17.75	17.75
	Navigation clearance m	Horizontal: 61m Vertical: 12.2m	Horizontal: 75m Vertical: 18m	Horizontal: 75m Vertical: 7.5m
Rehabilitation of existing bridges	Length m	396.5	930	1,410
	Width m	14.64	9.2	9.2
	Navigation clearance m	width: 61m height: 12.2m	width: 75m height: 18m	width: 75m height: 7.5m
Pier	Number	5 pier	11 pier	16 pier
	Foundation type	Steel pipe sheet	Steel pipe sheet	Steel pipe sheet

		pile	pile	pile
	Foundation width m	31.3m x 8.5m	32.44m x 14.97m	29.95m x 13.73m
	Maximum pile depth m	33m	42m	70m
Access to bridge	Length m	300m in Dhaka side and 300m in Chittagong side	500m in Dhaka side and 500m in Chittagong side	700m in Dhaka side and 300m in Chittagong side
	Maximum thickness of embankment m	7m in Dhaka side and 12m in Chittagong side	10m in Dhaka side and 9m in Chittagong side	7m in Dhaka side and 6m in Chittagong side

Area and material necessary are shown :

		Kanchpur Bridge	Meghna Bridge	Gumti Bridge	Total
Land to be used (all land in inside RHD land)	Road and Road m2	31,000	39,000	39,000	109,000
	Construction yard m2	3,000	25,000	22,000	50,000
	Temporary road m2	9,000	10,000	9,000	28,000
	Total area m2	43,000	74,000	70,000	187,000
Construction material used	Soil m3	47,000	39,200	32,800	119,000
	Sand ton	17,300	37,400	43,200	97,900
	Crushed stone ton	13,100	30,900	34,500	78,500
	Cement /ton	3,300	9,800	10,000	23,100
	Re-bar ton	1,100	3,300	3,400	78,000
	Steel ton	8,900	29,500	56,600	95,000
Manpower and equipment (tentative)	Manpower People/month	8,000	30,000	55,000	93,000
	Trucks No. x day	Trucks:1,000 Concrete mixing car: 1,900	Trucks:2,700 Concrete mixing car: 4,600	Trucks:5,100 Concrete mixing car: 5,600	Trucks:8,800 Concrete mixing car: 12,100
Waste to be generated	Type and amount m3	4,000	4,000	8,000	16,000

Construction schedule is tentatively proposed as:

Construction schedule is as follows	Kanchpur	Meghna	Gumti
Start of construction	July 2014	July 2014	July 2014
End of construction	December 2016	June 2017	June 2017
Start of rehabilitation	January 2017	July 2017	July 2017
End of rehabilitation	June 2019	June 2019	June 2019

Legal and institutional frameworks of Environmental Impact Assessment

In accordance with Bangladesh laws, the project is classified as "red category" (equivalent to Category A in international donors' safeguard guidelines). This means that full-scale Environmental Impact Assessment (EIA) is required in order to obtain Environmental Clearance Certificate (ECC).

EIA shall be implemented in accordance with not only the rules of Bangladesh Government but also to JICA Guidelines for Environmental and Social Considerations (April 2010). Information disclosure at EIA shall be implemented in accordance with JICA Guidelines.

Roads and Highway Department is the implementing agency of the project while Social and Environmental Circle (SEC) under RHD and Department of Environment (DOE) under the Ministry of Environment and Forest (MoEF) are the supervising agencies for environmental protection.

Alternative analysis

The project, construction of 3 new bridges rehabilitation of 3 existing bridges, is a key importance to secure the availability of NH-1 all year round without any delay of transportation service between Dhaka and Chittagong as is the primarily national income compared to any alternatives of transportation modes and routes.

Locations of new bridges were studied in the views of feasibility such as social impact, environmental impact and cost etc and the following locations are found to be most feasible respectively:

Bridges	The most feasible route
New Kanchipur Bridge	:Downstream of the existing bridge
New Meghna Bridge	:Upstream of the existing bridge
New Gumti Bridge	:Downstream of the existing bridge

Baseline data

From natural environment point, an endangered species River Dolphin is observed when it passes Meghna and Gumti Bridges. Noise generally exceeds the environmental standards of WHO in daytime in most of the surrounding project areas whereas it comes down almost less than 70 dB in nighttime except for roadside. Meghna river is famous for changing its route very frequently. Especially around Meghna and Gumti Bridges, it seems that the stream line shows almost the same profile. Therefore, it is supposed that river shore line around Meghna and Gumti Bridges is stable with respect to morphological view point.

From social environment point, while there is no fisherman in Kanchpur Bridge site, there are more or less ten in Meghna and Gumti Bridge site respectively. From the traffic volume of NH-1, the amount of CO_2 emission in 2010 was estimated as 1,000,000 ton per year in NH-1: about 35,000 vehicles/year, and about 3% of total emitted in Bangladesh.

Initial Environmental Examination

Initial Environmental Examination was made (1) to screen, or in another word, to pick up possible environmental impacts and (2) to scope or, in another word, propose the study approach to evaluate the degree of impacts and plan mitigation measures.

Scoping was implemented for following items:

1) Involuntary resettlement
2) Local economies, such as employment, livelihood, etc.
3) Land use and utilization of local resources
4) Social institutions such as social infrastructure and local decision-making institutions
5) Existing social infrastructures and services
6) Poor, indigenous, or ethnic people
7) Misdistribution of benefits and damages
8) Local conflicts of interest
9) Cultural heritage
10) Accident
11) Infectious diseases such as HIV/AIDS
12) Gender
13) Children's rights
14) Bank erosion and scouring
15) River transportation

16) Hydrological condition
17) Fauna and flora
18) Global warming
19) Air pollution
20) Water pollution
21) Soil pollution
22) Waste
23) Noise and vibration
24) Ground subsidence
25) Offensive odor
26) Bottom sediment
27) Landscape

Study approaches, where applicable, are:

- Existing data collection
- Discussion with expert
- Site reconnaissance
- Monitoring/ sampling/ laboratory analysis
- Numerical analysis

Prediction of impact
On these 27 items, baseline survey, project impact prediction and, if impact is considered either negligible or severe, environmental management planning including monitoring plan was established as bellow.

Summary of EMP (Before Construction)

Environmental Impact/Issue	Severity of Adverse Impacts	Mitigation Measures
SOCIAL ENVIRONMENT		
1) Involuntary Resettlement	Severe: Households and people are influenced	• Proper resettlement action Plan (RAP) • Provide adequate compensation in time to PAPs
2) Local Economies such as employment, livelihood etc.	Severe: Shop owners, employees, cultivators, properties and plantation owners are influenced	• All direct income loss must be adequately compensated within the RAP • Income loss can be mitigated by providing alternative job opportunities for PAPs.
3) Land use and utilization of local resources	Moderate: Plantation area and an aqua culturing household are affected	• Plantation area which will be tentatively occupied during construction, will be restored to original state and returned to the land owner after construction
4) Social institutions such as social infrastructures and decision-making institutions	Moderate: Social institutions are affected by relocation	• Proper resettlement action Plan (RAP) • Provide adequate compensation in time to PAPs
6) Poor, indigenous people or ethnic minority	Severe: Livelihood of poor or female headed households are affected	• Prepare RAP involving the following measures - Define the displaced persons and criteria for determining their eligibility for compensation - Establish external monitoring committee consists of the third party • For poor people, proponent activities improving surface water condition and making groundwater available shall be implemented
7) Maldistribution of benefits and damages	Severe: Displaced people may be suffered at all bridge sites	• Prepare RAP involving the following measures - Assessed compensation will base on the market price - Payment will be carried out before resettlement • Establish external monitoring committee consists of the third party
8) Local conflicts of interest	Moderate: candidates of construction workers may have some conflicts between communities	• Clear information about the needs of labor (number and qualification) should be provided with local people. • The job skills and the priority for the affected people shall be taken into account and the workers can be chosen..

RHD- Road & Highways Department, NGO-Non Government Organization, DoE- Department of Environment, PAP- Project Affected Person

Summary of EMP (During Construction)

Environmental Impact/Issue	Severity of Adverse Impacts	Mitigation Measures
SOCIAL ENVIRONMENT		
1) Involuntary Resettlement	Severe: Households and people are influenced	• Proper resettlement action Plan (RAP) • Provide adequate compensation and assistance in time to PAPs
2) Local Economies such as employment, livelihood etc.	Severe: Shop owners, employees, cultivators, properties and plantation owners are influenced	• All direct income loss must be adequately compensated within the RAP • Income loss can be mitigated by providing alternative job opportunities for PAPs.
3) Land use and utilization of local resources	Moderate: Plantation area and an aqua culturing household are affected	• Plantation area and part of fish pond which will be tentatively occupied during construction, will be restored to original state and returned to the land owner after construction

4) Social institutions such as social infrastructures and decision-making institutions	Moderate: Social institutions are affected by relocation and noise	• Proper resettlement action Plan (RAP) • Provide adequate compensation in time to PAPs • Periodical maintenance of construction vehicles • Installation of sound insulation
5) Existing social infrastructures and Services	Moderate: Social service utilities are located underground in the affected area	• Proper detailed design is going to be done and the utilities line will be diverted before starting the construction activity.
6) Poor, indigenous people or ethnic minority	Severe: Livelihood of poor or female headed households are affected	• Prepare RAP involving the following measures - Define the displaced persons and criteria for determining their eligibility for compensation - Establish external monitoring committee consists of the third party • For poor people, proponent activities improving surface water condition, making groundwater available and enhancing their job skill shall be implemented
7) Maldistribution of benefits and damages	Severe: Displaced people may be suffered at all bridge sites	• Prepare RAP involving the following measures - Assessed compensation will base on the market price - Payment will be carried out before resettlement • Establish external monitoring committee consists of the third party
8) Local conflicts of interest	Moderate: candidates of construction workers may have some conflicts between communities	• Clear information about the needs of labor (number and qualification) should be provided with local people. • The job skills and the priority for the affected people shall be taken into account and the workers can be chosen..
10) Accident	Moderate: Construction workers can have harmful and critical troubles	• Follow Health and Safety Management Plan (HSMP) rules and regulations designated by contractors
11) HIV/AIDS-	Moderate: Transmission of disease by inflow of migrant workers	• An HIV-AIDS awareness campaign via approved service provider shall be implemented
12) Gender	Moderate: Salary gap between genders	• Monitoring of payment to workers by the contractor shall be implemented not to allow payment gaps between male and female.
13) Children's right	Moderate: A bunch of children come and work in construction site	• Regular monitoring of sites to guide contactors and their related firms to discourage child labor. • When the child labor will be detected, necessary and decisive actions to the violating firms are implemented. Some assistance for parents of working child
15) River Transportation	Moderate: Congestion of vessels generates any collision	• -Provision of illumination night time around anchorages
NATURAL AND ECOLOGICAL ENVIRONMENT		
17) Fauna and flora	Moderate: Wildlife including River Dolphin is affected by the construction using steel piles	• Any illegal discharge of waste water, leaked oil shall be prohibited • Construction development area shall be fixed, not to develop or cut trees out of project area • Monitor to both upstream and downstream side will be conducted from the bridge surface • If dolphin is observed around project site, piling works and vessels should keep being suspended until the dolphin passes over. • Night lightning in construction should be restricted to the construction site.
ENVIROMNTAL POLLUTION		

19) Air Pollution	Moderate: Dust rising from unpaved road and others during construction	• Good maintenance and operation of equipment and vehicles • Use environmentally-friendly material • Spraying water to suppress the dust rising • Cover entire load with tarpaulin to prevent the load from being blown. • Good maintenance of material • Monitoring and regular meeting for air quality
20) Water Pollution	Moderate: Pile drivin, mud water from earthwork, domestic waster liquid from worker's camp, and oil leaking from construction vessel	• Generated construction sludge by pile driving, concrete plant and asphalt plant is treated by silt basin and remaining sludge is disposed at designated dumping site • Impermeable wall shall be used with cast-in-place pile • Turbid water from earthwork area is treated in silt basin for satisfying water quality standard and drain away to the nearest drainage or river • Domestic water is treated by septic tank for satisfying water quality standard and drain away to the nearest drainage or river. • Water quality including contents of arsenic will be checked before using groundwater as potable water for construction workers. • Waste oil shall be stored without leaking before legal disposal process. • Refueling place to equipment/ vehicles shall be concreted floor • Fuel and oil shall be stored at concrete floored tank surrounded with concrete fence • Equipment and vehicles are properly maintained not to cause leaking of fuel onto ground surface. Inspection sheet of maintenance record shall be submitted regularly • Batteries containing liquid inside shall be kept on impervious place to prevent battery liquid that contains hazardous heavy metals leaks and percolate into subground • To be on the safe side, study on groundwater will be implemented by the consultant during detailed design stage in order not to cause adverse impact on surrounding wells.
21) Soil pollution	Moderate: leakage of oil, and borrow can contaminate soil	• Disposal at designated dumping site • Soil quality Testing • Disposal of waste oil without leakage • Refueling place having concreted floor • Preserved in the tank surrounded with concrete fence • Equipment and vehicles are properly maintained • Batteries containing liquid inside shall be kept on impervious place
22) Waste	Moderate: Generation of construction sludge and domestic waste	• Minimize volume to use silt basin before disposing • Segregate waste to minimize waste material • Disposed in designated dumping site instructed by the section handling waste • Recycled as possible with consideration of soil property.
23) Noise and Vibrations	Moderate: Noise and vibration from construction machines and vehicles	• Periodical maintenance .of construction vehicles • Installation of sound insulation cover on boundary near residential area
25) Offensive Odor	Moderate: open burning of construction waste, improper treatment of human liquid waste, exhausted smoke from heavy equipment etc	• Prohibition of open burning • Proper treatment of camp waste • Proper maintenance of heavy equipment.
26) Bottom sediment	Moderate: Waste demped into rivers can contaminate river bed	• Construction contractor will be obliged to no dumping of waste into the river

RHD- Road & Highways Department, NGO-Non Government Organization, DoE- Department of Environment, PAP- Project Affected Person

Summary of EMP (During Operation)

Environmental Impact/Issue	Severity of Adverse Impacts	Mitigation Measures
SOCIAL ENVIRONMENT		
10) Accident	Moderate: Traffic accident occurred	• Provision of traffic sings, road mark, bump, zebra mark, guard rail and pole, and curb stones etc
ENVIROMNTAL POLLUTION		
16) Hydrological condition	Severe: hydrological condition was affected by scouring	• Steel Pipe Sheet Pile (SPSP) foundation has been selected ; the size and depth of the SPSP foundation shall be designed that the riverbed scouring will not create any threatening to overall bridge stability.
23) Noise and vibration	Moderate: a forecasted value exceeds a standard one.	• Securement of buffer zone around 100m as noise decay distance (land utilization guide by RHD and local authority)

RHD- Road & Highways Department, NGO-Non Government Organization, DoE- Department of Environment, PAP- Project Affected Person

Environmental Management

Environmental management plan is presented in the previous table. The monitoring plan proposed is:

Costs for environmental management and monitoring

Component	Stage	Item	Unit	Unit Cost (BDT)	Quantity	Total Costs (BDT)
Enhancement of environment (A)						
17)Fauna and flora and 27) Landscape	During Operation	Plantation of native tree species including maintenance for three years	Nos.	500	1,800	900,000
17) Fauna and flora and 27) Landscape	During Operation	Maintenance including monitoring of survival of plants	LS	100,000	1	100,000
Enhancement of environment (A)						*1,000,000*
Environmental management cost (B)						
1) Involuntary Resettlement	Before Construction	Compensation for impact	-	(69,638,734)	-	-
	During Construction	Compensation for impact	-	ditto	-	-
2) Local Economies such as employment, livelihood etc.	Before Construction	Compensation for impact	-	ditto	-	-
	During Construction	Compensation for impact	-	ditto	-	-
3) Land use and utilization of local resources	Before Construction	Proper occupation	-	ditto	-	-
	During Construction	Proper occupation	-	ditto	-	-

4) Social institutions such as social infrastructures and decision-making institutions	Before Construction	Compensation for impact	-	ditto	-	-
	During Construction	Compensation for impact	-	ditto	-	-
5) Existing social infrastructures and services	During Construction	Construction for diversion	-	ditto	-	-
6) Poor, indigenous, or ethnic people-	Before Construction	Compensation for impact Activities improving surface water condition, making groundwater available and enhancing their job skill	-	ditto	-	-
	During Construction	Compensation for impact Activities improving surface water condition, making groundwater available and enhancing their job skill	-	ditto	-	-
7) Maldistribution of benefits and damages	Before Construction	Compensation for impact	-	ditto	-	-
	During Construction	Compensation for impact.	-	ditto	-	-
8) Local conflicts of interest	Before Construction	Compensation for impact	-	ditto	-	-
	During Construction	Compensation for impact	-	ditto	-	-
10) Accident	During Construction	Ensuring that HSMP works right on the track	-	Included in construction cost	-	-
	During Operation	Installing traffic signs, road mark, bump, zebra mark, guard rail and pole, and curb stones etc	-	Included in construction cost	-	-
11) HIV/AIDS	During Construction	HIV campaign	Times	30	100,000	3,000,000
12) Gender	During Construction	Monitoring of the gaps between male and female	-	Included in RAP cost	-	-
13) Children's right	During Construction	Prevention activities to inhibit children's labor	-	ditto	-	-
15) River Transport	During Construction	Watch boat, watch man, sign boards etc	-	Included in construction cost	-	-
16) Hydrological condition	During Operation	Inspection of river bottom condition for scouring	-		-	-
17) Fauna and flora	During Construction	Restoration of construction development area	-	Included in construction cost	-	-
19) Air pollution	During Construction	Implement dust suppress plan and routine mitigation measure shall be taken to emitting equipments.	-	Included in construction cost	-	-
	During Operation	Inspection of road side air condition	-	Included in Monitoring cost	-	-
20) Water pollution	During Construction	Installation of silt basin and septic tank. Proper maintenance of equipment and vehicles. Removal of arsenic.	-	Included in construction cost	-	-

	During Operation	Inspection of river surface water condition	-	Included in Monitoring cost	-	-
21) Soil pollution	During Construction	Disposal at designated dumping site. Proper maintenance of equipment and vehicles.	-	Included in construction cost	-	-
	During Operation	Inspection of soil condition	-	Included in Monitoring cost	-	-
22) Waste	During Construction	Collection, transportation and dumping of waste at authorized dumping sites. Minimization of volume and recycling.	-	Included in construction cost	-	-
23) Noise and Vibration	During Construction	Periodical maintenance of construction vehicles and installation of sound insulation cover	-	Included in construction cost	-	-
	During Operation	Securement of buffer zone around 100m as noise decay distance	-	Included in Monitoring cost	-	-
25) Offensive odor	During Construction	Proper treatment of camp waste Proper maintenance of heavy equipment.	-	Included in construction cost	-	-
26) Bottom sediment	During Construction	Proper treatment in order to prevent waste from being dumped into the river.	-	Included in construction cost	-	-
27)Lnadscape	Before and During Construction	Inspection of landscape from vessel mooring station	-	Included in Monitoring cost	-	-
Environmental management cost (B)						*3,000,000*
Monitoring (C)						
1) Involuntary Resettlement	Before Construction	Compensation for impact	-	Included in RAP cost	-	-
	During Construction	Compensation for impact	-	Included in RAP cost	-	-
2) Local Economies such as employment, livelihood etc.	Before Construction	Compensation for impact	-	Included in RAP cost	-	-
	During Construction	Compensation for impact	-	Included in RAP cost	-	-
3) Land use and utilization of local resources	Before Construction	Proper occupation	-	Included in RAP cost	-	-
	During Construction	Proper occupation	-	Included in RAP cost	-	-
4) Social institutions such as social infrastructures and decision-making institutions	Before Construction	Compensation for impact	-	Included in RAP cost	-	-
	During Construction	Compensation for impact	-	Included in RAP cost	-	-
5) Existing social infrastructures and Services	During Construction	Construction for diversion	-	Included in RAP cost	-	-
6) Poor, indigenous people or ethnic minority	Before Construction	Compensation for impact Direct survey in the field by interviews with the poor people in order to ensure that groundwater is available for them..	-	Included in RAP cost	-	-

	During Construction	Compensation for impact Direct survey in the field by interviews with the poor people in order to ensure that groundwater is available for them..	-	Included in RAP cost	-	-
7) Maldistribution of benefits and damages	Before Construction	Compensation for impact	-	Included in RAP cost	-	-
	During Construction	Compensation for impact	-	Included in RAP cost	-	-
8) Local conflicts of interest	Before Construction	Direct survey in the field by interviews with the locals in order to ensure that local people, especially PAPs, are satisfied with their jobs.	-	Included in RAP cost	-	-
	During Construction	Direct survey in the field by interviews with the locals in order to ensure that local people, especially PAPs, are satisfied with their jobs.	-	Included in RAP cost	-	-
10) Accident	During Construction	Ensuring that HSMP works right on the track	-	Included in the construction cost	-	-
	During Operation	Installing traffic signs, road mark, bump, zebra mark, guard rail and pole, and curb stones etc	-	Included in the construction cost	-	-
11) HIV/AIDS	During Construction	Ensuring that contractor's personnel and local community understand HIV-AIDS awareness campaign	-	Included in the EMP cost	-	-
12) Gender	During Construction	Direct survey in the field by interviews with the women in order to ensure that there is no any gaps between man and women.	-	Included in the construction cost	-	-
13) Children's right	During Construction	Visual inspection, of children's laborer	-	Included in the construction cost	-	-
15) River Transport	During Construction	Giving adequate illumination	-	Included in the construction cost	-	-
16) Hydrological condition	During Operation	Inspection of river bottom condition for scouring	-	Included in the construction cost	-	-
17) Fauna and flora	During Construction	Restoration of construction development area and Counting the number of River Dolphin	-	Included in the construction cost	-	-
19) Air pollution	During Construction	Measurement of SPM, NOx, SO2, CO and inspection of brick, bitumen and cement facilities (spot check)	Set	33	75,000	2,475,000
	During Operation	Measurement of SPM,NOx,SO2,CO	Set	3	750,000	2,250,000
20) Water Pollution	During Construction	Measurement of pH, EC, Turbidity, DO, Coliform, BOD, NH4-N, Oil, Grease, fecal coliform,	Set	33	10,000	330,000

		Fe, and As				
	During Operation	Measurement of pH, EC, Turbidity, DO, Coliform, BOD, NH4-N, Oil, Grease, fecal coliform, Fe, and As	Set	6	10,000	60,000
21) Soil pollution	During Construction	Visual inspection, or measurement of Cd, Pb, As, oil, grease and so forth	-	Included in the construction cost	-	-
	During Operation	Visual inspection, or measurement of Cd, Pb, As, oil, grease and so forth	Set	6	50,000	300,000
22) Waste	During Construction	Inspection of waste disposal sites and construction camps	-	Included in the construction cost	-	-
23) Noise	During Construction	Visual inspection to ensure that good standard equipment is in use and sound insulation cover is installed.	Set	15	20,000	300,000
	During Operation	Measurement of noise dB(A)	Set	3	20,000	60,000
25) Offensive odor	During Construction	Odor inspection to ensure harmful odor is not released from equipments and waste	-	Included in the construction cost	-	-
26) Bottom sediment	During Construction	Bottom sampling of Cd, Pb, As, oil, grease and so forth	-	Included in the construction cost	-	-
27)Landscape	Before and During Construction	Vessel mooring station for 2 times at 3 sites	Set	6	50,000	300,000
Monitoring Costs (C)						*6,075,000*
Environmental training (D)						
Environmental Training	During Operation	Orientation Workshop and follow up training program for capacity building/ institutional development programme of SEC	LS	1	1,000,000	1,000,000
Environmental Training Costs (D)						*1,000,000*
Total (A+B+C+D)						11,075,000
Contingency @ 10%						1,107,500
Grand Total						12,182,500

Public participation

Three stakeholder meetings were held: (1) the 1st stakeholders' meeting for TOR discussion in 15th March 2012、 (2) the 2nd stakeholders' meeting for supplementary to the 1st public consultations regarding RAP and EIA draft in 1st August 2012 and (3) the 3rd stakeholders' meeting for supplementary to the 2nd public consultations regarding RAP and EIA draft in 1st September 2012.

CHAPTER 1. INTRODUCTION

1.1 Project Background

The National Highway No.1 (NH-1), namely, Dhaka-Chittagong Highway, is the lifeline for economy of Bangladesh with a capacity of 25,000 Passenger Car Unit (PCU) per day on 2-lane section and 60,000 PCU per day on 4-lane section. The NH-1 will be a part of the Asian Highway that connects with neighboring countries. On this highway, existing Kanchpur, Meghna and Gumti Bridges are major structures, which are the only way to cross Shitalakshya, Meghna and Gumti rivers. But, these bridges, constructed in the year of 1977, 1991 and 1995, respectively, are being deteriorated for several years. Consequently, they need urgent rehabilitations. In addition, the existing bridges were designed and constructed according to the outdated design standard. Therefore, these existing bridges may necessitate seismic retrofitting to withstand earthquake excitations in accordance with current codes.

According to the traffic survey conducted in this study (conducted in February and March, 2012), the NH-1 almost exceeded its traffic volume capacity to 78,000 PCU counted on Kanchpur Bridge and 73,300 PCU on Meghna and Gumti Bridges. Recently, the Government of Bangladesh has decided to widen the NH-1 into 4 lanes in order to mitigate excess traffic volume and remove traffic bottlenecks. But, these existing 2-lane bridges are becoming a critical bottleneck for traffic movement through the NH-1. It is obvious the existing 2-lane bridges will fail to cope with increased traffic volume of the NH-1 and cause serious traffic congestion. Therefore, the construction of new 2nd Kanchpur, 2nd Meghna and 2nd Gumti Bridges are becoming an essential issue.

1.2 Scope of the EIA

The EIA report was prepared on the basis of proposed engineering works, field investigations, stakeholder consultation, primary and secondary data collection, screening of all baseline environmental parameters, environmental quality baseline monitoring, and review of other similar project reports in Bangladesh. The study was taken up during March – August, 2012. The EIA covers the general environmental profile of the Project area including physical, ecological, environmental, social, cultural and economic resources. Baseline environmental monitoring was carried out on water (surface and ground), air, noise, soil and sediment quality measurements. The EIA includes an overview of the potential environmental impacts and their severity, and proposes necessary mitigation measures and environmental management plan for each of the identified impacts. Two rounds of public consultations were conducted as part of the EIA.

The EIA report in its present format as per the TOR (Annex-1) and specified terms and conditions in the DoE letter no. DoE/Clearance/5150/2012/31 7/2002/900 dated 23/05/2012 (Annex-1), has been prepared for obtaining the Environmental Clearance Certificate (ECC) from the Government of Bangladesh (GOB).

1.3 Methodology

The methodology used for this study is based on the procedures described in Environmental Guidelines, (Volume 1) published by RHD and the other relevant regulation of Bangladesh as well as “JICA Guidelines for Environmental and Social Considerations” (April 2010).

Methodology adopted for completion of the EIA study of bridges is as follows:

- Scoping workshop organisation with various stake holders at the beginning of the Project preparation activities;
- Reconnaissance survey was taken up to collect baseline information in devised formats;
- Analysis of collected data was carried out;
- Documentation of baseline conditions was done by doing on site environmental monitoring;
- Analysis and assessment of various alternatives was taken up;
- Identification and assessment of various impacts was done;
- Formulation of mitigation, and avoidance measures was done for identified impacts;
- Community consultations were carried out;

- Preparation of standalone environmental management plans (EMPs), for both the bridges, has been done.

1.4 Organization of the Report

The remaining part of this report has been organized as follows:

Chapter 2. Project Description: contains the components of the project, project location, technical features of bridges, sourcing of resources for implementation and proposed schedule of project implementation

Chapter 3. Policy, Legal, and Administrative Framework: explains the present legal and institutional frameworks of Bangladesh related environment and their challenges

Chapter 4. Baseline Environmental Condition: Explains the general description and background of physical resources, ecological resources, environmental quality baseline, social and cultural profile, and economic activities

Chapter 5. Alternative Study: examines the necessity of the project and their most feasible routes for three bridges respectively

Chapter 6. Initial Environmental Examination: describes about possible project impacts, study approach and mitigation measures presumed.

Chapter 7. Environmental Impacts: predicts the negative project influences induced by the implementation of project

Chapter 8. Environmental Management Plan: proposes feasible mitigation measures to the project impacts

Chapter 9. Public Participation: addresses the consultation, group discussion and stakeholders' meeting held

In the EIA, it is noted that the resettlement issues are discussed mainly in the separate volume "Resettlement Action Plan (RAP)" and, in the EIA, is not much mentioned.

Chapter 2. PROJECT DESCRIPTION

The overall objective of the Project is to meet the increasing traffic demand of National Road No.1 (NH-1), which can be made by

- Construction of new 2nd Kanchpur Bridge, 2nd Meghna Bridge and 2nd Gumti Bridge together with approach embankment road respectively.
- Rehabilitation existing Kanchpur Bridge, Meghna Bridge and Gumti Bridge

Location of the project is shown in Figure 2.1.

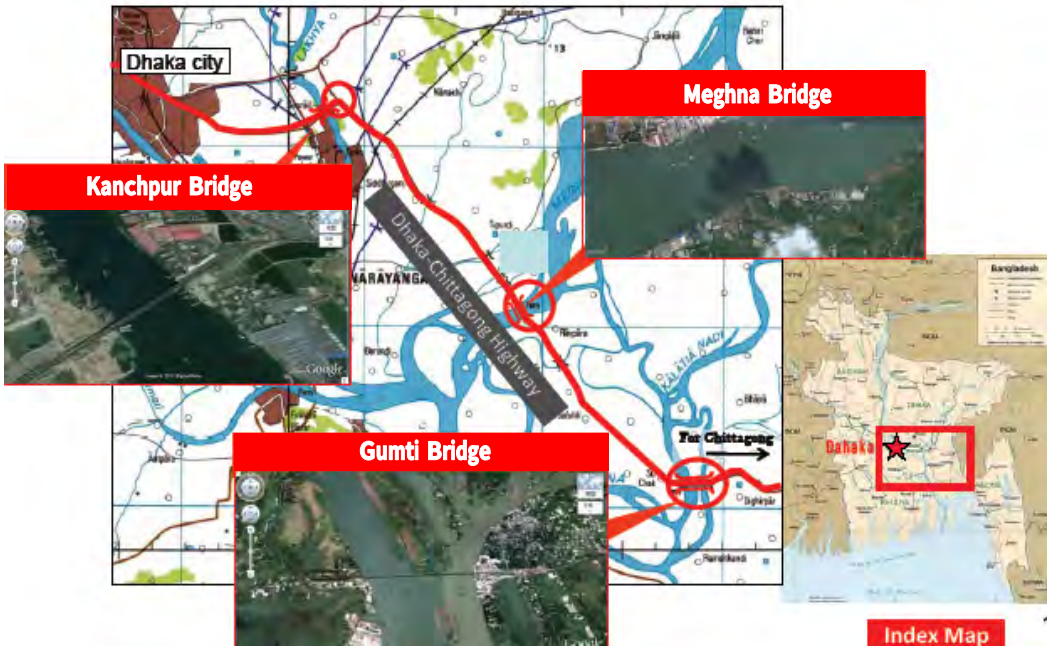


Figure2.1 Locations of the three Bridges

Figures from 2.2 to 2.7 indicate the locations of new and existing bridges together with construction yards.

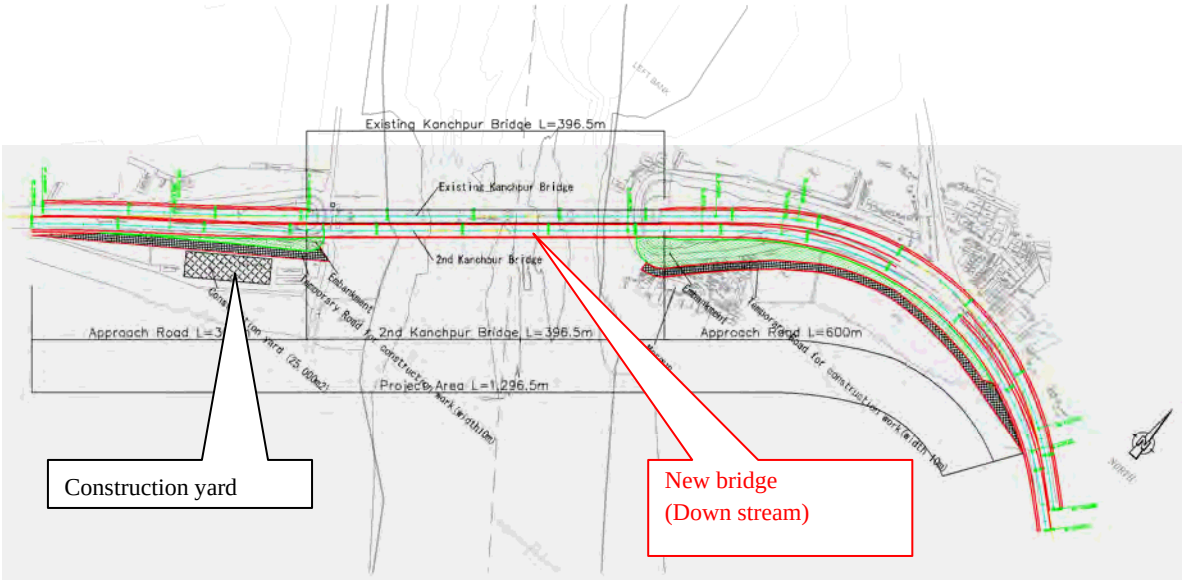


Figure 2.2 Locations of New and Existing Kanchpur Bridge with Construction Yards

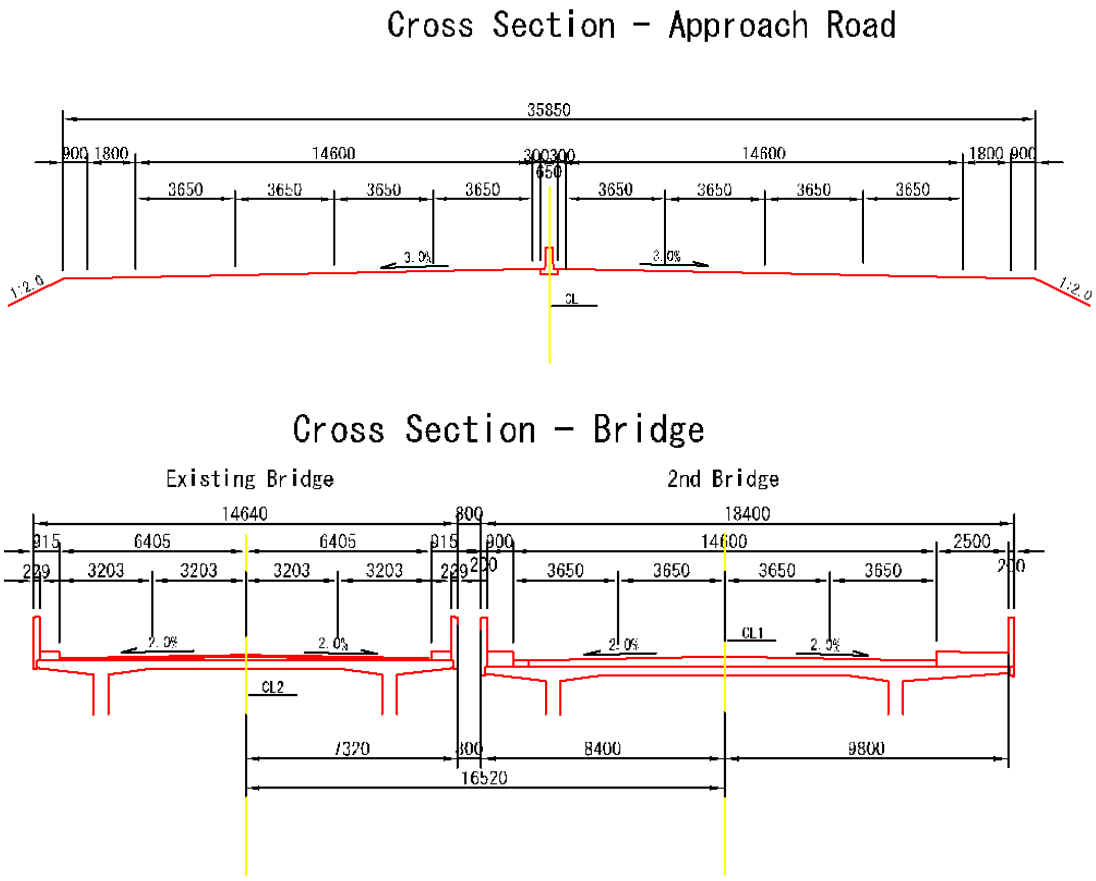


Figure 2.3 Typical Cross Sections of New and Existing Kanchpur Bridge

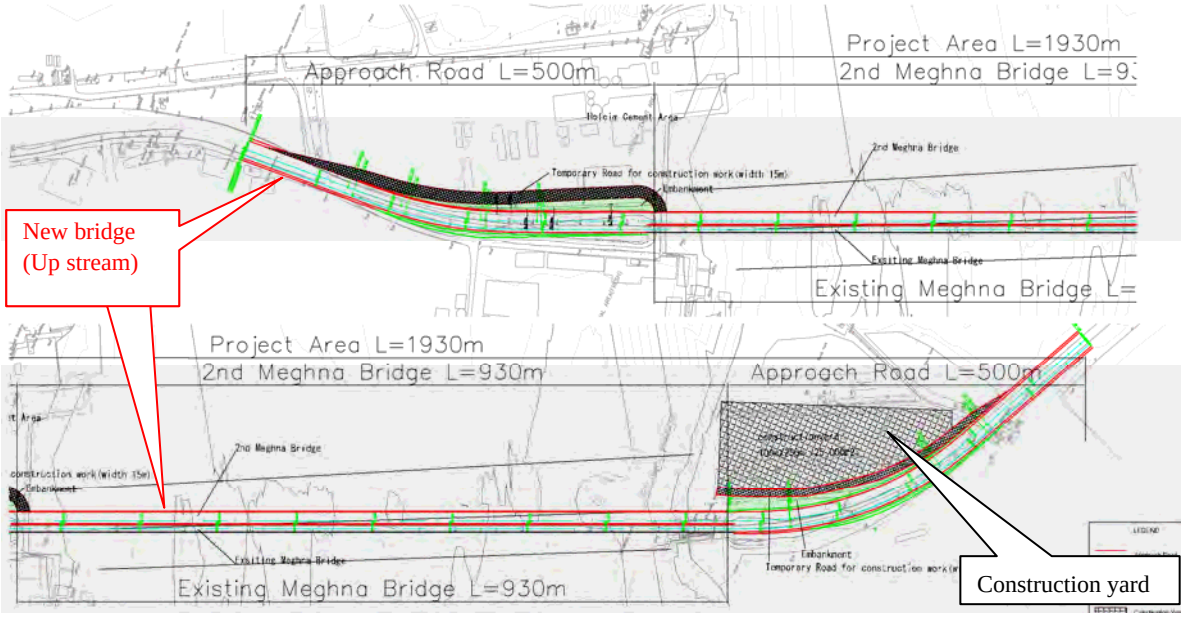


Figure 2.4 Locations of New and Existing Meghna Bridge with Construction Yards

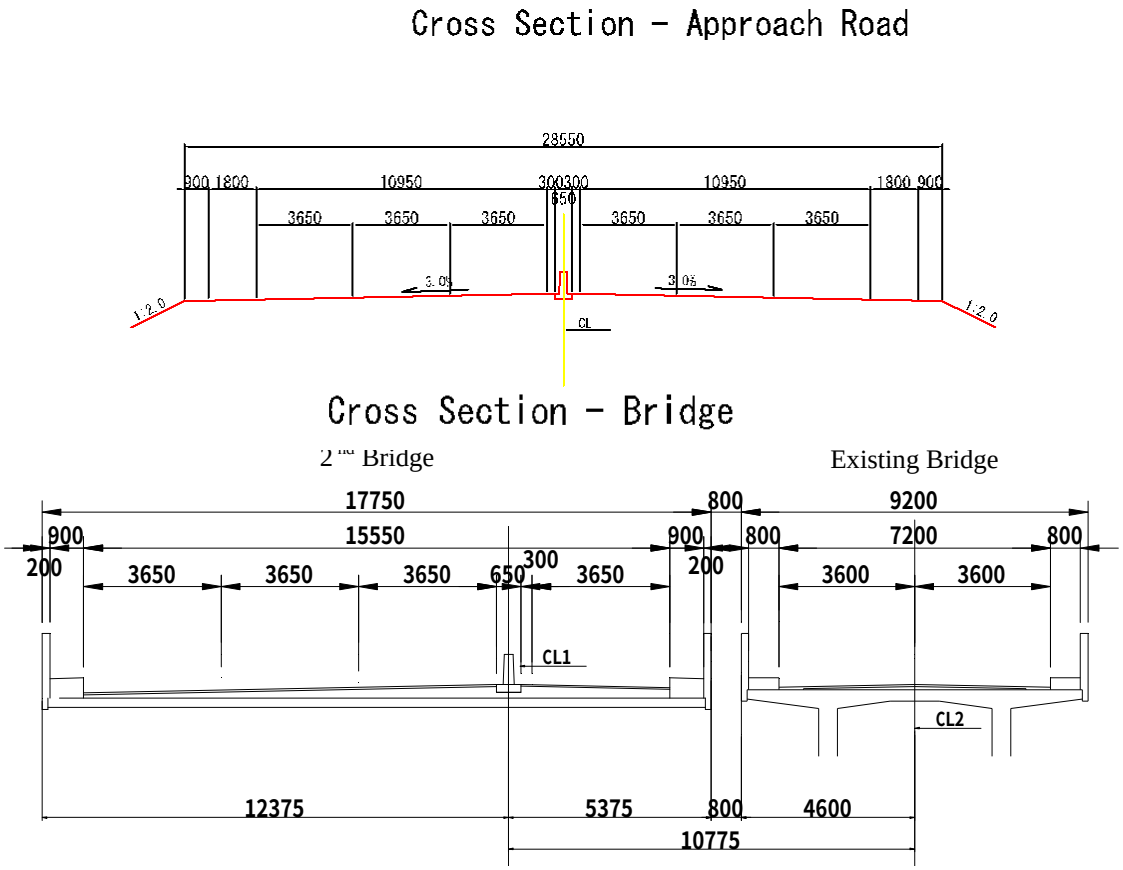


Figure 2.5 Typical Cross Section of New and Existing Meghna Bridge

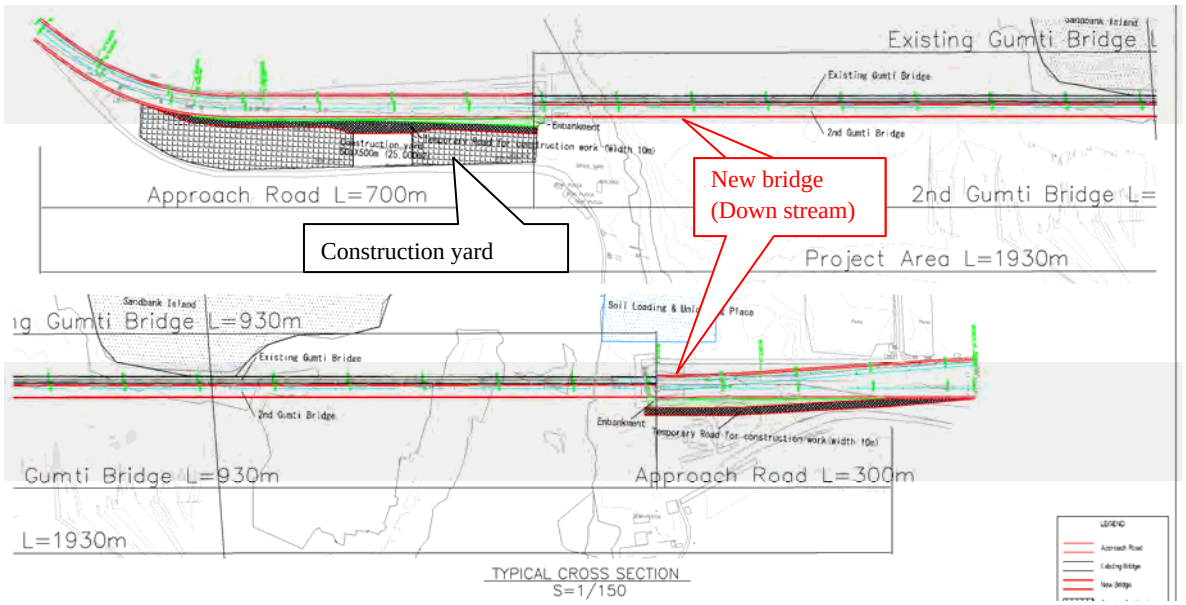


Figure 2.6 Locations of New and Existing Gumti Bridge with Construction Yards

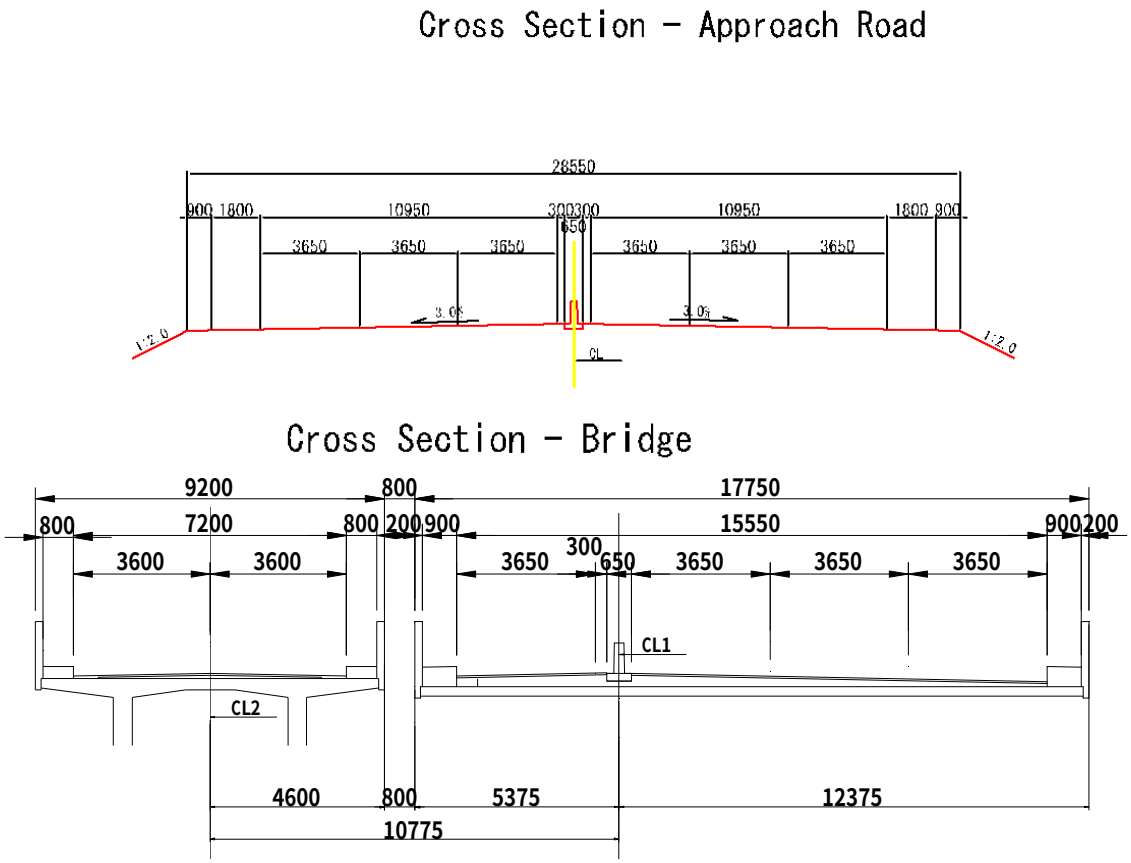


Figure 2.7 Typical Section s of New and Existing Gumti Bridge

Outline of bridges are summarized in Table 2.1.

Table 2.1 Outline of the Project

Description		Unit	Kanchpur Bridge	Meghna Bridge	Gumti Bridge
new bridges	Superstructure		Narrow box girder with weathering steel		
	Length	m	396.5	930	1,410
	Width	m	18.4	17.75	17.75
	Navigation clearance	m	width: 61 height: 12.2	width: 75 height: 18	width: 75 height: 7.5
Foundation	Number		5 pier	11 pier	16 pier
	Foundation type		Steel pipe sheet pile/ Bored pile	Steel pipe sheet pile/ Bored pile	Steel pipe sheet pile/ Bored pile
	Foundation width	m	31.3 x 8.5	32.44 x 14.97	29.95 x 13.73
	Maximum pile Length	m	33	42	70
existing bridges	Length	m	396.5	930	1,410
	Width	m	14.64	9.2	9.2
	Navigation clearance	m	width: 61 height: 12.2	width: 75 height: 18	width: 75 height: 7.5
Approach Road	Length	m	300m in Dhaka side and 300m in Chittagong side	500m in Dhaka side and 500m in Chittagong side	700m in Dhaka side and 300m in Chittagong side
	Maximum height of embankment	m	7m in Dhaka side and 12m in Chittagong side	10m in Dhaka side and 9m in Chittagong side	7m in Dhaka side and 6m in Chittagong side

Source: Study team

Construction camps are installed within the construction yards as shown in Figures 2.2, 2.4 and 2.6 respectively. All contractor camps will be provided with accommodation, office facilities, kitchen and provision for general domestic and sanitary waste disposal, equipment lay-down yard, laboratory facilities etc, and other structures and improvements found necessary. Provision for site storm drainage and erosion control will be in the form of ditches, paving of the ground surface and of perimeter drains.

Table 2.2 Material to be used and Waste to be Generated

		Unit	Kanchpur Bridge	Meghna Bridge	Gumti Bridge	Total
Land to be used (all land inside RHD land)	Approach Road	m2	31,000	39,000	39,000	109,000
	Construction yard	m2	3,000	25,000	22,000	50,000
	Temporary road	m2	9,000	10,000	9,000	28,000
	Total area	m2	43,000	74,000	70,000	187,000
Construction material used	Soil	m3	47,000	39,200	32,800	119,000
	Sand	ton	10,000	26,000	30,000	66,000
	Crushed stone	ton	9,300	24,000	28,000	61,300
	Cement	ton	2,000	6,800	7,000	15,800
	Re-bar	ton	1,000	2,700	3,600	73,000
	Steel	ton	7,000	31,000	37,000	75,000
Manpower and equipment (tentative)	Manpower	People/ month	8,000	30,000	55,000	93,000
	Trucks	number	1,000	2,700	5,100	8,800
	Concrete mixing car	number	1,900	4,600	5,600	12,100
Waste to be generated	Soil waste	m3	5,000	4,000	11,000	20,000

※embankment material, fine aggregate (sand),, and coarse aggregate (gravel) used through the project are not supposed to be taken from river and rock quarry, but to be purchased from vendors.

Source: Study team

General views comparing existing and new bridges are presented in Annex-3

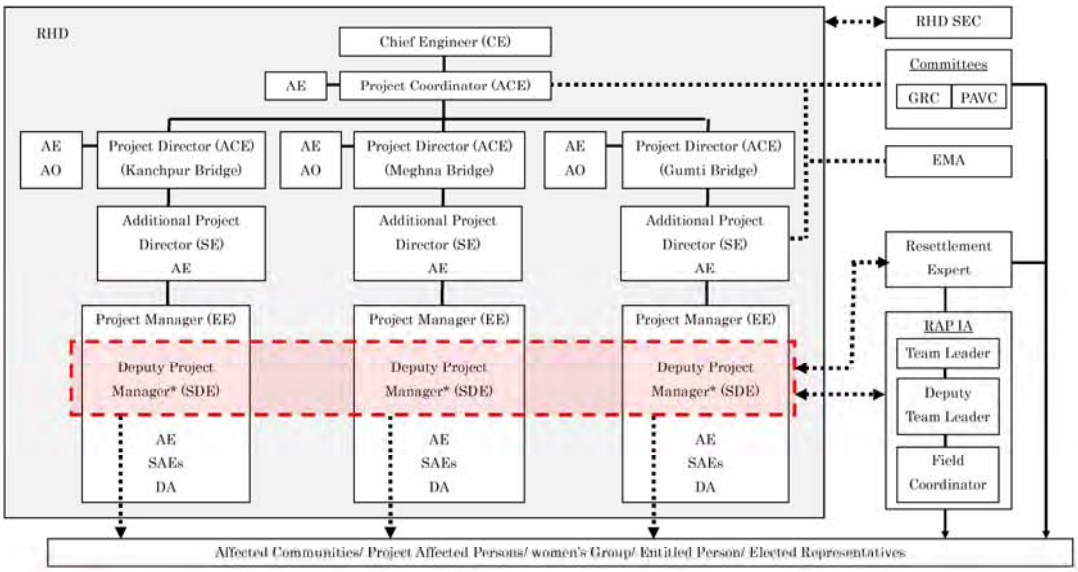
As shown above, numbers of piers are reduced for new bridges at Kanchpur while numbers of pier are same at Meghna and Gumti.

Construction schedule is presumed as follows;

Table 2.3 Construction Schedule (Tentative)

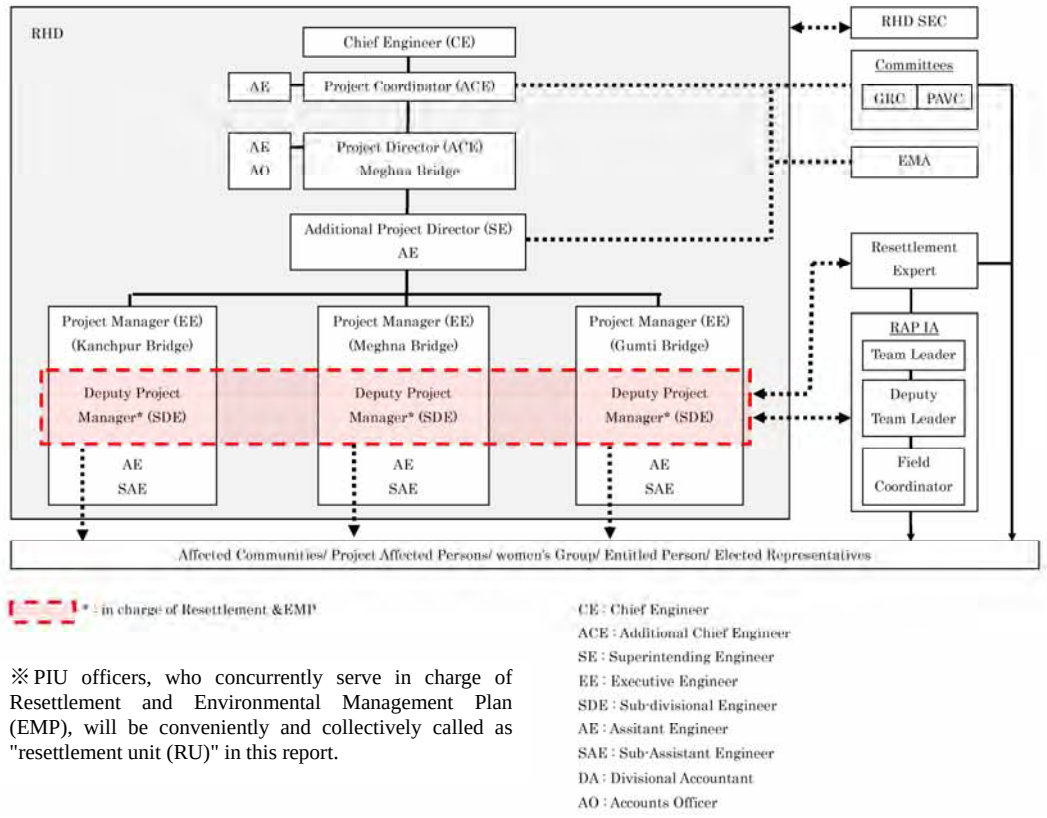
	Kanchpur Bridge	Meghna Bridge	Gumuti Bridge
Start of construction / rehabilitation	August 2016	August 2016	August 2016
End of construction	July 2019	December 2019	June 2020
End of rehabilitation	June 2020	November 2020	July 2021

Project Implementation Unit (PIU) of construction stage and of design and tender stage are shown in Figure 2.8 and 2.9 respectively.



※PIU officers, who concurrently serve in charge of Resettlement and Environmental Management Plan (EMP), will be conveniently and collectively called as "resettlement unit (RU)" in this report.

Figure 2.8 PIU of construction stage



※PIU officers, who concurrently serve in charge of Resettlement and Environmental Management Plan (EMP), will be conveniently and collectively called as "resettlement unit (RU)" in this report.

Figure 2.9 PIU of design and ternder stage

CHAPTER 3. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

Regulatory requirements toward protection and conservation of environment and various environmental resources and also toward protection of social environment from adverse impact of projects and activities associated with them have been enunciated by the Government of Bangladesh as well as financiers. Pertinent among these requirements are summarized as under.

3.1 Applicable Environmental Legislation in Bangladesh

National Environmental Policy, 1992

Bangladesh has adopted a national environmental policy in 1992 aimed at sustainable development. The policy sets out the basic framework for environmental action together with a set of broad sectoral guidelines for action. Key elements of the policy are:

- Maintaining ecological balance and ensuring sustainable development of the country through protection and conservation of the environment
- Protecting the country from natural disasters
- Identifying and regulating all activities that pollute and destroy the environment
- Ensuring environment-friendly development in all sectors
- Ensuring sustainable and environmentally sound management of the natural resources
- Maintaining active association, as far as possible, with all international initiatives related to environment.

With regard to the transport sector the environmental policy aims at prevention of pollution and degradation of resources caused by roads and inland waterways transport. The policy mentions that EIA should be conducted before projects are undertaken.

National Environment Management Action Plan (NEMAP), 1995

The National Environmental Management Action Plan (NEMAP) builds on the National Environmental Policy and was developed to address specific issues and management requirements during the period 1995-2005. The plan includes a framework within which the recommendations of a National Conservation Strategy are to be implemented. NEMAP was developed with the following objectives

- Identification of key environmental issues affecting Bangladesh
- Identification of actions necessary to halt or reduce the rate of environmental degradation

- Improvement of the natural environment
- Conservation of habitats and bio-diversity
- Promotion of sustainable development
- Improvement of the quality of life of the people

Environment Conservation Act, 1995

This Act authorizes the Department of Environment (DoE) to undertake any activity to conserve and enhance the quality of environment and to control, prevent and mitigate pollution. The department is the regulatory body and enforcement agency of all environmental related activities. The act includes amongst others addresses the following main issues:

- Declaration of Ecologically Critical Areas;
- Procedure for obtaining Environmental Clearance Certificates;
- Regulation with respect to vehicles emitting smoke harmful for the environment;
- Environmental regulations for development activities;
- Standards for quality of air, water, noise, and soils for different areas and for different purposes;
- Acceptable limits for discharging and emitting waste;
- Formulation of environmental guidelines to control and mitigate environmental pollution, conservation and improvement of environment.

Environment Conservation Rules, 1997

The Environment Conservation Rules provide a first set of rules under the Environment Conservation Act, 1995. These provide amongst others standards and guidelines for:

- Categorization of industries and development projects, including roads and bridges on the basis of actual and anticipated pollution load;
- Requirement for undertaking Initial Environmental Examination (lEE) and Environmental Impact Assessment (EIA), as well as formulating an Environmental Management Plan (EMP) according to categories of industries/development projects/activities;
- Procedure for obtaining environmental clearance;
- Environmental quality standards for air, surface water, groundwater, drinking water, industrial effluents, emissions, noise and vehicular exhausts;
- In Schedule -1, Projects/ activities are classified into four categories: Green, Orange A, Orange B and Red based on its location and impact on environment, “construction/reconstruction/expansion of bridge (length 100 meter and above)” is classified as Red in No.68.

Environmental Guidelines (Volume 1), 2004

This guideline was designed by The Roads and Highways Department (RHD) in Bangladesh and provides a broad picture of what procedures should be followed for environmental assessment and management. Also it focuses specifically on the activities and requirements of RHD and do not necessarily represent sector guidelines, and set a framework for the development of associated social guidance documents such as social and resettlement action plants. The brief composition is:

- Environmental Legislation and Institutional Procedures
- Good Environmental Practice in RHD
- Environmental Assessment of RHD Projects
- Initial Environmental Examination (IEE)
- Environmental Impact Assessment (EIA)
- The Need For and Scope of an Environmental Management Plan
- Environmental Management of Day To Day Activities

EIA Guidelines For Industry, 1997

This guideline has been prepared by DoE on the basis of the work done by various types of industry projects as well as on the requirements of the Environment Conservation Rules (1997). Owing to this, this guideline specifically covers industry projects and shows how the EIA for industry projects in Bangladesh should be implemented. The brief composition is:

- Introduction to EIA in Bangladesh
- Criteria for locating industrial plants
- Steps involved in conducting IEE
- Steps involved in conducting EIA
- Review of an EIA report

All requisite clearance from the DoE shall be obtained prior to commencement of civil work. RHD will proceed with the application for clearance in due course.

Other Relevant Legislation in Bangladesh

There are a number of other laws and regulations applicable which are relevant for the project. These are the following, see Table 3.1

Table 3.1 Other Relevant Legislations Applicable

Act/Law/Ordinance	Brief Description	Responsible Agency
Environment Court Act, 2000 and subsequent amendments in 2002	Describes environment related legal proceedings	Ministry of Environment and Forest (MOEF)
The Vehicle Act, 1927 The Motor Vehicles Ordinance, 1983	Provides rules for exhaust emission, air and noise pollution and road and traffic safety	Bangladesh Road Transport Authority (BRTA)
The Removal of Wrecks and Obstructions in inland Navigable Water Ways Rules 1973	Rules for removal for wrecks and obstructions	Bangladesh Water Transport Authority
Water Supply and Sanitation Act, 1996	Regulate the management and control of water supply and sanitation in urban areas	Ministry of Local Government, Rural Development and Cooperatives
The Ground Water Management Ordinance 1985	Describe the management of ground water resources and licensing of tube wells	Upazilla Parishad
The Forest Act, 1927 and subsequent amendments in 1982 and 1989	Regulates the protection of forests reserves, protected forests and village forests	Ministry of Environment and Forest
The Private Forests Ordinance Act, 1959	Deals with the conservation of private forests and afforestation of wastelands.	Ministry of Environment and Forest
Bangladesh Wild Life (Preservation) Act, 1974	Describes the preservation of wildlife sanctuaries, parks, reserves	Ministry of Environment and Forest
The Protection and Conservation of Fish Act 1950 subsequent amendments in 1982	Deals with the protection/ conservation of fishes in Government owned water bodies	Department of Fishery
The Embankment and Drainage Act 1952	Describes the protection of embankments and drainage facilities	Ministry of Water Resources
The Antiquities Act 1968	Describes the preservation of cultural heritage, historic monuments and protected sites.	Department of Archaeology .
The Land Acquisition Act, 1894 and The Acquisition and Requisition of Immovable Property Ordinance 1982 and subsequent amendments in 1994, 1995 and 2004	Describes procedures and provides guidelines to acquisition and requisition of land	Ministry of Land
Bangladesh Labour Law, 2006	Deals with the occupational rights and safety of factory workers; provision of comfortable work environment and reasonable working conditions	Ministry of Labo.

National Strategy for Waste Management

The strategy for solid waste management is essential in order to minimize the environmental, social and economical problems. To minimize these problems, recently the GoB has taken some initiatives and accordingly in December 2010, the Department of Environment under Ministry of Environment and Forest has formulated a national '3R' strategy for waste management in a

draft form. It is the latest strategy which will take time to implement globally. For the bridge project, the '3R' strategy shall be followed to minimize the solid waste impact on environment. The concept of this strategy is minimizing waste impacts in terms of quantity or ill-effects, by reducing the quantity of waste products with simple treatments and recycling the wastes by using it as resources to produce same or modified products. The principle of '3R' is stated as reducing waste, reusing and recycling resources and products.

- Reducing means choosing to use with items with care to reduce the amount of waste generated.
- Reusing involves the repeated use of items or parts of items which still have usable aspects
- Recycling means the use of waste itself as resources.

Waste Dumping Site Selection and Approval Process

As is said above the Nation '3R' strategy for waste management is in draft form, not implemented yet for any practical project and not becoming so familiar to users, therefore it may need some clarifications on rules regulation and how it can be practicable. In '3R' strategy, no specification is clearly mentioned on how to select the dumping site and how to get the concerned authority's approval on implementation. Therefore, to recover this gap in rules and regulation on solid waste dumping management, it may need to follow up some rules regulations which are generally followed in Bangladesh. As a general rule, the contractor shall develop a waste management plan for various specific waste streams (e.g., reusable waste, flammable waste, construction debris, soil-bentonite slurry, food waste etc.) prior to commencing of construction and submit to Executive Agency (RHD) for approval. This plan shall include the detailing of dumping site selection and how to get the local Government /authority's approval before dumping. In this regard, some guidelines for contractors on dumping site selection and how to get the concerned authority's approval are stated as below.

Dumping site selection criteria

- Ensure the selection of appropriate dumping sites which are 500 m (minimum) away from any inhabited areas
- Ensure that the sites are not located near any Marshy or low lying area
- Ensure that the Ground Water level sufficiently deep to avoid ground water contamination
- Ensure that no drinking water sources (surface or ground water) are located within 500 m radius of the facility
- Ensure that the soil is not permeable

Authority approval

The Contractor along with RHD and City/Municipal/ Pourashava authority will find out the probable land and provide suitable design for proper functioning of waste dumping site.

Bangladesh and International standards in for environment

Air Quality Standards

Bangladesh standards

The standards for the air in Bangladesh shall be determined in accordance with standards specified in Schedule-2 (Environmental Conservation Rule-1997).

Table 3.2 Standards for Air

(Density unit: $\mu g / m^3$)

Sl. No.	Categories of Area	Suspended Particulate Maters (SPM)	Sulphur-dioxide	Carbon Monoxide	Oxides Nitrogen
a.	Industrial and mixed	500	120	5000	100
b.	Commercial and mixed	400	100	5000	100
c.	Residential and rural	200	80	2000	80
d.	Sensitive	100	30	1000	30

Notes:
(1) At national level, sensitive area includes monuments, health center, hospital, archeological site, educational institution, and government designated areas.
(2) Industrial units located in areas not designated as industrial areas shall not discharge pollutants which may contribute to exceeding the standard for air surrounding the areas specified at Sl. nos. c and d above.
Suspended Particulate Matter means airborne particles of a diameter 10 micron or less.

Table 3.3 Standards for Emission from Motor vehicles

Parameter	Unit	Standard Limit
Black Smoke	Hartridge Smoke Unit (HSU)	65
Carbon Monoxide	gm/k.m. percent area	24 04
Hydrocarbon	gm/k.m. ppm	02 180
Oxides of Nitrogen	gm/k.m. ppm	02 600

International standards

Table 3.4 Ambient Air Quality Standards

Parameter	IFC/WB[1] guidelines ($\mu g / m^3$)	Bangladesh guidelines[2] ($\mu g / m^3$)
SPM	-	200 (8 hr average)
PM_{10}	150 (24 hour average)	50 (Annual average) 150 (24 hour average)
$PM_{2.5}$	75 (24 hour average)	15 (Annual average) 65 (24 hour average)
So_2	125 (24 hour average)	365 (24 hour average) 80 (Annual average)
No_2	200 (1 hour average)	100 (Annual average)
Pb	-	0.5 (Annual average)

Note:

[1]New version of the World Bank Group EHS Guidelines for General Environmental Guidelines, April 2007

[2]Ministry of Environment and Forest, Notification related Environment Conservation Rules,1997, Schedule 2, 16th July 2005

Water Quality Standards

Bangladesh standards

The standards for the water in Bangladesh shall be determined in accordance with standards specified in Schedule-3 (Environmental Conservation Rule-1997).

Table 3.5 Inland Surface Water Quality Standards

Best Practice based classification	Parameter			
	pH	**BOD mg/l**	**DO mg/l**	**Total Coliform number/100**
a. Source of drinking water for supply only after disinfecting:	6.5-8.5	2 or less	6 or above	50 or less
b. Water usable for recreational activity :	6.5 – 8.5	3 or less	5 of more	200 or less
c. Source of drinking water for supply after conventional treatment :	6.5 – 8.5	6 of less	6 or more	5000 or less
d. Water usable by fisheries:	6.5 – 8.5	6 of less	5 or more	---
e. Water usable by various process and cooling industries :	6.5 – 8.5	10 or less	5 or more	5000 or less
f. Water usable for irrigation:	6.5 – 8.5	10 or less	5 or more	1000 or less

Notes:

1. In water used for pisiculture, maximum limit of presence of ammonia as Nitrogen is 1.2 mg/l.
2. Electrical conductivity for irrigation water -2250 µmhoms/cm (at a temperature of 25^0C; Sodium less than 26%; boron less than 0.2%.

International standards

Table 3.6 Water quality standard (EHS)

(mg/l)

Pollutant	General EHS guideline of IFC (Indicative Values for Treated Sanitary Sewage Discharges a)
pH	6-9
BOD	30
COD	125
SS	150
n-hexane（mineral oil)）	-
n-hexane（animal and vegetable fats）	10
Residual chlorine	-
Phenols	-
Copper	-
Zinc	-
Dissolved iron	-
Dissolved manganese	-
Chromium	-
Cadmium	-
Total cyanogen	-
Total coliform bacteria	400MPN^{6}/100ml
Nitrogen	10 MPN^{6}/100ml
Phosphorus	2 MPN^{6}/100ml

Source: ① IFC, 2007, Environmental, Health, and Safety (EHS) Guidelines GENERAL EHS GUIDELINE

Noise Standards

Bangladesh Standards

The standards for Noise in Bangladesh shall be determined in accordance with standards specified in Schedule-4 (Environmental Conservation Rule-1997) which is revised by GOB in 2006 and published as gazette form.

Table 3.7 Noise Standards

SL. No.	Category of areas	Standards determined at dBase unit	
		Day	Night
a.	Silent zone	50	40
b.	Residential area	55	45
c.	Mixed area (mainly residential area, and also simultaneously used for commercial and industrial purpose)	60	50
d.	Commercial area	70	60
e.	Industrial area	75	70

Notes:
1. The time from 6 am to 9 pm is counted as daytime
2. The time from 9 pm to 6 am is counted as night time
3. Area up to a radius of 100 m around hospitals or educational institutions or special institutions/ establishments identified / to be identified by the Government is designated as Silent Zones where use of horns of vehicles or other audio signals, and loudspeakers are prohibited.
4. The standards shown in the table are based on revised data published by GoB in September 2006 as a gazette (Regd. No. DA-1)

International standards

Table 3.8 Noise quality standard (EHS guideline)

Receptor	One hour Laeq（dB)	
	Daytime (07:00 - 22:00)	Nighttime (22:00 - 07:00)
Residential, institutional and educational	55	45
Industrial and commercial	70	70

Source: IFC.2007.Environmental, Health, and Safety (EHS) Guidelines GENERAL EHS GUIDELINE

Table 3.9 Noise quality standard (WHO)

Specific Environment	Critical health effect(s)	LA_{eq} [dB]	Time base [hours]	LA max fast [dB]
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60
School class rooms and pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	During Class	-
Pre-school Bedrooms, indoors	Sleep disturbance	30	Sleeping time	45
School, playground outdoor	Annoyance (external source)	55	During Play	-
Hospital, Ward rooms, indoors	Sleep disturbance, night-time	30	8	40
	Sleep disturbance, daytime and evenings	30	16	-
Hospitals, Treatment rooms, indoors	Interference with rest and recovery	#1		
Industrial, commercial, shopping and traffic areas, indoors and Outdoors	Hearing impairment	70	24	110
Ceremonies, festivals and entertainment events	Hearing impairment (patrons:<5 times/year)	100	4	110
Public addresses, indoors and outdoors	Hearing impairment	85	1	110
Music through headphones/ Earphones	Hearing impairment (free-field value)	85 # 4	1	110
Impulse sounds from toys, fireworks and firearms	Hearing impairment (adults)	-	-	140 # 2
	Hearing impairment (children)	-	-	140 # 2
Outdoors in parkland and conservation areas	Disruption of tranquility	# 3		

#1: as low as possible;
#2: peak sound pressure (not LAmax, fast), measured 100 mm from the ear;
#3: existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low;
#4: under headphones, adapted to free-field values

Project Waste Standards

Bangladesh Standards

The standards for waste in Bangladesh shall be determined in accordance with standards specified in Schedule-10 (Environmental Conservation Rule-1997).

Table 3.10 Standards for Waste From Industrial Units or Projects Waste

Sl. No.	Parameter	Unit	Inland Surface Water	Public Sewer at secondary treatment plant	Irrigated Land
1.	Ammoniacal Nitrogen (N molecule)	mg/l	50	75	75
2.	Ammonia (free ammonia)	"	5	5	15
3.	Arsenic (As)	"	0.2	.05	0.2
4.	BOD_5 20°C	"	50	250	100
5.	Boron	"	2	2	2
6.	Cadmium (Cd)	"	0.05	0.5	0.5
7.	Chloride	"	600	600	600
8.	Chromium (total Cr)	"	0.5	1.0	1.0
9.	COD	"	200	400	400
10.	Chromium (hexavalent Cr)	"	0.1	1.0	1.0
11.	Copper (Cu)	"	0.5	3.0	3.0
12.	Dissolved Oxyzen (DO)	"	4.5-8	4.5-8	4.5-8
13.	Electrical Conductivity	micro mho/cm	1200	1200	1200
14.	Total Dissolved Solids (TDS)	mg/l	2,100	2,100	2,100
15.	Fluoride (F)	"	7	15	10
16.	Sulfide (S)	"	1	2	2
17.	Iron (Fe)	"	2	2	2
18.	Total Kjeldahl Nitrogen (N)	"	100	100	100
19.	Lead (Pb)	"	0.1	1.0	0.1
20.	Manganese (Mn)	"	5	5	5
21.	Mercury (Hg)	"	0.01	0.01	0.01
22.	Nickel (Ni)	"	1.0	2.0	1.0
23.	Nitrate (N molecule)	"	10.0	undetermined	10.0
24.	Oil & grease	"	10	20	10
25.	Phenol compounds (C_6H_5OH)	"	1.0	5	1
26.	Dissolved Phosphorus (P)	"	8	8	10
27.	Radioactive materials:	As determined by Bangladesh Atomic Energy Commission.			

28.	pH		6-9	6-9	
29.	Selenium	mg/l	0.05	0.05	0.05
30.	Zn (Zn)	"	5.0	10.0	10.0
31.	Total dissolved solid	"	2,100	2,100	2,100
32.	Temperature	Centi-grade			
	Summer		40	40	40
	Winter		45	45	45
33.	Total Suspended Solid (TSS)	mg/l	150	500	200
34.	Cyanide (CN)	"	0.1	2.0	0.2

Notes:
(1) These standards shall be applicable to all projects other than those specified under the heading "Standards for sector-wise industrial effluent or emission".
(2) Compliance with these standards shall be ensured from the moment and industrial unit starts trial production, and in other cases, from the moment a project starts operation.
(3) These standards shall be inviolable even in case of any sample collected instantly at any point of time. These standards may be enforced in a more stringent manner if considered necessary in view of the environment conditions of a particular situation.
(4) Inland Surface Water means drains/ponds/tanks/ water bodies/ ditches, canals, rivers, springs and estuaries.
(5) Public sewerage system means treatment facilities of the first and second stage and also the combined and complete treatment facilities.
(6) Irrigable land means such land area which is sufficiently irrigated by waste water taking into consideration the quantity and quality of such water for cultivation of selected crops on that land.
(7) Inland Surface Water Standards shall apply to any discharge to a public sewerage system or to land if the discharge does not meet the requirements of the definitions in notes 5 and 6 above.

Relevant National Policies

During recent years a number of national policy documents have been prepared and where accepted by GOB. These policy initiatives, strategies and plans all emphasize consideration of the environment and natural resources in order to achieve sustainable development. A summary of the major relevant policy documents prepared is given in Table 3.11. It is relevant to mention that GOB has prepared a National Strategy for Accelerated Poverty Reduction showing its strong commitment to achieving the Millennium Development Goals as defined by the UN. While the Government has made important strides towards achieving these targets, this report highlights a number of sources of environmental degradation that merit greater emphasis, not only to bring Bangladesh closer to achieving its targets but also to contribute to the removal of environmental constraints to poverty reducing growth.

Table 3.11 Relevant Major Policies

Policy	Brief Description	Responsible Agency
National Land Transport Policy (2004)	New roads and major improvements will be subjected to an EIA, Funding will be provided for mitigation measures, Environmental (design) standards for new roads	Road & Highways
The National Water Policy (1999)	Protection and restoration of water resources; Protection of water quality, including strengthening regulations concerning agro-chemicals ad industrial effluents Sanitation and potable water Fish and Fisheries; Participation of local communities in water sector development	Ministry of Water Resources
National Land Use Policy (2001)	The policy deals with land uses for several purposes including agriculture, housing, forestry, industrialization, railways and~. roads. The plan identifies land use constraints in these sectors.	Ministry of Land
National Forest Policy and Forest Sector Review(1994,2005)	Afforestation of 20% land; Bio-diversity of the existing degraded forests; Strengthening of agricultural sector Control of global warming, desertification, control of trade in wild birds and animals Prevention illegal occupation of the forestlands, tree felling	Ministry of Environment and Forest
National Biodiversity Strategy and Action plan (2004)	Conserve, and restore the biodiversity of the country; Strategy and Action - Maintain and improve environmental stability of ecosystems; Ensure preservation of the unique biological heritage of the nation for the benefit of the present and future generations; Guarantee safe passage, and conservation of globally endangered migratory species, especially birds and mammals in the country; Stop introduction of invasive alien species, genetically modified organisms and living modified organisms.	Ministry of Environment and Forest (MOEF)
National Fisheries Policy (1998) and Inland Capture Fisheries Strategy (2004)	Preservation, management and exploitation of fisheries and resources in inland open water; Fish cultivation and management in inland closed water; Prawn and fish cultivation in coastal areas; Preservation, management and exploitation of sea fishery	Ministry of Fisheries and Livestock

Policy	Brief Description	Responsible Agency
	resources	
National Agricultural Policy, 1999	The policy deals with programs to make the nation self-sufficient in food through increased production of all crops and I to ensure a dependable food security system	Ministry of Agriculture
Draft Wetland Policy, 1998	Establishment of principles for sustainable use of wetland resources; Maintenance of existing level of biological diversity; Maintenance of the functions and values of wetlands Promotion and recognition of the value of wetland functions in resource management and economic development	Ministry of Environment and Forest
Bangladesh Climate - Change Strategy and Action Plan (2008)	Establishment of six strategic pillars for action, including (l) food security, social protection and health, (2) disaster management, (3) protective infrastructure, (4) research and knowledge management, (5) Decreased carbon development, and (6) capacity building and institutional strengthening. A first list of37 programs is identified.	Ministry of Environment and Forest

Occupational Health and Safety

During construction, the project will confirm the labor laws, for occupational and health related rules as outlined in Table 3.12.

Table 3.12 Relevant Occupational Health and Safety Laws and Rules

Title	Overview
Bangladesh Labor Act 2006	Provides for safety of work force during construction period. The act provides guidance of employer's extent of responsibility and the workmen's right to compensation in case of injury caused by accident while working.
Water Supply and Sewerage Authority Act 1996	The act calls for ensuring water supply and sewerage system to the public, preservation of system, and other related health and environmental facilities for the community.
Labor Relations under Labor Laws, 1996 (Revisions to scattered Acts and Ordinances to formulate a unified code)	General concerns during the project implementation state that the project manager must recognize labor unions.
Public Health Emergency Provisions) Ordinance, 1994	Calls for special provisions with regard to public health. In case of emergency, it is necessary to make special provisions for preventing the spread of disease, safeguarding the public health, and providing adequate medical service, and other services essential to the health of respective communities and workers during construction-related work.
Bangladesh Factory Act, 1979	Workplaces provisions: these Act and Labor Laws require medical facilities, first aid, accident and emergency arrangements, and childcare services to be provided to the workers at workplace.
The Employees State Insurance Act, 1948	Health, injury, and sickness benefit should be paid.
The Employer's Liability Act, 1938	Covers accidents, risks and damages with respect to employment injuries
Maternity Benefit Act, 1950	Framed rules for female employees, who are entitled to

Title	Overview
	various benefits for maternity.

Source: Bangladesh Government Rules and Regulation book

International Treaties

Bangladesh has signed most international treaties, conventions and protocols on environment, pollution control, bio-diversity conservation and climate change, including the Ramsar Convention, the Bonn Convention on migratory birds, the Rio de Janeiro Convention on biodiversity conservation and the Kyoto protocol on climate change. An overview of the relevant international treaties and conventions signed by GoB is shown in Table 3.13

Table 3.13 Relevant International Treaties, Conventions and Protocols Signed by Bangladesh

Treaty or Convention	In	Brief Description	Responsible Agency
On Protection of birds, Paris	1950	Protection of birds in wild state	Department of Environment/Department of Fisheries
Convention on oil pollution damage (Brussels)	1969	Civil liability on oil pollution damage from ships	Department of Environment/Ministry of Shipping
Ramsar Convention	1971	Protection of wetlands	Department of Environment/Department of Fisheries
World Cultural and Natural Heritage (Paris)	1972	Protection of major cultural and natural monuments	Department of Archaeology
CITES Convention (Washington)	1973	Ban and restrictions on international trade in endangered species of wild fauna and flora	Department of Environment/Department of Fisheries
Bonn Convention	1979	Conservation of migratory species of wild animals	Department of Environment/Department of Fisheries
Prevention and Control of Occupational hazards (Geneva)	1974	Protect workers against occupational exposure to carcinogenic substances and agents	Ministry of Health and Family Welfare
Occupational hazards due to air pollution, noise & vibration (Geneva)	1977	Protect workers against occupational hazards in the working environment	Ministry of Health and Family Welfare
Occupational safety and health in working environment (Geneva)	1981	Prevent accidents and injury to health by minimizing hazards in the working environment	Ministry of Health and Family Welfare
Occupational Health Services (Geneva)	1985	To promote a safe and healthy working environment	Ministry of Health and Family Welfare
Vienna convention	1985	Protection of ozone layer	Department of Environment/Ministry of Environment and Forest
Civil liability on transport of dangerous goods (Geneva)	1989	Safe methods for transport of dangerous goods by road, railway and inland vessels	Ministry of Communication

Convention on oil pollution (London)	1990	Legal framework and preparedness for control of oil pollution	Department of Environment/Ministry of Shipping
London Protocol	1990	Control of global emissions that deplete ozone layer	Department of Environment/Ministry of Environment and Forest
UN framework convention on climate change (Rio de Janeiro)	1992	Regulation of greenhouse gases emissions	Department of Environment/Ministry of Environment and Forest
Convention on Biological Diversity (Rio de Janeiro)	1992	Conservation of bio-diversity, sustainable use of its components and access to genetic resources	Department of Environment/Ministry of Environment and Forest
International Convention on Climate Changes (Kyoto Protocol)	1997	International treaty on climate change and emission of greenhouse gases	Department of Environment/Ministry of Environment and Forest
Protocol on biological safety (Cartagena protocol)	2000	Biological safety in transport and use of	Department of Environment/Ministry of Environment and Forest

3.2 Environmental Impact Assessment

Category of Project

Under the Environmental Conservation Rules (1997) a classification system was established for development projects and industries on basis of the location, the size and the severity of potential pollution. There are four categories of projects: green, orange A, orange B and red with respectively no, minor, medium and severe environmental impacts. For the red category of projects a full EIA is required. All regional and national highway, railway and bridge projects of over 100 m length fall in the red category. The orange B category includes feeder and district roads and bridges under 100 m length.

The Proposed Bridge Construction and Rehabilitation project on Dhaka-Chittagong National Highway (NH-1) with a length of more than 100 m clearly falls under the red category of projects. The Environmental Impacts Assessment should include the prediction, evaluation and mitigation of environmental impacts caused, based on the characteristics of project, and an Environmental Management Plan (EMP) shall be prepared. The approval of the EIA and EMP is required before submitting an application for an Environmental Clearance Certificate (ECC). The procedure is shown in Figure 3.1.

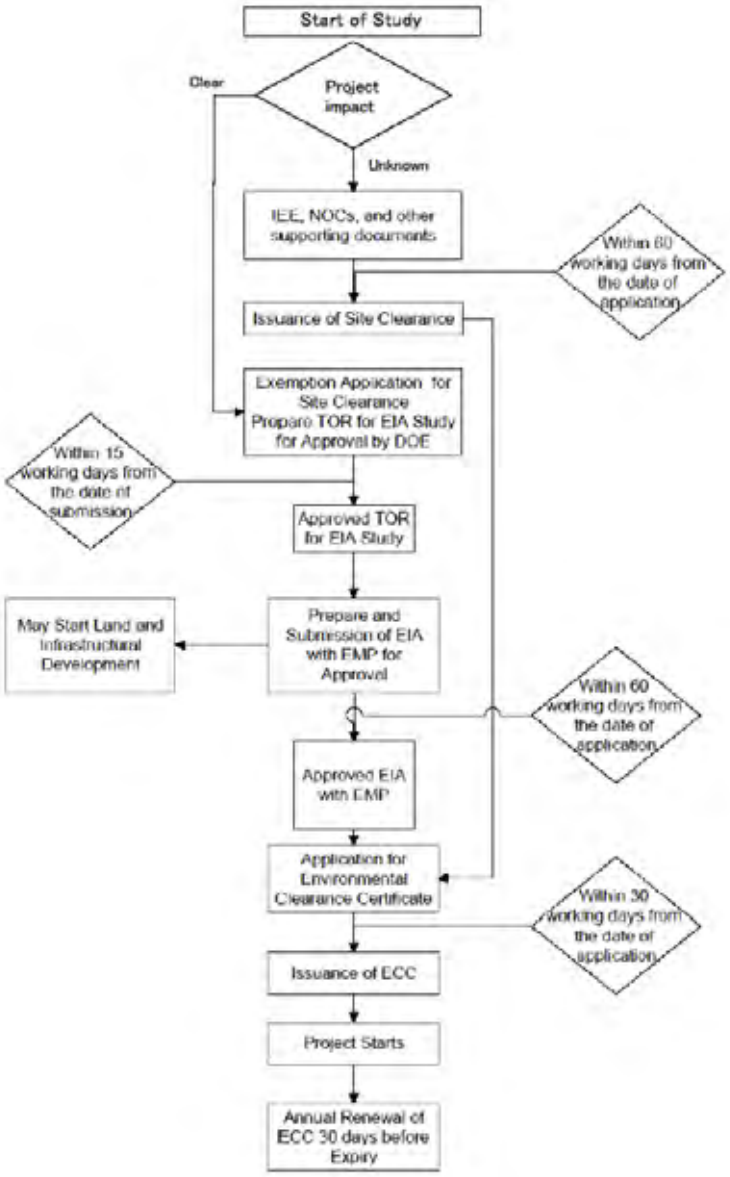


Figure 3.1 Steps to be followed for Environmental Clearance Certificate for Red Category Project[1]

[1] After EIA for Padma Multipurpose Bridge 2010

The Japan International Cooperation Agency Policy

JICA environmental Guidelines which is applied to the Project is “Guidelines for Environmental and Social Considerations” (April 2010).

The JICA Guidelines confirm that project proponents are undertaking appropriate environmental and social considerations, through various measures, so as to prevent or minimize the impact on the environment and local communities which may be caused by the projects for which JICA provides funding, and not to bring about unacceptable effects. It will thus contribute to the sustainable development of developing regions. In its confirmation of environmental and social considerations, JICA places importance on dialogue with all involved partners (e.g. the host country, local governments, borrowers and project proponents) regarding environmental and social considerations. Transparent and accountable processes, as well as active participation of key stakeholders (e.g. local residents and local NGOs affected by the project) in all stages of the project are highly considered. The JICA Guidelines are formulated in reference to the World Bank Operational Policy.

The JICA Guidelines provide following four categories of projects as per its environmental classification system.

- Category A: A proposed project is classified as Category A if it is likely to have significant adverse impact on the environment. Borrowers and related parties must submit Environmental Impact Assessment (EIA) reports. For projects that will result in large-scale involuntary resettlement, basic resettlement plans must be submitted. EIA and other reports need to be submitted through the borrower before the JICA environmental reviews.
- Category B: A proposed project is classified as Category B if its potential adverse environmental impact is less adverse than that of Category A projects.
- Category C: A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impact.
- Category FI: A proposed project is classified as Category FI if it satisfies all of the following:
  - JICA’s funding of the project is provided to a financial intermediary etc.;
  - the selection and assessment of the actual sub-projects is substantially undertaken by such an institution only after JICA’s approval of the funding and therefore the subprojects cannot be specified prior to JICA’s approval of funding (or assessment of the project); and
  - Those sub-projects are expected to have potential impact on the environment.

The Project, as per the above categorization, falls under Category A for the purpose of environmental investigations. Final EIA report approved by DoE needs to be laid open

for public inspection at the JICA headquarter 120 days before a loan agreement for category A projects.

Gaps between Environmental Regulations of GOB and the JICA Guidelines

There are gaps about categorization process, necessity of alternative study and information disclosure as shown in Table 3.14.

Table 3.14 Major Gaps between Environmental Regulations of GOB and the JICA Guidelines

Aspect of Operational Framework	JICA	GOB	Harmonized Operational Framework
Environmental Policy and Regulations	JICA Guidelines for Environmental and Social consideration, April 2004	● Environment Conservation Act (1995) ● Environment Conservation Rules (1977) ● EIA guidelines on Industrial projects	—
Alternatives	Environmental impact must be assessed and examined from the earliest possible planning stage. Alternatives studies shall be made to avoid or minimize adverse impact must be examined and incorporated into the project plan.	ECA (1995) and ECR (1997) do not explicitly ask for identification and assessment of alternatives.	Alternative study shall be made to minimize the project impact
Consultation	In projects, especially can have adverse effects on environment, information on projects needs to be known at early stage and stakeholders, such as local people, should be adequately consulted. The consultation result needs to be considered in projects. (Holding consultations is highly desirable, especially at scoping stage and when the draft report is being prepared)	No public disclosure is required as per ECR Although there are descriptions recommending public participation in EIA, any detailed regulations for local consultation are not laid down.	To implement public consultation accordingly throughout the preparation and implementation stages of the Project. During preparation of the EIA report, consultations were implemented at scoping stage and when the draft report was prepared.
Disclosure of EIA report	It is needed that EIA report is disclosed to projected countries and local people, and stakeholders, such as local people, can access to the report all the time. Also, allowance for copying the report is needed. JICA discloses EIA reports 120 days prior to concluding agreement documents.	There is no regulation for the time of EIA disclosure.	Setting up the time of EIA disclosure can guarantee people to access to the report.

3.3 Environmental Institutional Framework

Table 3.15 provides the public organizations that have a role in environment sector. While some of major institutions that have direct role in managing natural resources.

Table 3.15 Functions of Major Organizations in Environmental Sector

Organization	Current Function
Planning Commission	Responsible for the preparation of development plans and allocating funds to individual Ministries responsible for implementing specific projects. Authorized to supervise and coordinate cross-sectoral and inter-ministerial activities affecting the use of natural resources and the environment
Department of Environment	Technical arm of the Ministry is responsible for environmental planning, management, monitoring and enforcement.
Department of Agricultural Extension	Responsible for extension of new technologies, to farmers at the field level
Water Resources Planning Organization (WARPO)	Responsible for water resource management
Department of Fisheries	Managing fisheries resources
Department of Livestock	Works for improvement of livestock resources and production
Bangladesh Water Development Board (BWDB)	Project planning and implementation; flood control and watershed management; salinity control; maintaining water channels for transportation; regulating water channels
Roads and Highway (RHD)	Constricting and maintaining primary and secondary roads
Department of Public Health Engineering (DPHE)	Rural and urban water supply and sanitation
Water Supply and Sewerage Authorities (WASA)	Construction and upkeep of potable water supply, sewerage and storm drainage in major cities
Bangladesh Inland Water Transport Authority	River conservancy work, including river training for navigation and meteorological information, including river charts; hydraulic survey; programming for dredging and reviving dead or dying water bodies; developing, maintaining, and operating inland river ports; developing rural water transport.
National Herbarium	Surveys and authenticates locally used genetic resources, taxonomic identification of floral species.
Livestock Research Institute	Conduct research production of livestock
Bangladesh Bureau of Statistics	Environmental statistical data compilation

Sources: Country Environmental Analysis Bangladesh, July 2004, ADB

Local government institutions like Union Parishad, Upazila Parishad, and Zila Parishad have been vested with a wide range of development functions including planning for the provision of

general physical infrastructure such as roads, culverts, bridges, potable water supplies, flood control, and irrigation infrastructure. Local Government Ordinances mandate Union Parishad and Upazila Parishad to coordinate development activity implemented by Government and Non-Government Organizations by their territorial and functional jurisdiction.

Followings are description about key organization related:

Department of Environment

The primary institution for environmental management in Bangladesh is the Department of Environment (DoE), under the Ministry of Environment and Forest (MoEF). The DoE is the authority with the mandate to regulate and enforce environmental management, and the setting and enforcement of environmental regulations. The Department was created in 1989 to ensure sustainable development and to conserve and manage the environment of Bangladesh. Creating public awareness on environmental management and legal obligations are needed for this. The following Policy, Acts and Rules facilitate the activities of the Department:

- Environment Policy, 1992;
- Environment Conservation Act, 1995 and subsequent amendments in 2000 and 2002;
- Environment Conservation Rules, 1997 and subsequent amendments in 2002 and 2003;
- Environment Court Act, 2000 and subsequent amendments in 2002

The principal activities of the DoE are

- Defining Environmental Impact Assessment (EIA) procedures and issuing environmental clearance permits - the latter being legal requirements before proposed projects can proceed to implementation;
- Providing advice or taking direct action to prevent degradation of the environment;
- Pollution control, including the monitoring of effluent sources and ensuring mitigation of environmental pollution;
- Setting the Water Quality Standard (WQS) for particular uses of water and for discharges to water bodies; and
- Declaring Ecologically Critical Areas (ECAs) where the ecosystem has been degraded to a critical state.

The Forestry Department

It is responsible for Sensitive Area protection in four types of legally protected areas - wildlife sanctuaries, game reserves, reserved forests and natural forests).

Roads and Highways Department (RHD)

Under the Ministry of Communications, RHD has the responsibility for construction and maintenance of all national and regional highways. RHD also has a significant fleet of ferries operating on the main highway system in locations where there are no road bridges. Figure 3.2 indicates organization chart of RHD.

As shown in the chart, RHD, within its Technical Services Wing, has established a Social and Environment Circle (SEC), which comprises an Environmental Division and a Social Division. The objective of the Circle is to ensure that all RHD works and projects are executed in accordance with appropriate environmental and social standards and practices. Tree planting on RHD road alignments is the responsibility of the Arboriculture Circle and road safety issues are the responsibility of the Road Design and Safety Circle. Both of these circles are within the Technical Services Wing of RHD are shown in the chart.

On site, RHD are primarily responsible for ensuring contractors to implement best environmental practice on site. RHD officers supervising contracts (and consultants where employed by RHD) should review and monitor the contractor's performance in relation to the EMP. Particular responsibilities include:

- Promoting environmental best practice in all day-to-day project activities.
- Contributing to the development of clauses about environmental standards for consultants' TOR, of contract conditions and of environmental management plan for contractors.

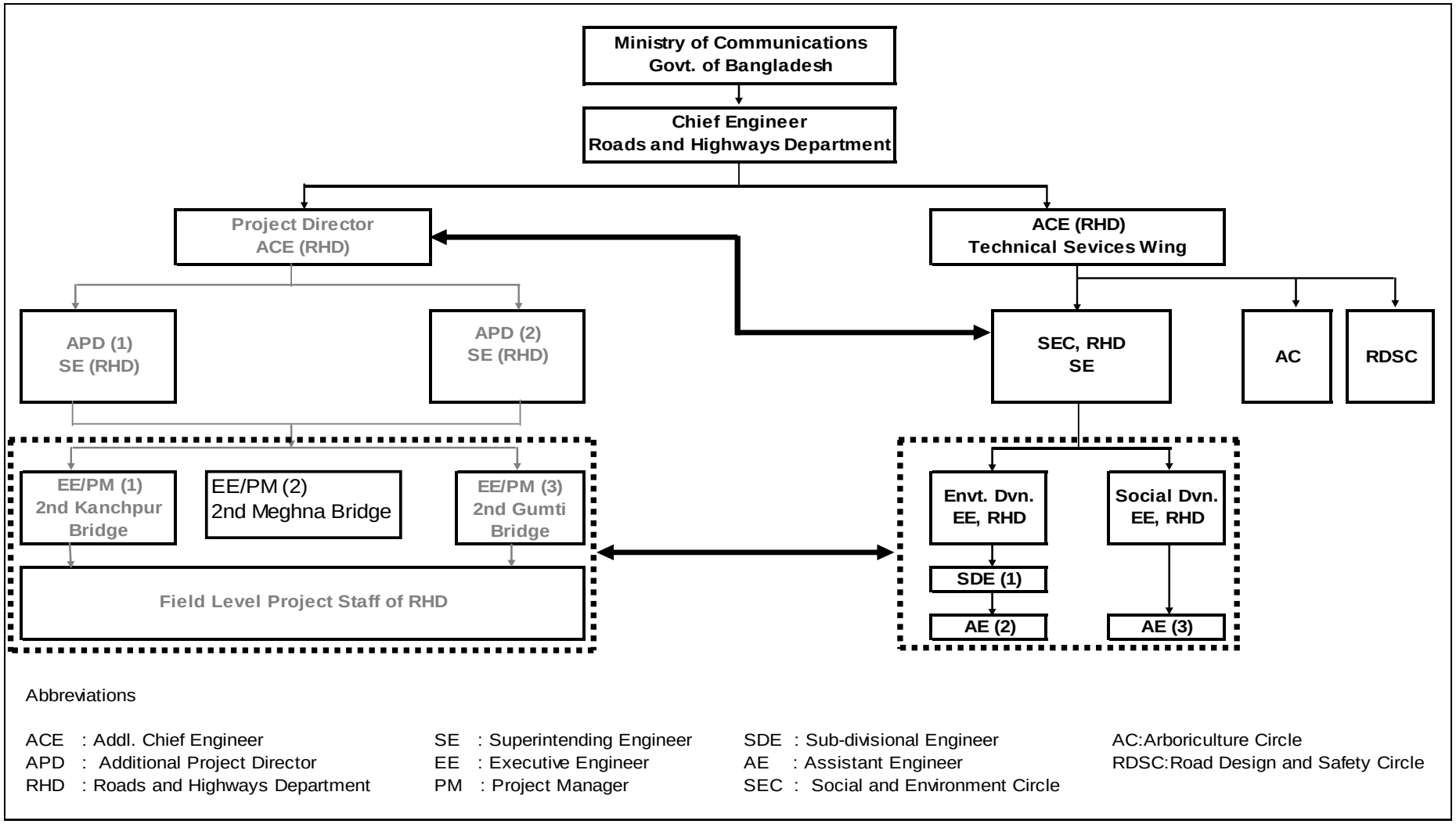


Figure 3.2 Organization chart of RHD EMP implementation

Inter-institutional Coordination

Regular liaison should be maintained between officers of the RHD SEC and the DoE officer with the responsibility for overseeing Environmental Assessment for the communications sector. This is particularly crucial to ensure that the Environmental Clearance Certificate (ECC) applications are filed in sufficient time such that delay in project implementation does not occur. Any delays that result in a construction contractor being prevented from mobilizing at the commencement of the dry season can have very serious cost implications for a project. It is thus imperative that a good working relationship is maintained between the relevant staff of RHD and DoE.

CHAPTER 4. BASELINE ENVIRONMENTAL CONDITION

4.1 General

This chapter describes (1) conditions of sites in general and then (2) key items which were discussed in the scoping.

The primary objective in this chapter is for providing an environmental baseline that potential impacts at the construction and operation phases of the three new bridges can be compared in chapter 7. Baseline data includes an inventory of physical, ecological and socio-economic parameters. Covering these aspects, data has been compiled for:

- Land Environment (topography, geology, seismology and soils);
- Water Environment (water resources, water quality);
- Air Environment (meteorology, air quality);
- Noise Environment (noise levels);
- Ecological Environment
- Socio-economic Environment

Baseline data for the study area was collected using the following methods:

- Published Literature (Physiography, Geological and Hydrological Survey Report for three new bridges, Preparation of Maps)
- Primary Survey
- Laboratory Analyses
- Local people consultation
- Organizational Visit

Organization visited:

Professor, Department of Geography and Environment Dhaka University
Professor, Department of Geology Dhaka University
Assistant Professor Dhaka University
Chairman, Department of Zoology Dhaka University
Director General Geological Survey of Bangladesh, Ministry of Energy and Mineral Resources
Head, Department of Environmental Science State University of Bangladesh, Dhaka
Director, Soil Research evelpment Institute, Mrittika Bhaban, Dhaka
Executive Director CEGIS, Gulshan 1, Dhaka
Chief Executive CARINAM, Center for Advanced Research in, Natural Resources

Management,

The influence area (impact zone) for the EIA covers 0.5km from the bridge center line for each Bridges and 1 km on either side of the road alignment in order to include sufficient coverage of the receiving environment of the impacts of the Project.

4.1.1 Climate

Temperature

Meteorological stations (of Bangladesh Meteorological Department, BMD) located closest to the Project areas are: Dhaka and Comilla. Weather data from these two stations is collected from 2000 to 2009. Locations of these stations are presented in Figure 4.1.

Figure 4.1 Locations of Monitoring Stations

Mean monthly temperature data of Dhaka Station is given in Figure 4.2. January is the coldest month with average monthly temperature of about 17℃, while April to October is the hottest month with average monthly temperatures ranging from 28 to 31℃.

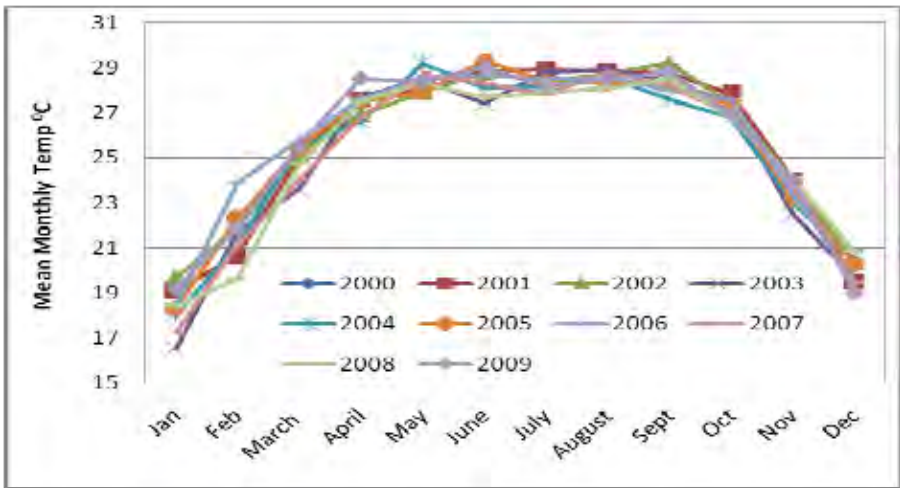


Figure 4.2 Mean Monthly Temperatures in Dhaka Station

Distribution of mean monthly temperature of Comilla Station for last ten years is given in Figure 4.3. Mean monthly temperature data of Comilla Station varies in the range of 16.5 – 29.3°C. January is the coldest month having average minimum temperature of 12.1°C. The average maximum temperature occurs in the month of May being 32.5°C.

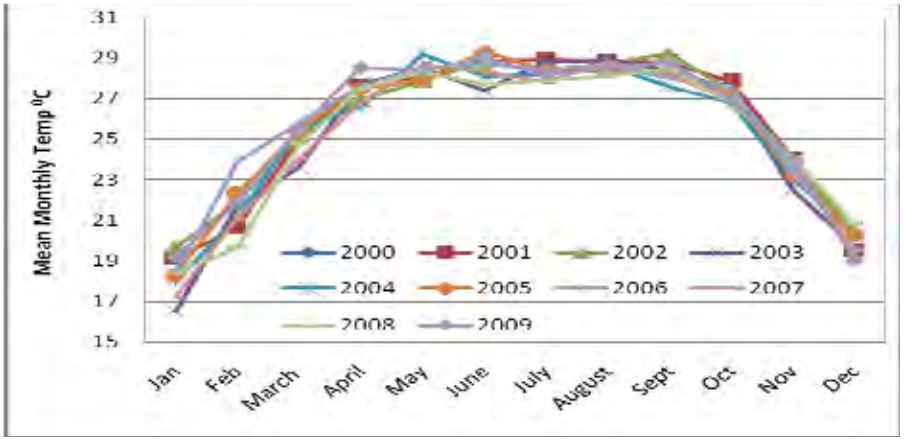


Figure: 4.3 Mean Monthly Temperatures in Comilla Station

Rainfall

According to monthly rainfall data from 2000 to 2009, average annual rainfall is about 2100 - 2200 mm/yr at Dhaka and Comilla Station. Normally rainy season starts from May and ends in October, especially there is heavy rainfall in June and July in comparison to other months, which is about 400 mm/month. Dry season lasts from November to April.

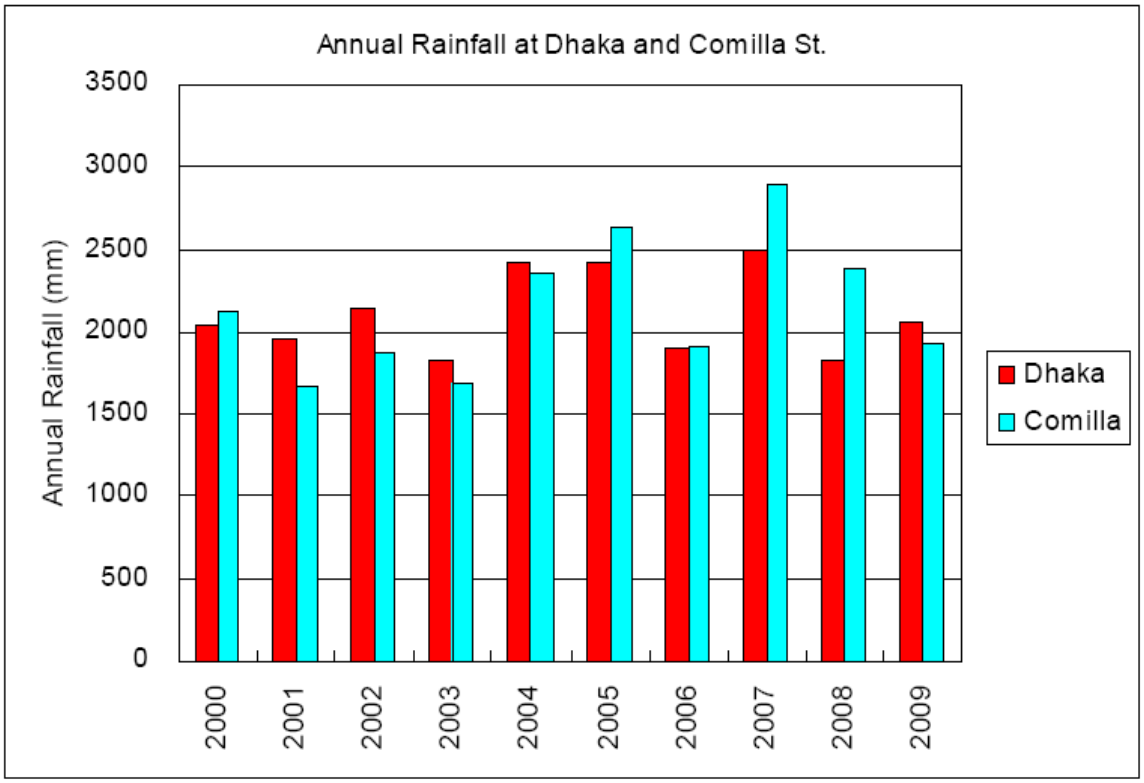


Figure 4.4 Annual Rainfall at Dhaka and Comilla Meteorological Station

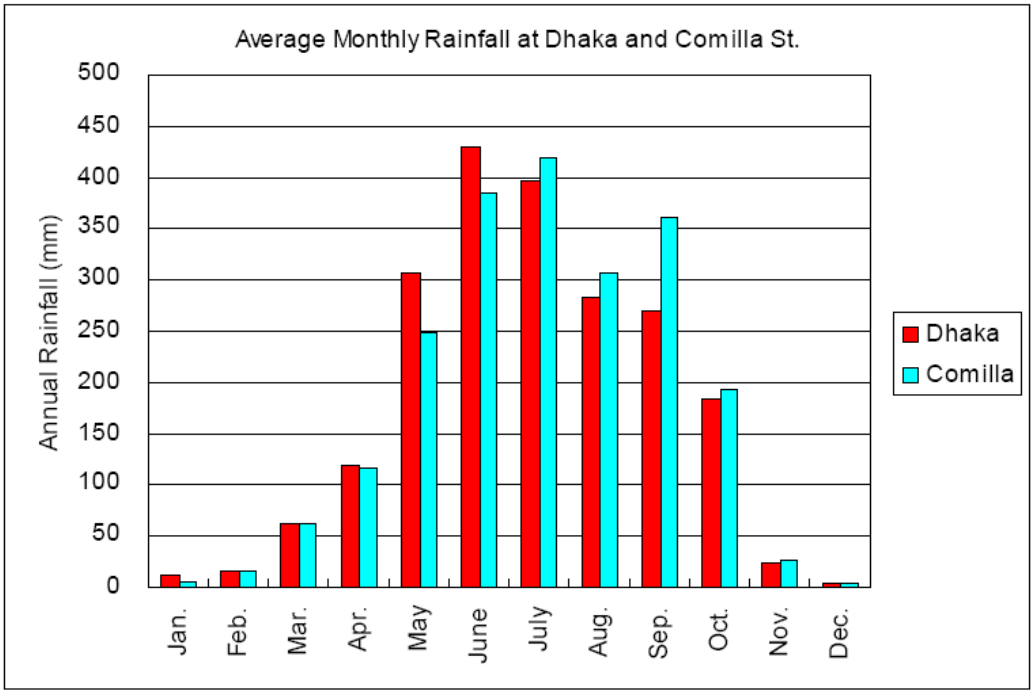


Figure 4.5 Average Monthly Rainfall at Dhaka and Comilla Meteorological Station

Humidity

In Dhaka, the maximum relative humidity varies from 94- 100% in winter months but the maximum range varies from 94-99% in other months. The minimum humidity ranges from 13 -24% in winter months and this varies from 11- 16 % in the months of March- May. The figure varies from 31- 54% in summer and rainy months from June to October.

In Comilla, the maximum relative humidity varies from 98- 100% in winter months but the maximum range varies from 97-100% in other months. The minimum humidity ranges from 16 -23% in winter months and this varies from 22- 26 % in the months of March- May. The figure varies from 31- 66% in summer and rainy months from June to October. .

Wind Speed and Direction

In Dhaka, it is recorded that that the wind speeds mostly remain in the range of 8 – 10 knot[1]/hr occasionally rising to 15knot /hr. But in the winter months it remains in the range of 2-7 knot/hour occasionally rising to 9 knots/.hr. The highest speed is recorded as 20 knots/ hr in the month of September, 2007 in a north westerly direction.

In Comilla, it is recorded that that the wind speeds mostly remain in the range of 2 – 4.5 knots/ hr occasionally rising to 8.5 knots /hr. But in the winter months it remains in the range of 1.8-4 knots/hour occasionally rising to 6.8 knots/.hr.

[1] 1 knot/hr = 0.45m/second

4.1.2 Physiography and Soils

Kanchpur Bridge

The Project area is known as Modhupur tract. There are compact clays, previously called Pleistocene clays, but now called Modhupur clay. These clays have been uplifted techtonically.

The flood plain sediments occupy the south of the study area. These clays are overlaying by sediments deposited on the old Meghna floodplain. This flood plain has, in turn, been partially buried by sediment deposited by Brahmaputra River.

Soils of the project impact area are mainly old Brahmaputra and old Meghna flood plain deposits. Flood plan soils generally show a pattern of friable silt loams or silt clay loams on the ridges and clays in the basins. Some clays are commonly dark gray but others flood plain soils are mainly mid gray and finely mottled yellow and brown. Because of these mottling, soils of the old Brahmaputra and old Meghna flood plain have an overall yellow-brown or olive brown appearance. The majority are neutral to moderately alkaline in reaction.

Meghna and Gumti Bridge

Physiographically, the Meghna site is located on the flood plain of the Meghna. Gazaria Upazlia is located between two channels of the Meghna River. On the eastern side is the Daudkandi Ghat Channel and on the western side is the Meghan Ghat Channel of the Meghna River. At present, there are bridges over both the channel – Gumti Bridge over the Daudkandi Ghat Channel and Meghna Bridge over the Meghna Ghat Channel. However, since the construction of bridges on these channels, the Daudkandi Ghat Channel has become less active and more silting is taking place in the passage. Gazaria town is located further east of the proposed project site, on the bank of the Fuldi River. General elevation of the proposed project site varies from about 8 m to 10 m PWD (Public Works Datum) .

As the Gazaria Upazila is located between two channels of the Meghna River, it has been suggested that the whole area is a Char (Island - channel bar). However, review of the geology of the area tends to suggest that the Meghna River possibly encountered some obstruction (major clay beds) up stream of Sonargoan (in the north) and diverted part of its flow southeastwards through channels of other streams of the area. The other stream channels could be the older channel of the Tista River and the Katalia Nadi. Ultimately, this diverted flow assumed the name of the Meghna River. However, part of the eastern channel of the Meghna river is still known as Katalia Nadi in Homna Upazial. Indication from old maps and literature review suggests that the landform of the area is more than 100 years old. However, some of the

land on the extreme south and southeast of Bausia may be younger.

Soil of the area is grey loam on the ridges and grey to dark grey clays in the basins. The dominant general soil type is non-calcareous grey flood plain soil. Top soils are strongly acidic and sub-soils slightly acidic to slightly alkaline. General fertility level is medium with low nitrogen and organic matter.

4.1.3 Geology

About Kanchpur Bridge, the project area is known as Modhupur tract. There are compact clays, previously called Pleistocene clays, but now called Modhupur clay. These clays have been uplifted techtonically.

Soils of the project impact area are mainly old Brahmaputra and old Meghna flood plain deposits. Flood plan soils generally show a pattern of friable silt loams or silty clay loams on the ridges and clays in the basins. Some clays are commonly dark gray but others flood plain soils are mainly mid gray and finely mottled yellow and brown. Because of these mottling, soils of the old Brahmaputra and old Meghna flood plain have an overall yellow-brown or olive brown appearance. The majority are neutral to moderately alkaline in reaction.

About Meghna and Gumti Bridge areas, physiographically, the Meghna site is located on the flood plain of the Meghna. Gazaria Upazlia is located between two channels of the Meghna River. On the eastern side is the Daudkandi Ghat Channel and on the western side is the Meghna Ghat Channel of the Meghna River. At present, there are bridges over both the channel – Gumti Bridge over the Daudkandi Ghat Channel and Meghna Bridge over the Meghna Ghat Channel. However, since the construction of bridges on these channels, the Daudkandi Ghat Channel has become less active and more silting is taking place in the passage. Gazaria town is located further east of the proposed project site, on the bank of the Fuldi River. General elevation of the proposed project site varies from about 8 m to 10 m PWD .

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Soil of the area is grey loam on the ridges and grey to dark grey clays in the basins. The dominant general soil type is non-calcareous grey flood plain soil. Top soils are strongly acidic and sub-soils slightly acidic to slightly alkaline. General fertility level is medium with low nitrogen and organic matter.

Seismicity

According to BNBC (1993), Bangladesh has three seismic zones with moderate and low seismic activity. The Project area falls in Zone II, i.e. medium intensity seismic zone of the country. No major earthquake has been reported in the project area in recent years or recent past. It is understood that seismic risk at the project area is of medium intensity. Development taking into consideration the seismic co-efficient would not pose a major constraint to development of the project. The seismic zones of Bangladesh are depicted in Figure 4.6 for reference.

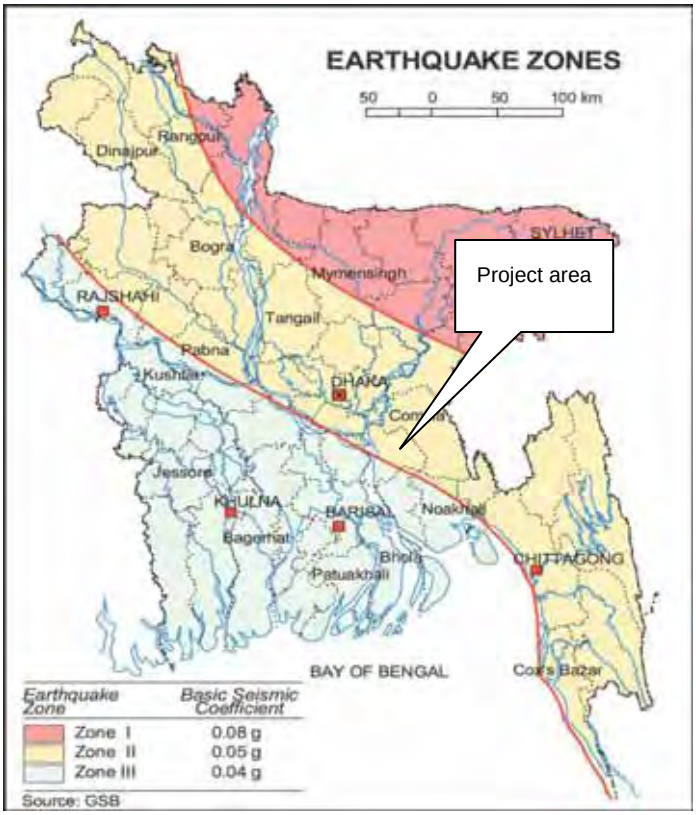


Figure 4.6 Earthquake Zones of Bangladesh

4.1.4 Surface Water Resources

Shitalakshya River

Kanchpur Site is part of the Shitalakshya River system, which ultimately connected to other surrounding main rivers such as Balu, Daleshwari, Buriganga and leaded to Meghna river system. Shitalakshya River system is connected by large number of tributaries which are flowing water from the surrounding rivers system and is also connected with small canals. The main sources of water flows in these rivers are rainfall during the wet season. Both stream velocity and water levels remain high in the wet season, which drops down significantly in the dry season. The highest water level observed is 5.5m in wet season and in dry season they were 0.6m. Velocities estimated are 1.3 m/s in wet season and 0.2m in dry season. Data sources are edited BWDB observation data by Study Team

Beside rivers and canals, the other surface water sources are ponds/tanks and few natural depressions in and around the project area similarly to other parts of the country. This area also receives sufficient amount of rainfall. There are some low agricultural lands which are seasonally flooded and used as fish culture.

There is rise in water level with commencement of monsoon rainfall from May/June till September/October. Tidal influence reduces with monsoon flooding.

Meghna River

The Meghna River is one of the longest rivers in Bangladesh. It originates from the Barrack River passing through Assam Province of India and finally enters into Bangladesh near Zakiganj Thana of Sylhet district in the name of the Surma River. The Barrack River has been bifurcated at the point Zakiganj in the name of 1) The Surma and 2) The Kushiara. The united courses of these rivers in the downstream near Habiganj the river system flows southward in the name of the Meghna. The Meghna meets the old Brahmaputra near Bhairab passes through the present Meghnaghat and flows into the Bay of Bengal again meeting with the Padma River at the ownstream of Chandpur. Many people (45% of the total population of Bangladesh) residing in the flood plain of the Meghna live on fishing, in-land trading activities on the Meghna including a substantial contribution to the agricultural production system of the entire river basin. The highest water level observed is 5.6m in wet season and in dry season they were 1.1m. Velocities estimated are 1.5m/s in wet season and 0.2 m/s in dry season.

Gumti-River

Gumti River is one of the branches of Meghna River. The highest water level observed is 5.8m

in wet season and in dry season they were 0.9m. Velocities estimated are 1.7m/s in wet season and 0.2m/s in dry season.

Groundwater resources

The Project area belongs to the hydro-geological unit II Holocene Deltaic and flood Plains. Ground water is available in plenty and water table does not go beyond suction limit throughout the year. Groundwater is available at shallow depth for which most of the tube wells are sunk in the depth 40-200 ft. Water is available in the tube wells round the year. The water of shallow layer contains lot of iron and is contaminated with Arsenic in several areas.

4.1.5 Land Use Pattern

1) Land Use Pattern

Kanchpur Bridge

Existing land use within 5km surrounding project site was determined by on screen digitizing and extensive ground truthing GPS (Global Positioning System). The study area is mostly occupied with heavy industries such as Siddhirganj power plant complex, Adamjee EPZ complex, Silo project within industrial zone including some small industries distributed within Adamjee EPZ campus and scattered around the project area. In addition, there is a massive settlement in the residential area adjacent to industrial installations.

Figures from 4.7 to 4.9 present Google maps around the sites respectively.

Figure 4.7 Land Use Map at Kanchpur Bridge Site

Meghna Bridge

There are no agricultural land and crop field available in the project influence area. The Project area has monoculture tree plantation, and homestead-based agro-forestry. Within a three-kilometre radius of the project site are numerous industrial and commercial developments that comprise the burgeoning industrial area of Narayanganj.

Figure 4.8 Land Use Map at Meghna Bridge Site

Gumti

There is a little bit of agricultural area which is seasonal. Those agricultural areas just beside the river and char land (island), where farmer can grow crops only in one season (dry season, November to April,) while it sinks below water in wet season, May to October..

Dry season (January 2012)

Wet season (July 2012)

Picture 4.1 Views of Char agriculture

Figure 4.9 Land Use Map at Gumti Bridge Site

2)Land use and utilization of local resources

Kanchpur Bridge Site, within 5km from the bridge is mostly occupied with heavy industries such as Siddhirganj power plant complex, Adamjee EPZ complex, Silo project within industrial zone including some small industries distributed within Adamjee EPZ campus and scattered around the project area. In addition, there is a massive settlement in the residential area adjacent to industrial installations.

About Meghna Bridge and Gumti Bridge Sites, there are no agricultural land and crop field available in the Project area except on Chars in Gumti River. The Project area has monoculture tree plantation, and homestead-based agro-forestry. Within a three-kilometer radius of the

project site are numerous industrial and commercial developments that comprise the burgeoning industrial area of Narayanganj.

Fishes are major sources of protein for nationals. As for local resources, fishes as Table 4.1 are available in the fish markets in Meghna and Gumti Sites respectively.

Table 4.1 Fishes available in Local Fish Markets

SL #	Types of Fish Landed in the fish Landing and Marketing Centers in 1st Quarter		Source	Average Quantity (kg/day)*	Average Price (BDT/kg)
	Scientific Name	Local Name	Open Water		
Landing Center: Tetul tala (Meghna)					
1.	*Labeo rohita*	*Rui*	*R,C*	*40*	*150-200*
2.	*Catla catla*	*Katla*	*R,C*	*40*	*100-150*
3.	*Cirrhina mrigala*	*Mrigel*	*R,*	*20*	*100-150*
4.	*Not available*	*Baila*	*R,C*	*60*	*60-75*
5.	*Pangasius Suchii*	*Pangus*			
6.	*Gudusia Chapra*	*Chapila*	*R,C*	*40*	*70-80*
7.	*Channa Striatus*	*Shol*	*R,C*	*20*	*120-150*
8.	*Eutropiichthys vacha*	*Bacha*	*R,C*	*10*	*80-100*
9.	*Pangasius pangasius*				
10.	*Puntius species*	*Puti*	*R,C*	*60*	*70-80*
11.	*Mastacemelus species*	*Baim*	*R,C*	*10*	*80-100*
12.	*Corica sobrona*	*Kaski*			
13.	*Mystus tengara*	*Tengra*	*R,*	*15*	*70-80*
14.	*Labeo bata*	*Bata*			
15.	*Amblypharyngodon mola*	*Mola*	*R,C*	*20*	*50-65*
16.	*Wallago attu*	*Boal*	*R,*	*10*	*150-200*
17.	*Channa punctatus*	*Taki*	*R,C*	*20*	*80-90*
18.	*Mystus aor*	*Aire*	*R,*	*20*	*200-230*
19.	*Mystus cavasius*	*Gulsha Tengra*	*R,C*	*5*	*100-120*
20.	*Tenualosa ilisha*	*Ilish*	*R,*	*20*	*250-300*
21.	*Macrobracium Species*	*Chingri*	*R,C*	*10*	*80-300*
22.	*Apocryptes Species*	Chewa	R,C	20	60-70
23.	*Chanda species*	Chanda	R,C	20	70-80
24.	*Mystus tengra*	Bujuri	R,C	5	80-90
25.	*Clupisoma garua*	Gaura			
26.	*Labea calbasu*	Calbaus			
27.	*Poa pama*	Poa	R ,C	25	65-75
28.	*Heteropneustes fossilies*	Shing	R ,C	15	90-95
29.	*Labeo rohita*	Nala	R ,C	30	60-70
Landing Center: Baidyer Bazar (Gumti)					
1.	*Labeo rohita*	Rui	R,C	20	150-200
2.	*Rita rita*	Reda	R,	10	250-300
3.	*Catla catla*	Katla	R,C	25	150-200
4.	*Cirrhina mrigala*	Mrigel	R,C	20	150-200
5.		Baila	R,C	30	80-100

6.	*Pangasius Suchii*	Pangas	R	15	250-300
7.	*Gudusia Chapra*	Chapila	R,C	30	80-90
8.	*Channa Striatus*	Shol	R,C	30	150-200
9.	*Eutropiichthys vacha*	Bacha	R,C	15	80-90
10.	*Pangasius pangasius*	Pangas	R	20	200-250
11.	*Puntius species*	Puti	R,C	30	70-80
12.	*Glossogobius giuris*				
13.	*Mastacemelus species*	Baim	R,C	15	120-150
14.	*Corica sobrona*	Katcki	R,C	25	70-80
15.	*Mystus tengara*	Tengra	R,C	10	100-120
17.	*Amblypharyngodon mola*	Mola	R,C	20	60-75
18.	*Wallago attu*	Boal	R,	40	200-250
19.	*Channa punctatus*	Taki	R,C	20	70-80
20.	*Mystus aor*	Aire	R,	25	300-350
21.	*Mystus cavasius*	Gulsha Tengra	R,C	10	120-130
22.	*Tenualosa ilisha*	Hilsa	R	500	120
23.	*Macrobracium Species*	Chingri	R,C	80	350-400
24.	*Apocryptes Species*	Chewa	R,C	25	70-80
25.	*Chanda species*	Chanda	R,C	20	60-70
26.	*Mystus tengra*	Bujuri	R,C	15	70-80
27.	*Clupisoma garua*	Garua	R,C	10	80-90
28.	*Labeo calbasu*	Baus	R,C	20	70-90
29	*Not available*	Vada	R ,C	10	100-120
30	*Not available*	Fali	R,C	15	150-200
31	*Not available*	Taki	R ,C	35	80-90
32	*Not available*	Shing	R ,C	40	130-150

Note:R= Meghna River, P= Pond, C= Canal
Source: Study team

Locations of fish markets around Meghna Bridge and Gumti Bridge sites are show in Figure from 4.10 to 4.11 which includes very minor scale fish market as are not shown in the above table.

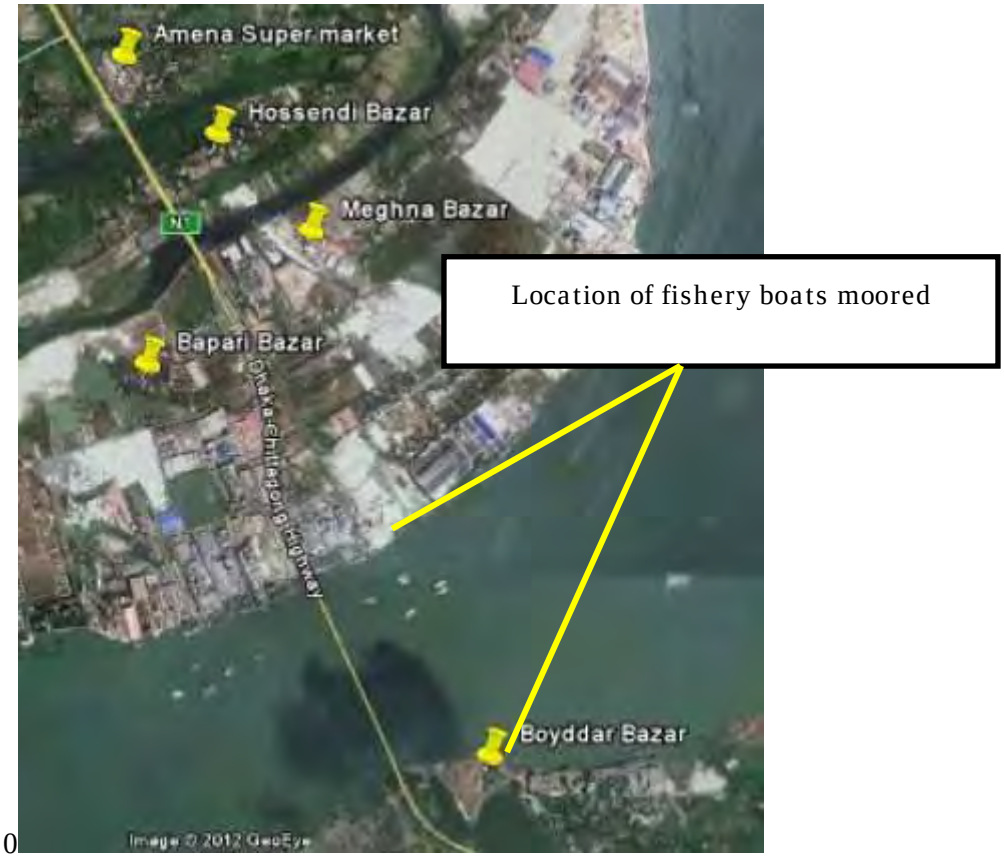


Figure 4.10 Location of Fish Markets in Meghna Bridge Site

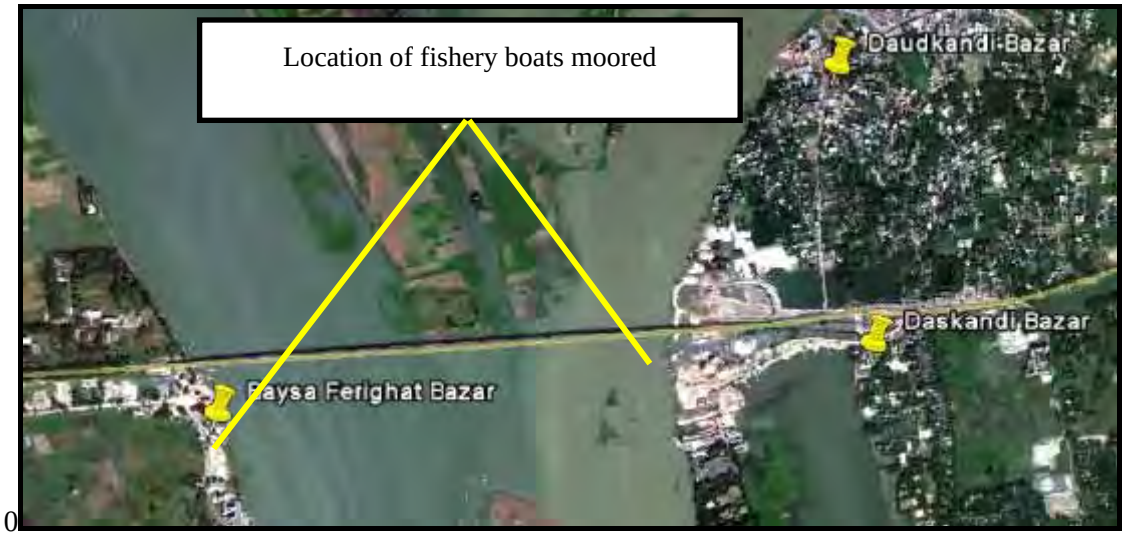


Figure 4.11 Location of Fish Markets at Gumti Bridge Site

Number of fishermen who resides projects site are less than 10 respectively for Meghna Bridge

and Gumti Bridge sites. They come from far away since the markets at Meghna Bridge and Gumti Bridge sites are the major markets around. There is no fisherman at Kanchpur Bridge site.

4.1.6 Water Use

The river port at Narayanganj is a major inland port and trading center. Various developments in the region continue to increase this port's importance to cargo ships, fishing boats, passenger boats, and trawlers. The Shitalakshya and Meghna River, and connecting waterways, will be relied upon for heavy construction equipment transportation as well as being used for power station cooling and general water uses. The construction contractor will only use groundwater for the provision of potable water during the construction phase.

4.1.7 Hydrological condition

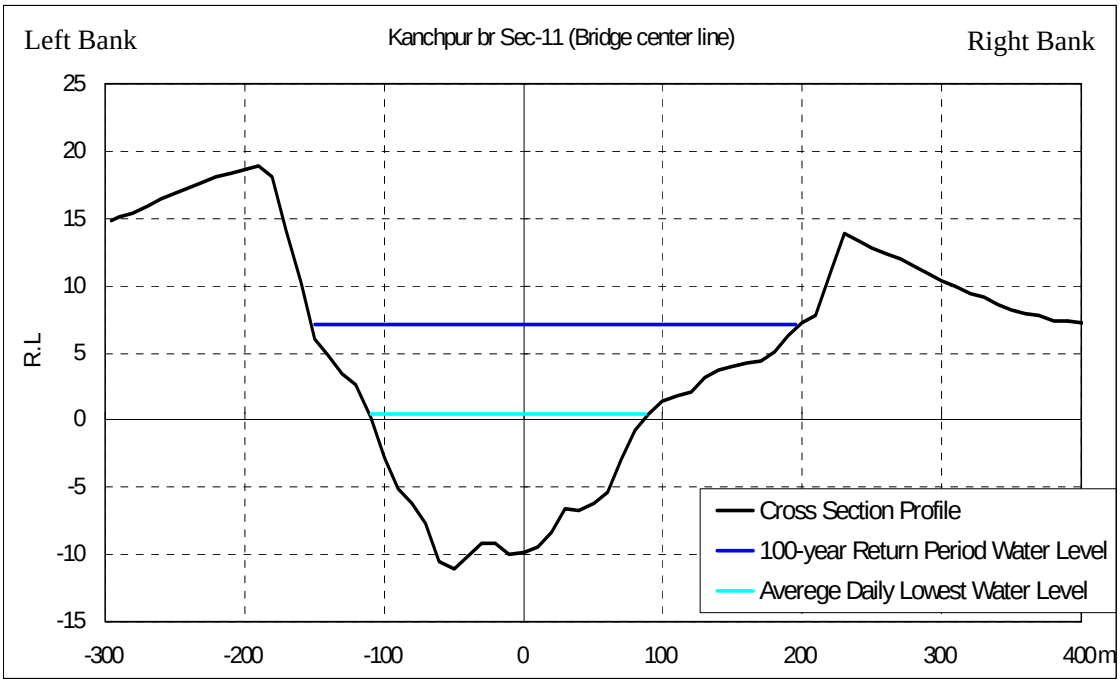


Figure 4.12 Shitalakshya River Section at Kanchpur Bridge

Table 4.2 Hydrological Conditions of Shitalakshya River at Kanchpur Bridge

	Water Level [R.L.m]	Cross Section Stream Area [m2]	Average Velocity [m/s]	Cross Section Discharge [m3/s]
100-year Return Period	7.05	3311.6	1.05	3,480
Averege Daily Lowest	0.40	1459.3	0.20	292

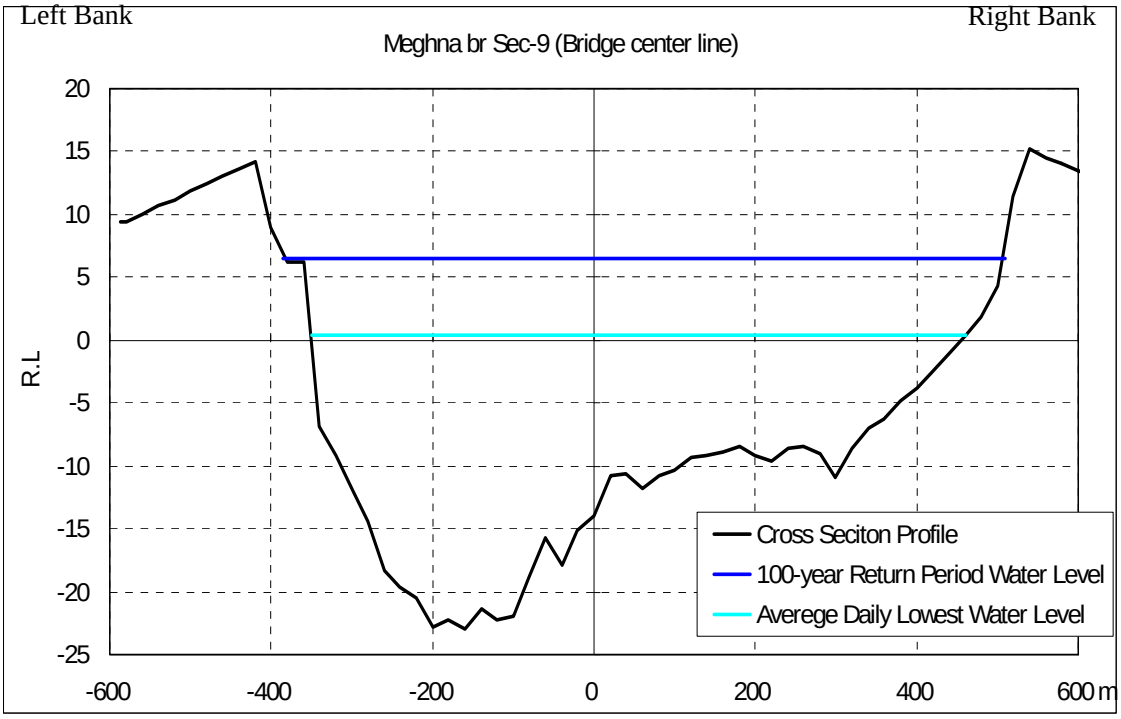


Figure 4.13 Meghna River Section at Meghna Bridge

Table 4.3 Hydrological Conditions of Meghna River at Meghna Bridge

	Water Level [R.L.m]	Cross Section Stream Area [m2]	Average Velocity [m/s]	Cross Section Discharge [m3/s]
100-year Return Period	6.56	15443.4	0.98	15,200
Average Daily Lowest	0.39	10231.6	0.20	2,046

0

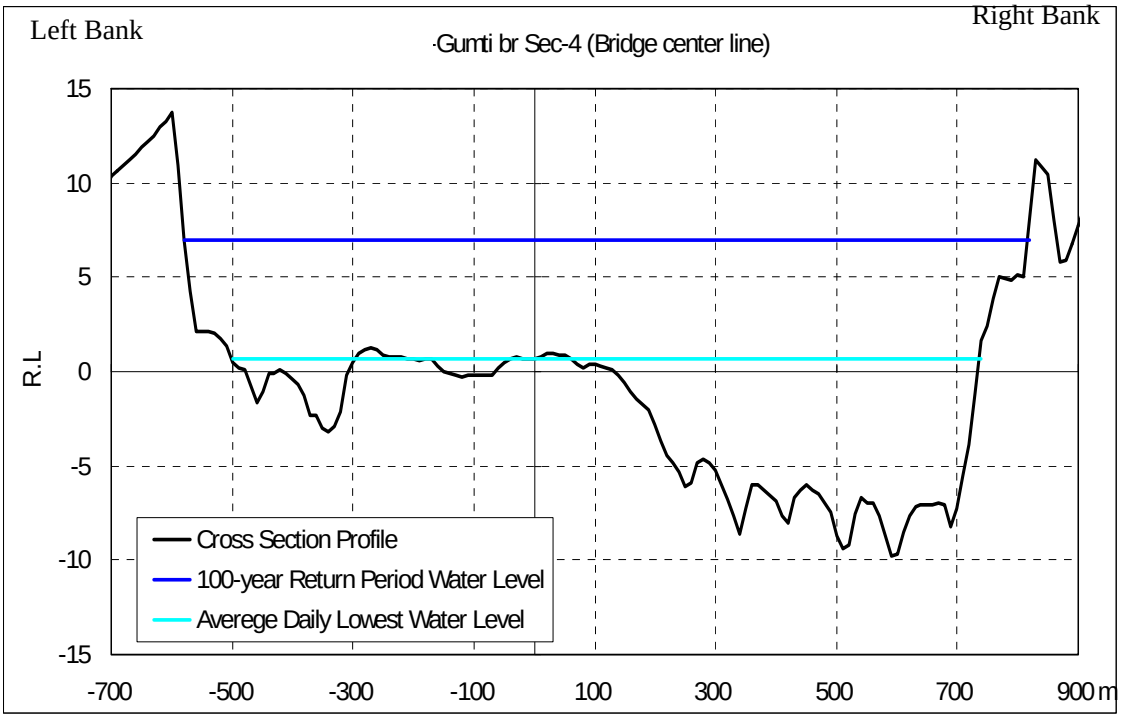


Figure 4.14 Gumti River Section at Gumti Bridge

Table 4.4 Hydrological Conditions of Gumti River at Gumti Bridge

	Water Level [R.L.m]	Cross Section Stream Area [m2]	Average Velocity [m/s]	Cross Section Discharge [m3/s]
100-year Return Period	6.94	12812.9	0.98	12,600
Average Daily Lowest	0.63	4477.8	0.20	896

4.2 Protected Areas

Based on Bangladesh Wildlife Preservation Order,1973 Protected Areas (PAs) is classified into national parks, wildlife sanctuaries, game reserves and private game reserves.

Bangladesh has 34 nationally designated protected areas covering approximately 2,705km^2 , which is 1.88percent of land area of the country, and the areas are 17 national parks and 17 wildlife sanctuaries.

A detailed list of these areas is provided in the Table 4.5. A map showing the Project site and PAs are given in Figure 4.15.

The objectives of managing these PAs：(1)to preserve breeding places and habitats of flora and fauna, (2)to protect communities and ecosystems, (3)to maintain natural processes, and (4)to provide facilities for research, education and recreation.

The nearest nature reserve, Bhawal National Park, is located 45km away from Kanchpur Bridge of the north Project site.

The ecological status of Bhawal National Park is said as follows:

"(IPAC) STATE OF BANGLADESH'SFOREST PROTECTED AREAS'S2010 INTEGRATED PROTECTED AREA CO-MANAGEMENT"

“Approximately 10 species of mammals, 6 species of amphibians, 9 species of reptiles and 39 species of birds are found in the park. Civet, Mongoose, Fox, Jungle Cat, Wild Boar and Hare are the main mammals. Monitor lizard, Snake, Python and Tortoise are the main reptiles. Nearly 220 species of plants are being recognized in the PA area, among which are 24 species of climbers, 27 species of grasses, 105 species of herbs, 3 species of palms, 19 species of shrubs and 43 species of timber trees . ”

Table4.5 PAs of Bangladesh

Sl.	Protected Areas	Habitat Types	Location	Area(ha)	Established (Extended)
A.	NATIONAL PARKS (IUCN category V)				
01	Modhupur NP	Deciduour Forest	Tangail	8,436.00	1962(24/2/1982)
02	Bhawal NP	Deciduour Forest	Gazipur	5,022.00	1974(11/5/1982)
03	Himchari NP	Mixed Evergreen	Cox's Bazar	1,729.00	15/2/1980
04	Lawachara NP	Mixed Evergreen	Moulvibazar	1,250.00	7/7/1996
05	Kaptai NP	Wetland	Chitagong Hill Tracts	5,464.00	9/9/1999
06	Ramsagar NP	Wetland	Dinajpur	27.75	30/4/2001
07	Nijhum Dweep NP	Mangrove Forest	Noakhali	16,352.23	8/4/2001
08	Medha Kachapia NP	High Hill Mixed Forest	Cox's Bazar	395.92	8/8/2008
09	Satchari NP	Evergreen	Habigonj	242.91	15/10/2005
10	Khadimnagar NP	Mixed Evergreen	Sylhet	678.80	13/4/2006
11	Baraiyadhala NP		Chittagong	2,933.61	06/04/2010
12	Kuakata NP		Patuakhali	1,613.00	24/10/2010
13	Nababgonj NP		Dinajpur	517.61	24/10/2010
14	Shingra NP		Dinajpur	305.69	24/10/2010
15	Kadigarh NP		Mymensingh	344.13	24/10/2010
16	Altadighi NP	Sal Deciduous Forest	Naogaon	264.12	24/12/2011
17	Birgonj NP		Dinajpur	168.56	24/12/2011
B.	WILDLIFE SANCTUARIES (IUCN category IV)				
18	Sundarban (East) WS	Mangrove Forest	Bagerhat	31,226.94	1960(6/4/1996)
19	Pablakhali WS	High Hill Mixed Forest	Chittagong HillTracts	42,087.00	1962(20/9/1983)
20	Char Kukri-Mukri WS	Char land & Mngrove Forest	Bhola	40.00	19/12/1981
21	Chunati WS	Mixed Evergreen Forest	Chittagong	7,763.97	18/3/1986
22	Rema-KalengaWS	Mixed Evergreen Forest	Hobiganj	1,795.54	7/7/1996
23	Sundarban (South)WS	Mangrove Forest	Khulna	36,970.45	6/4/1996
24	Sundarban (West)WS	Mangrove Forest	Satkhira	71,502.10	6/4/1996
25	Fasiakhali WS	Mixed Forest	Cox's Bazar	1,302.43	11/4/2007
26	Duch Pukuria-Dhopachari WS	Tropical Evergreen and Semi-Evergreen	Chittagong	4,716.57	6/4/2010
27	Hazarikhil WS	Tropical Evergreen and Semi-Evergreen	Chittagong	1,177.53	6/4/2010
28	Sangu WS		Bandarban	2,331.98	6/4/2010
29	Teknaf WS		Cox's Bazar	11,615.00	1983(24/3/2010)
30	Tengragiri WS	Coastal Mangrove Plantations	Barguna	4,048.58	24/10/2010
31	Dudhmukhi WS		Bagerhat	170.00	29/1/2012
32	Chadpai WS		Bagerhat	560.00	29/1/2012
33	Dhangmari WS		Bagarhat	340.00	29/1/2012
34	Sonarchar WS	Coastal Mangrove Plantations	Patuakhali	2,026.48	24/12/2011

Source：Forest Department (http://www.bforest.gov.bd/index.php/protected-areas)

Source：PAs of Bangladesh: A Visitor's Guide, Nishorgo, PAs Management Program, MoEF, Forestry Department,2006

Figure 4.15 PAs of Bangladesh

4.3 Ecological Resources

For baseline survey of present ecosystem around the sites, 2 experts (natural environmentalists) and with 3 enumerators made site reconnaissance within 2km radius from the bridges from 21st to 23rd June survey and 4th to 7th July survey together with interview to 10s of locals including fishermen. As a result, existing species observed were recorded.

Experts consultation made are:

DoE: Ph.D. Hafiza khatun, Professor,Department of Geography and Environment, Dhaka University

Fish and ecological expert：Kazi Farhed Iqubal, Head, Department of Environmental Science, State University of Bangladesh, Dhaka

Dolphin expert：Dr. S. M. A. Rashid, Chief Executive of CARINAM, Center for Advanced Research in Natural Resources and Management, Md.Istiak Sobhan,RhD,Programme Coordinator IUCN Bangladesh

Table4.6 Suggestions Obtained from Experts and Response

Expert	Suggestion
DOE	- Generally, impact to the environment by the construction of Bridges is tolerable. - Do not dump any waste into river - Safety for river transportation during construction shall be taken into account
Fish and ecological expert	- Important species around the Project sites - Fishing activities
Dolphin expert	- Since River Dolphin prefers the river having plenty of curves, orders and sand banks, there is possibility that it lives around Meghna and Gumti Bridges. - Do not build an enclosing bund and the bund can prevent River Dolphin from running for spawning. - Although River Dolphin is almost blind, it is vulnerable to strong light and there is need to pay attention to the intensity of construction light at night. - Because the life of River Dolphin depends on sound wave, it should be avoided that it gets frightened at noise when it passes the Project sites. Its auditory perception is so decent that it can hear some sound generated far place. From this, there is doubt if halt of piling has effect on it. - Do not allow passing construction vessels to interrupt the way of River Dolphin. - As River Dolphin chiefly feeds benthic animal, river bottom and water quality should not be contaminated. - The suitable water depth for River Dolphin’s habitat is more than 10 meters.

4.3.1 Flora

Homestead vegetation at the Project site is in well condition and bearing the important of plant community in terms of diversity. Most of the houses are vegetated by local cultivated plants and a big portion of the coverage occupied by wild shrubs and herbs. Common planted tree species are Aam (*Mangifera indica*), Kathal (*Artocarpus heterophyllus*), Tal (*Borassus flabelifer*), Sissoo (*Swietenia sissoo)*, Supari (*Areca catechu*), Mehogani (*Swietenia mahagoni*), Kola (*Musa sp*), Boroi (*Zizyphus mauritiana)*, Narikel (*Cocos nucifera*) and Supari (*Areca catechu*) occupied the top canopy. Among the shrubs Kachu (*Colocasia esculenta*) is the most common of all species. This type of vegetation have a major contribution for meeting food, fodder, medicine, fuel and other household requirements to the local people. Homesteads vegetation also supports good shelter for many wildlife species. There is no acts affecting to vegetation, during both construction and operation.

Types of crops on the char are very common species such as wheat,paddy,beans etc.

All of the plant species on the table 4.7 are not regarded as preserved species by domestic rules.

Table 4.7(1) Plant Species with Habitat Distribution, Abundance and Usage

Local status: VC – Very Common, C – Common, R – Rare, VR – Very rare

IUCN status: VU—Vulnerable, NT—Near Threatened, LC—Least Concern

SL#	Scientific Name	Family	Local Name	Local Status	IUCN Status	Usage	Habit
	Plant species in Kanchpur Bridge surrounding area						
1.	*Azadirachta indica*	Meliaceae	Nim	C	LC	Timber and medicine	Tree
2.	*Dalbergia sissoo*	Fabaceae	Sisso	C	VU	Timber and fuelwood	Tree
3.	*Mangifera indica*	Anacardiaceae	Aam	VC	LC	Fruit and Timber	Tree
4.	*Musa paradisiaca var. sapientum*	Musaceae	Kala	VC	LC	Fruit	Shrub
5.	*Psidium guajava*	Myrtaceae	Peyara	C	LC	Fruit	Shrub
6.	*Swietenia mahagoni*	Meliaceae	Mahogoni	VC	LC	Timber and medicine	Tree
7.	*Syzygium cumini*	Myrtaceae	Kalojam	C	LC	Fruit	Tree
8.	*Zizyphus mauritiana*	Rhamnaceae	Baroi	C	LC	Fruit	Tree
9.	*Mimosaceae Albizia*	Mimosaceae	Sil Koroi	C	LC	Timber and fuelwood	Tree
10.	*Syzygium samarangense*	Moraceae	Jamrul	R	LC	Fruit and fuelwood	Tree
11.	*Cynodon dactylon*	Gramineae	Durba	VC	LC	Grass	Herb
12.	*Colocasia esculenta*	Araceae	Kachu	C	LC	Vegetable	Herb
13.	*Caesalpinae Delonix*	Caesalpinceae	Krishnachura	C	LC	Ornamental and fuelwood	Tree

Data source: Study team using International Union for Conservation of Nature (IUCN)classification system

Table 4.7(2) Plant Species with Habitat Distribution, Abundance and Usage

Local status: VC – Very Common, C – Common, R – Rare, VR – Very rare

IUCN status: VU—Vulnerable, NT—Near Threatened, LC—Least Concern

	Plant species in Meghna Bridge surrounding area						
1.	*Aegle marmelos*	Rutaceae	Bel	R	LC	Fruit and Medicine	Tree
2.	*Areca catechu*	Palmae	Supari	VC	LC	Fruit and Timber	Tree
3.	*Artocarpus heterophyllus*	Moraceae	Kathal	C	LC	Fruit, Timber and fuelwood	Tree
4.	*Azadirachta indica*	Meliaceae	Nim	C	LC	Timber and medicine	Tree
5.	*Borassus flabelifer*	Palmae	Tal	R	LC	Fruit, Fuel wood and Timber	Tree
6.	*Carica papaya*	Caricaceae	Papay	C	LC	Fruit	Shrub
7.	*Cocos nucifera*	Palmae	Narikel	VC	LC	Fruit and Fuelwood	Tree
8.	*Litchi chinensis*	Sapindaceae	Lichu	C	LC	Fruit	Tree
9.	*Mangifera indica*	Anacardiaceae	Aam	VC	LC	Fruit and Timber	Tree
10.	*Psidium guajava*	Myrtaceae	Peyara	C	LC	Fruit	Shrub
11.	*Swietenia mahagoni*	Meliaceae	Mahogoni	VC	LC	Timber and medicine	Tree
12.	*Syzygium cumini*	Myrtaceae	Kalojam	C	LC	Fruit	Tree
13.	*Zizyphus mauritiana*	Rhamnaceae	Baroi	C	LC	Fruit	Tree
14.	*Cynodon dactylon*	Gramineae	Durba	VC	LC	Grass	Herb
15.	*Colocasia esculenta*	Araceae	Kachu	C	LC	Vegetable	Herb
16.	*Acacia auriculiformis*	Mimosaceae	Akashmoni	C	LC	Timber	Tree
17.	*Albizia lebbeck*	Mimosaceae	Kalo koroi	C	LC	Timber	Tree
18.	*Averrhoa carambola*	Averrhoaceae	Kamranga	C	LC	Fruit	Tree

Data source: Study team using IUCN classification system

Table 4.7(3) Plant Species with Habitat Distribution, Abundance and Usage

Local status: VC – Very Common, C – Common, R – Rare, VR – Very rare

IUCN status: VU—Vulnerable, NT—Near Threatened, LC—Least Concern

	Plant species iGumti Bridge surrounding area						
1.	*Aegle marmelos*	Rutaceae	Bel	R	LC	Fruit and Medicine	Tree
2.	*Anthocephalus chinensis*	Rubiaceae	Kadom	C	LC	Timber and fuelwood	Tree
3.	*Areca catechu*	Palmae	Supari	VC	LC	Fruit and Timber	Tree
4.	*Artocarpus heterophyllus*	Moraceae	Kathal	C	LC	Fruit, Timber and fuelwood	Tree
5.	*Averrhoa carambola*	Averrhoaceae	Kamranga	C	LC	Fruit	Tree
6.	*Azadirachta indica*	Meliaceae	Nim	C	LC	Timber and medicine	Tree
7.	*Bombax ceiba*	Bombacaceae	Shimul	C	LC	Cotton and Fuelwood	Tree
8.	*Borassus flabelifer*	Palmae	Tal	R	LC	Fruit, Fuel wood and Timber	Tree
9.	*Carica papaya*	Caricaceae	Papay	C	LC	Fruit	Shrub
10.	*Cassia fistula*	Leguminosae	Badarlathi / Sonalu	R	LC	Ornamental and Medicine	Tree
11.	*Citrus grandis*	Rutaceae	Jambura	C	LC	Fruit	Tree
12.	*Cocos nucifera*	Palmae	Narikel	VC	LC	Fruit and Fuelwood	Tree
13.	*Dalbergia sissoo*	Fabaceae	Sisso	C	LC	Timber and fuelwood	Tree
14.	*Litchi chinensis*	Sapindaceae	Lichu	C	LC	Fruit	Tree
15.	*Mangifera indica*	Anacardiaceae	Aam	VC	LC	Fruit and Timber	Tree
16.	*Musa paradisiaca var. Sapientum*	Musaceae	Kala	VC	LC	Fruit	Shrub
17.	*Phoneix sylvestris*	Palmae	Khejur	C	LC	Fruit and Fuelwood	Tree
18.	*Psidium guajava*	Myrtaceae	Peyara	C	LC	Fruit	Shrub
19.	*Swietenia mahagoni*	Meliaceae	Mahogoni	VC	LC	Timber and medicine	Tree
20.	*Syzygium cumini*	Myrtaceae	Kalojam	C	LC	Fruit	Tree
21.	*Terminalia catappa*	Combretaceae	Katbadam	R	LC	Fruit	Tree
22.	*Zizyphus mauritiana*	Rhamnaceae	Baroi	C	LC	Fruit	Tree
23.	*Mimosaceae Albizia*	Mimosaceae	Sil Koroi	C	LC	Timber and fuelwood	Tree
24.	*Syzygium samarangense*	Moraceae	Jamrul	R	LC	Fruit and fuelwood	Tree
25.	*Caesalpinae Delonix*	Caesalpinceae	Krishnachura	C	LC	Ornamental and fuelwood	Tree
26.	*Feronia jambheri*	Rutaceae	Jamir Lebu	C		Fruit	Shrub
27.	*Elaeocarpu floribundus*	Elaeocarpaceae	Jalpai	C	LC	Fruit	Tree
28.	*Cynodon dactylon*	Gramineae	Durba	VC	LC	Herb	
29.	*Colocasia esculenta*	Araceae	Kachu	C	LC	Herb	
30.	*Acacia auriculiformis*	Mimosaceae	Akashmoni	C	LC	Timber	Tree
31.	*Albizia lebbeck*	Mimosaceae	Kalo koroi	C	LC	Timber	Tree
32.	*Eucalyptus teritocornis*	Myrataceae	Eucalyptus	C	LC	Timber	Tree
33.	*Feronia limonia*	Rutaceae	Kothbel	C	LC	Fruit	Tree
34.	*Feronia jambheri*	Rutaceae	Jamir lebu	C		Fruit	Shurb

Data source: Study team using IUCN classification system

Plant Species diversity: A total of 34 homestead species of 18 Families were listed in the three bridges area. Of which 21 are fruit producing, 11 timbers, 10 are fuel wood and 4 are medicinal. However, this list is not full and some of the species are uses for multiple purposes such as flavor for cooking, medical uses traditional treatment and coloring of cloths. It is found that Rutaceae, Palmae and Myrtaceae families rank top of the list and are represented by 5, 4 and 3 species respectively. Homestead flora consists of both native and exotic species and some of them are naturalized. There is no precious species within 2km from the Project site because of the following results: (1) primary survey, (2) consultation with local people and experts, (3) published literature.

4.3.2 Fauna

Avi-fauna (Bird)

The surroundings of the Project area are not ecologically good condition for resident birds; no migratory birds come in this area ever recorded. A total of about 9 bird species were observed within the Project area.

All bird is terrestrial bird species were observed within the project area. House Crow, Indian Pond Heron and Common Myna in Table4.8 were observed in the Kanchpur, Meghna, Gumti Bridge surrounding area respectively. Beside the Meghna, Gumti River there are some villages and some bird's species were observed in these villages and here are more species observed than other two Project area. House Crow (*Corvus splendens*), Striated Heron (*Butorides striata*), Common Myna (*Acridotheres tristis*), Oriental Magpie-Robin (*Copsychus saularis*) species are common in these Project area.

There is no governmental institute who implements monitoring of ecosystem. Year round ecological survey is done by private environmental consultancy firm. As a specific project, the ecologist will observe birds and implement Focus Group Discussions (FGD) with local people to ensure these species availability in those areas.

Table 4.8 List of Bird at the Sites

IUCN Status	Birdlife Global Status	Local Status
VU- Vulnerable	Same as IUCN Status	CR-Common Resident
EN-Endangered		UR-Uncommon Resident
CR- Critically Endangered		CWV- Common Winter Visitor
LC-Least Concern		UWV- Uncommon Winter Visitor

Birds species in Kanchpur bridge surrounding area									
SL#	Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status	Occurrence of Species		
							Primary Survey	Local people consultation	Published Literature
1	Corvus splendens	House Crow	Pati Kak	LC	CR	LC	√ Seen		
2	Ardeola grayii	Indian Pond Heron	Deshi Kanibok	LC	CR	LC	√ Seen		

3	Acridotheres tristis	Common Myna	Bhat Shalik	LC	CR	LC	√ Seen		
4	Copsychus saularis	Oriental Magpie-Robin	Udoi Doel	LC	CR	LC		√	

Birds species in Meghna bridge surrounding area

SL#	Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status	Occurrence of Species		
							Primary Survey	Local people consultation	Published Literature
1	Corvus splendens	House Crow	Pati Kak	LC	CR	LC	√ Seen		
2	Acridotheres tristis	Common Myna	Bhat Shalik	LC	CR	LC	√ Seen		
3	Passer domesticus	House Sparrow	Pati Chorui	LC	CR	LC		√	
4	Copsychus saularis	Oriental Magpie-Robin	Udoi Doel	LC	CR	LC	√		
5	Columba livia	Common Pigeon	Gola Paira	LC	CR	LC		√	
6	Ardeola grayii	Indian Pond Heron	Deshi Kanibok	LC	CR	LC	√ Seen		

Birds species in Gumti bridge surrounding area

SL#	Scientific Name	English Name	Local Name	IUCN Status	Local Status	Birdlife Status	Occurrence of Species		
							Primary Survey	Local people consultation	Published Literature
1	Corvus macrorhynchos	Large-billed Crow	Dar Kak	LC	CR	LC		√	
2	Corvus splendens	House Crow	Pati Kak	LC	CR	LC	√ Seen		
3	Ardeola grayii	Indian Pond Heron	Deshi Kanibok	LC	CR	LC	√ Seen		
4	Acridotheres tristis	Common Myna	Bhat Shalik	LC	CR	LC	√ Seen		
5	Alcedo atthis	Common Kingfisher	Pati Machranga	LC	CR	LC		√	
6	Passer domesticus	House Sparrow	Pati Chorui	LC	CR	LC		√	
7	Copsychus saularis	Oriental Magpie-Robin	Udoi Doel	LC	CR	LC	√ Seen		
8	Columba livia	Common Pigeon	Gola Paira	LC	CR	LC		√	

Data source: Study team using IUCN classification system

Amphibians

Within the study site the number of amphibian population is low and not in abundance. The amphibians are the major components of their respective biological ecosystems, both as predator and prey. They are the valuable part of the biotic community, and have not received as much attention as birds and mammals, but they do play an important role in the balance of nature. In the project area 1, 2, 4 amphibian species were observed in the Kanchpur, Meghna and Gumti Bridge surrounding area respectively. Common Toad (*Duttaphrynus melanostictus*)

is common in the Project areas.

Table 4.9 List of Amphibians at the Sites

Local Status code: CR – Common Resident, C – Common, UR – Uncommon Resident, RR – Rare Resident, V – Vagrant, WV – Winter Visitor; UWV – Uncommon Winter Visitor
IUCN Status code: CR – Critically Endangered, EN - Endangered, VU - Vulnerable, LC - Least Concern

Amphibian in Kanchpur Bridge surrounding area									
SL#	Scientific Name	English Name	Local Name	Family	IUCN Status	Local Status	Occurrence of species		
							Primary Survey	Local people consultation	Published Literature
	Duttaphrynus melanostictus	Common Toad	Kuno Bang	Bufonidae	LC	CR	√		
Amphibian in Meghna Bridge surrounding area									
1	Duttaphrynus melanostictus	Common Toad	Kuno Bang	Bufonidae	LC	CR	√		
2	Fejervarya limnocharis	Cricket Frog	Jhijhi Bang	Dicroglossidae	LC	C		√	
Amphibian in Gumti Bridge surrounding area									
1	Duttaphrynus melanostictus	Common Toad	Kuno Bang	Bufonidae	LC	CR	√		
2	Euphlyctis cyanophylctis	Skipper Frog	Kotkoti Bang	Dicroglossidae	LC	C		√	
3	Fejervarya limnocharis	Cricket Frog	Jhijhi Bang	Dicroglossidae	LC	C		√	
4	Hoplobactrachus tigerinus	Indian Bull Frog	Sona bang	Dicroglossidae	LC	C	√		

Data source: Study team using IUCN classification system

Reptiles

During study, it has been found that the reptilian population (number of the individuals) was low because the Project surrounding area commonly industrial zone. There are only on turtle population were found because habitat and habitat niche is being destroyed by the local people for rapid urbanization and drastic changes in type of land use.

The Project areas are very poor in biodiversity. Common reptiles that were found within the area are Brooks House Gecko (*Hemidactylus brookii*), Bengal Monitor (*Varanus bengalensis*), and Checkered Keelback (*Xenochropis piscator*)

As a result of interview with the crocodile experts (Dr. S. M. A. Rashid, and Md. Istiak Sobhan), it is said that there is no brackish water crocodile around the sites.

Table 4.10 List of Reptile at the Sites

Local Status code: CR – Common Resident, C – Common, UR – Uncommon Resident, RR – Rare Resident, V – Vagrant, WV – Winter Visitor; UWV – Uncommon Winter Visitor

IUCN Status code: CR – Critically Endangered, EN - Endangered, VU – Vulnerable, LC- Least Concern, LR- lower Risk

Reptile in Kanchpur Bridge surrounding area

SL#	Scientific Name	English Name	Local Name	Family	IUCN Status	Local Status	Occurrence of species		
							Primary Survey	Local people consultation	Published Literature
	Hemidactylus brookii	Brooks House Gecko	Tiktiki	Gekkonidae	LC	CR	√		
	Varanus bengalensis	Bengal Monitor	Gui Shap	Varanidae	LC	CR		√	
	Xenochropis piscator	Checkered Keelback	Dhora Shap	Colubridae	LC	C		√	
Reptile in Meghna Bridge surrounding area									
1	Pangshura tectum	Indian Roofed Turtle	Kori/Hali Kasim	Bataguridae	-	C		√	
2	Hemidactylus brookii	Brooks House Gecko	Tiktiki	Gekkonidae	LC	CR	√		
3	Varanus bengalensis	Bengal Monitor	Gui Shap	Varanidae	LC	CR		√	
4	Xenochropis piscator	Checkered Keelback	Dhora Shap	Colubridae	LC	C		√	
Reptile in Gumti Bridge surrounding area									
1	Pangshura tectum	Indian Roofed Turtle	Kori/Hali Kasim	Bataguridae	-	C		√	
2	Hemidactylus brookii	Brooks House Gecko	Tiktiki	Gekkonidae	LC	CR		√	
3	Varanus bengalensis	Bengal Monitor	Gui Shap	Varanidae	LC	CR		√	
4	Xenochropis piscator	Checkered Keelback	Dhora Shap	Colubridae	LC	C		√	
5	Hemidactylus frenatus	Common House Gecko	Tiktiki	Gekkonidae	LC	CR	√		
6	Enhydris enhydris	Common Smooth Water Snake	Painna Shap	Colubridae	LC	CR		√	

Data source: Study team using IUCN classification system

Fish

Meghna and Gumti Rivers are a major source of fish species. These rivers meet major part of fishing demand of the country.

A comprehensive survey from the Meghna Estuaries area in Bangladesh was made at the delta and floodplain fishery (FAP 17 1994; ODA 1997). In total for the whole freshwater sector 98 species were recorded the lowland sites at Meghna River showed considerable similarities with communities dominated by cyprinids, particularly major carp species and catfishes. A distinction can be made between main channel migratory species, such as the major carps and the floodplain resident species that are often small and have accessory respiratory systems and prolific reproduction.

Table 4.11: List of fish in Shitalakshya, Meghna and Gumti Rivers

Fish Species in Kanchpur Bridge area (Shitalakshya river and Market survey)				
SL#	Scientific Name	Local Name	Common English name	IUCN status
1	*Labio rohita*	Rui	Rohu	LC
2	*Catla catla*	Catla	Katla	LC
3	*Mystus vitatus*	Tangra	Striped dwarf Catfish	LC
4	*Puntius ticto*	Puti	Ticto Barb	LC
5	*Lepidosephalus guntia*	Gutum	Guntia Loach	LC
6	*Ompok pabda*	Pabda	Pabo catfish	LC
7	*Channa panchtatus*	Taki	Spotted snakehead	LC
8	*Barbonymus gonionotus*	Sorputi	Olive Barb	LC
9	*Anabus Testudineus*	Koi	Climbing Perch	LC
10	*Oreochromis mossambicus*	Tilapia	Mozambique tilapia	LC
11	*Hypophthalmichthys Molitrix*	Silver carp	Silver carp	LC
12	*Pangasius pangasius*	Pangas	Yellowtail catfish	LC
13	*Rita rita*	Rita	Rita	LC
14	*Sperata seenghala*	Air	Giant river-catfish	LC
15	*Channa striata*	Shol	Snakehead murrel	LC
16	*Macrobrachium rosenbergii*	Galda chingri	Tiger prawn	LC
Fish Species in Meghna Bridge area (Meghna river and Market survey)				
SL#	*Scientific Name*	Local Name	Common English name	IUCN status
	Puntius ticto	Puti	Ticto Barb	LC
	Labio rohita	Rui	Rohu	LC
	Catla catla	Catla	Katla	LC
	Mystus vitatus	Tangra	Striped dwarf Catfish	LC

	Barbonymus gonionotus	Sorputi	Olive Barb	LC
	Anabus testudineus	Koi	Climbing Perch	LC
	Channa striata	Shol	Snakehead murrel	LC
	Macrobrachium rosenbergii	Galda chingri	Tiger prawn	LC
	Oreochromis mossambicus	Telapia	Mozambique tilapia	LC
	Hypophthalmichthys Molitrix	Silver carp	Silver carp	LC
	Pangasius pangasius	Pangas	Yellowtail catfish	LC
	Rita rita	Rita	Rita	LC
	Sperata seenghala	Air	Giant river-catfish	LC
	Lepidosephalus guntia	Gutum	Guntia Loach	LC
	Ompok pabda	Pabda	Pabo catfish	LC
	Channa panchtatus	Taki	Spotted snakehead	LC
	Tenualosa ilisha	Illish	Hilsa shad	LC
	Wallago attu	Boal	Wallago	LC
	Awaous guamensis	Baila	-	LC
	Labeo bata	Bata	Bata	LC
	Salmostoma bacaila	Chela	Large razorbelly minnow	LC
	Pseudapocryptes Elongates	Chewa	-	LC
	Chitala chitala	Chitol	Clown Knifefish	LC
	Mystus cavasius	Kabashi Tengra	Gangetic mystus	LC
	Sicamugil cascasia	Kechhki	Yellowtail mullet	LC
	Ailiichthys punctata	Kajuli	Jamuna ailia	LC
	Catla catla	Katol	Catla	LC
	Amblypharyngodon mola	Mola	Mola carplet	LC

Fish Species in Gumti Bridge area (Gumti river and Market survey)

SL#	Scientific Name	Local Name	Common English name	IUCN status
1	Labio rohita	Rui	Rohu	LC
2	Puntius ticto	Puti	Ticto Barb	LC
3	Catla catla	Catla	Katla	LC
4	Mystus vitatus	Tangra	Striped dwarf Catfish	LC
5	Barbonymus gonionotus	Sorputi	Olive Barb	LC
6	Anabus testudineus	Koi	Climbing Perch	LC
7	Channa striata	Shol	Snakehead murrel	LC
8	Macrobrachium rosenbergii	Galda chingri	Tiger prawn	LC
9	Oreochromis mossambicus	Telapia	Mozambique tilapia	LC
10	Hypophthalmichthys Molitrix	Silver carp	Silver carp	LC
11	Pangasius pangasius	Pangas	Yellowtail catfish	LC
12	Rita rita	Rita	Rita	LC
13	Sperata seenghala	Air	Giant river-catfish	LC
14	Lepidosephalus guntia	Gutum	Guntia Loach	LC
15	Ompok pabda	Pabda	Pabo catfish	LC

16	Channa panchtatus	Taki	Spotted snakehead	LC
17	Tenualosa ilisha	Illish	Hilsa shad	LC
18	Wallago attu	Boal	Wallago	LC
19	Awaous guamensis	Baila	-	LC
20	Labeo bata	Bata	Bata	LC
21	Salmostoma bacaila	Chela	Large razorbelly minnow	LC
22	Pseudapocryptes Elongates	Chewa	-	LC
23	Chitala chitala	Chitol	Clown Knifefish	LC
24	Mystus cavasius	Kabashi Tengra	Gangetic mystus	LC
25	Sicamugil cascasia	Kechhki	Yellowtail mullet	LC
26	Ailiichthys punctata	Kajuli	Jamuna ailia	LC
27	Catla catla	Katol	Catla	LC
28	Amblypharyngodon mola	Mola	Mola carplet	LC
29	Macrognathus aculeatus	Tara baim	Lesser spiny eel	LC
30	Pisodonophis cancrivorus	Snake eel	Longfin snake-eel	LC
31	Parambassis ranga	Ranga chanda	Indian glassy fish	LC
32	Cirrhinus cirrhosus	Mrigol	Mrigal	LC
33	Ompok pabda	Modhu pabda	Pabdah catfish	LC
34	Pseudolaguvia ribeiroi	Kani tengra	Painted catfish	LC
35	Labeo calbasu	Kalibaus	Orange-fin labeo	LC
36	Notopterus notopterus	Foli/Chitol	Bronze featherback	LC
37	Gudusia chapra	Chapila	Indian River Shad	LC

Data source: Study team using (IUCN classification system

Among above, Hilsa is the nation-wide and the most popular fish because it is reasonable enough to get and is rich in protein. It is caught around lower Meghna River, namely downstream of Padma River, and the project does not affect the local people to fish it.

Mammals

Among the mammals, total 6 species were recorded, of which 3, 5, 6 species were found in Kanchpur, Meghna, Gumti Bridge surrounding respectively. River Dolphin (*Platanista gangetica*) is an IUCN red list threatened species are found in the project areas as endangered species. Common mammals that were found within the area are Dormer's Bat (*Scotozous dormeri*), House Rat (*Rattus rattus*), House Mouse (*Mus musculus*) only other than livestock.

Table 4.12 List of Mammals at the Sites

IUCN Status code: CR – Critically Endangered, EN - Endangered, VU – Vulnerable, LC-Least Concern

Mammals in Kanchpur Bridge surrounding area						
Sl. No.	Scientific Name	Common Name	IUCN status	Occurrence of species		
				Primary Survey	Local people consultation	Published Literature
	Scotozous dormeri	Dormer's Bat	LC		√	
	Rattus rattus	House Rat	LC	√		
	Mus musculus	House Mouse	LC		√	
Mammals in Meghna Bridge surrounding area						
1	Scotozous dormeri	Dormer's Bat	LC		√	
2	Rattus rattus	House Rat	LC	√		
3	Mus musculus	House Mouse	LC		√	
4	Suncun murinus	House shrew	LC		√	
5	Platanista gangetica gangetica	River Dolphin	EN		√	
Mammals in Gumti Bridge surrounding area						
1	Scotozous dormer	Dormer's Bat	LC		√	
2	Rattus rattus	House Rat	LC	√		
3	Mus musculus	House Mouse	LC		√	
4	Suncun murinus	House shrew	LC		√	
5	Vulpes bengalensis	Bengal fox	LC	√		
6	Platanista gangetica	River Dolphin	EN		√	

Data source: Study team using IUCN classification system

River Dolphin

It is noted that the endangered species, river dolphin is observed passing Meghna and Gumti Bridges frequently. South Asian River Dolphin (Platanista gangetica) is an IUCN red list threatened species are found in the Project areas as endangered species (EN) by IUCN (International Union for Conservation for Nature).

Since the river dolphin was observed by local, further study was implemented including other experts[2] meetings, data research etc. As a result, the status of river dolphin is as follows in Bangladesh[3]

Academic name:

[2] Ph.D.Mr. S. M. A. Rashid, Chief Executive of CARZINAM, Center for Advanced Reserch in Natural Resources and Management, Ph.D. Iqbal, Head of Environmental Science, the State University (No specialist was available from IUCN)

[3] After Asiatic Society, *Fauna and flora in Bangladesh*, 2009

Platamista gangetica (roxburgh, 1801)

English name: South Asian River Dolphin, (River Dolphin hereafter)

Blind River Dolphin

Local name: Shushuk

Ilucchum

Sishu

Nadir Shushuk

Hoom

Description:

Body is robust and soft, with a flexible neck, often characterized by a constriction or crease. Head small, with a rounded melon bisected by a shallow longitudinal ridge in front of the blowhole. Blow hole is a slit on top of the head that runs along the long axis of the animal's body. It's most striking feature is the long, narrow snout or rostrum, which can be as much as one fifth of its body length, laterally compressed, broadens at the tip where it is slightly thickened, sometimes upwardly curved in females. It is proportionally longer in females than in the males. Belly of young animals are lighter and often have a pinkish cast. Female adults are up to 2.6 and males 2.2m long, weighing 110kg. New born animal measures 70-90 cm in length.

Habits:

Being blind, the animal proves with its sensitive snout for food in the bottom mud. The diet consists of primarily fish and crustaceans. Vision is almost useless in the much turbid river environment. The River Dolphin breathes every three minutes. It may undergo local migrations, is curious and inoffensive, and travels and feeds in schools of three to ten or more although often alone or in pairs. Mostly they comfortably move 10m below the water surface. The shushuk is believed to have navigate 30km/day and, as a simple arithmetic calculation, they can migrate as much as 1,000km a year.

They can find food with help of an extremely sophisticated noise detecting system (bisonar).

Habitat:

River dolphin can be tolerable to stay in some concentration of brackish water but not in pure sea water. Generally occur alone or in clusters in counter current downstream of channel convergences and sharp meanders, and upstream and downstream of mid-channel islands. They prefer turbid, deep, meandered, strong and deep stream. They are very sensitive to strong light since they are almost blind. Most active time is 9-10a.m. and Afternoon in general.

Breeding:

High season for breeding is March to June although they can breed any season through out year if sufficient environment such as enough depth/ is secured. They bear 1 only. It takes 10 months until the baby gets matured. Life expectancy is 30-50 years. The breeding area, same as living

area, is the corner of the river, merging points of rivers where is tubid with mud, enough food and oxygen, with rapid stream and sufficient water depth much deeper than 10m.

Distribution:

It occurs in the Ganges, Brahmaputra, Meghna, Karnaplhuli, and Sangu River Systems and their tributaries in India, Bangladesh, Nepal etc, below an elevation of 250m. Relatively high density is reported recently in the Virkramshila Gangetic Dolohin Sunctury in India and in the lower Sangu River in southeast Bangladesh (south to Chittagong). They are also in good number in Sundarbans delta. A map of historical distribution, chaired by 19th century British naturalist John Anderson in 1879, show Shushuks[4] occurring throughout Ganges-Brahmaputra-Meghna and Karnaphuli River Systems in 1879, stated that the distributing range of river dolphin was only limited downstream or increasing salinity in deltas and upstream by rocky barriers or insufficient water. Their distribution has shrunk considerably since then, largely due to river development, which has blocked river dolphin movement and degraded their habitat. The locations of rivers are indicated in Figure 4.16.

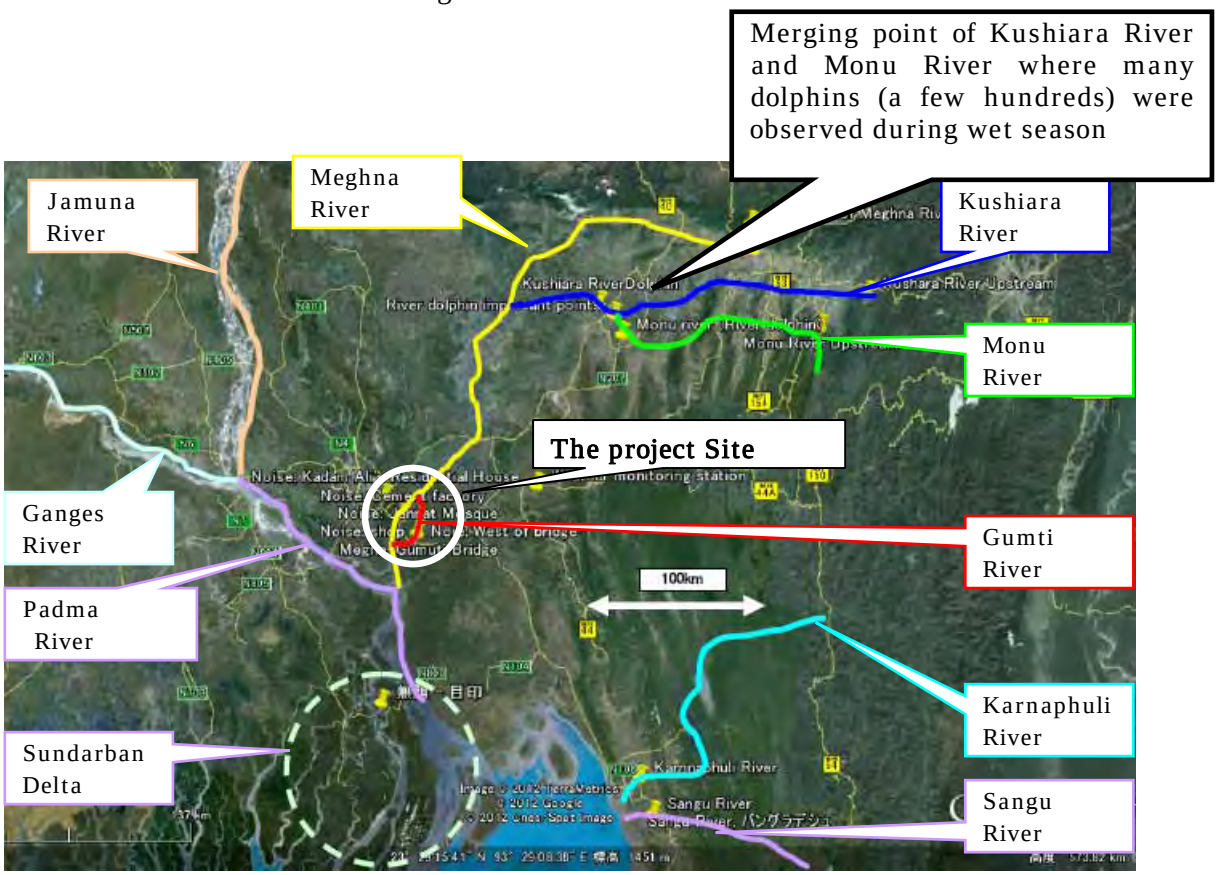


Figure 4.16 Rivers and Area where River Dolphin is Commonly Observed

Ecological role:

[4] South Asian River Dolphin in local name

Shushuks(local name of South Asean River Dolphin) are vulnerable to changes in their habitat and could potentially be used to monitor the ecological effect of hydrologic and oceanographic changes brought by declining of fresh water flows and sea-level rising. They are visible symbols of the need for wise maintenance of aquatic resources

Status:

There is no good overall abundance estimate for river dolphins. The total world population has been crudely estimated as 4,000. River dolphins are threatened in Bangladesh from the effects of dams, large embankment schemes, dredging, fisheries by catch, direct hunting water pollution and ship traffic.

Distribution of within Shitalakshya, Meghna and Gumti Rivers:

No river dolphin was observed in Shitalakshya River having Kanchpur Bridge. Both banks of Shitalakshya are much developed and river water has been deteriorated for River dolphin to stay. There are supposed to be some river dolphins in Meghna River System including Meghna and its branches of Gumti River, Kushiara River and Monu River. It is reported that many river dolphins were observed while breeding season at the merging point of Kushiara River and Monu River, some 200km upstream from Meghna Bridge Sire, where river is meandering and water quality is turbid with many fishes and strong flow and is like to be one of the major habitats but not confirmed. Although conditions are clear in which River Dolphin prefer to stay in the views of food and habit they prefer, the actual location of their habitat is not confirmed.

Site reconnaissance by the exerts and hearing from 10 locals at the Meghna and Gumti Sites, River Dolphins seem passing through these Bridge sites sometimes based on the observation from the bank and Bridges in wet season when enough waters are there in the river

4. 4 Environmental Quality

Environmental quality baseline monitoring was conducted in two rounds survey programs to cover both dry and wet seasons. Parameters for baseline quality monitoring are chosen based on the requirements of national air, noise and water quality standards and as well as the expert consultations. The following parameters are measured:

Surface Water Quality: pH, Turbidity, BOD5, COD, TDS, TSS, DO, NH3-N, Total Coliform, and oil and grease.

Ground Water Quality: pH, Turbidity, Mn, Fe, As, Electrical Conductivity, Chloride as Cl

Air Quality: SPM, PM2.5, PM10, SOx, NOx, Lead

Soil Quality (River bed and Top soil): Lead, Cadmium, Arsenic, Organic content, Mercury, Cromium+6, Pesticides Residual Test for Agricultural chemical

Noise Quality: 4 sets of continuous hourly average for day and night time

1) Air pollution

Air Quality was measured both at dry and wet season respectively at three Bridges. Locations of samplings are presented in Figures from 4.17 to 4.19 and results were summarized in Table 4.13. Locations were selected based on the land used patterns (industrial, residential, commercial areas etc.) as are defined in Environmental Conservation Rules 1997.

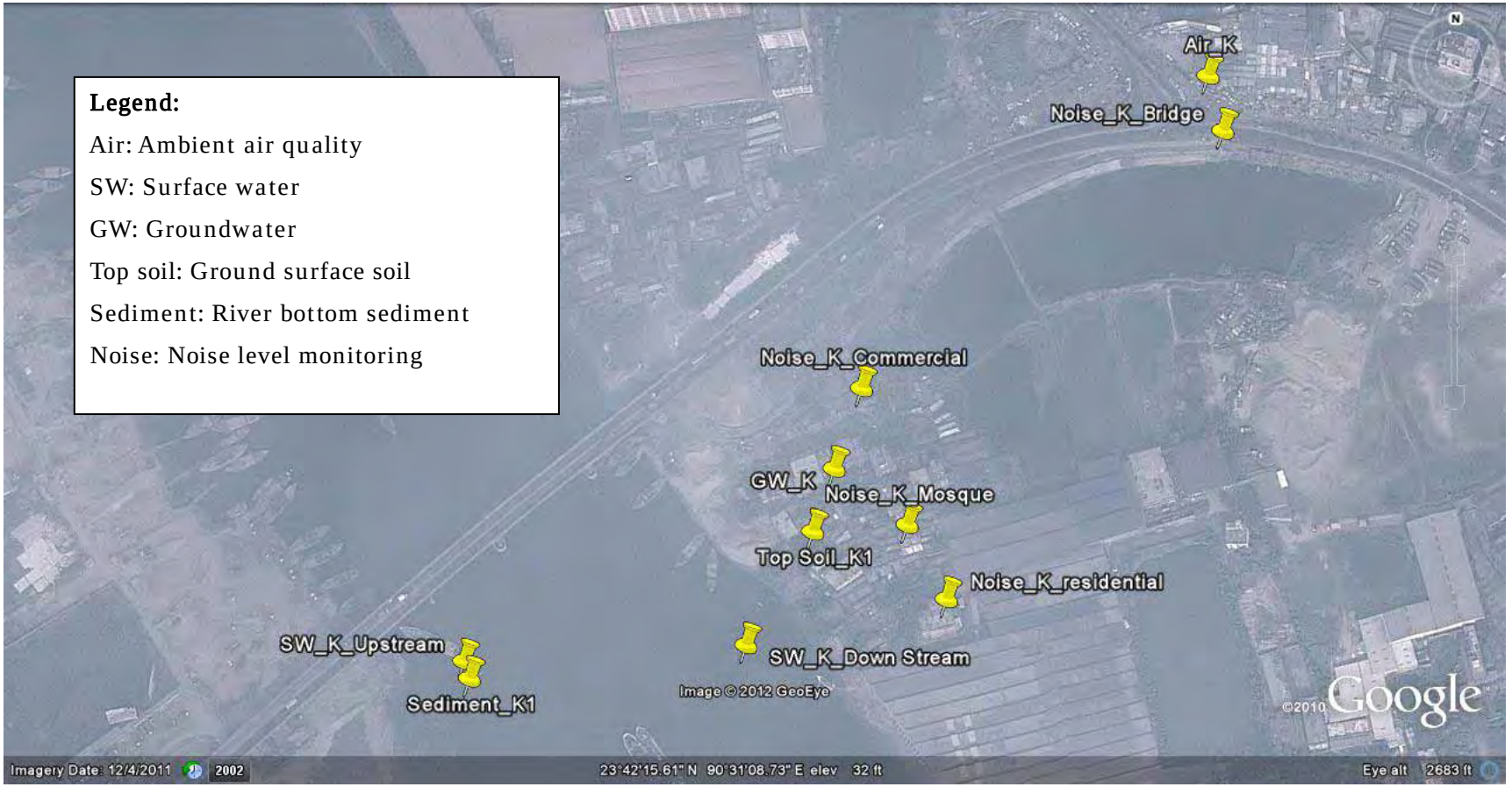


Figure 4.17 Locations of Samplings for Chemical Analyses at Kanchpur Bridge

Figure 4.18 Locations of Samplings for Chemical Analyses at Meghna Bridge

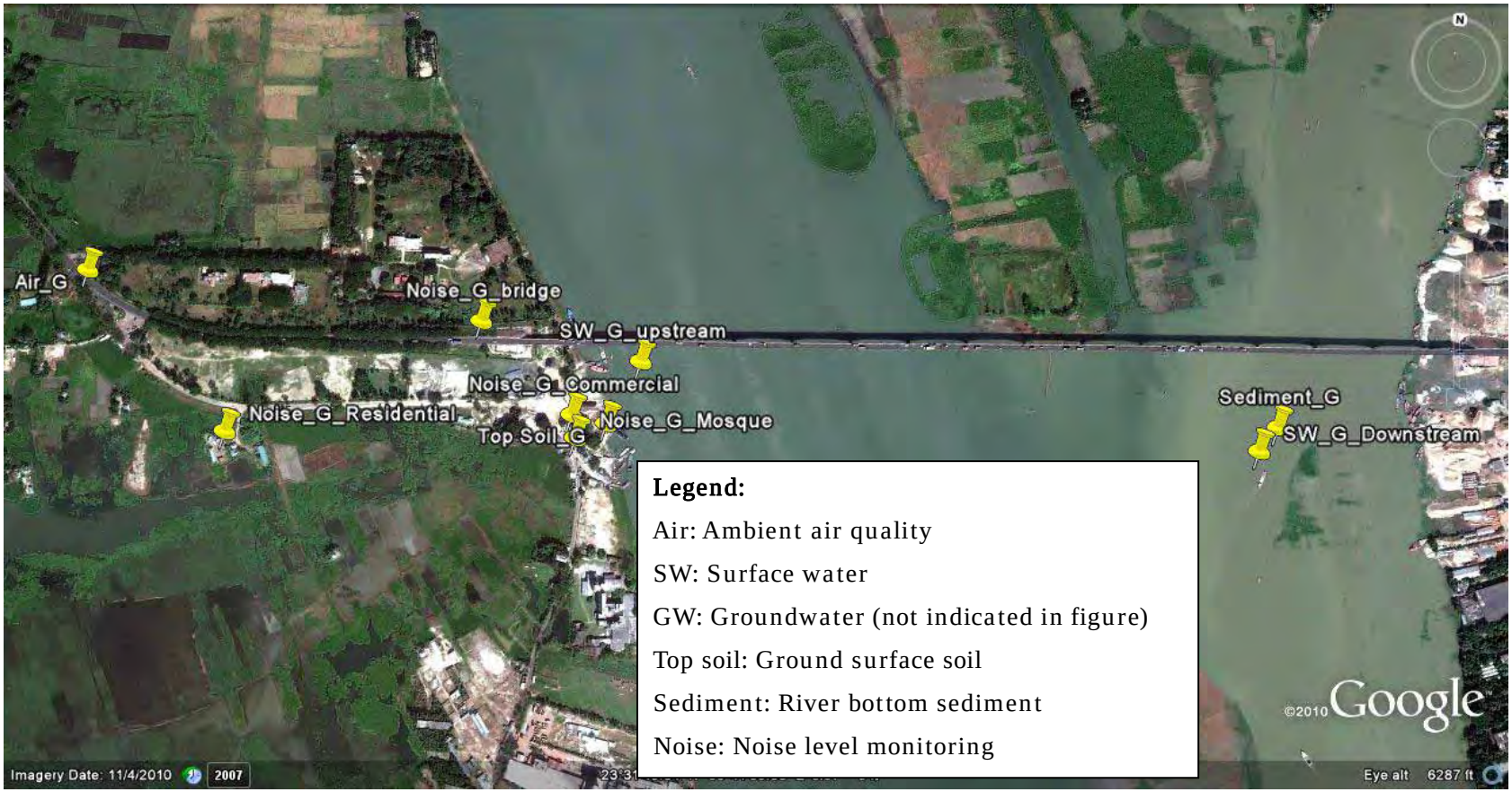


Figure 4.19 Locations of Samplings for Chemical Analyses at Gumti Bridge

Table 4.13 Results of Ambient Air Quality Analysis

Unit: microgram/m^3,

	Kanchpur		Meghna		Meghna- Gmuti				Environmental Conservation Rules, 1997 (Bangladesh)			
Season	Dry	Wet	Dry	Wet	Dry	Wet						
Sampling date	8/5/2012	16/7/2012	8/5/2012	16/7/2012	9/5/2012	17/7/2012	Japanese Standard	WHO	Industrial area	Commercial and mix areas	Residential and rural areas	Sensitive area
SPM	714	1,013	1,041	1,530	339	607	100	-	500	400	200	100
PM2.5	94	160	144	197	61	86	-	10	65			
PM10	193	270	317	510	131	170	-	20	150			
SO2	96	191	60	110	55	80	110	20	120	100	80	30
NO2	70	160	56	90	50	74	80	40	100	100	80	30
Pb	0.63	0.55	0.38	0.33	0.27	0.25	-	-	0.5			

: Exceeding Standards

Note: Standard applied is as industrial area for Kanchpur and Meghna, Sites. Gumti Bridge Site is categorized as commercial area based on the surrounding conditions of economic activities

As shown in the above table, followings are noted:

- Suspended Particulate Matter (SPM) is much higher than the standard.
- PM2.5 and PM10 also very high
- Sulphate Dioxides (SO2) sometimes exceeds the standard.
- Nitrogen Dioxides (NO2) is within the standard.
- Lead (Pb) is within standard except Kanchpur Site.
- Main source of NO2 and SPM may be the emission from vehicles.
- Numerous number of

Background values, estimated as of location far away from road without impact from vehicles' emission are estimated[5] as Table 4.14.

Table 4.14 Estimation of Air Pollution at Background

Pollutant	Background estimated μg/cm3	Industrial area	Commercial and mix areas	Residential and rural areas	Sensitive area
SPM	846	500	400	200	100
SO2	98	120	100	80	30
NO2	74	100	100	80	30

Source: Study team

As shown above, SPM exceeds all standards. SO2 is not acceptable as (1) Residential and rural area, and (2) Sensitive area. NO2 is not accepted only as Sensitive area and acceptable as (1) Industrial area, (2) Commercial and mix, and (3) Residential and rural area.

2) Water pollution

A series of water sampling for surface water and groundwater and analyses on the samples were implemented for 3 bridges respectively. 2 litter of water was sampled in jar and immediately sealed, kept in shadow and transported to laboratory for analyzing. Testing method follows the method recommended by Environmental Protection Agency of United States (USEPA).

Surface water

Surface water was measured in dry season (May 2012) and wet season (July 2012) at upstream and downstream of existing bridges at respective sites. Table 4.15 presents the results of surface water analyses.

[5] Road Environment Institute, *Manual for road impact assessment*,2007

Table 4.15 Results of Surface Water Analysis

Unit: mg/L

River water	Shidarakya				Meghna				Gumti				Environmental Conservation Rule 1997 (Bangladesh)					
Lacation	Upstream		Downstream		Upstream		Downstream		Upstream		Downstream							
Season	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet						
Date	05/05/2012	16/7/2012	05/05/2012	16/7/2012	05/05/2012	16/7/2012	05/05/2012	16/7/2012	05/05/2012	16/7/2012	05/05/2012	16/7/2012	Source of drinking water after disinfection	Recreation purpose	Source of water after conventional treatment	Fishery	Industry use	Irrigation use
pH	7.0	8.2	7.0	8.4	6.7	7.2	6.7	7.1	6.7	7.3	6.6	7.1	6.5 -8.5	6.5 -8.5	6.5 -8.5	6.5 -8.5	6.5 -8.5	6.5 -8.5
Turbidity NTU	85	158	12	123	35	10	28	6	12	8	53	3	-	-	-	-	-	-
DO mg/L	0.3	3.2	0.1	4.1	4.2	6.3	4.7	6.7	4.4	5.8	4.4	6.7	>6	>5	>6	>5	>5	>5
Total Coliform CFU/100ml	10,000>	>10,000	10,000>	>10,000	200	8	520	21	540	10>	1040	10>	50>	200>	5,000 >	-	5,000 >	1,000 >
TDS mg/L	468	2305	570	1810	85	72	76	54	72	47	108	87	-	-	-	-	-	-
TSS mg/L	153	248	16	123	29	13	28	11	25	9	40	12	-	-	-	-	-	-
COD mg/L	59	84	47	128	8	6	7	8	8	6	8	5	-	-	-	-	-	-
BOD5 mg/L	20	12	10	19	3	1	3	1	1	1	3	1	2>	3>	6>	6>	10>	10>
NH4-N mg/L	9.6	3.5	9.5	1.2	0.3	0.1	0.5	0.1	0.27	0.1>	0.3	0.1	-	-	-	-	-	-
Oil and grease Mg/L	4.7	2.8	5.1	3.9	3.8	0.8	4.1	0.7	6.2	0.1	5.3	0.1	0.01	-	-	-	-	-

: Exceeding Standards

Although the standard/ evaluation to be taken is determined by the user of river water, based on the table above, followings are noted:

- pH is not much changed between seasons in three rivers
- Turbidity in wet season increases in Shidalakhya River while it decreases in Meghna and Gumti Rivers
- Dissolved Oxygen (DO), in wet season, recovers to reasonable level in Shitalakshya River while it improves in Meghna and Gumti Rivers
- Total coliform is quite high in Shitalakshya River.
- Total Dissolved Solid (TDS) is beyond the standard value in Stalakhya River in wet season.
- Ammonium nitrogen, NH4-N, is high while they are within the standard as drinking water at Meghna and Gumti Rivers.
- Total Suspended Solid is almost every time beyond the standard as drinking water.
- COD and BOD decrease in wet season probably due to the increase of discharge.
- Oil and grease concentrations are always beyond acceptable limit in all rivers

Water quality of Shitalakshya River is estimated as so deteriorated by human's activities since:

- High concentration of Total Coliform probable due to discharge of human liquid waste into river without treatment
- High concentration of COD and BOD which indicates many raw material including above waste before oxidization/decomposition discharged and as the result of very low dissolved oxygen concentration as difficult for fish to live in
- High concentration of Ammonia Nitrogen probably from human waste
- High concentration of oil and greases as untreated effluents from factory

Due to its high Total Coliform concentration, Shitalakshya River water is not suitable for any use. As for water qualities Meghna and Gumti Rivers, they are similar and are much better than Shitalakshya River since Total Coliform concentration and COD/BOD are somewhat tolerable as other than drinking water in Bangladesh Standard except oil and grease contents.

Groundwater

The groundwater is necessary for daily life of local people and, among all as drinking water in most area where pipeline water is not available. The dependency ratios on well are 75% at Kanchpur, while they are 95-100% at Meghna and Gumti Bridge sites.

At the Project site, well are dug in settlement and used for drinking by local people. The qualities of groundwater tested are shown in Table 4.16.

Table 4.16 Results of Groundwater Analyses

Unit: mg/L

Location	Kanchpur	Meghna	Gumti	Bangladesh	WHO
Date of sampling	5/5/2012	5/5/2012	5/5/2012	Drinking water	Drinking water
pH	6.7	6.8	6.8	6.5-8.5	6.5-8.5
EC μS/m	824	553	646	-	(2,000 by EPA)
Turbidity	24.7	28.7	43.1	10>	5>
Chloride	75	27	23	150-600	250>
Total hardness	248	238	222	200-500	500>
Iron	2.0	2.5	3.6	0.3-1.0	0.3>
Manganese	0.053	0.840	1.156	0.1>	0.4>
Arsenic	0.052	0.075	0.079	0.05>	0.01>

：Exceeding Standards

As shown in the above table, the concentrations of Iron, Manganese and Arsenic of groundwater are higher than standards in almost all cases.

In three Bridges, concentrations of Arsenic are always not satisfying drinking water standards of Bangladesh and WHO. Arsenic is classified by IARC[6] in Group 1 (carcinogenic to human) while Iron and Manganese are not so harmful. Arsenic concentration in groundwater in recent deposits (10,000 year or younger) and it is considered as natural origin (geological reason), and not by human activity.

3) Noise and vibration

Noise

Noise was measured at road sides (10m away from edge of car lane) for 24 hours and at other areas for daytime and night time of limited hours only, such as industrial area, residential area, commercial area and religious area which are located away from the road so that no impact from the project is expected but just as background data. Results are presented in Table 4.17. Locations of monitoring are presented in Figures from 4.20 to 4.22.

[6] International Agency for Research on Cancer

Table 4.17 Noise Monitored

		Unit	Roadside	Industrial area	Residential area	Commercial area	Religious area	Hourly traffic volume, No/Hour
Daytime	Standard	dB	70*	75	60	70	45	-
	Kanchipur	Distance from NH-1 m	10	-	200	70	150	
		dB	79	-	62	76	58	2,481
	Meghna	Distance from NH-1 m	10	260	440	-	270	
		dB	74	72	55	-	58	1,449
	Gumti	Distance from NH-1 m	10	130	160	-	160	
		dB	71	-	58	68	60	1,524
Night	Standard	dB	70*	70	50	60	35	
	Kanchipur	dB	75	-	59	62	64	1,602
	Meghna	dB	66	67	70	-	66	1,195
	Gumti	dB	69	-	55	61	58	1,443

*WHO Guidelines for noise at traffic place

As shown in the table, in the most area, noise exceeds environmental standards in daytime. In night time noise level comes down almost less than 70 dB except roadside.

Figures from 4.20 to 4.22 indicate hourly traffic volume, noise and environmental standard versus hour respectively in three Bridges taken in May 2012. As show in these figures, in almost all time noise is above the environmental standard at Kanchpur Bridge site.

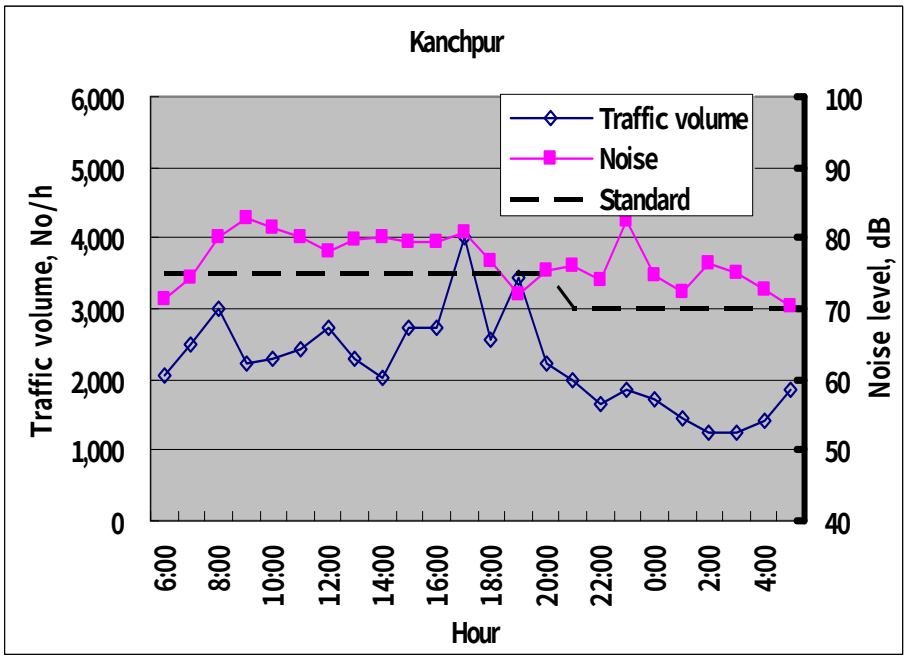


Figure 4.20 Noise and Hourly Traffic Volume at Kanchpur

At Meghna Bridge site, noise is acceptable range for all time.

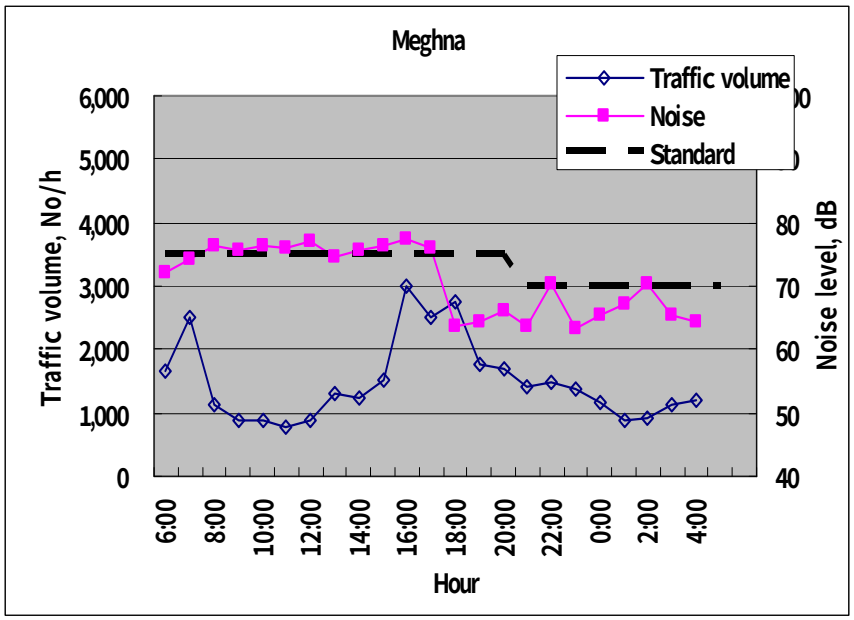


Figure 4.21 Noises and Hourly Traffic Volume at Meghna Bridge

At Gumti Bridge Site, noise may be acceptable in daytime while it exceeds the standard in night time.

In general, noise levels measured do not reflect traffic volume. The reason is considered the use of car hon are related especially in day time.

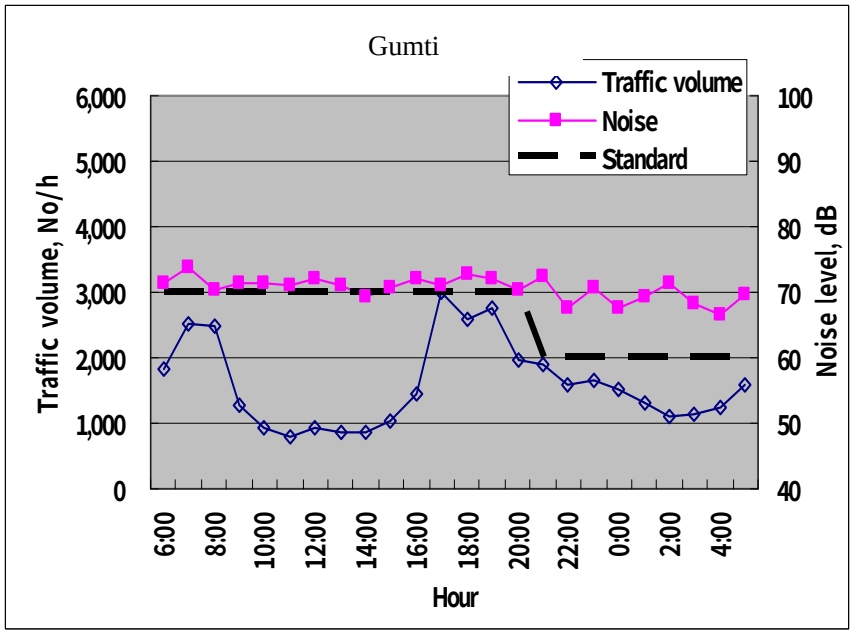


Figure 4.22 Noise and Hourly Traffic Volume at Gumti Bridge

Vibration

In March 2012, vibration was monitored and the maximum vibration level, even if at the road side, was less than 60dB as is regarded satisfactory level in international standard and further monitoring was cancelled.

4) Soil pollution

Surface soils on the ground around three bridges were sampled and analyzed respectively. Because Bangladesh does not have any standard for soil pollution, the standards in Canada, the United States and Japan are used here for evaluation. The results of primary survey are satisfied with those all of the three standards and it can be said that there is no soil pollution in project site.

Table 4.18 Results of Surface Soil Analysis

Unit: mg/kg dry soil

	Location			Guidelines[7]		
	Kanchpur	Meghna	Gumti	CCME[8]	US EPA[9]	Japan[10]
Arsenic As	1.8	2.4	2.7	-	-	150
Cadmium Cd	0.10	0.07	0.09	0.822	850	150
Chromium Cr	18	25	28	87	850	-
Lead Pb	3.6	3.6	9.2	600	400	150
Mercury Hg	0	0	0	50	510	15
Ignition loss	2,200	2,800	2,700	-	-	-

4.5 Socioeconomic Resources

4.5.1 Demography

The selected three Bridges are located in three districts i.e. Narayanganj, Munshiganj and

[7] Soil Environment Center,1999 and Commercial Law Instiute,1999

[8] *CCME- The Canadian Council of Ministers of the Environment have adopted these guideline numbers as the Canadian Soil Quality Guidelines for the Protection of Environment and Human Health- Industrial Land Use (1999)*

[9] *US EPA- The United States Environmental Protection Agency (USEPA), adopted these guidelines number as their Risk Based Screening Levels for Industrial Land Use , 1996*

[10]

Comilla. The following Table shows the detail location of Bridges.

Table 4.19 Locations of Bridges

Name of the Bridge	Side	District	Upazila	Union
Kanchpur Bridge	Dhaka	Narayanganj	Siddhirganj	Shimrail,
	Chittagong		Sonargaon	Kanchpur
Meghna Bridge	Dhaka	Narayangonj	Sonargaon	Pirojpur
	Chittagong	Munshigonj	Gazaria	Baliakandi
Gumti Bridge	Dhaka	Munshigan	Gazaria	Baushia
	Chittagong	Comilla	Gazaria Daudkandi	Daudkandi

Some selective demographic variables of the Focus area along the Bridge location are shown in Table 4.20.

Table 4.20 Selective Demographic Variables of Focus Area along the Bridge location

Parameters	Focus area			
	Narayanganj Sadar	Sonargaon	Gazaria	Daudkandi
Area (sq. km)	100.74	171.66	130.92	13.18
No. of Household	188,400	60,800	26,559	6,258
Avg. Household size	4.7	5.02	5.2	4.63
Population	886,600	305,640	138,108	29,001
Density(per sq. km)	8,801	1,781	1,055	2,200
Sex Ratio**	82	94	87	91
Literacy % (7 years+)	49	28	54	49

Source: Bangladesh Population Census, Community Series, 2001;
**- (Number of Female per 100 Male)

The Socioeconomic survey covers 338 households (67.74%) Meghna Bridge, 142 households (28.46%) in Kanchpur Bridge and 19 households (3.81%) in Gumti Bridge area. A total of 2241 people are found in 499 surveyed households (household size is 4.49), of which 52.07% are males and 47.93% are females. The table 4.21 below presents the total number households and people surveyed in three bridges.

Table 4.21 Bridge Area Wise Distribution of Households and Population by Sex

Name of the Bridge	HH		Male		Female		Total population	
	No.	%	No.	%	No.	%	No.	%
Kanchpur	142	28.46	282	12.58	286	12.76	568	25.35
Meghna	338	67.74	836	37.30	746	33.29	1582	70.59
Gumti	19	3.81	49	2.19	42	1.87	91	4.06
Total	499	100	1167	52.07	1074	47.93	2241	100

Source: Study team , 2012

4.5.2 Religion

Distribution of surveyed population by religion under the Project area is presented in Table 5.22. It is found that about 96.70% (2167) surveyed population belong to Islam religion and remaining 3.30% (74 people) belong to Hindu (Sanatan) religion by faith. In the Kanchpur Bridge project area 100% of the surveyed population found Muslim, while in the Meghna Bridge area 96.27% and 3.73% of the surveyed population found Muslim and Hindu respectively. According to the survey a large number (16%) of Hindu population were found in Gumti Bridge area.

Table 4.22 Surveyed Population by Religion

Religion	Kanchpur Bridge		Meghna Bridge		Gumti Bridge		Total	
	Population	Percentage	Population	Percentage	Population	Percentage	Population	Percentage
Islam	568	100	1,523	96.27	76	83.52	2,167	96.70
Hindu	0	0	59	3.73	15	16.48	74	3.30
Total	568	100	1,582	100	91	100	2,241	100

Source: Study Team,2012;

4.5.3 Education Level

About 19% of the total surveyed population is found illiterate. However, some of the illiterate population can sign their names only. Out of 19% illiterate people, the males are 9.06% while the females are 9.77%. It is found that 31.59% of the people have gone to primary schools while 27.76% have education between class six and class ten. Only 5.35% and 3.17% of the people have completed Secondary School Certificate (SSC) and Higher Secondary Certificate (HSC) level education respectively. Only 1.16% of the people have obtained Bachelor degree while 0.22% of the people have obtained Master degree. However, 0.22% of the people found Hafez-E-Quran. Details about the status of education of the male and female people are shown in Table 4.23.

Table 4.23 Distribution of Population by Education Level under the Project Area

Education level	Male		Female		Total	
	Number	%	Number	%	Number	%
1 TO 5	354	15.80	354	15.80	708	31.59
6 TO 10	317	14.15	305	13.61	622	27.76
SSC	74	3.30	46	2.05	120	5.35
HSC	47	2.10	24	1.07	71	3.17
BA	19	0.85	7	0.31	26	1.16
MA	4	0.18	1	0.04	5	0.22
Hafez-E-QurAn	5	0.22	0	0.00	5	0.22
Child	144	6.43	118	5.27	262	11.69
No Schooling	203	9.06	219	9.77	422	18.83
Total	1167	52.07	1074	47.93	2241	100

Source: Study Team, 2012

Remark:
1 to 5:Grades of school
6 to 10:Grades of school
SSC: Secondary School Certificate
HSC: Higher Secondary Certificate
BA: Bachelor Degree
MA: Master Course
Hefez-E-QurAn Course
Child: before Grade 1(elementary school)

4.5.4 Character of the population

An overwhelming number of population under the Project area is housewives (24.01%) followed by business person(14.86%), daily wage laboring occupation (5.62%),service/employment (5.04%), overseas employment (1.25%), pulling rickshaw and van (1.16%), others (1.07%) and drivers (0.98%).It is found that 24.94%, 11.65%, 4.69% and 3.61% of the population are students, children, unemployed and old people respectively. Details about Character of the male and female population are shown in Table 4.24.

Table 4.24 Distribution of the People by Occupation under the Entire Project Area

Occupation	Male		Female		Total	
	No.	%	No.	%	No.	%
Student	284	12.67	275	12.27	559	24.94
Housewife	0	0.00	538	24.01	538	24.01
Business	330	14.73	3	0.13	333	14.86
Child	143	6.38	118	5.27	261	11.65
Day labor	114	5.09	12	0.54	126	5.62
Service	81	3.61	32	1.43	113	5.04
Unemployed	73	3.26	32	1.43	105	4.69
Old people	37	1.65	44	1.96	81	3.61
Overseas service	26	1.16	2	0.09	28	1.25
Rickshaw/Van Polar	25	1.12	1	0.04	26	1.16
Others	17	0.76	7	0.31	24	1.07
Driver	21	0.94	1	0.04	22	0.98
Disabled	5	0.22	2	0.09	7	0.31
Agriculture	5	0.22	1	0.04	6	0.27
Tailor	1	0.04	5	0.22	6	0.27
Doctor	2	0.09	1	0.04	3	0.13
Fisherman	2	0.09	0	0	2	0.09
Mason	1	0.04	0	0	1	0.04
Total	1,167	52. 07	10,74	4,793	2,241	100

Source: Study Team,2012

4.5.5 Income and Poverty Dimensions

1) Income and Poverty Dimensions

As per the Statistical Year Book of Bangladesh 2005, average household size is 5.13 and

40.94% of households earn less than BDT 60,000 per year. Average annual income and expenditure of these households are BDT 24,648.00 and BDT 32,072.00 respectively. Table 4.25 shows that as per this survey, each of 53 households (10.62%) in the entire project area earn less than BDT 60,000.00 per year. Considering the economic condition of the project area, scope of work and level of income, these 53 households may be considered as ultra-poor and each of 185 households (37.07%) within the range of BDT 60,001.00 to 120,000.00 is poor. It should be mentioned that each of 261 households (52.30%) earn above BDT 120,000.00 is non-poor.

It is found in the Kanchpur Bridge area that each of 21 households (16.90%) earn income less than BDT 60,000 per year. These households are considered as extremely poor. Each of 59 affected households (41.55%) earns income ranging from BDT 60,001 and 120,000 per year which households are considered as the poor. On the contrary, each of 59 affected households (41.55%) earns income above BDT 120,001 is considered to be the non-poor.

It is found in the Meghna Bridge area that each of 24 households (7.11%) earn income less than BDT 60,000 per year. These households are considered as extremely poor. Each of 120 households (35.50%) earns income ranging from BDT 60,001 and 120,000 per year. These households are considered as the poor households. On the contrary, each of 194 households (57.40%) earns income above BDT 120,001 is considered to be non-poor.

It is found in the Gumti Bridge area that each of 5 households (26.31%) earn income less than BDT 60,000 per year. These households are considered as extremely poor. Each of 6 households (31.58%) earns income ranging from BDT 60,001 and 120,000 per year. These households are considered as the poor households. On the contrary, each of 8 households (42.11%) earns income above BDT 120,001is considered to be non-poor.

2)Local economies such as employment, livelihood, etc

There are many daily wage workers in each site for unloading dredged sand from barges and loading on the delivery trucks. The number of these workers can reach to 300 in total of three sites. In each sites, there are small shops illegally installed within RHD land and making small business to the sand carrying workers. Their daily income is BDT 300 only in the maximum. Locations of their working places are shown in Figures 4.23(1) to 4.23(3).

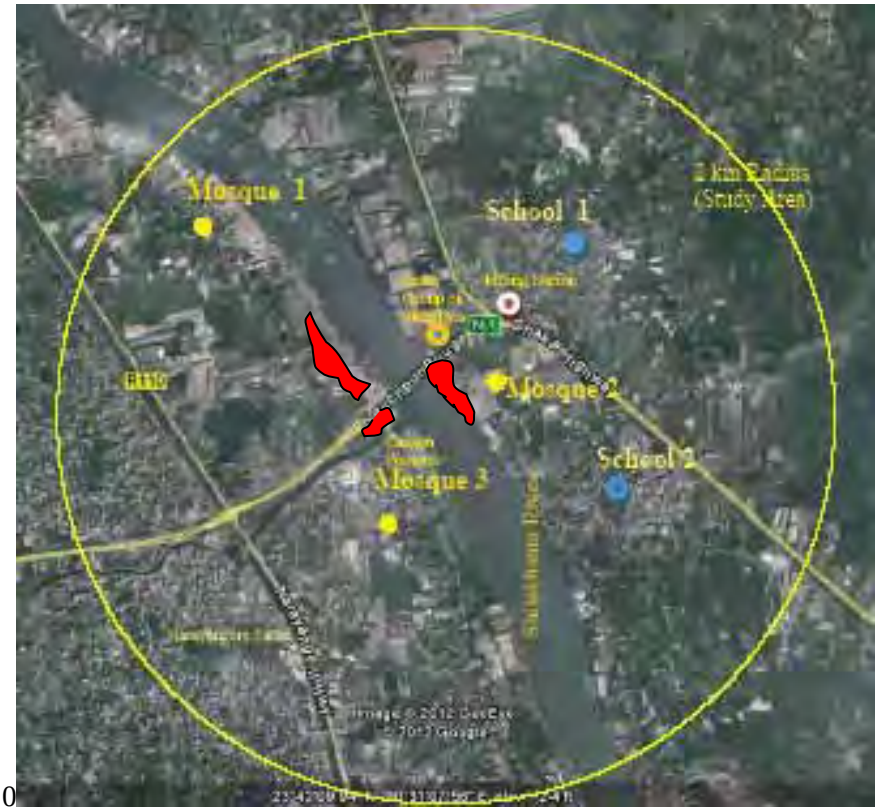


Figure 4.23(1) Location (red colored) of Sand loading/unloading workers working at Kanchpur Site

Figure 4.23(2) Location (red colored) of Sand loading/unloading workers working at Meghna Site

Figure 4.23(3) Location (red colored) of Sand loading/unloading workers working at Gumti Site

On the Chars at Gumti Bridge Site, it is noted that some crop are planted, grown and harvested. The number of crop per below existing bridge is worth about 4 persons in the harvest season (dry season) .

Figure 4.24 Chars (sand bar island) at Gumti Bridge Site

	
Dry season (January 2012)	Wet season (July 2012)

Picture 4.2 Views of Char agriculture

4.5.6 Yearly Household Expenditure

Table 4.25 shows almost similar trend on yearly household expenditure compared to income in Kanchpur, Meghna and Gumti areas. In Kanchpur Bridge area, each of 40% of the households has yearly expenditure above BDT 120,000. Each of 29% of the households has yearly expenditure ranged from BDT 60,001 to BDT 90,000. Each of 8% of the households has yearly expenditure within BDT 30,000. In Meghna Bridge area, each of 52% of the households has yearly expenditure above BDT 120,000. It is found that each of 20.41% of the households has yearly expenditure ranged from BDT 90,001-BDT 120,000. Each of 20% of the households has

yearly expenditure ranged from BDT 60,001-BDT 90,000. Each of 2.07% of the households has yearly expenditure within BDT 30,000. In the Gumti Bridge area, each of 47.37% of the households has yearly expenditure above BDT 120,000. Each of 21% of the households has yearly expenditure ranged from BDT 60,001-BDT 90,000 and each of another 21% of the households has yearly expenditure ranged from BDT 30,001-BDT 60,000.

4.5.7 Access to Electricity

In Kanchpur Bridge area, out of 142 households, 128 households (90.14%) have electricity supplied from national grid. In Meghna Bridge area, out of 338 households, 281 households (83.13%) have electricity access of which 80.47% are supplied from national grid while 2.66% are from solar energy. In Gumti Bridge area out of 19 households, 14 households (73.68) have electricity access of which 52.63% are supplied from national grid while 21.05% are from solar energy by themselves

Table 4.25 Distribution of Households by Yearly Expenditure in Kanchpur, Meghna and Gumti Bridge areas

Yearly Expediter level	Kanchpur		Meghna		Gumti		Total	
	No.	%	No.	%	No.	%	No	%
Up to TK 30,000	11	7.75	7	2.07	0	0.00	18	3.61
30,001-60000	13	9.15	20	5.92	4	21.05	37	7.41
60,001-90,000	41	28.87	66	19.53	4	21.05	111	22.24
90,001-120,000	20	14.08	69	20.41	2	10.53	91	18.24
Above 120,000	57	40.14	176	52.07	9	47.37	242	48.50
Total	142	100	338	100	19	100	499	100

Source: Study team,2012

4.5.8 Social institutions such as social infrastructures and decision-making institutions

Table from 4.26 represent locations of existing social infrastructures for sites respectively. Sensitive facilities such as school and mosques are away from the bridge and road

Table 4.26 Distances from the NH-1 to the Sensitive Facilities

Unit: meter

	Series No	Kanchpur	Meghna	Gumti
Mosque	1	1,500	200	200
	2	80	150	100
	3	300	-	100
	4	-	-	180
	5	-	-	300

School	1	300	200	100
	2	200	200	120
Grave yard	1	-	-	50

Source: Study team,2012

4.5.9 Health Care Facility

There are several categories health care facilities in the Project surrounded areas such as hospital, clinic, rural dispensary, etc. within the reach of the people. These are mostly found within 5 km except Government Hospital in Kanchpur Bridge area. In other Bridge areas the scenario is almost similar. Details on health care facilities and distance from their residence in the Kanchpur Bridge project, the Meghna Bridge project and the Gumti Bridge project areas are shown in Table 4.27.

Table 4.27 Distance of Healthcare Center

Name of the Bridge	Healthcare center	Up to 1 km		1 to 3 km		3 to 5 km		Above 5 km		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%
Kanchpur	Government Hospital	2	1.41	1	0.70	1	0.70	138	97.18	142	100
	Upazila Health complex	3	2.07	19	13.10	65	44.83	58	40.00	145	100
	Private Hospital	105	74.47	24	17.02	7	4.96	5	3.55	141	100
	Rural healthcare center	135	97.12	2	1.44	2	1.44	0	0.00	139	100
	Family care center	122	84.72	5	3.47	2	1.39	15	10.42	144	100
Meghna	Government Hospital	2	0.59	2	0.59	4	1.18	330	97.63	338	100
	Upazila Health complex	3	0.89	21	6.21	81	23.96	233	68.93	338	100
	Private Hospital	84	24.85	98	28.99	31	9.17	125	36.98	338	100
	Rural healthcare center	266	79.17	13	3.87	31	9.23	26	7.74	336	100
	Family care center	237	70.33	23	6.82	2	0.59	75	22.26	337	100
Gumti	Government Hospital	0	0.00	1	5.26	2	10.53	16	84.21	19	100
	Upazila Health complex	1	5.26	2	10.53	12	63.16	4	21.05	19	100
	Private Hospital	3	15.79	13	68.42	2	10.53	1	5.26	19	100
	Rural healthcare center	15	78.95	4	21.05	0	0.00	0	0.00	19	100
	Family care center	18	90.00	2	10.00	0	0.00	0	0.00	20	100

Source:sSudy Team, 2012

4.5.10 Educational Institutions

A lot of educational institutions are found in the Project area mostly schools, colleges and Madrasah. There is no University in the project area. The educational institutions are mainly located within 5 km except Universities. Islamic religious institutions such as Madrasah and Maktob are also fund a bit more in number in the project area. It is found that overwhelming

percentages of primary schools, non-formal education, *madrassa*and *Maktob* are located within 1 kilometre distance in the Kanchpur Bridge, the Meghna Bridge and the Gumti Bridge area. Available educational institutions in the Kanchpur Bridge, Meghna Bridge and Gumti Bridge project and distance from the residence shown in Table 4.28.

Table 4.28 Distance of Educational Institutes

Name of Bridge	Educational institute	Up to 1 km		1 to 3 km		3 to 5 km		>5 km		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%
Kanchpur	University	0	0.00	1	0.71	3	2.13	137	97.16	141	100
	College	45	32.14	46	32.86	43	30.71	6	4.29	140	100
	High School	93	66.43	43	30.71	4	2.86	0	0.00	140	100
	Primary School	128	93.43	9	6.57	0	0.00	0	0.00	137	100
	Non-formal Education	133	97.08	3	2.19	0	0.00	1	0.73	137	100
	Madrasah	129	96.27	4	2.99	1	0.75	0	0.00	134	100
	Maktob	103	100	0	0.00	0	0.00	0	0.00	103	100
Meghna	University	0	0.00	0	0.00	1	0.30	337	99.70	338	100
	College	6	1.77	37	10.91	124	36.58	172	50.74	339	100
	High School	201	59.47	111	32.84	17	5.03	9	2.66	338	100
	Primary School	326	96.74	10	2.97	0	0.00	1	0.30	337	100
	Non formal Education	318	99.07	2	0.62	0	0.00	1	0.31	321	100
	Madrasah	326	98.49	3	0.91	0	0.00	2	0.60	331	100
	Maktob	258	99.61	1	0.39	0	0.00	0	0.00	259	100
Gumti	University	0	0.00	0	0.00	0	0.00	19	100	19	100
	College	0	0.00	0	0.00	13	68.42	6	31.58	19	100
	High School	3	15.79	14	73.68	2	10.53	0	0.00	19	100
	Primary School	19	100	0	0.00	0	0.00	0	0.00	19	100
	Non formal Education	19	100	0	0.00	0	0.00	0	0.00	19	100
	Madrasah	19	100	0	0.00	0	0.00	0	0.00	19	100
	Maktob	15	100	0	0.00	0	0.00	0	0.00	15	100

Source: Study Team, 2012

4.5.11 Archeological, Historical and Cultural Sites

There are no archaeological sites within the Project site. There are some historical places in the Sonargaon Pourashava (4km away from Meghna Site). The pourashava is a rich treasure of archaeological treasures. It was once the capital of Isha Khan one of Bhuiyans of Bengal. The present important sites are Bangladesh Lokshilpa Museum, Goaldi Shahi Masjid and Historic Panam city. All of them are far away, located more than 100km, from the bridge alignment.

Since all archaeological and historical places are far from the bridge sites, it is irrelevant to discuss any aspects of impact over the places due to the project.

Besides few mosques, Dorga[11], graveyard exists on both sides of the Bridge, there are no other cultural or potential sites around the Project area.

Figures from 4.25 to 4.27 present Google maps around the sites respectively.

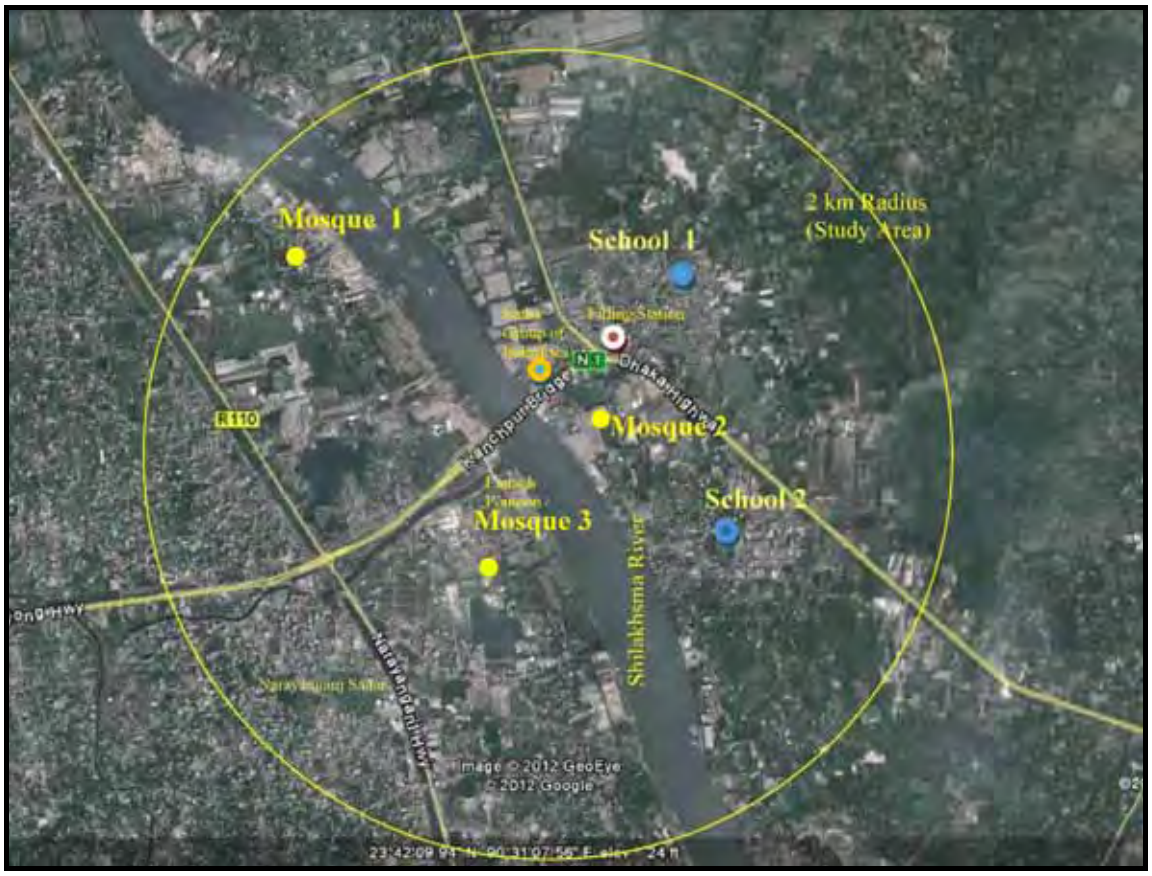


Figure 4.25 Land Use Map at Kanchpur Bridge

[11] Dorga means Mazar. It is the grave of the religious leader

Figure 4.26 Land Use Map at Meghna Bridge

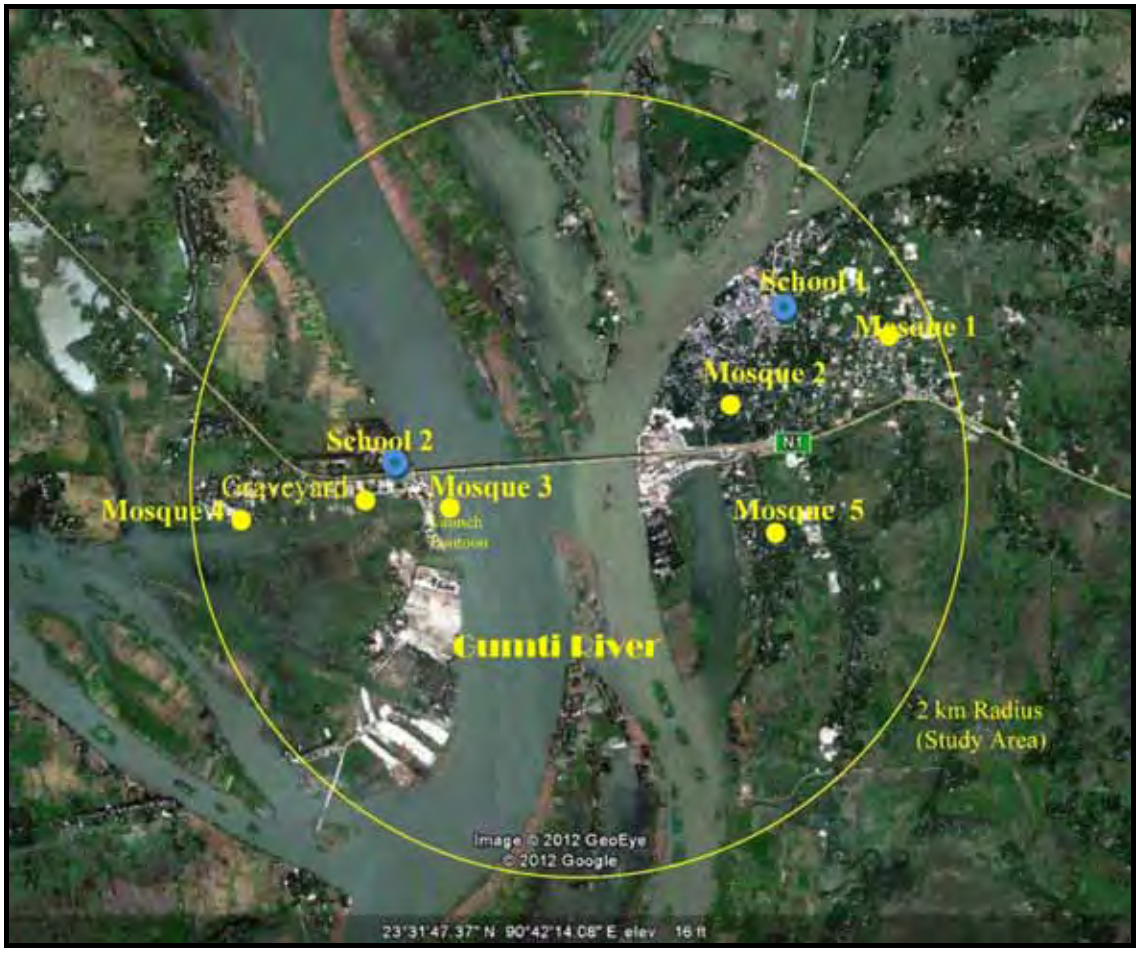


Figure 4.27 Land Use Map at Gumti Bridge

The main essence of cultural outlook of Bangladesh is the predominance of Islam in the society but people in the Project sites maintain good understanding amongst the various cultural groups. The villages are homogenous and most of the populations are Muslim with few others belonging to Hindu religion. People live here with amity, amid variance in their financial capabilities symmetrical to other rural areas of Bangladesh.

1) Cultural heritage

Figure 4.28 indicates the location of cultural heritage andthe nearby cultural heritage, Goaldi Mosque at Goaldi in Sonargaon, is located 1 km away from NH-1. Thus, there is not any adverse impacts to the heritage.

Figure 4.28 Location of nearby Cultural Heritage

4.5.12 Fishermen Community

In Fishermen Community, three types of fishers namely full-time fisher, part-time fisher and subsistence fishers were present in the Study Area. Full-time fishers were mostly Hindu, Part-time fishes were Muslin and Subsistence fishers were mostly local villagers of the Study Area. While there is no fisherman in Kanchpur Bridge site, there are generally 10 fishermen in both Meghna and Gumti Bridge site respectively. Actually, several boats having approximately a total of 10 fishermen in both bridges were observed in primary survey (Meghna Bridge: 4th April 2012, Gumti Bridge: 11th April 2012).

They stay in the settlements along old national road, not far from the rivers. Types of fishes they catch are carp, cat fish and snake-head etc. and are detailed in Table 4.1 in the first section. Major fishery ground is indicated as below:

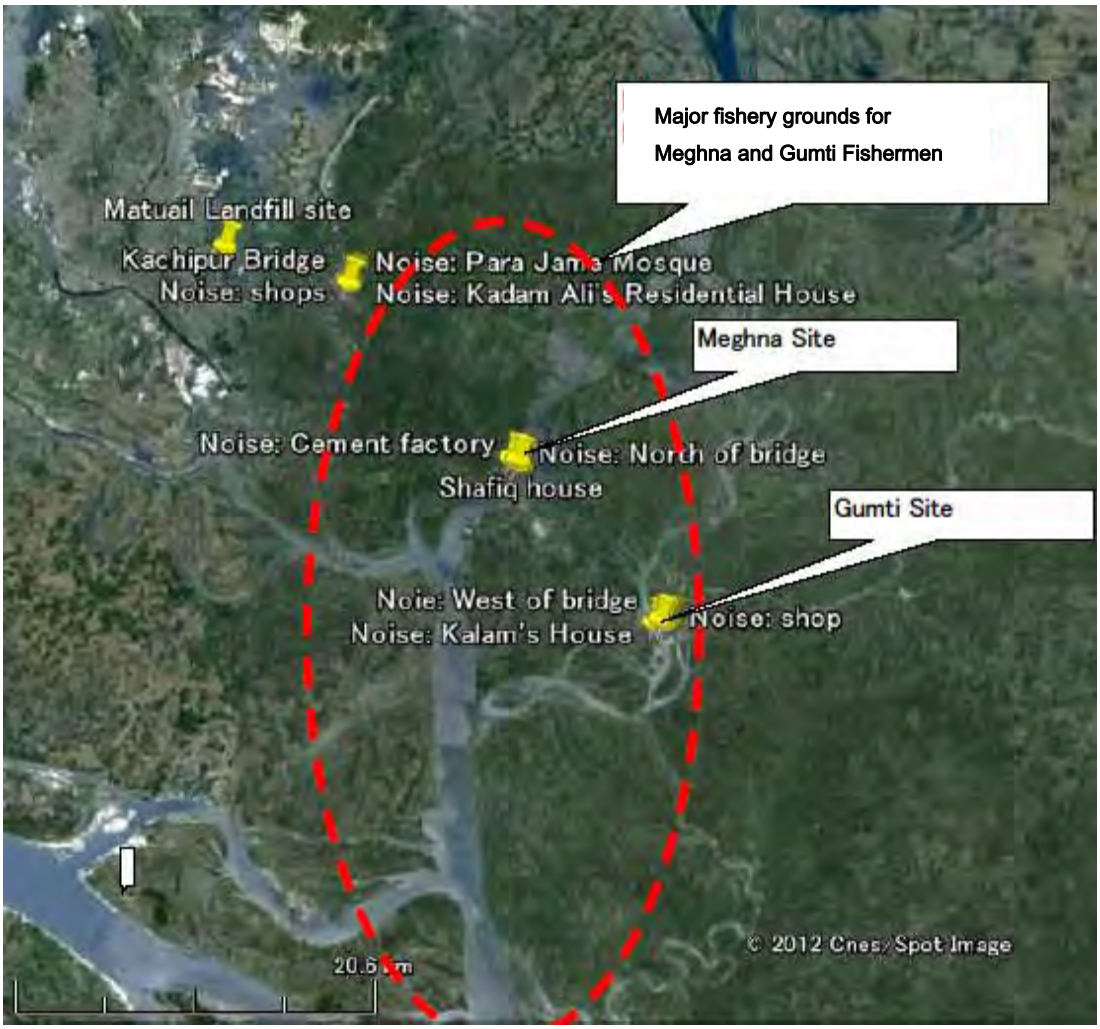


Figure4.29 Major fishing grounds

Most of the fish traders of the Project area were Muslims. Communal harmony between Muslims and Hindu fisher communities was present. They caught fish in the same fishing grounds located in Meghna Riverine tract, its associated canals and seasonal flood plains. In the Project area, average family size of full-time fishermen family was about 6 and the annual income of this group ranged from BDT 15,000- 105,000. Most of the full-time fishermen have fishing gears and crafts. Food intake was usually 2 meals a day. The average literacy rate of the fishermen community was found 21%. Part-time fishers worked as helpers in the fishing units. During off-season, they were engaged in various agricultural and house hold activities.

3 major Fish Landing & Marketing Centers were surveyed along with seasonal variation of catch in order to know the total quantity of each of different species of fish caught in the Project

area and landed in these centers. The names of these centers are Baidyer Bazar, Meghnaghat East and Tetuitala. In these centers, only kaccha houses were present for the Aratdars. There were no fish preservation facilities in these centers. Fish are sold on open sky. Operational duration of these centers was 5 a.m. to 8 a.m. for each day. Average weight of the total fish landed in these landing centers per day was within the range of 500-1000 kg depending on the season. In peak season, daily fish landing sometimes went up to 2000 kg[12].

No Fish Preservation facilities were found to exist in the fish landing centers during inspection visit to the respective centers. The landing centers were not hygienically maintained. There were 6/7 ice-plants exist in the Project area. The total production capacity of ice in these plants was about 200kg/day. The fish traders of these centers followed the conventional technique of fish preservation to prevent the immediate spoilage of fish by washing, icing and finally packing the fish in bamboo buskets and wooden boxes for distribution in the marketing channel.

4.5.13 Poor, indigenous people or ethnic minority

According to socio-economic survey at the sites, half of them (51%) are classified as poor with yearly income less than 120,000 BDT.

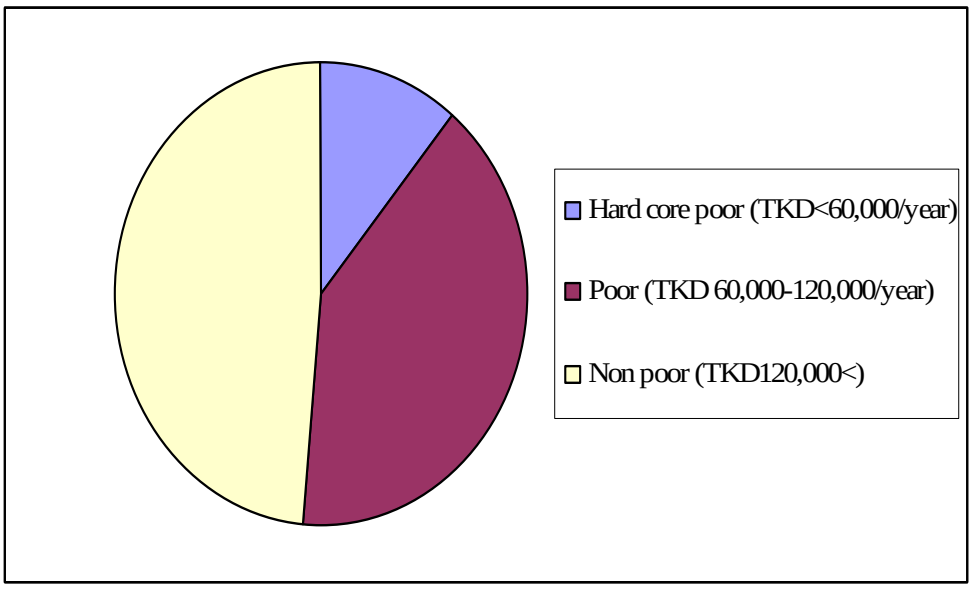


Figure 4.30 Income of Households at the Project sites

There is about 3% of Hindu people is there while 97 % is Islam according to the national

[12] Baseline Fisheries Study, AES Meghnaghat, June 2002

census. In our census performed for displaced people, 3 families are found to be Hindi.

No indigenous people[13] are present at the site, although 3% of population is Hindu (2 households affected by the project) while 95% is Muslim in all areas around the Project sites. The rest 2% is Christian etc including local religions. There is no Hindu Shrine around.

5.4.14 Accident

Onland traffic accident

Presently land traffic accident reported between Gumti and Kanchipur are as:

Table 4.29 Estimation of Accidents Rate

	Fatal accidents case	Non fatal accidents case	Total case	Yearly average case	Distance x average yearly traffic volume, 100 million km・nos/ year	Accident rate, Nos/100 million km nos・year
1998-2006	98	34	132	16	No available	No available
2007-2008	26	6	32	16	No available	No available
2009-2011	11	1	12	6	4	1.4

Remark: NH-1 between Kanchpur and Gumti Bridge

As show in the above table, number of cases become reducing.

River transport accident

Accidents of river transportation vessels in 2009 were 201 cases, in which, 10 cases were recorded in Shitalakshya River while 2 in Meghna River. The types of accidents are:

[13] As per definition of World Bank OP4.20 Indigenous People

Table 4.30 Occurrence of Accidents by Cause (1975-2009)

Sr No	Cause of Accident	Frequency	Percent
1.	Bottom Hull Damage	2	1.0
2.	Capsize	1	.5
3.	Collision	109	54.2
4.	Foggy Weather	9	4.5
5.	Fouling	1	.5
6.	Grounding	2	1.0
7.	High Tide	1	.5
8.	Overloading	50	24.9
9.	Rap with Electric Wire	1	.5
10.	Storm	21	10.4
11.	Tornado	4	2.0
	Total	**201**	**100.0**

Source: *Department of Shipping 20*

Source: BRAC University, *Riverine Passanger cessel disaster in Bangladesh*, 2009

Collision is the highest cause of accidents between ships.

4.5.15 HIV/AIDS

Although total ratio of people with HIV is far less than 0.1% presently, the number is steadily being increased due to infection from[14]:

- Injection drug users
- Overseas migrant workers returned

The ratios of people with HIV at the Unions of sites are unknown.

4.5.16 Gender

The majority of women in the project area live within the confines of the household; an arena still thoroughly regulated by custom and devotion to domestic work and the raising of children. *Purdah*, in the form of strict veiling, is not strongly observed in the area, although women lack mobility and expeditions outside the home usually require

[14] UNICEF, *HIV and AIDS in Bangladesh*

permission from the head of the household. There is a strong tradition of female modesty, based upon the perceived requirements of Islam.

Given the sensitive nature of interactions with village women, a Bangladesh female sociologist conducted both field interviews and a focus group session with potentially women. The field interviews and focus group feedback confirmed the expectation that women have important roles in the agrarian cycle. Women are particularly involved in the care of kitchen gardens, seeds and seed beds, and the processing of paddy when it is brought in from the fields. These functions are undertaken in the home and women of the affected households say they did not visit the *char* area during the period of cultivation. Women do not claim to have a role in family decision-making, but their knowledge of the crop cycle and fishing arrangements indicate that their role is important, informal albeit .

4.5.17 Children's right

In Bangladesh it is not allowed for children's labor under 18 years old. According to the national wide baseline survey[15], children labor in Bangladesh is serious as:

- Of the total estimated number of child workers is about 500,000 at least or about 33.5 % of workforce of 2 million in focused enterprises such as fish drying, restaurant, rickshaw pulling, carpentry, metal works, brick breaking, welding, laundry work and so on.
- The ages of child workers are 10 – 14 in 50% and 15-17 in 48%
- About 45% of child workers could not attend school, while illiteracy rate is about 40%.They work to help the livelihood of their family. The occupations of parents are rickshaw pulling at the highest proportion and day labor secondly.

[15] Bangladesh Bureau of Statics, *Baseline survey for determining hazardous child labor sectors in Bangladesh*,2005

4.5.18 Waste

There is no collection system about solid waste produced from houses at rural area in Bangladesh. Domestic liquid waste is treated at cesspit which will percolate into sub-ground and can affect groundwater.

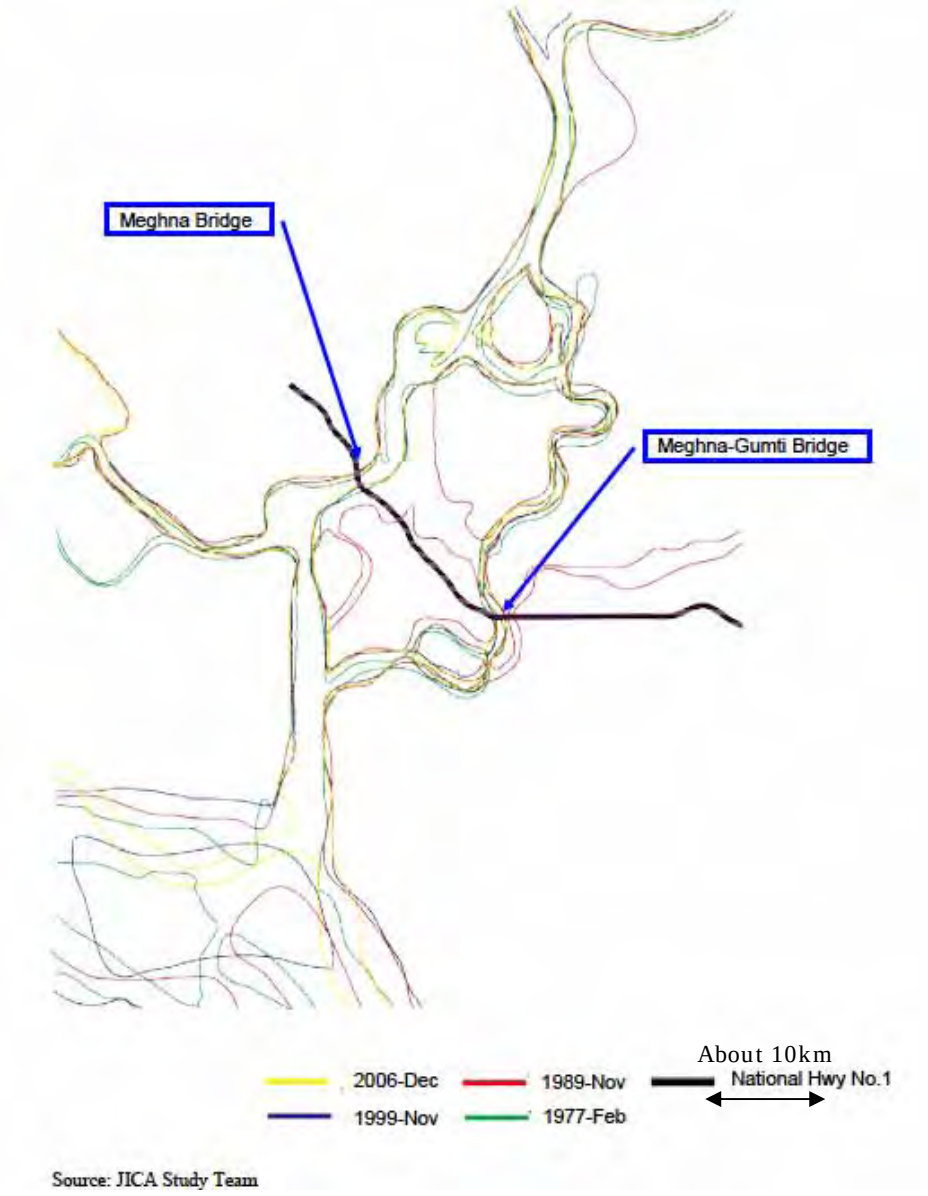
As are common practice to treat construction waste, including concrete sludge, contractor will select the proposed dumping site the following.

- Ensure appropriate site selection for new dumping sites and ensure that a minimum of 500 m from any inhabited areas;
- Ensure that the site is not located in Marshy or low lying area
- Ensure that the Ground Water level sufficiently deep to avoid ground water contamination
- Ensure that no drinking water sources (surface or ground water) are located within 500 m radius of the facility
- Ensure that the soil is not permeable

4.6 Bank erosion and scouring

Bank erosion

Meghna River is famous for changing its river route very frequently. Figure 4.31 shows that the course of Meghna River is morphing by year and accordingly, the channel width changes depending on river discharge. Especially around Meghna and Gumti Bridges, it seems that the stream line shows almost the same profile. Therefore, it is supposed that river shore line around Meghna and Gumti Bridges is stable with respect to morphological view point.



Source: JICA Study Team

Figure 4.31 Change of River Banks

Scouring

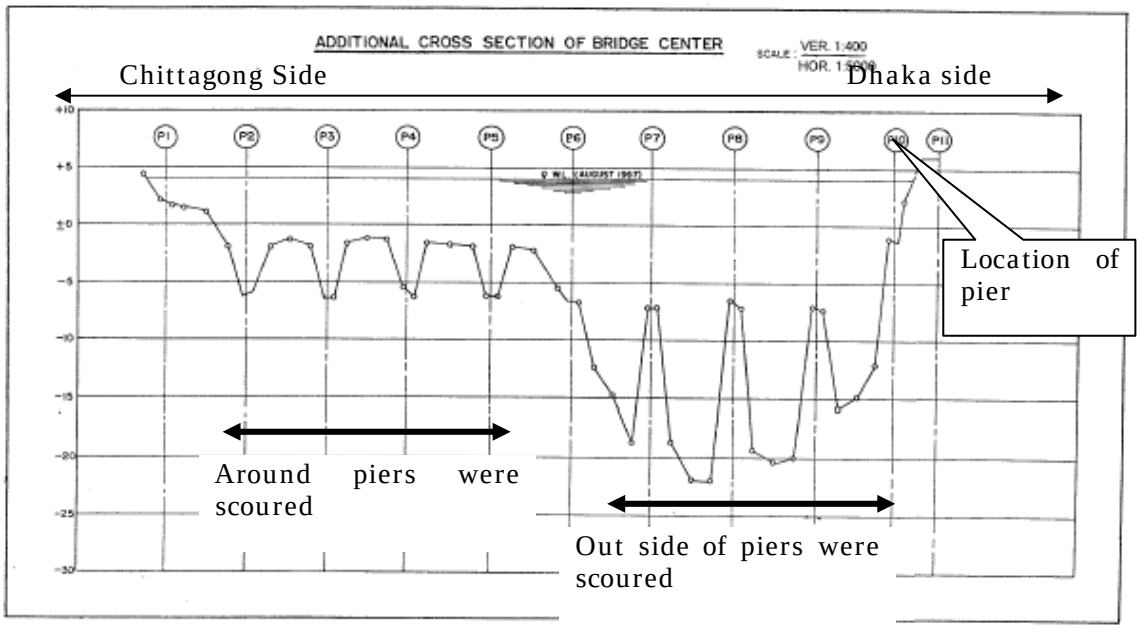
River bed scouring around the piers can be expected based on the fact that serious scoring have been taken place in. Table 4.31 presents the Maximum depths of scouring taken place in the past.

Table 4.31 Depths of Scouring Caused in the Past

	Kanchpur	Meghna	Gumti
Maximum scouring taken placed in the past, m	0	18	5

Source: Study team

Figure 4.32 presents the river section of Meghna revealed in 1998.



Data source: JICA, *Rehabilitation of embankment of Meghna Bridge*, 1998

Figure 4.32 Results of Scouring took place at Meghna Bridge

As shown in the above figure, scouring of 18 m was caused at the river bed in the maximum. However it is noted that river bed scouring took place just around piers in Chittagong Side while riverbed was scoured except around the pier in Dhaka Side. It is likely that riverbed its self is being widely eroded due to the lack of supply of river bed material, probably due to over exploit of river sand by human activity.

Over exploitation of riverbed sand is a serious social issue and is focused in the newspaper as

below.

Star NATIONAL

Daily Star 2012.02.21

Sand lifting threatens 2 Thakurgaon bridges

QUAMRUL ISLAM RUBAIYAT
Thakurgaon

Ignoring threat to two important bridges over Tangon River in Thakurgaon town, contractors allegedly with the consent of the district administration are extracting sand from the river about 100 yards from the bridges to fill up the premises of an under-construction Liberation War memorial.

Vacuum in the river bed, caused by the sand lifting, poses threat to the concrete bridge that serves as link between the district headquarters with four upazilas, said experts and local people.

A century-old iron bridge near Art Gallery More in the town is also affected due to the callous act, they said.

During a visit on Saturday morning, this correspondent saw sand lifting was going on from the Tangan River, around 100 yards from the middle of the concrete bridge with a local made dredger.

The district administration took initiative to build a Liberation War memorial on the bank of Tangon River near Art Gallery More in Thakurgaon municipality area with the help of local NGO Eco Social Development Organisation last year.

Water Resources Minister Ramesh Chandra Sen laid the foundation stone of the memorial on March 26 last year.

Following allocation of 16 tonnes of rice meant for Test Relief to fill up the premises of the monument, Mahmud Hasan Raju, convener of a 'project committee', started filling up the ground with a local made dredger a few days ago.

When contacted, Raju said, "We are extracting sand from the river with a light dredger with the consent of the district administration. It will not harm the bridge as we dug only five feet deep."

Replying to a query he said the sand lifting work is going on under a project committee and he is the convener of it. But he failed to tell who the other members of the committee are.

Nejarat Deputy Collector Aslam Mollah told this correspondent, "We told the contractors to take sand from the upper portion of the river."

When contacted, Sub-Divisional Engineer of Roads and Highways Department Jahid Hossain said over cell phone, "I am not yet aware of the matter. The pillars of the concrete bridge might be affected if sand lifting creates a hole near the bridge. It may also affect embankments of the river. We will see the matter."

It would better to fill up the premises of the monument by bringing sand from the river manually instead of dredging, he added.

PHOTO: STAR

Lifting of sand from Tangon River in Thakurgaon town continues to pose a threat to the concrete bridge, only 100 yards away.

Figure 4.33 An Article Presented in the Newspaper about River Sand Exploit

4.7 River transportation

The river port at Narayanganj is a major inland port and trading center. Various

developments in the region continue to increase this port's importance to cargo ships, fishing boats, passenger boats, and trawlers. The Shitalakshya and Meghna River, and connecting waterways, will be relied upon for heavy construction equipment transportation as well as being used for power station cooling and general water uses.

River traffic survey was implemented between 7-18 hours in 3rd April at Kanchpur Bridge, 4th April at Meghna Bridge and 10th to 11th in April at Gumti River. The results are summarized and presented in Figures from 4.34 to 4.36. In the figures, arrows represent the direction of vessels going to. The returning arrow means the vessel does not pass the bridge but deliver people/ material to the ferry terminal/ stockpiles. Length of passengers' boat is at most 30m or less while the cargo/ barges are 55m in the maximum.

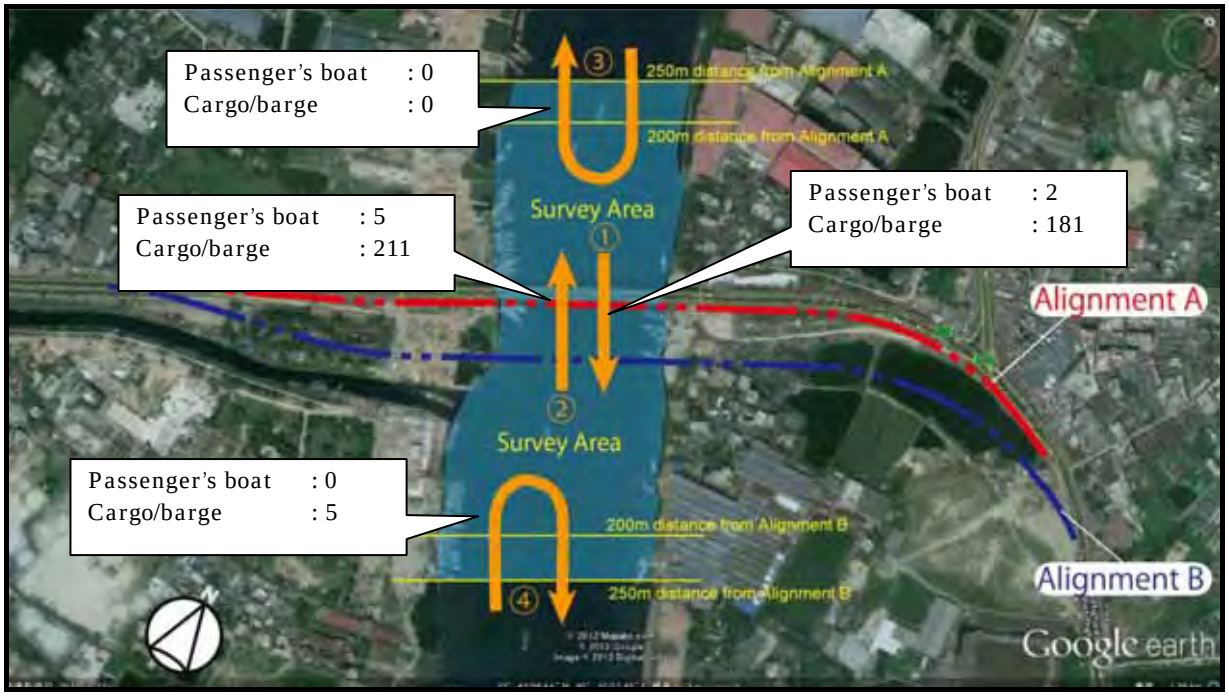


Figure 4.34 Number of Passing Vessels in Day Time at Kanchpur Bridge

As shown in the above figure at Kanchpur Bridge, major vessels observed are cargos and barges. Passengers' boat was almost not observed. Number of vessels passing the bridge and going downstream or upstream is about 400 respectively.

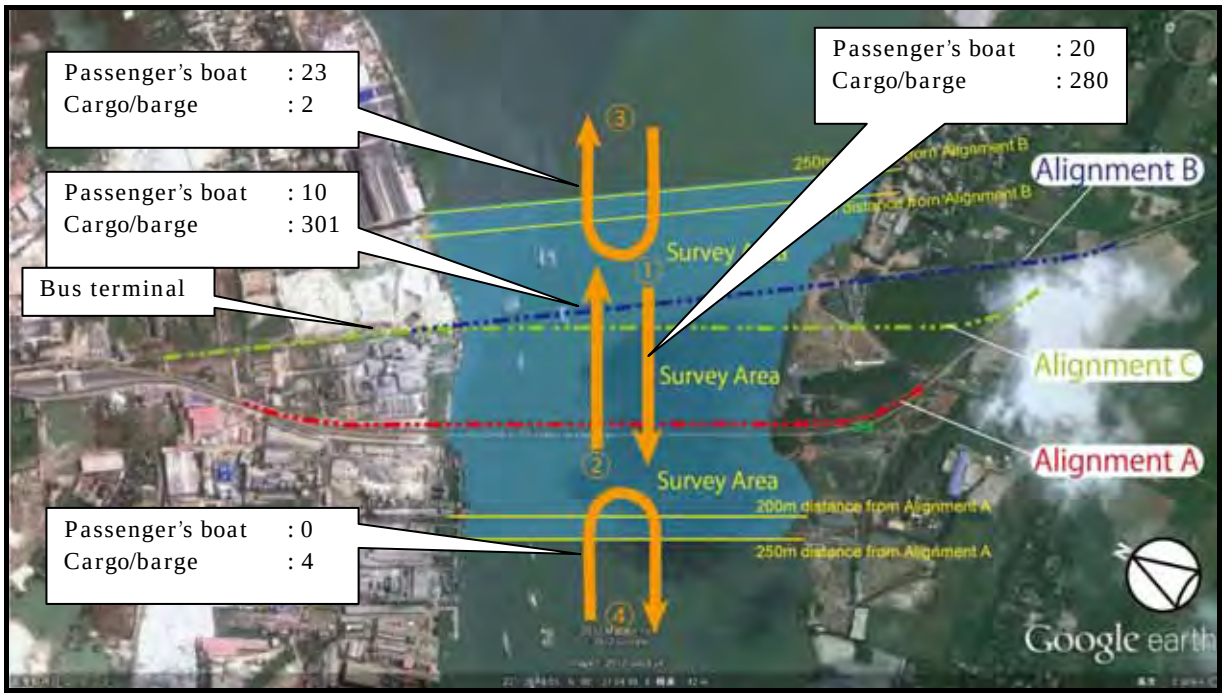


Figure 4.35 Number of Passing Vessels in Day Time at Meghna Bridge

At Meghna Bridge as shown above, 20 passengers' boats were observed that deliver customers from upstream villages to the bus terminal bound for Dhaka.

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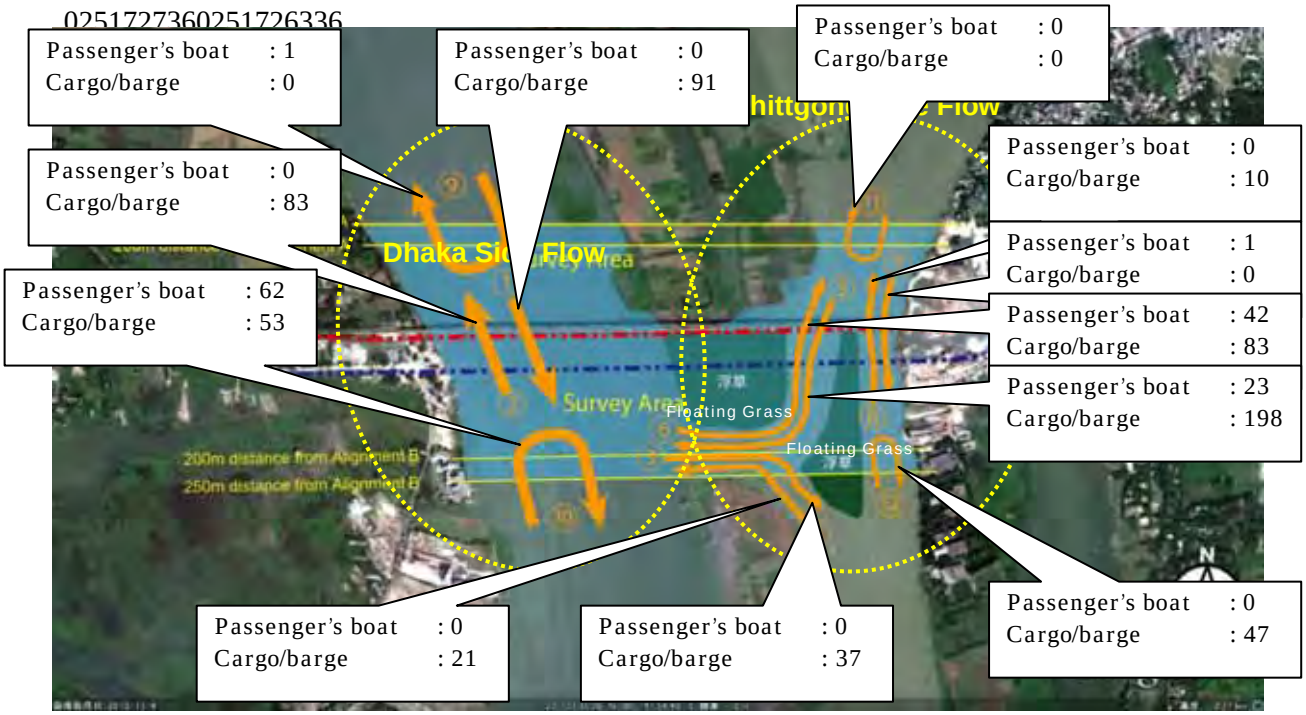


Figure 4.36 Number of Passing Vessels in Day Time at Gumti

In Gumti, there are about 130 passengers' boats going through Chars in the river. Many cargo/ barges take same route as passengers' boat.

River passenger vessel disaster caused in 2009 is reported as

Table 4.32 River Passengers Boat Accidents in 2009

River	Accident number
All rivers in Bangladesh	205
Shitalakshya River	10
Meghna River	1
Gumti River	0

Source: BRAC University, *River passenger vessel disaster in Bangladesh: Option for mitigation and safety*, 2009

About 40 passengers' boats are observed at daytime, coming from upstream/downstream to the Bridges for bus terminals at Meghna Bridge Site and Gumti Bridge Site respectively. No passengers' were observed at Kanchpur Site. The boats arrive at any places and facilities such as quay or pontoon are not required.

Picture 4.3 Passengers' Boats Arrived

4.8 Global warming

It is estimated that 88cm[16], in the maximum, a rise of mean seawater level within this century. Global warming is a critical issue for Bangladesh due to its dependency on river water for agriculture and vulnerability to Tsunami due to lowness of ground level. The amount of emission of Carbon Dioxides in 2010 was estimated as 1,000,000 ton per year emitted based on the traffic volume of NH-1, About 35,000 vehicles/year, and is about 3% of total emitted in Bangladesh.

4.9 Ground subsidence

There is no evidence or trace of ground surface subsidence around all the sites. The results of subsoil investigation indicate that there is no soft ground as would cause a long term consolidation subsidence after construction.

4.10 Offensive odor

Offensive odor can be generated from cesspit or incineration of solid waste. Locals do not that present odor level is as serious environmental problem by local people.

4.11 Bottom sediment

River bottom sediments were sampled at the location, where many vessels are being moored, and analyzed in three rivers respectively and the results are summarized in Table 4.33. International guidelines are taken since there is no standard for sediment pollution in Bangladesh. As shown in the table, contamination by heavy metals, arsenic, Cadmium, Chromium, Lead and Mercury are within guidelines and considered as no polluted. The organics content is also acceptable. .

Table 4.33 Results of Sediment Analysis

Unit: mg/kg dry soil

	Location			Guidelines, criteria or classification
	Kanchipur	Meghna	Gumti	USEPA Guide -line
Arsenic As	2.1	0.9	4.2	33
Cadmium Cd	0.8	<0.002	0.1	4.98
Chromium Cr	9	6	20	111
Lead Pb	3.6	3.6	9.2	128
Mercury Hg	0	0	0	1.06
Loss on ignition (Organicscontent)	6,700	2,000	4,300	-

1. *Consensus-based freshwater sediment quality guidelines, US EPA, 2000*

[16] ADB, EIA for Padma Bridge, 2010

4.12 Landscape

There is no landscape issue at the Project sites according to the group discussion for local people.

CHAPTER 5. ALTERNATIVE ANALYSIS

5.1 Project Justification

Priority in national strategy

To achieve an average GDP growth rate of 7 percent per annum, the transport sector growth rate is projected to increase by 7.5 percent per annum. It is required to accommodate the increased domestic traffic volume as well as the future traffic volume from the Asian Highway and Trans-Asia Railway as indicated in the Sixth Five Year Plan (2011-2015). In the plan, importance is mainly concentrated on five main corridors: Dhaka-Chittagong, Dhaka-Northwest, Dhaka-Khulna, Dhaka-Sylhet and Khulna-Northwest with special emphasis on Dhaka-Chittagong, Dhaka-Northwest and Khulna-Northwest arterial corridors. The two sea ports will be further developed and linked to Dhaka.

Other transportation modes

Although there are other modes of transport, such as railway and in land water transport as shown Figure 5.1 and are being reinforced to upgrade to ease the present overburden of road transport, they are still weak in the views of capacity and reliability compared road transport with many points to improve.

Figure 5.1 Modes of Mass Transportation

Other routes

From Chittagong to Dhaka, only one route is available presently although other routes are being studied their realization is far future.

Issues in NH-1

The purpose of the present project is to link Dhaka with Chittagong through a fully access-controlled expressway. However the condition of 3 key bridges, Kanchpur Bridge, Meghna Bridge and Gumti Bridge on NH-1 are in problem such as damaged hinges, scouring of pier, narrow widths etc, becoming a bottle neck.

As a conclusion of above discussion, not only repair the present damaged bridges but also enlarge the bridge width by the construction of 3 new bridges are required.
The 'without project scenario' will cause heavy congestion, as a result, social losses such as traffic accidents, environmental deterioration and increase of travelling time will be accelerated.

5.2 Route Selection

For 3 bridges sites respectively, 3 alternative routes, namely Route A, Route B and Route C were proposed to compare their feasibilities in terms of :

- Convenient to road users
- Impact on Socio- environment
- Impact on natural environment
- Obstacle Object (steel towers, water pipe, gas pipe)
- Construction condition
- Project cost

The characteristics of Route A, B and C in each of the three bridges are described as below:
Kanchpur Bridge
Route A: Next to existing bridge (down stream); fairly low resettlement; no land acquisition; fairly low impacts to economic activities; good construction condition; low project cost.
Route B: Next to existing bridge (down stream); fairly high resettlement; land acquisition occurs; low impacts to economic activities; fairly bad construction condition; high project cost.
Route C: Next to existing bridge (up stream); fairly high resettlement; land acquisition occurs; high impacts to economic activities; good construction condition; low project cost.

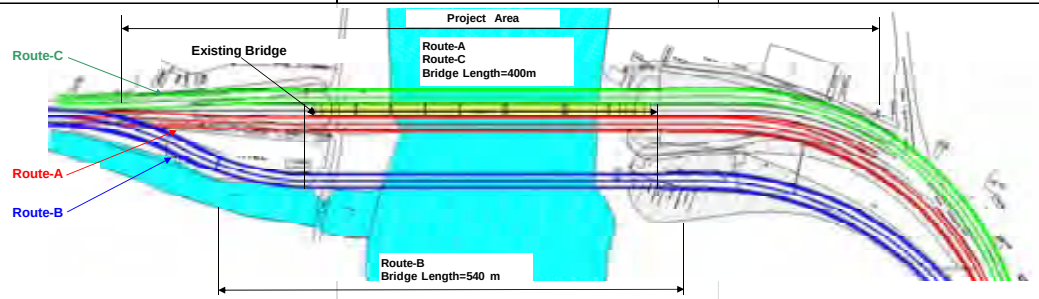
Meghna Bridge
Route A: Next to existing bridge (up stream); low resettlement; land acquisition occurs ; low impacts to economic activities; good construction condition; low project cost.

Route B:Secure distance of 250m upstream near old ferry route; high resettlement; no land acquisition; hight impacts to economic activities; bad construction condition; high project cost.
Route C:Secure distance of 250m upstream of shifted ferry route Minimize resettlement issue(Ctg.side) on Alignment B; fairly high resettlement; no land acquisition; high impacts to economic activities; normal construction condition; high project cost.

Gumti Bridge
Route A: Next to existing bridge (down stream); fairly low resettlement; no land acquisition; low impacts to economic activities; good construction condition; low project cost.
Route B: Route that secures distance from existing bridge(down stream); high resettlement; no land acquisition; hight impacts to economic activities; normal construction condition; slightly high project cost.
Route C: Next to existing bridge(up stream) ; fairly low resettlement; land acquisition occurs ; normal impacts to economic activities; good construction condition; low project cost.

For each item in each comparison is described by the list. (Refer to Table 5.1, 5.2, 5.3)

Table 5.1 Comparison of the road alignment at Kanchpur Bridge site

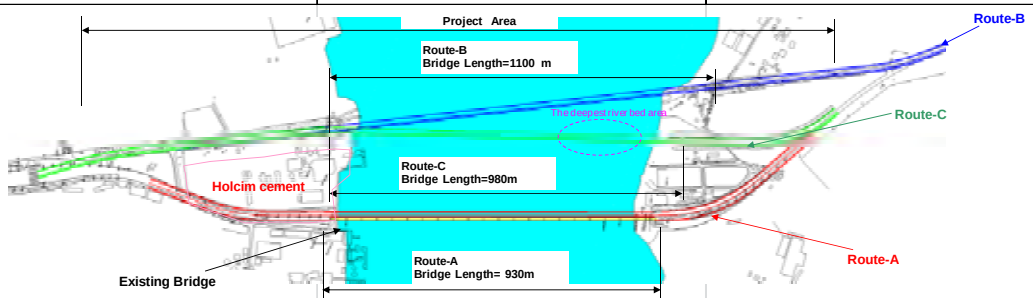
Kanchpur Bridge		Route A		Route B		Route C	
Route							
Summary		Next to existing bridge(down stream)		Route that secures distance from existing bridge (down stream)		Next to existing bridge(up stream)	
① Convenient to road user		No specific problem	◎	Two intersections are needed at the point of connecting existing road, so it's lower safe	△	No specific problem	◎
Impact on Socio-environment	② Resettlement	45 structure (15 houses, 20 shops,10 stalls)	◎	60 structure (40 houses, 20 shops)	○	60 structure (30 houses, 30 shops)	○
	③ Public facility	No	◎	Mosque relocation	△	No	◎
	④ Land acquisition (area, landowner)	0 m2	◎	5,000 m2	△	2,000 m2	△
	⑤ Traffic safety for vessels	Negligible (one foundation combined with both bridge)	◎	Slightly (two foundations are separated)	○	Negligible (one foundation combined with both bridge)	◎
	⑥ Economic activities (sand unloading, ferry terminal operation, factory etc)	20 shops, 10 stalls 30 Sand loading/unloading workers	○	20 shops 30 Sand loading/unloading workers	◎	30 shops 60 Sand loading/unloading workers	△
Impact on natural environment	⑦ Ecosystem	Some impacts to natural fauna and flora during construction	○	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 conbined)	○	Negligible (scoring will be same around existing bridge)	◎	Slightly (enlarge scoring if some foundation will be conbined)	○
	⑨ noise / air pollution	Moderate impact since some houses are remained along new accesses	○	Moderate impact since some houses are remained along new accesses	○	Moderate impact since some houses are remained along new accesses	○
	⑩ River flow	Negligible (one foundation combined with both bridge)	◎	Slightly (two foundations are separated)	○	Negligible (one foundation combined with both bridge)	◎
	⑪ Landscape	Negligible (two bridges are close)	◎	Slightly (two bridges are separated)	○	Negligible (two bridges are close)	◎
⑫ Obstacle Object (steel towers, water pipe, gas pipe)		No specific problem	◎	No specific problem	◎	No specific problem	◎
⑬ Construction condition		Construction period is shorter comparing to Route B Bridge Length: 400m Earthwork : 47,000m3	◎	Construction period is the longest Bridge Length: 540m Earthwork : 102,000m3	△	Construction period is shorter comparing to Route B Bridge Length: 400m Earthwork : 35,000m3	◎
⑭ Project cost		Cheap	◎	Expensive	△	Cheap	◎
Evaluation		◎		△		○	

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

Note: Number of structure within the proposed alignment were counted and rouded 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 231 households, which include one household with several rentees per one structure. It is estimated 5.1 households per one structure on an average. Based on such estimation, that of Route B and C is both 308 households. It is therefore Route A is the most feasible due that number affected households is the smallest compared with the other plans.

Table 5.2 Comparison of the road alignment at Meghna Bridge site

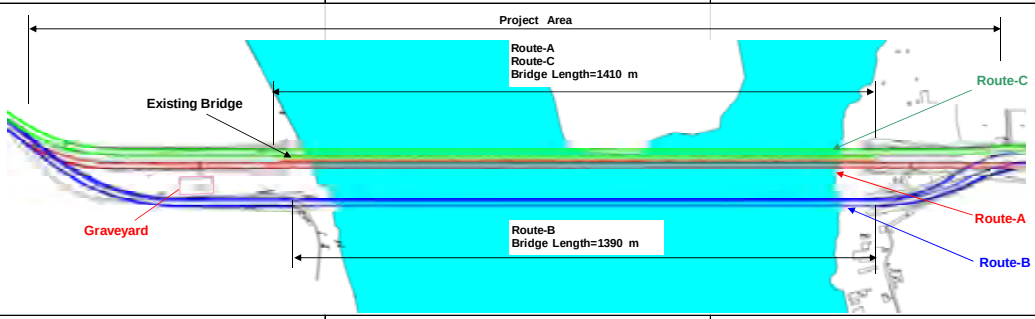
Meghna Bridge		Route A		Route B		Route C	
Route							
Summary		Next to existing bridge(up stream)		Secure distance of 250m upstream near old ferry route		Secure distance of 250m upstream of shifted ferry route Minimize resettlement issue (Ctg. side) on Alignment B	
① Convenient to road user		No specific 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	△	Many roadside trees shall be cut	△	Many roadside trees shall be cut	△
	⑧ Hydrological conditions	Slightly (enlarge scoring if some foundation in main channel will be conbined, but bank erosion will be little)	○	Slightly (new bridge inpact 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 remaind along new access on Chittagon side	◎	Severe impact since many houses remaind along new accesses A school is located near the new access	△	Seevere impact since many houses remaind 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 rouded 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 rentees 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	◎	No specific problem	◎
Impact on Socio-environment	② Resettlement	20 structure (5 houses, 15 shops)	◎	80 structure (40 houses, 40 shops)	△	20 structure (20 shops)	◎
	③ Public facility	No	◎	No	◎	No	◎
	④ Land acquisition (area、landowner)	0 m2	◎	0 m2	◎	32,000m2	△
	⑤ Traffic safety for vessels	Negligible (one foundation combined with both bridge)	◎	Slightly (two foundations are separated)	○	Negligible (one foundation combined with both bridge)	◎
	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	△	20 shops 100 sand loading/unloading workers cultivating farm on sand bars 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	○	Some impacts to natural fauna and flora during construction	○
	⑧ Hydrological conditions	Slightly (enlarge scoring if some foundation will be conbined)	○	Negligible (scoring will be same around existing bridge)	◎	Slightly (enlarge scoring if some foundation will be conbined)	○
	⑨ noise / air pollution	No impact since no house remained along new access	◎	Moderate impact since several houses remained along new access	○	Negligible impact since few houses remained along new access	◎
	⑩ River flow	Negligible (one foundation combined with both bridge)	◎	Slightly (two foundations are separated)	○	Negligible (one foundation combined with both bridge)	◎
	⑪ Landscape	Negligible (two bridges are close)	◎	Slightly (two bridges are separated)	○	Negligible (two bridges are close)	◎
⑫ Obstacle Object (steel towers, water pipe, gas pipe)		No specific problem	◎	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	○	Construction period is shorter comparing to Route B Bridge Length: 1,410m Earthwork : 33,000m3	◎
⑭ Project cost		Cheap	◎	Slightly expensive	○	Cheap	◎
Evaluation		◎		△		○	

Legend ◎：Excellent, ○：Good, △：Poor

Note: Number of structure within the proposed alignment were counted and rouded up based on the number of roofs identified through Google maps and site reconnaissance made

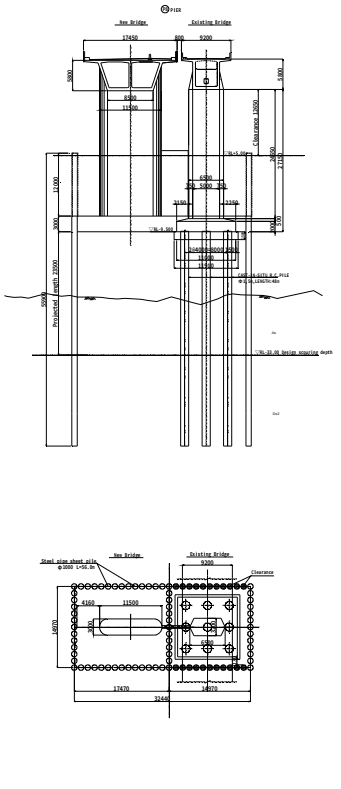
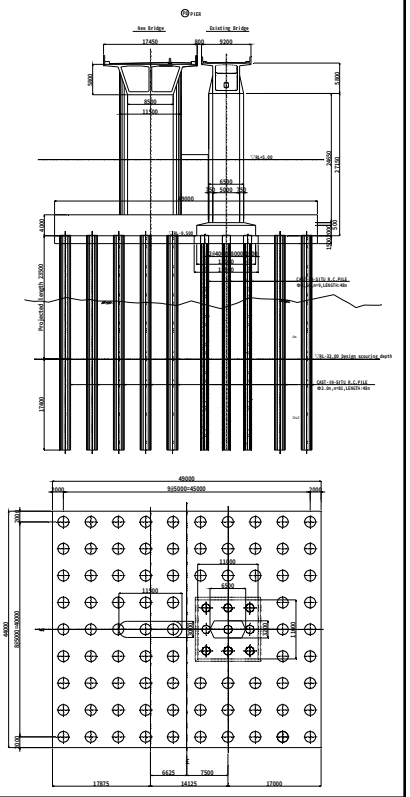
In the Census survey, number of actual affected households of Route A is 24 households, which include one household with several rentees per one structure. It is estimated 1.2 households per one structure on an average. Based on such estimation, that of Route B and C is both 96 households and 24 households, respectively. It is therefore Route A is the most feasible due that number affected households is the smallest compared with the other plans.

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 acquatic 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 of 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.

Table 5.5 Bridge type evaluation for 2nd Kanchpur Bridge

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										
Strctural performance	Record of usage		Many	◎	Many	◎	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 superstraucture	○	moderate	○	advantageous	◎	moderate	○
Constructability	Construction method	Difficulty level of constructuction	normal	○	normal	○	normal	○	slightly difficult	△
	Quality control	Difficulty level of quality control	normal	○	normal	○	normal	○	slightly difficult (Camber adjustemnt)	△
	Construction period		3.0 years	○	3.0 years	○	2.5 years	◎	3.5 years	△
Maintenace	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	○
	Maintenace	Intermidiate 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 5.6 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		Continuous steel narrow box girder bridge with weathering steel		PC extradosed bridge + PC box girder bridge	
Bridge shape										
Strctural 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 superstraucture	○	slightly advantageous	○	advantage	◎	moderate	○
Constructability	Construction method	Difficulty level of constructuction	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	○
	Maintenace	Intermidiate 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 5.7 Bridge type evaluation for 2nd Gumti 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														
Strctural 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 superstraucture	moderate	○		slightly advantageous	○		advantageois	◎		moderate	○	
Constructability	Construction method	Difficulty level of constructuction	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 a 50 years	◎	◎	Painting once in 30 years	○	○
	Maintenace	Intermidiate joint numbers	2 points	○		2 points	○		1 point	◎		2 points	○	
		Pier with bearings	2 points	◎		2 points	◎		16 points	△		4 points	○	
	Cable	replacement of cable sheath	Not required	◎		Not required	◎		Not required	◎		replacement once in 75years.	△	
Landscape	Aesthetic view		Slende arch shape	○	○	Slende arch shape	○	○	Straight	○	○	Monumental appearance	◎	◎
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

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 Const-ruction	During Oper ation	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 Const-ruction	During Oper ation	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 Const-ruction	During Oper ation	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 Const-ruction	During Oper-ation	Before / During Construction	DuringOperation	
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

No.	Item	Rating			Potential impact description		Study methodology
		Overall	Before / During Const-ruction	During Oper-ation	Before / During Construction	DuringOperation	
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
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 analysisAnalysis for erosion and scouring

No.	Item	Rating			Potential impact description		Study methodology
		Overall	Before / During Const-ruction	During Oper-ation	Before / During Construction	DuringOperation	
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
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 Const-ruction	During Oper- ation	Before / During Construction	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

No.	Item	Rating			Potential impact description		Study methodology
		Overall	Before / During Const-ruction	During Oper- ation	Before / During Construction	During Operation	
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
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 Const-ruction	During Oper- ation	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-1of 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 ma 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 he site as construction workers
14	Erosion and scouring	- Bank erosion - River bottom scouring	- Intensification of bank erosion and river bottom scoring
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

CHAPTER 7. ENVIRONMENTAL IMPACTS

7.1 Impact Identification

An environmental impact is defined as any change to an existing condition of the environment. Findings of the assessment are presented according to site preparation, construction and operation phases. The impacts will be determined as significant, positive or negative, direct or indirect, long term or short term.

The EIA study, based on the screening and scoping of IEE study, review of proposed civil works, review of similar environmental assessment reports, baseline monitoring and stakeholder consultations, has identified 27 major environmental and social concerns that are expected from the project (Table from 6.1 to 6.3). The impacts are broadly classified into following 4 rating during preconstruction, construction and operation stage:

- Social Environment
- Natural Environment
- Ecological Environment
- Environmental Pollution

This chapter describes the rating and environmental impacts caused by the project both tentatively during construction and permanently during operation.

7.2 Project Impact to Key 27 Items

1) Involuntary resettlement

Before/During Construction

Severe

A total of 208 affected households and 768 affected people (Residential house owner : 107 households and 445 people, residential tenant : 98 households and 313 people and residential & shop owner: 3 households and 10 people) have been identified through a series of resettlement survey. It is likely to have significant adverse impact on this item since more than 200 resettlers are predicted.

Detailed data is indicated in the resettlement action plan report.

During Operation

No impact is expected

2) Local economies such as employment, livelihood, etc

Before/During Construction

Severe:

A total 66 shop owners (61 shop owners and 5 tenant shop owners), 28 employees, 5 fish pond cultivators, 2 companies properties and 1 plantation owner will be affected by the project. Detailed data is indicated in the Resettlement Action Plan report.

In addition, about 300 daily labors who are engaged in river sand unloading from sand carrier and loading on delivery trucks on the banks are there in the sites. However the impact to them by the project is considered as negligible since:

- Large open spaces are still remained there even if some spaces are lost by the project
- Sand carrier (barges) can moor to any place on the banks.
- Labors can unload from the barges and can tentatively pile at any open spaces.
- The delivery trucks can come to this stock pile and labor can upload on the truck there
-

There are generally 10 fishermen in both Meghna and Gumti Bridge site respectively. They would have some adverse impacts on fishing by changes of water quality and hydrological condition through construction.

There are some crops to grow and harvest just below Gumti Bridge. The number of crop there is worth approximately 4 persons in the harvest season (dry season).

During Operation

Negligible

No impact is expected since water quality or hydrological condition is not affected (or worsen) by the project.

3) Land use and utilization of local resources

Before/During Construction

Moderate:

Plantation area on Chittagong Side Bank at Meghna Site and an aqua cultureing household is affected by the Project. The fish pond's area is approximately 183,000 m^2 and the reclaimed area would be 5,500 m^2, which is approximately 30 % of the total area (183,000 m^2).

Figure 7.1 Locations of Fish Pond Affected (in Kanchpur Bridge Site only)

Figure 7.2 Location of Plantation Area (in Meghna Bridge Site Only)

<u>During Operation</u>

No impact is expected

4) Social institutions such as social infrastructures and decision-making institutions

<u>Before/During Construction</u>

Moderate:

Possible impact considered for social institution is (1) relocation, (2) disturbance by pollution such as noise.

During construction, noise from the construction area and operation of construction machines will be generated. However construction time and period is limited, thus it is not likely to give serious impact on this item.

During Operation

Negligible:

No social institute such as school and mosque is to be relocated. Although one mosque is located 70m away from the planned carriage way of NH-1 in Kanchpur site, predicted noise level is 72 dB(A) (daytime) and it is within the standard level of Industrial Area.

Additionally one college is located in Gumti Site 130m away from the planned road. Predicted noise is 69 dB(A) (daytime) and it is not exceeding standard level of Commercial area, thus project does not disturb activities at school and mosque.

5) Existing social infrastructures and services

During Construction

Moderate:

While no social infrastructures, such as school, hospital, bus terminal and so forth, exist in the affected area, social service utilities such as power, water, drainage and communication line are located underground in the affected area. Hence, construction adversely has some impacts on such social service utilities.

During Operation

No impact is expected

6) Poor, indigenous people or ethnic minority

Before/During Construction

Severe:

There are not any indigenous people in the project affected area.

However about 40% of the population interviewed is classified as poor with yearly income of less than BDT 120,000. If they are displaced without compensation as per Bangladesh rules, their livelihood and life levels will be extremely worsen.

During Operation

No impact is expected

7) Maldistribution of benefit and damages

Before/During Construction

Severe:

Displaced people may suffer from losing their shelter (residential house), business access (small kiosk) and social network (relationship with families/ neighbor/ friends) generally at all bridge sites. Some suffers for loss of plantation at Meghna Bridge Site.

During Operation

No impact is expected

8) Local conflict of interest

Before/During Construction

Moderate:

Due to employment opportunity will be increasing during construction, candidates of construction workers may have some conflicts between communities.

During Operation

No impact is expected

9) Cultural heritage

Before/During Construction

Negligible:

No cultural property exists around the sites (4km away from Meghna Bridge Site.)

During Operation

No impact is expected

10) Accident

During Construction

Moderate:

There can be some sorts of accidents during construction as below:

- Bridge construction requires works in elevated place such as work on the top of pier, girders and so on and falling down is critical.
- Handling a large amount of paints containing some volatile materials may not good for human health.
- Heavy equipments can bring on various significant accidents.
- The groundwater having arsenic from wells can have a hazardous impact on the locals.

During Operation

Moderate:

Based on the data of traffic accidents caused between Kanchpur Bridge and Meghna Bridge, assuming that the ratio of traffic accident per vehicle number per day is same, the traffic accidents in the future can be estimated as below:

Table 7.1 Prediction of Traffic Accidents in the Future

	2012	2022	2032
Vehicles No./day	35,000	60,000	100,000
Number of Traffic accident	4	8	12

Note) Calculated based on statistical data (4.1 accident / 10 millions vehicle kilometer)

11) Infectious Diseases such as HIV/AIDS

During Construction

Moderate:

During Construction, in general, a lot of migrant workers flow into the sites, who may have the possibility with HIV/AID (1-2 person assuming 0.1%[1] of 1,500 worker) and the disease can spread among local people.

During Operation

No impact is expected

12) Gender

During Construction

Moderate:

The ratio of discrimination cases between genders by the Project is not known. However many women workers are required during construction, not only as daily catering at workers camps but also as unskilled construction workers during construction. In these cases, discrimination of salary between genders can be caused.

During Operation

No impact is expected

13) Children's right

During Construction

Moderate:

More than 33% of laborer in Bangladesh is children and it is highly possible that a bunch of children come and work in construction site.

[1] Ratio of HIV patient per population in Bangladesh, assumed as maximum

14) Bank erosion

Before/During Construction

No impact is expected

Especially around Meghna and Gumti Bridges, it seems that the stream line shows almost the same profile. Therefore, it is supposed that river shore line around Meghna and Gumti Bridges is stable with respect to morphological view point.

During Operation

Negligible:

Based on the numerical analysis, construction of bridge will not cause bank erosion because hydrological change, such as increasing of water level by the construction of new piers is negligible.

15) River transportation

During Construction

Moderate:

During construction, many construction barges, 10 to 20, will be brought to the sites. Risk of collision of passing vessels such as passengers' boat, cargo, barges with piers and construction vessels can be increased by the congestion of vessels at the sites.

During Operation

Negligible:

Since location of new piers of the bridges will be constructed approximately 10m offset from existing piers, thus vessels and passenger's boat will be able to pass same route.

16) Hydrological condition

Before/During Construction

No impact is expected

During Operation

Totally Severe:

-Change of water level

Negligble:

Water flow direction doesn't change or water level doesn't rise by construction of piers in the riverbed.

The increasing of water level by the construction of the new piers is estimated as Table

7.4. As shown in the table, the increments are almost 2cm only at three bridges, as can be negligible range compared to the rise of water level as high as 8m in flood season from dry season in the maximum.

Table 7.2 Prediction of Water Level Rises by the New Bridges

Symbol/ formula	Factor	Kanchpur	Meghna	Gumti
Q	Discharge in the mazimum, m3/s	3,480	15,200	12,600
C	Shape factor of pier	0.9	0.9	0.9
b1	Width of river, m	400	930	1410
t	Width of pier, m	14.6	9	9
n	Number of pier	5	10	16
b2=b1-t*n	Net width of pier, m	327	840	1266
H1	Water depth at upstream corner of the pier in wet season, m	13	18	12
$x = Q^2/2/9.8*(1/C^2/(H1-x)^2 -1/b1^2/H1^2)$	Increment of water table by the installation of pier, m	0.02	0.022	0.015

Reference: Japan Institution of Construction Engineering, 2009

From groundwater point, the groundwater level will hardly change because the construction activity does not use groundwater, but river water, and the groundwater is just used for portable water of construction workers, the poor and so on. Thus, there is hardly change of groundwater level and the wells, located around the site, have the stable water level.

-Scouring

Severe:

Foundation of new bridge will be combined with that of existing bridge and, as a result, the scouring depth becomes deep to 11m from river bed. Thus appropriate bridge construction technology and periodic maintenance should be followed.

Table 7.3 Depths of Scouring Made in the Past and Depths can be Caused in 100 years' Period Return in the Future

	Kanchpur	Meghna	Gumti
Maximum scouring taken placed in the past, m	0	18	6
Maximum scouring maybe taken place in the future, m	8	4	7

Data source: Study team

Details of estimation are discussed in the engineering report of separate volume (Preparatory Survey Report for Dhaka-Chittagong National Highway No.1 Bridge Construction and Rehabilitation Project Report 2012).

-Back water

No impact is expected

17) Fauna and flora

During Construction

Moderate:

Wildlife habitats in the Project area are very limited. This is due to the natural environment in this area being already under stress from human habitation, agriculture, grazing, navigation and other human activities. There is no acts affecting to vegetation, during both construction and operation. River dolphin is observed in the project area and picked up as a key species from the view of natural environment consideration. However, it seems that the Meghna and Gumti river is a secondary habitat based on interview with experts[2] and literature survey. Their main habitat is merging point Kushiara River and Monu River the Meghna where more than 200km away from the Project site. (see Figure 4.16) Thus it is not likely to give serious impact to this species. However moderate impacts on the wildlife including above River Dolphin will be imposed by ①driving hundreds of steel piles into riverbed causing vibration and noise, ②passing construction vessels, and ③night lighting.

During Operation

Negligible:

Activities which give negative impact to wildlife including River Dolphin are not expected during operation, thus no impact is expected.

18) Global warming

During Construction

Negligible:

Although construction machines and vehicles generate greenhouse gases, quantities of generated gases do not give serious impact and negligible on this item.

During Operation

No impact is expected (but positive impact is expected):

Amount of emission of Carbon Dioxides (CO_2) based on the increase of vehicles are estimated as Table 7.4 In the table, Emission from construction vehicles/equipments is negligible compared to the number of passing vehicles daily.

[2] Dr. S. M. A. Rashid, Chief Executive of CARINAM, Center for Advanced Reserch in Natural Resources and Management, Ph.D. Nd.Istiak Sobhan,PhD.Programme Coordinator IUCN Bangladesh

Table 7.4 Amount of CO_2 Emitted from Vehicles[3]

Ton/year

		2012	2022	2032
Vehicles No./day presumed		35,000	60,000	100,000
Average vehicle velocity presumed km/h	With project,	50	40	30
	Without project	40	30	20
Carbon Dioxides emission Ton/year	With project,	579,500	1,093,750	2,063,000
	Without project	638,000	1,237,750	2,456,000

Note) Formulation is attached in Annex 2

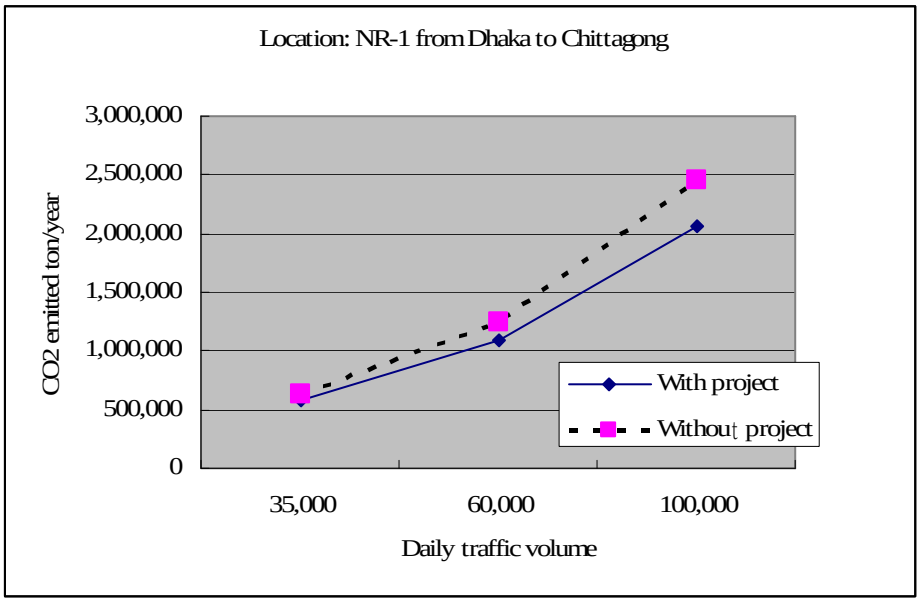


Figure 7.3 Amount of CO_2 Emitted in Prediction

As shown, the vehicle number is estimated as sharply increased, while the average velocity decreases due to narrow bridges without project in 2022 and 2032 respectively. As the results, the amount of CO_2 emitted will increase accordingly in those times since the CO_2 emitted is in proportion to the fuel consumed. However by the implementation of project, the driving velocity of vehicles improves compared to the case without project in the future and then emitted CO_2 are not so much as the case of without project since the amount of fuel consumption improves by increased driving velocity. Thus, by the implementation of the project, the amount of CO_2 emission will be decreased as is in favor to prevent global warming issue.

[3] Environmental Information Science Center",1999

19) Air pollution

During Construction

Moderate:

The air may be tentatively polluted due to:

- Dust arisen from unpaved road, sand/ earth stock pile by wind
- Emission from heavy equipment/ trucks

During Operation

No impact is expected (but positive impact is expected):

In Bangladesh, most vehicles are run by Compressed Natural Gas (CNG) and no pollutant except Nitrogen Dioxides (NO_2), as of one tenth of gasoline fuel, is emitted. So, other than that, no air pollution is caused by increase of traffic volume in the future about Suspended Particular Matters (SPM) and Sulfur Dioxides (SO_2).

Total amount of NO_2 emission was estimated based on the increase of vehicle number and then velocity. Table 7.5 presents the results of estimation.

Table 7.5 Estimation of NO_2 Emitted

			2012	2022	2032
Vehicles No./day			35,000	60,000	100,000
Average vehicle velocity km/h	With project,		50	40	30
	Without project		40	30	20
Nitrogen dioxides emission ton/year	With project	From vehicle	38.5	78.8	161.0
		From Construction equipment	1.2	0	0
	Without project	From vehicle	45.5	96.3	199.5

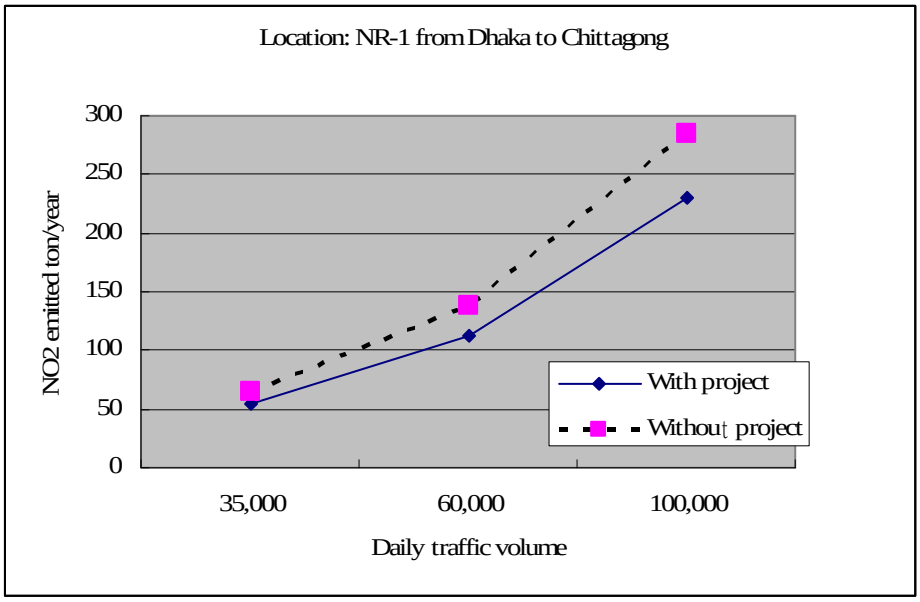


Figure 7.4 Estimation of NO2 Emitted Yearly

As shown in the table and the figure above, amount of air pollutant, when the Project is implemented (With project), is decreased compared when project is not implemented (Without project).

Next, concentration of NO_2 at the Project site along the road is estimated and is shown in Figure 7.5

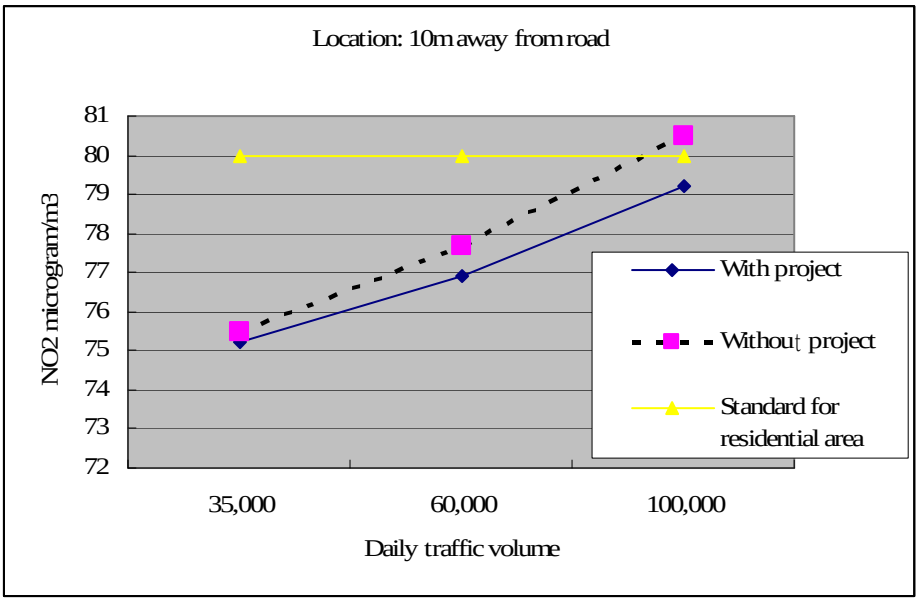


Figure7.5 Concentration of NO_2 Estimated

NO_2 concentration is also estimated to be still within the standard of residential area if the

Project is implemented until traffic volume reaches to 100,000 in the year of 2032.

As a conclusion about air pollution caused by the Project during operation, following is noted:

- Presently, SPM measured along the road is about 800 microgram/m3 which is more than 500 microgram/m3 as of industrial area standard. It is assumed that current high SMP Concentration is mainly from many brick kilns and cement factories in the Project area, not traffic exhaust. However quantity of generated SPM from vehicles will be increased in conjunction with increase of traffic volume.
- SO2 exceeds at Kanchpur Bridge site only and is also not emitted from CNG run vehicles. No impact is caused by the increase of the traffic volume as well.
- NO2 is emitted a little (one tenth) of gasoline run vehicles from CNG run vehicles. Concentration of NO2 is within the standard of residential area until 2032 if the project is implemented. If the project is not implemented, it slightly exceeds the standard.

20) Water pollution

<u>During Construction</u>

Totally Moderate:

<u>-Surface water</u>

In this project, surface water pollution will be minimized because Steel Pipe Sheet Pile (SPSP) foundation is supposed to be used and its high impermeability does not basically allow turbid water by construction to come out. Despite the above minimized impact, some surface water pollutants can adversely cause water pollution.

About the causes of surface water pollution, followings are considered:

Table 7.6 Pollutants and Their Possible Sources

Pollutants		Sources of pollutants			
		Pile driving in the river	Mud water from earthwork for approach embankment while rainy season	Domestic waste liquid from worker's camp	Oil leaking from construction vessel
a	Suspended Solid (SS)	Possible source	Possible source	Possible source	-
b	Biochemical Oxygen Demand (BOD)	-	-	Possible source	-
c	Ammonium nitrogen (NH4-N)	-	-	Possible source	-

d	Coliform	-	-	Possible source	-
E	Oil and greases	-	-	-	Possible source

For each pollutant, qualitative/quantitative studies are made as:

a. Suspended Solid (SS)

Increment of SS in river water is estimated based on the volume of soils which is push out into river water by the installation of steel pipe sheet piles for piers. Table 7.7 indicates the estimation by pier construction.

Picture 7.1 Example of Steel Pipe Sheet Pile Foundation

Table 7.7 Estimation of increase of Suspended Solid (SS) in the River Water by Pier Construction

a	Width	m	31.3	32.44	29.95
b	Length	m	8.5	14.97	13.73
c	Perimeter length: 2(a+b)	m	79.6	94.82	87.36
d	Driven depth	m	33	48	70
e	Soil dissolved out per pier : c*d	m3	2,627	4,551	6,115
f	Duration of construction (8 hours/ day)	days	225	225	225
g	Number of pier constructed at the same time	No	3	3	3
h	Dissolved rate of soil volume	m3/s	0.0012	0.0021	0.0028
i	Water content of soil		60%	60%	60%
j	Dissolved rate of soil volume	m3/s	0.0005	0.0008	0.0011
k	Dry unit weight of soil	ton/m3	2.7	2.7	2.7
l	Dissolve rate of soil weight	ton/s	0.0013	0.0022	0.0030
m	River flow in dry season	m3/s	292	2,046	3,703
n	SS in the current River : l/m	mg/l	4.45	1.08	0.81
o	Present SS in dry season	mg/l	16-153	28-29	72-108
p	SS for construction period in dry season	mg/l	20-157	29-30	73-109

Note: SS (mg/l) was assumed as equal to Turbidity (NTU)

Amount of surface soils washed away by rain can be estimated as[4]:

$Y = 0.023X^{1.2}$

Where:

Y: Soil washed out by rain (ton/ha/year)/1,000,000

X: Rainfall (mm/year) ×Maximum possible SS (mg/l)

Table 7.8 presents the results estimated.

Table 7.8 Estimation of Increment of SS by Wash Out of Surface Soil by Rain

Maximum rain fall assumed, mm/year	Possible maximum SS mg/l	Soils washed out by rain ton/ha/ year	Construction Area*, ha a	Total weight of soil washed out, ton/year	Strength of soil weight washed out by rain, ton/s	Increment of SS, mg/l	Presents SS in three rivers mg/l
2000	10000	1.327	10	13.3	0.0000004	0.0005	11-85

*100m width with a total of 1,000m length of approach road on banks were assumed as a source of muddy water while raining.
Data source: study team

As shown in the above table, the increment of SS by earthwork can be practically zero. Therefore, mud water generated running off from embankment during construction can be acceptable and no measure is necessary to take for mud water during construction. However in rainy day, earthwork shall not be done to minimize.

Table 7.9 estimates the increment of SS by the discharge into river of domestic liquid waste from workers' camp.

Table 7.9 Estimation of SS Increment by Discharge of Domestic Liquid Waste from Worker's Camp

	Unit	Kanchpur	Meghna	Gumti
Effluent unit of SS*	g/person/day	28	28	28
Number of worker	Person	500	500	500
Concentration	mg/l	91	91	91
Total SS	g/day	14000	14000	14000
Discharge in wet season	m3/s	3,480	15,200	12,600
Discharge in dry season	m3/s	292	2,046	3,703
Increment of concentration at wet season	mg/l	0.00001	0.00001	0.00001

[4] "The estimate method of soil loss with relation to rainfall" (2001 Eisaburo HIGA/ Okinawa Prefectural Institute of Health and Environment)

Increment of concentration at dry season	mg/l	0.00022	0.00003	0.00004
Present TSS in wet season	mg/l	579-2,305	54-72	47-82
Present TSS in dry season	mg/l	16-153	28-29	72-108

Source:Environmental Information Science Center, 1999
Data source: study team

As shown in the above table, the increment of SS by the discharge of liquid waste from workers camp is also practically zero. An effluent standard of SS in domestic liquid waste is specified as 100mg/l in the maximum and the estimated concentration of SS is within this standard.

Table 7.10 Total Amount of SS Estimated to be Increased in the River Waters in the Maximum

Causes	Maximum increment of SS, mg/l
Installation of piers in the river	1.7
Mud water from earthwork	0.0005
Liquid waste from workers' camp	0.0002
Total	Practically 1.7

Data source: Study team

Thus, at most 2 mg/l can be increased during construction, as is negligible range compared to the present concentration of SS, 10-80mg/l.

b. BOD

BOD estimated to be increased by the Project is considered by domestic liquid waste from workers camp only. Table 7.11 predicts the increment.

Table 7.11 Estimation of Increase of BOD in the River Water by Domestic Liquid Waste from Worker's Camp

		Kanchpur	Meghna	Gumti
Effluent unit of BOD	g/person/day	45	45	45
Number of worker	Person	500	500	500
Total BOD	g/day	22500	22500	22500
Concentration	mg/l	146	146	146
Discharge in wet season	m3/s	3500	12700	10400
Discharge in dry season	m3/s	750	4700	4000
Increase of concentration at wet season	mg/l	0.00001	0.00001	0.00001
Increase of concentration at dry season	mg/l	0.00035	0.00006	0.00007
Present BOD concentration in	mg/l	12-19	1	1-3

wet season				
Present BOD concentration in dry season	mg/l	10-20	3	1-3

Data source: study team

As shown in the table, the increment 0.00035 mg/l as is negligible compared to the present concentration of 1.0 mg/l in the minimum. However, there is an effluent standard of BOD for sewage as 40 mg/l in the maximum and the concentration of BOD in effluent from camp, 45 mg/l, is estimated as beyond the effluent standard of 40mg/l, regardless the total amount. Therefore, domestic liquid waste from the camp can not be directly discharged into the river.

c. Ammonium nitrogen (NH4-N)

NH4-N is an important indicator of eutrophication of river caused by urbanization. Increment of NH4-N is estimated based on the amount of domestic liquid waste generated from the workers' camp as shown in Table 7.12.

Table 7.12 Estimation of Increase of Total Nitrogen in the River Water by Domestic Liquid Waste

		Kanchpur	Meghna	Gumti
Effluent unit of Total Nitrogen T-N*	g/person/day	9	9	9
Number of worker	Person	500	500	500
Total T-N	g/day	9	9	9
Concentration of T-N	mg/l	29	29	29
Concentration of NH4-N assumed as of T-N	mg/l	29	29	29
Discharge in wet season	m3/s	3500	12700	10400
Discharge in dry season	m3/s	750	4700	4000
Increase of concentration at wet season	mg/l	0.00001	0.00001	0.00001
Increase of concentration at dry season	mg/l	0.00007	0.00001	0.00001
Present NH4-N in wet season	mg/l	1.2-3.5	0.1	0.1
Present NH4-N in dry season	mg/l	9.6	0.3-0.5	0.3

Data source: study team

As shown in the table, amount of Total Nitrogen, including NH4-N, is in the order of far negligible range, 0.00007 in the maximum, are predicted. Concentration of estimated T-N is within the effluent standard, 250 mg/l.

d. Coliform

The method to estimate Coliform concentration in sewage is yet established. Coliform is included in the domestic liquid waste very commonly. If the domestic liquid waste from workers' camp is directly discharged into the river, the river will be contaminated.

e. Oil and grease

It is very commonly observed that more or less of fuel oil is always leaking and floating around construction vessels moored on the water surface. Presently there is no way to predict the amount of oil leaking although the concentrations of oils and greases, 3-6 m/l, are already always higher than standards, 0.01 mg/l. Therefore, oil leaking can take place as usual during pier foundation construction.

Environmental impacts to surface water can be concluded as:

Table 7.13 Evaluation of activities as may pollute the surface water

	Environmental standard	Effluent standard	Total evaluation
Run off mud water	Accepted	-	Accepted
Domestic liquid waste from camp	Accepted	Not accepted	Not accepted
Leaked oil from vessels	Not accepted	Not accepted	Not accepted

- Groundwater

Groundwater cannot be contaminated due to the Project activity which does not include the injection of large amount of cement or chemicals into the ground/groundwater.

During Operation

No impact is expected

21) Soil pollution

During Construction

Moderate:

Usually soil pollution by leaked petrol from pipe connection of ill-maintenance heavy equipment and storage tanks which are installed directly on the soil surface can cause oil leaking that result in pollution of subsoil and groundwater during construction.

Furthermore totally 119,000 m3 borrow is taken from surrounding areas for construction of embankment, such borrow may be contaminated by hazardous matter.

During Operation

No impact is expected

22) Waste

During Construction

Moderate:

Construction sludge by boring from underground and domestic waste from base camp is generated during construction. However, owing to the results of primary surveys (soil pollution and bottom sediment), construction sludge does not have high density of pollutants.

Estimated volume is shown below;

Table 7.14 Evaluation of activities as may pollute the surface water

Category of Waste	Generated location	Estimated volume	Remarks
Construction sludge	Borehole in the river	Total 5,500 m3 Kanchpur: 1,300m3 Meghna: 1,800m3 Gumti: 2,400m3	Contains bentonite Bentnite is not hazardous matter, but it causes turbidity in the water
Domestic waste	Base camp site	450 ton/ 5 years/3 camps*	

* Estimation formulation: 200g/day/person X 500 workers for each camp=100kg/day=3 ton/month

During Operation

No impact is expected

23) Noise and vibration

During Construction

Moderate:

Construction noise and vibration will be caused from construction machines and vehicles. However, significant impact does not occur because of the below reasons.

a. Construction of bridge foundation and pier strengthening construction of existing bridge

Though huge noise is relatively generated through construction of bridge foundation and pier strengthening construction of existing bridge, the construction site is 40 meters away from residential area. This far distance does not give significant impact to residential area.

b. Embankment construction for construction road

The construction site is relatively near to residential area and the most nearby construction site from residential area is the Chittagong side of Kanchpur Bridge. However, low-noise construction vehicles will be used and construction work is not done at night. Moreover, construction period is no more than 6 months. Hence, there would be not significant impact

on residential area.

During Operation

Moderate:

A result of quantitative noise forecast is shown in Table 7.15, 7.16, and 7.17. In current time (2012), the nearest house or shop from the road is 10m away and the values of noise are shown with bold text on the three tables. On the other hand, in future time (2022), the nearest house or shop from the road would be 20m away and the values of noise are shown with bold text on the three tables.

According to the result, the forecasted value of 67 dB(A) at Gumti only exceeds the standard value of 60 dB(A). However forecasted value of 67 dB(A) in 2022 is less than the current measured value of 69 dB(A).

Thus, it is not likely to give significant impact to the nearest residents or shops.

Since it can be predicted that traffic jam decreases and traffic condition improves in 2022, car horn is not used as much as 2012 and the noise level could be lower than the forecasted value shown on the tables.

Table 7.15 Prediction of Noises in the Future (Kanchpur Bridge)

Year	Time	Forecasted Noise dB(A)					Standard Value*1	Land use	Evaluation
		10m Current Evaluated point*2	20m Future's Evaluated point*3	50m	100m	200m			
2012	Day	**79**	67	65	63	61	75	Industrial	Not satisfied
2022		82	**70**	67	65	62			Satisfied
2012	Night	**75**	64	62	61	61	70		Not satisfied
2022		78	**66**	63	62	61			Satisfied

Note1) Standard: Standard for Sound (Environmental Conservation Rules, 1997)
Note2) Current evaluated point in 2012: In front of house/shop
Note3) Future's evaluated point in 2022: In front of house / shop during operation

Table 7.16 Prediction of Noises in the Future (Meghna Bridge)

Year	Time	Forecasted Noise dB(A)					Standard Value*1	Land use	Evaluation
		10m Current Evaluated point*2	20m Future's Evaluated point*3	50m	100m	200m			
2012	Day	**74**	69	64	61	60	75	Industrial	Satisfied
2022		78	**72**	67	63	61			Satisfied
2012	Night	**66**	62	61	60	60	70		Satisfied
2022		68	**64**	61	60	60			Satisfied

Note1) Standard: Standard for Sound (Environmental Conservation Rules, 1997)
Note2) Current evaluated point in 2012: In front of house/shop
Note3) Future's evaluated point in 2022: In front of house / shop during operation

Table 7.17 Prediction of Noises in the Future (Gumti Bridge)

Year	Time	Forecasted Noise dB(A)					Standard Value*1	Land use	Evaluation
		10m Current Evaluated point*2	20m Future's Evaluated point*3	50m	100m	200m			
2012	Day	**71**	67	62	61	60	70	Commercial	Not satisfied
2022		73	**68**	63	61	60			Satisfied
2012	Night	**69**	65	62	61	60	60		Not Satisfied
2022		72	**67**	64	61	60			Not Satisfied

Note1) Standard: Standard for Sound (Environmental Conservation Rules, 1997)
Note2) Current evaluated point in 2012: In front of house/shop
Note3) Future's evaluated point in 2022: In front of house / shop during operation

Based on the noise monitored/predicted,distributions of noise level were estimated as in Figures from 7.6 to 7.8

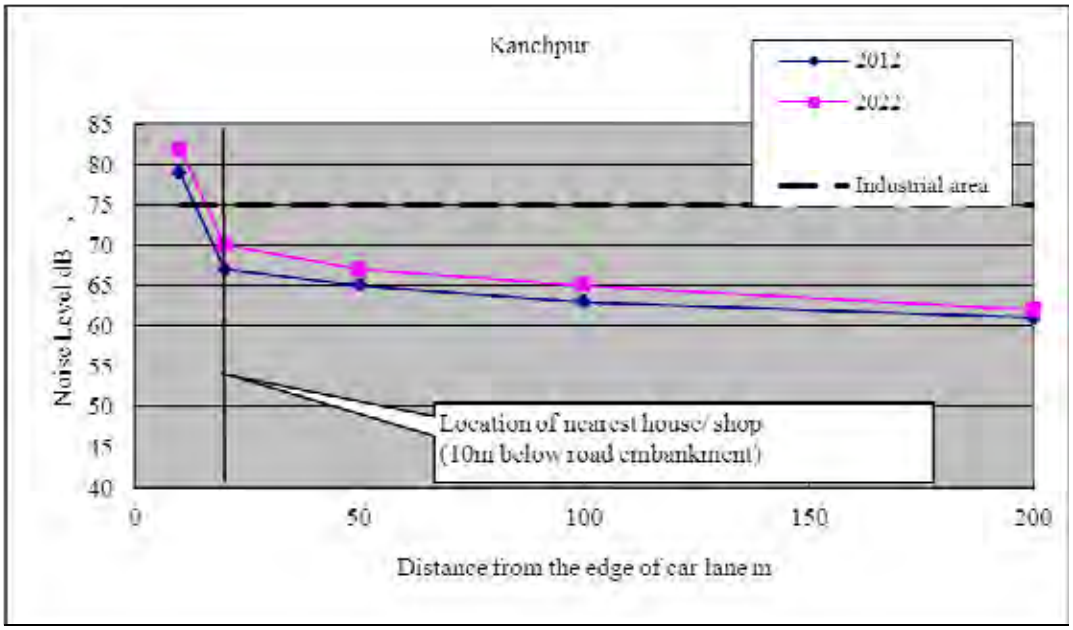


Figure7.6 Noise Versus Horizontal Distance at Kanchpur

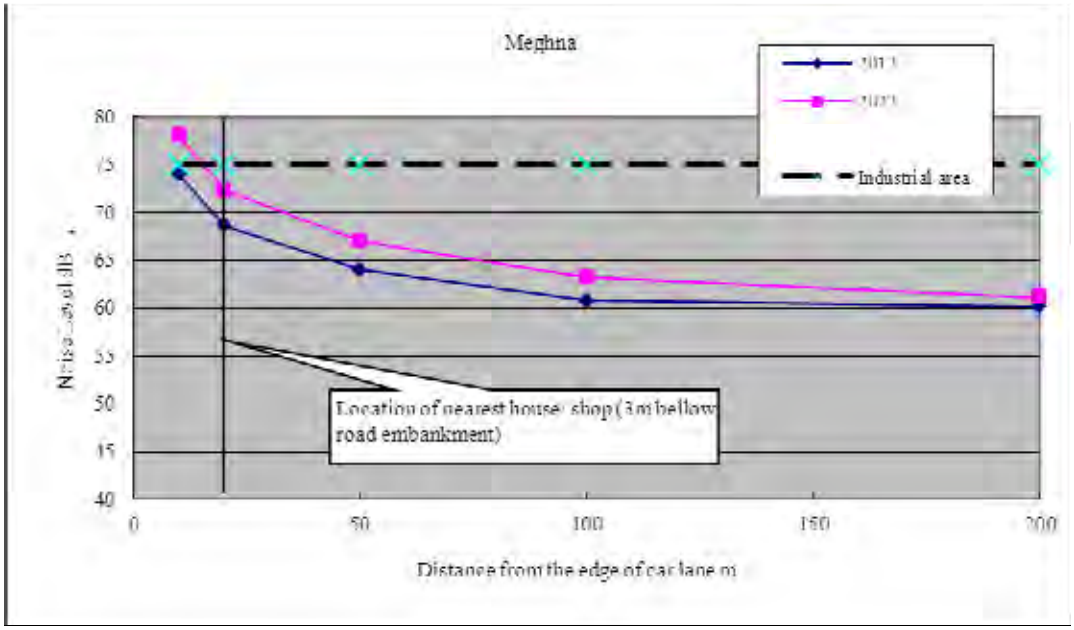


Figure7.7 Noise Versus Horizontal Distance at Meghna

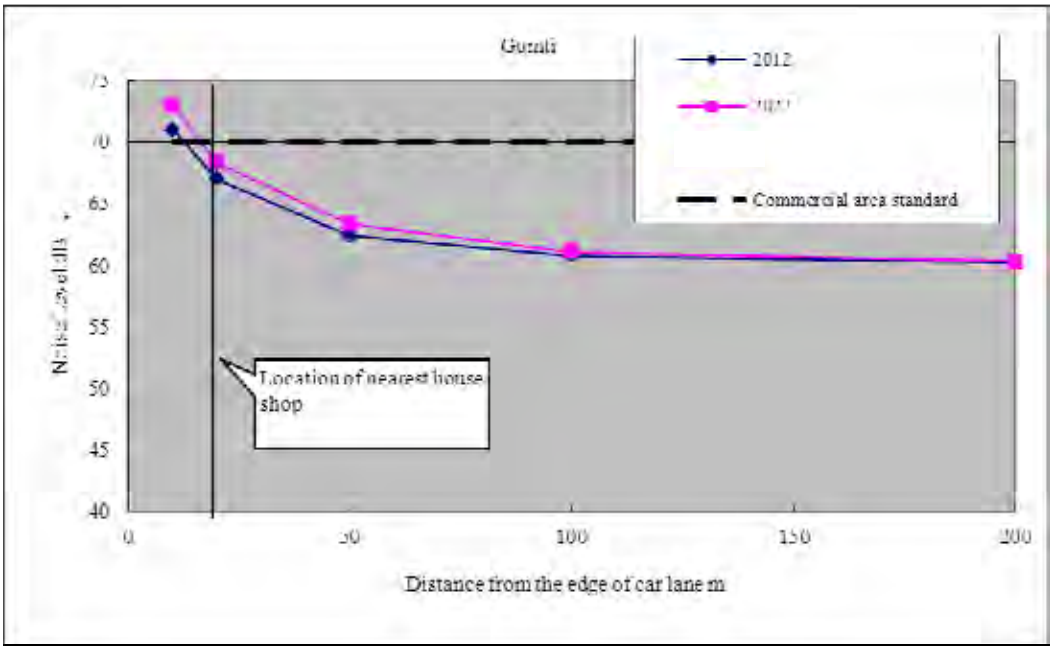


Figure7.8 Noise Versus Horizontal Distance at Gumti

24) Ground subsidence

During Construction and Operation

Negligible:

No long term subsidence is predicted since the there is no clayey soft deposit as may cause long term consolidation settlement.

25) Offensive odor

Before/During Construction

Moderate:

Local people residing just beside the construction field/ camp may complain on open burning of construction waste, improper treatment of human liquid waste, exhausted smoke from heavy equipment etc.

During Operation

No impact is expected

26) Bottom contamination

During Construction

Moderate

River bed can be contaminated if waste is indiscriminately dumped into rivers. Among all, heavy metal contained in chemical paints and sludge in camp liquid waste can be accumulated in the river bottom.

During Operation

No impact is expected

27) Landscape

Before/During Construction

No impact is expected

During Operation

Negligible

Followings are image photos for new Kanchpur Bridge and new Meghna Bridge respectively. As shown, since the height of new Bridges are same as existing bridges and new piers are also located parallel to existing piers, there is no major change in landscape of bridges.

Figure 7.9 New bridge (imaged) and Existing Bridge (background) at Kanchpur Bridge Site

Figure 7.10 New Bridge (imaged) and Existing Bridge (background) at Meghna Bridge Site

CHAPTER 8. ENVIRONMENTAL MANAGEMENT PLAN

8.1 Objective

The Environmental Management Plan (hereinafter, the Plan or EMP) aims to ensure the compliance of all activities undertaken during the construction and the operation of the Kanchpur, Meghna and Gumti bridge at Dhaka-Chittagong National Highway No.1 (NH-1) with the environmental safeguard requirements of JICA and the Government of Bangladesh. Furthermore, it aims at integrating the environmental components of the project with existing initiatives and programs in these fields. The plan consists of mitigation, monitoring and institutional measures to be taken during construction and operation to minimize adverse environmental impacts, offset them, or reduce them to acceptable levels. The plan also includes the actions needed to implement these measures.

8.2 Environmental Management Measures Proposed

(1) Policy

During construction work, all the reasonable steps shall be taken to protect the environment both on and off sites and to limit the damage and nuisance to people and resulting from pollution, noise and others as the result.

The EMP holds details: (a) the measures to be taken during the implementation and operation of a project to eliminate or offset adverse environmental impacts or to reduce them to acceptable levels; and (b) the actions needed to implement these measures. Basically, mitigation measure is prepared for the items that are concluded “severe” and ”moderate” in chapter 7.

(2) Acknowledgement of laws and regulations

The contractor/engineers shall acknowledge the law, regulations and target set forth for the project of the Government of Bangladesh pertaining health, safety and environmental protection related to:

- Air pollution
- Water quality
- Prevention of social impact
- Noise and vibration
- Fuel and chemical storage
- Protection of historic and cultural heritage/activity

(3) Staffing with contractor's responsibilities

Environmental/safety/health officers are appointed whose responsibilities include:

- Assisting contractor to implement health, safety and environmental protection and management as set forth in the contract
- Undertaking day to day environmental management tasks
- Maintaining a site diary recording all relevant matters concerning environmental management including protection, control, audit, inspection and interviews.
- Regular checking and keeping records of all safety and protective apparatus, equipment and clothing provided and
- Organizing the orientation courses on safety and health for new comers, including provision of measures for awareness and prevention of Sexually Transmitted Infection (STI) and HIV/AIDS among all.

(4) Regular meeting with communities

Monthly meeting shall be held to explain the work progress and take any concern/ complains about construction raised by the residents to mitigate.

(5) Reporting

Following reports shall be prepared, submitted and coordinated:

- Weekly environmental and safety reports, documenting the safety and environmental inspection/audit taken on a weekly basis
- Monthly summary of weekly inspection
- Accident report of workers or staff on site or off site whichever

(6) Environmental Management Plan

Table 8-1 summarizes the proposed environmental mitigation plans. The monitoring itself is implemented by the contractor, the RHD is in the first position to supervise the monitoring activities and evaluate the results except resettlement issue.

Table 8.1, 8.2, 8.3 summarizes ①the potential impacts which are to be controlled, ②the mitigation measures, ③construction stage, and ④impremention and monitoring agency. This EMP is outlining a preliminary; detail EMP should be prepared during detail design stage.

Table 8.1 Summary of EMP (Before Construction)

Environmental Impact/Issue	Severity of Adverse Impacts	Mitigation Measures	Implementation and Monitoring Agency
SOCIAL ENVIRONMENT			
1) Involuntary Resettlement	Severe: Households and people are influenced	• Proper resettlement action Plan (RAP) • Provide adequate compensation in time to PAPs	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
2) Local Economies such as employment, livelihood etc.	Severe: Shop owners, employees, cultivators, properties and plantation owners are influenced	• All direct income loss must be adequately compensated within the RAP • Income loss can be mitigated by providing alternative job opportunities for PAPs.	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
3) Land use and utilization of local resources	Moderate: Plantation area and an aqua culturing household are affected	• Plantation area which will be tentatively occupied during construction, will be restored to original state and returned to the land owner after construction	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
4) Social institutions such as social infrastructures and decision-making institutions	Moderate: Social institutions are affected by relocation	• Proper resettlement action Plan (RAP) • Provide adequate compensation in time to PAPs	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
6) Poor, indigenous people or ethnic minority	Severe: Livelihood of poor or female headed households are affected	• Prepare RAP involving the following measures - Define the displaced persons and criteria for determining their eligibility for compensation - Establish external monitoring committee consists of the third party • For poor people, proponent activities improving surface water condition and making groundwater available shall be implemented	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
7) Maldistribution of benefits and damages	Severe: Displaced people may be suffered at all bridge sites	• Prepare RAP involving the following measures - Assessed compensation will base on the market price - Payment will be carried out before resettlement • Establish external monitoring committee consists of the third party	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency

8) Local conflicts of interest	Moderate: candidates of construction workers may have some conflicts between communities	• Clear information about the needs of labor (number and qualification) should be provided with local people. • The job skills and the priority for the affected people shall be taken into account and the workers can be chosen..	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency

RHD- Road & Highways Department, DoE- Department of Environment, PAP- Project Affected Peoples, EMA- External Monitoring Agency, IMA- Internal Monitoring Agency

Table 8.2 Summary of EMP (During Construction)

Environmental Impact/Issue	**Severity of Adverse Impacts**	**Mitigation Measures**	**Implementation and Monitoring Agency**
SOCIAL ENVIRONMENT			
1) Involuntary Resettlement	Severe: Households and people are influenced	• Proper resettlement action Plan (RAP) • Provide adequate compensation and assistance in time to PAPs	Supervisor:RHD, EMA Reviewer:Consultant, EMA, IMA, PAPs Performer:RAP Implementing Agency
2) Local Economies such as employment, livelihood etc.	Severe: Shop owners, employees, cultivators, properties and plantation owners are influenced	• All direct income loss must be adequately compensated within the RAP • Income loss can be mitigated by providing alternative job opportunities for PAPs.	Supervisor:RHD, EMA Reviewer:Consultant, EMA, IMA, PAPs Performer:RAP Implementing Agency
3) Land use and utilization of local resources	Moderate: Plantation area and an aqua culturing household are affected	• Plantation area and part of fish pond which will be tentatively occupied during construction, will be restored to original state and returned to the land owner after construction	Supervisor:RHD, EMA Reviewer:Consultant, EMA, IMA, PAPs Performer:RAP Implementing Agency
4) Social institutions such as social infrastructures and decision-making institutions	Moderate: Social institutions are affected by relocation and noise	• Proper resettlement action Plan (RAP) • Provide adequate compensation in time to PAPs • Periodical maintenance of construction vehicles • Installation of sound insulation	Supervisor:RHD, EMA Reviewer:Consultant, EMA, IMA, PAPs Performer:RAP Implementing Agency
5) Existing social infrastructures and Services	Moderate: Social service utilities are located underground in the affected area	• Proper detailed design is going to be done and the utilities line will be diverted before starting the construction activity.	Supervisor:RHD, EMA Reviewer:Consultant, EMA, IMA, PAPs Performer:RAP Implementing Agency

6) Poor, indigenous people or ethnic minority	Severe: Livelihood of poor or female headed households are affected	• Prepare RAP involving the following measures - Define the displaced persons and criteria for determining their eligibility for compensation - Establish external monitoring committee consists of the third party • For poor people, proponent activities improving surface water condition, making groundwater available and enhancing their job skill shall be implemented	Supervisor:RHD, EMA Reviewer:Consultant, EMA, IMA, PAPs Performer:RAP Implementing Agency
7) Maldistribution of benefits and damages	Severe: Displaced people may be suffered at all bridge sites	• Prepare RAP involving the following measures - Assessed compensation will base on the market price - Payment will be carried out before resettlement • Establish external monitoring committee consists of the third party	Supervisor:RHD, EMA Reviewer:Consultant, EMA, IMA, PAPs Performer:RAP Implementing Agency
8) Local conflicts of interest	Moderate: candidates of construction workers may have some conflicts between communities	• Clear information about the needs of labor (number and qualification) should be provided with local people. • The job skills and the priority for the affected people shall be taken into account and the workers can be chosen..	Supervisor:RHD, EMA Reviewer:Consultant, EMA, IMA, PAPs Performer:RAP Implementing Agency
10) Accident	Moderate: Construction workers can have harmful and critical troubles	• Follow Health and Safety Management Plan (HSMP) rules and regulations designated by contractors	Supervisor:RHD, Reviewer:Consultant, PAPs Performer:Contractor
11) HIV/AIDS-	Moderate: Transmission of disease by inflow of migrant workers	• An HIV-AIDS awareness campaign via approved service provider shall be implemented	Supervisor:RHD, Reviewer:Consultant, PAPs, Performer: Contractor
12) Gender	Moderate: Salary gap between genders	• Monitoring of payment to workers by the contractor shall be implemented not to allow payment gaps between male and female.	Supervisor:RHD, Reviewer:Consultant, PAPs Performer:Contractor
13) Children's right	Moderate: A bunch of children come and work in construction site	• Regular monitoring of sites to guide contactors and their related firms to discourage child labor. • When the child labor will be detected, necessary and decisive actions to the violating firms are implemented. • Some assistance for parents of working child	Supervisor:RHD, Reviewer:Consultant, PAPs Performer:Contractor
15) River Transportation	Moderate: Congestion of vessels generates any collision	• -Provision of illumination night time around anchorages	Supervisor:RHD, Reviewer:Consultant, PAPs Performer:Contractor
NATURAL AND ECOLOGICAL ENVIRONMENT			

17) Fauna and flora	Moderate: Wildlife including River Dolphin is affected by the construction using steel piles	• Any illegal discharge of waste water, leaked oil shall be prohibited • Construction development area shall be fixed, not to develop or cut trees out of project area • Monitor to both upstream and downstream side will be conducted from the bridge surface • If dolphin is observed around project site, piling works and vessels should keep being suspended until the dolphin passes over. • Night lightning in construction should be restricted to the construction site.	Supervisor:RHD, DoE Reviewer:Consultant, PAPs Performer:Contractor
ENVIROMNTAL POLLUTION			
19) Air Pollution	Moderate: Dust rising from unpaved road and others during construction	• Good maintenance and operation of equipment and vehicles • Use environmentally-friendly material • Spraying water to suppress the dust rising • Cover entire load with tarpaulin to prevent the load from being blown. • Good maintenance of material • Monitoring and regular meeting for air quality	Supervisor:RHD, DoE Reviewer:Consultant, PAPs Performer:Contractor

20) Water Pollution	Moderate: Pile drivin, mud water from earthwork, domestic waster liquid from worker's camp, and oil leaking from construction vessel	• Generated construction sludge by pile driving, concrete plant and asphalt plant is treated by silt basin and remaining sludge is disposed at designated dumping site • Impermeable wall shall be used with cast-in-place pile • Turbid water from earthwork area is treated in silt basin for satisfying water quality standard and drain away to the nearest drainage or river • Domestic water is treated by septic tank for satisfying water quality standard and drain away to the nearest drainage or river. • Water quality including contents of arsenic will be checked before using groundwater as potable water for construction workers. • Waste oil shall be stored without leaking before legal disposal process. • Refueling place to equipment/ vehicles shall be concreted floor • Fuel and oil shall be stored at concrete floored tank surrounded with concrete fence • Equipment and vehicles are properly maintained not to cause leaking of fuel onto ground surface. Inspection sheet of maintenance record shall be submitted regularly • Batteries containing liquid inside shall be kept on impervious place to prevent battery liquid that contains hazardous heavy metals leaks and percolate into subground • To be on the safe side, study on groundwater will be implemented by the consultant during detailed design stage in order not to cause adverse impact on surrounding wells.	Sueprvisor：RHD, DoE Reviewer:Consultant, PAPs Performer:Contractor
21) Soil pollution	Moderate: leakage of oil, and borrow can contaminate soil	• Disposal at designated dumping site • Soil quality Testing • Disposal of waste oil without leakage • Refueling place having concreted floor • Preserved in the tank surrounded with concrete fence • Equipment and vehicles are properly maintained • Batteries containing liquid inside shall be kept on impervious place	Supervisor:RHD、DoE Reviewer:Consultant, PAPs Perfomer:Contractor

22) Waste	Moderate: Generation of construction sludge and domestic waste	• Minimize volume to use silt basin before disposing • Segregate waste to minimize waste material • Disposed in designated dumping site instructed by the section handling waste • Recycled as possible with consideration of soil property.	Supervisor:RHD, DoE, Reviewer:Consultant, PAPs Performer:Contractor
23) Noise and Vibrations	Moderate: Noise and vibration from construction machines and vehicles	• Periodical maintenance .of construction vehicles • Installation of sound insulation cover on boundary near residential area	Supervisor:RHD, DoE, Reviewer:Consultant, PAPs Performer:Contractor
25) Offensive Odor	Moderate: open burning of construction waste, improper treatment of human liquid waste, exhausted smoke from heavy equipment etc	• Prohibition of open burning • Proper treatment of camp waste • Proper maintenance of heavy equipment.	Supervisor:RHD, Reviewer:Consultant, PAPs Performer: Contractor
26) Bottom sediment	Moderate: Waste demped into rivers can contaminate river bed	• Construction contractor will be obliged to no dumping of waste into the river	Supervisor:RHD, Reviewer:Consultant, PAPs Performer:Contractor

RHD- Road & Highways Department, DoE- Department of Environment, PAP- Project Affected Peoples, EMA- External Monitoring Agency, IMA- Internal Monitoring Agency

Table 8.3 Summary of EMP (During Operation)

Environmental Impact/Issue	Severity of Adverse Impacts	Mitigation Measures	Implementation and Monitoring Agency
SOCIAL ENVIRONMENT			
10) Accident	Moderate: Traffic accident occurred	• Provision of traffic sings, road mark, bump, zebra mark, guard rail and pole, and curb stones etc	Supervisor:RHD, Reviewer:NGO, PAPs Performer:Consultant, RHD
ENVIROMNTAL POLLUTION			
16) Hydrological condition	Severe: hydrological condition was affected by scouring	• Steel Pipe Sheet Pile (SPSP) foundation has been selected；the size and depth of the SPSP foundation shall be designed that the riverbed scouring will not create any threatening to overall bridge stability.	Supervisor:RHD, DoE Reviewer:Consultant, PAPs Performer:Contractor
23) Noise and vibration	Moderate: a forecasted value exceeds a standard one.	• Securement of buffer zone as noise decay distance (land utilization guide by RHD and local authority)	Supervisor:RHD, DoE Reviewer:Consultant, PAPs Performer:Contractor

RHD- Road & Highways Department, DoE- Department of Environment, PAP- Project Affected Peoples, EMA- External Monitoring Agency, IMA- Internal Monitoring Agency

Outline of environmental management plan for items recommended in JICA Guidelines are:

1) Involuntary Resettlement

A total of 274 households (972 people) will be relocated and 32 households (44 people) will be affected. It is likely to have significant adverse impact on this item since more than 200 resettlers are predicted. Thus appropriate compensation and livelihood restoration program is prepared in the resettlement action plan (RAP)

2) Local Economies such as employment, livelihood, etc

A total 66 shop owners (61 shop owners and 5 tenant shop owners), 28 employees, 5 fish pond cultivators, 2 companies properties and 1 plantation owner will be affected by the project. Thus appropriate compensation and livelihood restoration program is prepared in the RAP .

For fisherman, an investigation to clarify fish habitat is carried out and can tell where fish makes its habitat if fisherman has difficulty with fishing due to the change of fish habitat.

3) Land use and utilization of local resources

Although a plantation area and part of fish pond will be tentatively occupied before and during construction, it will be restored to original state and returned to the land owner after construction

4) Social institutions such as social infrastructures and decision-making institutions

For relocation, appropriate compensation and livelihood restoration program is prepared in the RAP. For noise from construction vehicles, periodical maintenance of the vehicles and installation of sound insulation are carried out.

5) Existing social infrastructures and Services

Detailed design is going to be done with the consideration of preventing social service utilities, such as power, water, drainage and communication line, from be affected. Then, the utilities line will be diverted before starting the bridge construction activity.

6) Poor, indigenous people or ethnic minority

There are not any indigenous people in the project affected area.

However about 40% of the population interviewed is classified as poor with yearly income of less than BDT 120,000.Thus appropriate compensation and livelihood restoration program is prepared in the RAP. For poor people, proponent activities improving surface

water condition, making groundwater available and enhancing their job skills shall be implemented.

7) Maldistribution of benefit and damages

Displaced people may suffer from losing their shelter (residential house), business access (small kiosk) and social network (relationship with families/ neighbor/ friends) generally at all bridge sites. Some suffers for loss of plantation at Meghna Bridge Site. Thus appropriate compensation and livelihood restoration program is prepared in the RAP report.

8) Local conflict of interest

Due to increased employment opportunity during construction, candidates of construction workers may have some conflicts between communities. Thus such job opportunities should be provided in fair way. Clear information about the needs of labor (number and qualification) should be provided with local people. The job skills and the priority for the affected people shall be taken into account and the workers can be chosen.

10) Accident

Construction safety and Health Plans

At all the time, precautions to maintain the health and safety of all workers shall be exercised. In collaboration with local health authorities, medical staff, first aids facilities, sick bay and ambulance service shall be available at the site all the times and suitable arrangement is made for all necessary welfare and hygiene requirements and prevention of epidemics. For this purpose, plans for construction safety and traffic safety shall be established before construction and operation in Health and Safety Management Plan (HSMP) by contractor.. For the preparation of HSMP, following is measures to be taken in the minimum,

- A health management officer at the site responsible for maintaining health and safety against accidents shall be appointed. This person shall be qualified for this responsibility and shall have the authority to issue instructions and take protective measures to prevent accidents
- Prepare the emergency response plan to deal with accidents and emergency
- Provide fully equipped first aid base in each construction camp
- Provide at least one clinic stationed with a nurse and a doctor every working day
- Establish mobile phone link with nearest hospitals
- Ensure safety, rescue and industrial health issues are given the first priority to all persons at the site.
- Train all workers in basic sanitation, health care, safety matters and specific hazard of the work

- Provide personnel protection equipment such as safety boots, helmet, gloves, protective cloths, goggles and ear protection in accordance with type the work he/she is engaged
- Provide clean and sufficient fresh water at construction site, camp, office, laboratory and workshop.
- Provide enough number of latrines with septic tanks at the site
- Provide a tentative waste dumping space is facilitated in each camp so that the garbage car can collect regularly.
- Ensure that the drains in the camp are sufficiently provided so that no standing water be generated
- Protect all employees from mosquito, rats and other pest bearings
- Ensure that critical operations which could lead to incidents with potential of severe loss are identified, assessed, evaluated and documented so that adequate control measures are taken.
- The safety of construction workers, nearby residents and road users should be taken into consideration during design process as well as the construction stage of the project. Training and protective equipment should be provided.
- Appropriate speed limits should be imposed to reduce the number and severity of accidents. To reduce the speed, hump shall be installed at the right places
- Examine the portable water from a well on a regular basis with considerations of arsenic amount.

Traffic safety after operation starts

For land traffic safety, provision of traffic sings, road mark, bump, zebra mark, guard rail/ poles, and curb stone etc to protect vehicles and pedestrians, motor bike and auto rickshaws respectively for after operation.

During construction, the route of truck movement shall be predetermined around the site. The flag person shall be arranged at the key points to prevent accidents based on the HSMP.

11) HIV/AIDS

An HIV-AIDS awareness campaign via approved service provider shall be implemented and other measures to reduce the risk of the transfer of the HIV virus between and among contractor’s personnel and local community, to promote early diagnosis and to assist affected individuals. It is proposed,

- To conduct Information, Education and Consultation Communication (IEC) campaign at least every other months to all site staff, employees, and immediate local communication concerning the risks, dangers and impact and appropriate avoidance behaviour with respect

to , of Sexually Transmitted Disease (STD) or Sexually Transmitted Infection (STI) in general and HIV/AIDS in particular,

- To provide male or female condoms for all staff and labourers as appropriate and
- To provide for STI and HIV/AIDS screening, diagnosis, counseling and referral to dedicated national STI and HIV/AIDS program.

12) Gender

Monitoring of payment to workers by the contractor shall be implemented not to allow payment gaps between male and female. Environmental and Safety Officer of contractor shall check the payment book monthly and report to RHD if there is any salary gap between genders. Then, if RHD evaluates that there is need to redress, RHD implements any support.

13) Children's right

Child labor at the construction site during the project implementation shall be strictly prohibited since such practices are banned by both Bangladesh laws and JICA guidelines. The RAP Implementing Agency and RHD shall regularly monitor project sites to guide contactors and their related firms to discourage child labor. A contract between contractor and RHD shall include provisions for prohibition of child labor.

When the child labor will be detected, the RAP-IA shall immediately report to RHD and RHD shall take necessary and decisive actions including suspension and/or rescind of the contract (if the case is extremely malicious) to the violating firms based on the applicable laws and regulations of Bangladesh.

If root cause of the child labor originated from impoverished living standard of project affected families due to improper or insufficient relocation assistance, RHD, through RAP-IA, will provide the following assistance to parents of working child:

(1) Support of sending children to school
(2) Helping the parents with hunting for a job, including the one at the construction site
(3) Mediation for micro credit loan
(4) Introducing them to assistance organizations such as NGO and so forth

15) River transportation

River traffic shall be controlled during construction as:

- Provision of illumination at the night time around anchorages

16) Hydrological condition

This time the foundation of 4-lane new bridge will be unified with that of 2-lane existing

bridge, therefore it has a negative impact on riverbed scouring due to construction of the bridge substructure in a large scale and the scouring level is expected to be higher. Consequently, it requires to estimate design scouring level more accurately. The design scouring level shall be determined from a riverbed simulation model, which will be fully incorporated in the design of bridge foundation. As a countermeasure of riverbed scouring, the foundation type as Steel Pipe Sheet Pile (SPSP) foundation has already been selected. The size and depth of the SPSP foundation shall be designed so that the riverbed scouring will not create any threatening to overall bridge stability.

17) Fauna and flora

Following measures are required for the exiting fauna and flora species.

Any illegal discharge of waste water, leaked oil shall be prohibited. Thus the contractor shall store waste material before taking legal process.

Construction development area shall be fixed, not to develop or cut trees out of project area. Thus the contractor shall set up marking on the boundary of construction area and educate all related construction workers.

With regard to South Asian River Dolphin which is categorized as endangered species and observed in the project area, special care shall be taken as follows at Meghna and Gumti;

- Monitoring to both upstream and downstream side will be conducted from the bridge surface.
- If dolphin is observed around project site, piling works and vessels should keep being suspended until dolphin passes over.
- Night lightning during construction should be restricted to the construction site.

19) Air Pollution

To suppress the air pollution during construction, it is recommended:

- Good maintenance of equipment/vehicles to save fuels
- Prohibition of idling of vehicles/equipment
- Adaption of fuel saving equipment/vehicles and construction methods
- Prohibition of incineration of wood, paper and other waste
- Spraying water over not-surfaced embankment to suppress the rising of dust
- Ensuring that all trucks carrying dust raising material shall not be overloaded, provided with tarpaulin covering entire load not to blown by wind.
- Material is stock piled under sheltered area and covered with tarpaulin to prevent them

airborne

- Undertaking seasonal air quality monitoring around the sites
- Regular meeting shall be held with adjacent community to know if any problem I there about air pollution

20) Water pollution

Pile driving in the river, mud water from earthwork for approach embankment in rainy season, domestic waste liquid from worker's camp and oil leaking from construction vessel & machines is predicted as water pollution sources during construction.

Following mitigation measures are prepared for them.

Table 8.4 Mitigation Measures by Pollution Source

Pollution source/Activities	Mitigation measure
1. Pile driving in the river	- Generated construction sludge does not disposed in the river. The sludge is treated by silt basin and remaining sludge is disposed at designated dumping site - Impermeable wall shall be used with cast-in-place pile
2. Earthwork at embankment	- Turbid water from construction work area is treated in silt basin for satisfying water quality standard and drain away to the nearest drainage or river
3. Domestic liquid water from workers camp	- Domestic water is treated by septic tank for satisfying water quality standard and drain away to the nearest drainage or river. -Water quality including contents of arsenic will be checked before using groundwater as potable water for construction workers.
4. Oil leaking from construction vessel and machines	- Waste oil shall be stored without leaking before legal disposal process. - Refueling place to equipment/ vehicles shall be concreted floor - Fuel and oil shall be stored at concrete floored tank surrounded with concrete fence - Equipment and vehicles are properly maintained not to cause leaking of fuel onto ground surface. Inspection sheet of maintenance record shall be submitted regularly - Batteries containing liquid inside shall be kept on impervious place to prevent battery liquid that contains hazardous heavy metals leaks and percolate into subground
5. Turbid water from concrete plant	- Generated turbid water is treated by silt basin and remained sludge is disposed at designated dumping site
6. Turbid water from asphalt plant	- Generated turbid water is treated by silt basin and remained sludge is disposed at designated dumping site

To be on the safe side, study on groundwater will be implemented by the consultant during detailed design stage in order not to cause adverse impact on surrounding wells.

21) Soil pollution

Oil leaking and contaminated borrow may cause soil pollution in the project area. Thus, following measures shall be implemented during construction.

Generally, construction sludge by pile driving in the river does not contain hazardous matter, but the sludge causes turbid in the river. Thus, the sludge is disposed on legal process prescribed by local authority.

It is significant to consider original places of borrow to prevent soil pollution in the project area and the survey for original places will be carried out in detailed design.

Table 8.5 Mitigation Measures by Pollution Source

Pollution source/Activities	Mitigation measure
1. Pile driving in the river	- Generated construction sludge does not contain hazardous matter, thus the sludge is disposed at designated dumping site
1. Contaminated borrow for construction of embankment	- Soil quality Testing shall be done before utilization.
2. Oil leaking from construction vessel and machines	- Waste oil shall be stored without leaking before legal disposal process. - Refueling place to equipment/ vehicles shall be concreted floor - Fuel and oil shall be stored at concrete floored tank surrounded with concrete fence -Equipment and vehicles are properly maintained not to cause leaking of fuel onto ground surface. Inspection sheet of maintenance record shall be submitted regularly - Batteries containing liquid inside shall be kept on impervious place to prevent battery liquid that contains hazardous heavy metals leaks and percolate into subground

22) Waste

Construction sludge by boring from underground and domestic waste from base camp is generated mainly during construction. Both of the waste is disposed in designated dumping site instructed by the section handling waste.

Following table is generated volume and mitigation measures to minimize impacts.

Table 8.6 Type of Waste and Disposal Process

Category of Waste	Generated location	Estimated volume	Mitigation Measures
Construction sludge	Borehole in the river (by pile driving)	Total 5,100 m3	- Minimize volume to use silt basin before disposing
Domestic waste	Base camp site	450 ton/ 5 years/3 camps	- Segregate waste to minimize waste material

.

Generated waste is recycled as possible with consideration of soil property.

23) Noise and Vibration

According to the result of noise forecast, the forecasted value of 67 dB(A) at Gumti exceeds the standard value of 60 dB(A). However, the forecasted value of 67 dB(A) in 2022 is less than the current measured value of 69 dB(A) in 2012. Thus, it is not likely to give

significant impact to the nearest residents or shops.

Additionally, construction noise and vibration will be caused from construction machines and vehicles. Because of the construction time and duration is limited, it is not likely to give significant impact to residential area.

Despite the above prediction, following mitigation measures should be implemented during construction and operation.

In terms of vibration, the valiue is negligible on the basis study made in Initial Environment Examination (IEE) of less than 60 dB in any areas as an international standard; hence, mitigation measure is not required.

Table 8.7 Mitigation Measures for Noise Pollution

Stage	Noise Source	Mitigation Measures
During Construction	Construction noise by construction machines and vehicles	- Periodical maintenance - Installation of sound insulation cover on boundary near residential area
During Operation	Traffic noise from carriage way	- Securement of buffer zone as noise decay distance (land utilization guide by RHD and local authority)

25) Offensive Odor

Construction contractor will undertake measures to prohibit open burning, and to ensure proper treatment of camp waste and proper maintenance of heavy equipment etc.

26) Bottom Contamination

Construction contractor will obliged to no dumping of waste into the river.

8.3 Institutional Arrangement

Implementation of the EMP including monitoring during construction are the responsibility of the contractor, supervised by PIU and the SEC.

1) The Project Director of RHD

   With the assistance of SEC will be overall responsible for ensuring compliance of safeguard measures and will be reporting to the regulatory bodies and JICA certifying that relevant environmental safeguard measures have been complied with during project implementation. After operation, monitoring will become the work of PIU/ SEC.

2) The Social and Environmental Circle (SEC)

   Headed by a Superintendent Engineer who has two Executive Engineers – one for Environment and one for Resettlement under him/her. The role of SEC include:

   - Monitoring progress of the project as per planned schedule of activities
   - Exercising oversight over the implementation of environmental mitigation measures by the contractors
   - Assisting the Site Engineers by providing appropriate environmental advise and solutions
   - Documenting the experience in the implementation of the environmental process
   - Preparing training materials and implementing programs in collaboration with the Consultant
   - Maintaining interfaces with the other line departments / stakeholders
   - Reporting to JICA and DOE on status of EMP implementation
   - Preparing budget and maintaining records of expenditure

3) The Construction Supervision Consultant (CSC)

   Will have in-house capacity to advise on and to supervise the implementation of the EMP during this project implementation. The CSC is expected:

   - To prepare an Environmental Supervision Manual in the beginning of their contract to finalize the environmental supervision procedures including inspection, monitoring and reporting to be followed by all relevant parties during the implementation of the project.
   - To liaise with PIU / SEC to ensure that Contractor complies with the requirements of various environmental safeguard measures through supervision, monitoring and reporting on the same.

- Efforts must be made by the Consultant to ensure that environmental mitigation and good-construction-practices are not only considered but actually implemented as integral component of each civil activity. It should be considered as day-to-day activity.
- Implementation of environmental safeguard measures needs team effort and as such the Team Leader will delegate the responsibilities to each member of the supervision team with respect to their core responsibilities. Besides, the Team Leader of the Consultant will nominate a senior level engineer for being directly responsible for implementation of stipulated safeguard measures, to establish accountability. He will provide guidance to the field staff of the Consultant and Contractor for implementing each of the activities as per the EMP. He will review Contractor's EMP, traffic management plan and safety plan. He will be responsible for record keeping, providing instructions through the Engineer for corrective actions, ensuring compliance of various statutory and legislative requirements and assist Engineer for submitting reports to PIU/ SEC. He will maintain a close coordination with the Contractor and PIU/ SEC for successful implementation with the environmental safeguard measures.

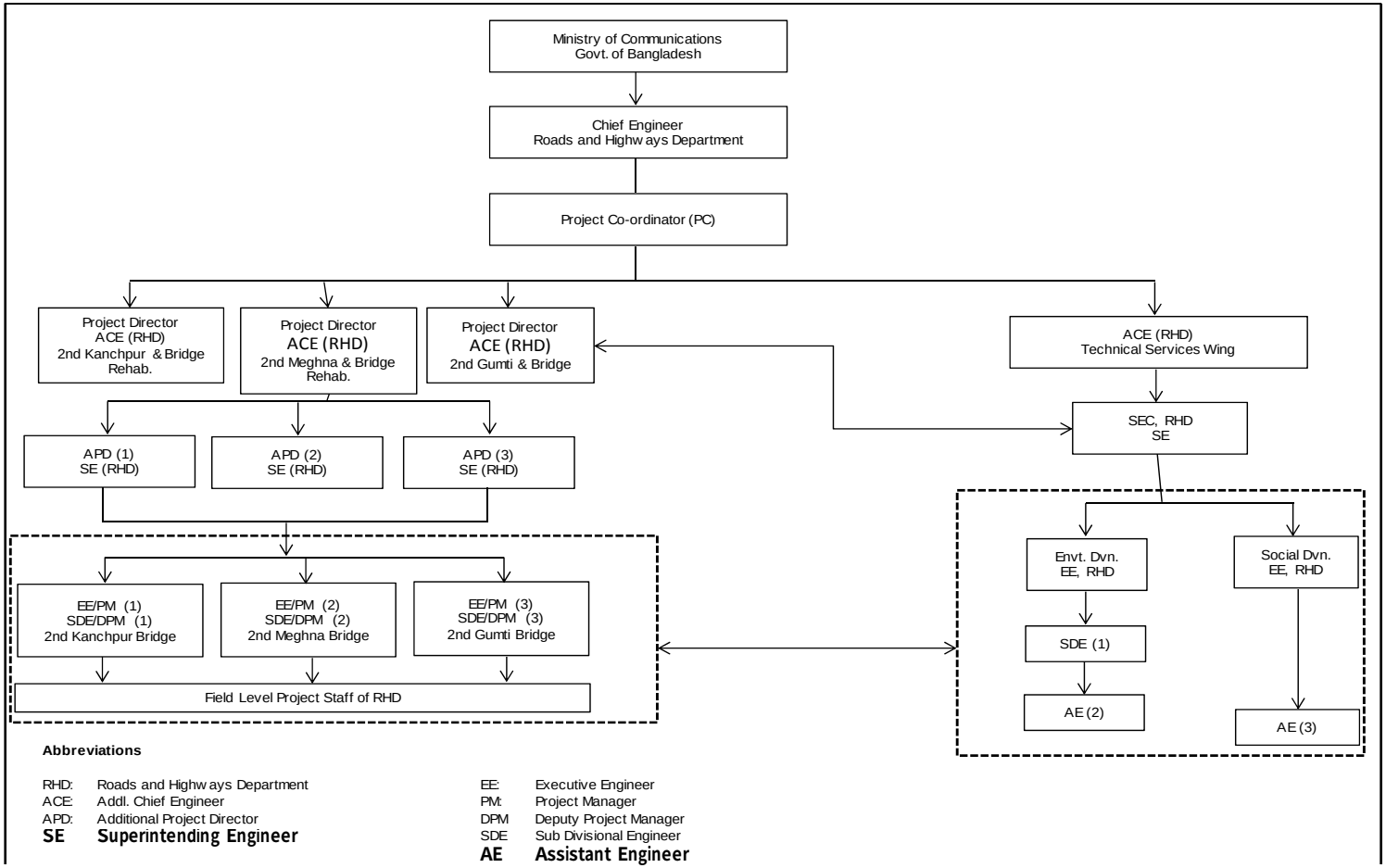
4) The contractors

Will undertake implementation of the environment measures, and will conduct periodic self-audits. The construction of the proposed bridge would be carried out by the qualified Contractors. Much of the EMP must be carried out by Contractors and those must be incorporated in the contract document. The role of consultant will include checking on conformity with the relevant clauses in construction contracts and national and international environmental legislation and regulations. Responsibilities of the Contractor in relation to environmental management will have to be elaborated during detail EMP preparation but must include the followings:

- The Contractor shall take all reasonable steps to protect the environment and avoid damage and nuisance arising because of his operations.
- The Contractor shall be responsible for the costs of cleaning up any environmental pollution resulting from his activities.
- The Contractor shall take adequate preventive measures against water, air, and soil pollution.
- The Contractor shall, at all times, maintain all sites under his control in a clean and tidy condition and shall provide appropriate and adequate facilities for the temporary storage of all wastes before disposal.
- The Contractor shall be responsible for the safe transportation and disposal of all wastes

- The Contractor shall be responsible for the provision of adequate sanitary facilities for the construction workforce.
- The Contractor shall make every reasonable effort to reduce noise nuisance caused by construction activities.

The proposed organizational set-up of three bridges for the implementation together with EMP implementation is shown in Figure 8.1.



- Figure 8.1: Organizational Framework for the EMP Implementation under the Project

8.4 Environmental Monitoring PLAN

8.4.1 Requirements for Monitoring Plan

Environmental monitoring is an essential tool for environmental management as it provides the basic information for rational management decisions.

The purpose of the monitoring program is to ensure that the envisaged purposes of the project are achieved and result in desired benefits to the target population. To ensure the effective implementation of the EMP, it is essential that an effective monitoring program be designed and carried out. Environmental Monitoring in the EMP for three bridges have been designed with the following objectives to:

- Measure the extent of expected or poorly quantified impacts;
- Ensure incorporation of Environmental Mitigation Measure during implementation of the proposed project;
- Observe effectiveness of Environmental Mitigation Measures;
- Ensure early detection of unexpected impacts and adoption of appropriate protection measures;
- Provide periodic reviews to observe adherence to Environmental Quality Standards (EQS) and adjust Environmental Mitigation Measures, if required; and
- Detect unacceptable level of impacts and adopt corrective measures.

8.4.2 Monitoring Plan

The monitoring program for the various performance indicators of three bridges are outlined in Table 8.8, 8.9 and 8.10.

Table 8.8 Environmental Monitoring Plan (Before Construction)

Impact	Means of Monitoring	Frequency of Monitoring	Location	Implementing party
1) Involuntary Resettlement	RAP monitoring plan is carried out	Monthly or quarterly	Resettlement places	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
2) Local Economies such as employment, livelihood etc.	RAP monitoring plan is carried out	Monthly or quarterly	Resettlement places	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
3) Land use and utilization of local resources	Direct survey in the occupied area to see the condition	Quarterly	The occupied areas	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
4) Social institutions such as social infrastructures and decision-making institutions	RAP monitoring plan is carried out	Monthly or quarterly	Resettlement places	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
6) Poor, indigenous people or ethnic minority	RAP monitoring plan is carried out. Direct survey in the field by interviews with the poor people in order to ensure that groundwater is available for them..	Monthly or quarterly	Resettlement places, Construction sites	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
7) Maldistribution of benefits and damages	RAP monitoring plan is carried out.	Monthly or quarterly	Resettlement places	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
8) Local conflicts of interest	Direct survey in the field by interviews with the locals in order to ensure that local people, especially PAPs, are satisfied with their jobs.	Monthly or quarterly	Local residences, Resettlement places	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency

BOD=biochemical oxygen demand, DO=dissolved oxygen, NOx=Oxides of Nitrogen, SO2,=sulfur dioxide, SS=suspended solids, SPM=Suspended Particulate Matter,
RHD- Road & Highways Department, DoE- Department of Environment, PAP- Project Affected Peoples, EMA- External Monitoring Agency, IMA- Internal Monitoring Agency

Table 8.9 Environmental Monitoring Plan (During Construction)

Impact	Means of Monitoring	Frequency of Monitoring	Location	Implementing party
1) Involuntary Resettlement	RAP monitoring plan is carried out	Monthly or quarterly	Resettlement places	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
2) Local Economies such as employment, livelihood etc.	RAP monitoring plan is carried out	Monthly or quarterly	Resettlement places	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
3) Land use and utilization of local resources	Direct survey in the occupied area to see the condition	Quarterly	The occupied areas	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
4) Social institutions such as social infrastructures and decision-making institutions	RAP monitoring plan is carried out.	Monthly or quarterly	Resettlement places	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
5) Existing social infrastructures and Services	Direct survey in the field by interviews with the locals in order to ensure that social service utilities work as before.	Monthly	Construction sites	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
6) Poor, indigenous people or ethnic minority	RAP monitoring plan is carried out. Direct survey in the field by interviews with the poor people in order to ensure that groundwater is available for them..	Monthly or quarterly	Resettlement places, Construction sites	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
7) Maldistribution of benefits and damages	RAP monitoring plan is carried out.	Monthly or quarterly	Resettlement places	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
8) Local conflicts of interest	Direct survey in the field by interviews with the locals in order to ensure that local people, especially PAPs, are satisfied with their jobs.	Monthly or quarterly	Local residences, Resettlement places	Supervisor:RHD, EMA Reviewer:Consultant,EMA, IMA, PAPs Performer:RAP Implementing Agency
10) Accident	Ensuring that HSMP works right on the track	Every day or weekly	Construction sites	Supervisor:RHD, Reviewer:Consultant, PAPs Performer:Contractor
11) HIV/AIDS-	Ensuring that contractor's personnel and local community understand HIV-AIDS awareness campaign	Quarterly	Construction sites	Supervisor:RHD, Reviewer:Consultant, PAPs Performer:Contractor
12) Gender	Direct survey in the field by interviews with the women in order to ensure that there is no any gaps between man and women.	Quarterly	Construction sites	Supervisor:RHD, Reviewer:Consultant, PAPs Performer:Contractor

Impact	Means of Monitoring	Frequency of Monitoring	Location	Implementing party
13) Children's right	Regular inspection of children's laborer	Quarterly	Construction sites	Supervisor:RHD, Reviewer:Consultant, PAPs Performer:Contractor
15) River Transportation	Giving adequate illumination	Every day	Around anchorages for construction barges	Supervisor:RHD, Reviewer:Consultant, PAPs Performer:Contractor
17) Fauna and flora	Counting the number of River Dolphin	Yearly	The both sides (upstream and downstream) of Meghna and Gumti Bridges within one side of 200m	Supervisor:RHD, DoE Reviewer:Consultant, PAPs Performer:Contractor
19) Air Pollution	Measurement of SPM, NOx, SO2, CO	Monthly or after complaint	10 m offset from end of car lane for 3 bridges	Supervisor:RHD, DoE Reviewer:Consultant, PAPs Performer:Contractor
	Inspection of brick, bitumen and cement facilities (spot check)	Monthly	Around the facilities	Supervisor:RHD, DoE Reviewer:Consultant, PAPs Performer:Contractor
20) Water Pollution	(Surface water) Measurement of pH, EC, Turbidity, DO, Coliform, BOD, NH4-N, Oil and Grease	Quarterly or after pollution event	Upstream and downstream near the construction vessels of 3 rivers respectively	Supervisor:RHD, DoE Reviewer:Consultant, PAPs Performer:Contractor
	(Drinking water/ Groundwater for construction workers and the poor, etc.) Measurement of pH, fecal coliform, Fe and As	Monthly	(The location will be selected later with the consideration of the surrounding environment)	Supervisor：RHD, DoE Reviewer:Consultant, PAPs Performer:Contractor
	(Turbid water from pile driving, concrete plant, and asphalt plant) Measurement of pH and SS	Weekly or monthly	The sites where pile driving is done and the plants are built	Supervisor：RHD, DoE Reviewer:NGO, PAPs Performer: Consultant,
21) Soil pollution	Visual inspection, or measurement of Cd, Pb, As, oil, grease and so forth	Beginning of earth filling works	At all project sites including construction yards, approach roads, bridge end facilities, etc.	Supervisor:RHD、DoE Reviewer:Consultant, PAPs Performer:Contractor
22) Waste	Inspection of waste disposal sites and construction camps	Monthly	Designated dumping sites	Supervisor:RHD, DoE, Reviewer:Consultant, PAPs Performer:Contractor
23) Noise and Vibrations	Measurement of noise dB(A)	Monthly or after complaint	10 m offset from end of car lane for 3 bridges	Supervisor:RHD, DoE, Reviewer:Consultant, PAPs Performer:Contractor
	Visual inspection to ensure that good standard equipment is in use and sound insulation cover is installed.	Weekly	Construction sites	Supervisor:RHD, DoE, Reviewer:Consultant, PAPs Performer:Contractor
25) Offensive Odor	Odor inspection to ensure	Weekly or monthly	Construction sites	Supervisor:RHD,

Impact	Means of Monitoring	Frequency of Monitoring	Location	Implementing party
	harmful odor is not released from equipments and waste			Reviewer:Consultant, PAPs Performer:Contractor
26) Bottom sediment	Bottom sampling of Cd, Pb, As, oil, grease and so forth	Monthly	Construction sites	Supervisor:RHD, Reviewer:Consultant, PAPs Performer:Contractor

BOD=biochemical oxygen demand, DO=dissolved oxygen, NOx=Oxides of Nitrogen, SO2,=sulfur dioxide, SS=suspended solids, SPM=Suspended Particulate Matter,
RHD- Road & Highways Department, DoE- Department of Environment, PAP- Project Affected Peoples, EMA- External Monitoring Agency, IMA- Internal Monitoring Agency

Table 8.10 Environmental Monitoring Plan (During Operation)

Impact	Means of Monitoring	Frequency of Monitoring	Location	Implementing party
10) Accident	Ensuring traffic sings, road mark, bump, zebra mark, guard rail and pole, and curb stones etc to be properly installed	Annually	Around the bridges	Supervisor:RHD, Reviewer:Consultant, PAPs Performer:Contractor
16) Hydrological condition	Inspection of river bottom condition for scouring	Annually	Around abutments	Supervisor:RHD, DoE Reviewer:Consultant, PAPs Performer:Contractor
19) Air Pollution	Measurement of SPM, NOx, SO2, CO	Monthly or after complaint	10 m offset from end of car lane for 3 bridges	Supervisor:RHD, DoE Reviewer:Consultant, PAPs Performer:Contractor
20) Water Pollution	(Surface water) Measurement of pH, EC, Turbidity, DO, Coliform, BOD, NH4-N, Oil and Grease	Quarterly	Upstream and downstream near 3 bridges respectively	Supervisor：RHD,DoE Reviewer:Consultant, PAPs Performer:Contractor
23) Noise and vibration	Measurement of noise dB(A)	Quarterly	10 m offset from end of car lane for 3 bridges	Supervisor:RHD, DoE Reviewer:Consultant, PAPs Performer:Contractor

BOD=biochemical oxygen demand, DO=dissolved oxygen, NOx=Oxides of Nitrogen, SO2,=sulfur dioxide, SS=suspended solids, SPM=Suspended Particulate Matter,
RHD- Road & Highways Department, DoE- Department of Environment, PAP- Project Affected Peoples, EMA- External Monitoring Agency, IMA- Internal Monitoring Agency

8.5 Implementation Schedule

Following are the key activities, which are to be performed at different phases of the project, as per the requirement of this EMP:

- Obtaining environmental Clearance from DoE
- Allocating Budget for environmental management
- Engaging agency for pollution monitoring
- Nominating Environmental and Safety Officer of Contractor
- Review and approval of Contractors' EMP, traffic management and safety plan
- Finalizing site/s and layout plan for construction camp incorporating environmental requirements
- Tree cutting
- Tree plantation
- Implementation of mitigation and enhancement measures
- Environmental Pollution Monitoring
- Environmental training

The EMP Implementation Schedule along with the responsibilities for each of the above-mentioned activities is given in Table 8.8. Arboriculture Circle of RHD or Forest Dept. may be assigned the task of compensatory plantation for which budget has been provided. The actual sequence will be decided by PIU during project implementation.

Table 8.11 Implementation Schedule

	Activity Description	Responsibility	Pre-Construction(month)		Construction (month)									Post-Construction(month)					
			1	2	1-6	7-12	13-18	19-24	25-30	31-36	37-42	43-48	49-54	55-60	1	2	3	4	5	6
1	Environemntal Clearance from DOE	RHD/SEC																		
2	Allocating Budget for Environmental Management	RHD																		
3	Engaging Agency for Pollution Monitoring	RHD/SEC																		
4	Mobilisation of Contractor's Environmental Officer	RHD/SEC/ Contractor																		
5	Review and Approval of Contractors' EMP	SEC																		
6	Finalising site and layout plan of construction camp	RHD/SEC/ Contractor																		
7	Tree Cutting	Contractor																		
8	Tree Plantation	RHD/ SEC																		
9	Implementation of Mitigation Measures	RHD/ Contractor																		
10	Environmental Pollution Monitoring	RHD/SEC/ Contractor																		
11	Environmental Training	RHD/SEC																		

8.6 EMP Cost Estimate

Budget for implementing various activities and mitigation measures proposed in this EMP have been estimated. The details of EMP budget are given in Table 8.12. The total budget for implementing EMP has been estimated as about TK 12 million. This EMP budget will form part of the total project budget. Cost of environmental protection works, which will be implemented by the contractor, shall be considered to be incidental to the corresponding item of main civil work for which Bill of Quantity (BoQ) has been given in the bid document and no separate payment shall be made.

Table 8.12 Environmental Management Budget

Component	Stage	Item	Unit	Unit Cost (BDT)	Quantity	Total Costs (BDT)
Enhancement of environment (A)						
17)Fauna and flora and 27) Landscape	During Operation	Plantation of native tree species including maintenance for three years	Nos.	500	1,800	900,000
17) Fauna and flora and 27) Landscape	During Operation	Maintenance including monitoring of survival of plants	LS	100,000	1	100,000
Enhancement of environment (A)						*1,000,000*
Environmental management cost (B)						
1) Involuntary Resettlement	Before Construction	Compensation for impact	-	(69,638,734)	-	-
	During Construction	Compensation for impact	-	ditto	-	-
2) Local Economies such as employment, livelihood etc.	Before Construction	Compensation for impact	-	ditto	-	-
	During Construction	Compensation for impact	-	ditto	-	-
3) Land use and utilization of local resources	Before Construction	Proper occupation	-	ditto	-	-
	During Construction	Proper occupation	-	ditto	-	-
4) Social institutions such as social infrastructures and decision-making institutions	Before Construction	Compensation for impact	-	ditto	-	-
	During Construction	Compensation for impact	-	ditto	-	-
5) Existing social infrastructures and services	During Construction	Construction for diversion	-	ditto	-	-

6) Poor, indigenous, or ethnic people-	Before Construction	Compensation for impact Activities improving surface water condition, making groundwater available and enhancing their job skill	-	ditto	-	-
	During Construction	Compensation for impact Activities improving surface water condition, making groundwater available and enhancing their job skill	-	ditto	-	-
7) Maldistribution of benefits and damages	Before Construction	Compensation for impact	-	ditto	-	-
	During Construction	Compensation for impact.	-	ditto	-	-
8) Local conflicts of interest	Before Construction	Compensation for impact	-	ditto	-	-
	During Construction	Compensation for impact	-	ditto	-	-
10) Accident	During Construction	Ensuring that HSMP works right on the track	-	Included in construction cost	-	-
	During Operation	Installing traffic signs, road mark, bump, zebra mark, guard rail and pole, and curb stones etc	-	Included in construction cost	-	-
11) HIV/AIDS	During Construction	HIV campaign	Times	30	100,000	3,000,000
12) Gender	During Construction	Monitoring of the gaps between male and female	-	Included in RAP cost	-	-
13) Children's right	During Construction	Prevention activities to inhibit children's labor	-	ditto	-	-
15) River Transport	During Construction	Watch boat, watch man, sign boards etc	-	Included in construction cost	-	-
16) Hydrological condition	During Operation	Inspection of river bottom condition for scouring	-		-	-
17) Fauna and flora	During Construction	Restoration of construction development area	-	Included in construction cost	-	-
19) Air pollution	During Construction	Implement dust suppress plan and routine mitigation measure shall be taken to emitting equipments.	-	Included in construction cost	-	-
	During Operation	Inspection of road side air condition	-	Included in Monitoring cost	-	-
20) Water pollution	During Construction	Installation of silt basin and septic tank. Proper maintenance of equipment and vehicles. Check for the amount of arsenic	-	Included in construction cost	-	-

	During Operation	Inspection of river surface water condition	-	Included in Monitoring cost	-	-
21) Soil pollution	During Construction	Disposal at designated dumping site. Proper maintenance of equipment and vehicles.	-	Included in construction cost	-	-
	During Operation	Inspection of soil condition	-	Included in Monitoring cost	-	-
22) Waste	During Construction	Collection, transportation and dumping of waste at authorized dumping sites. Minimization of volume and recycling.	-	Included in construction cost	-	-
23) Noise and Vibration	During Construction	Periodical maintenance of construction vehicles and installation of sound insulation cover	-	Included in construction cost	-	-
	During Operation	Securement of buffer zone around 100m as noise decay distance	-	Included in Monitoring cost	-	-
25) Offensive odor	During Construction	Proper treatment of camp waste Proper maintenance of heavy equipment.	-	Included in construction cost	-	-
26) Bottom sediment	During Construction	Proper treatment in order to prevent waste from being dumped into the river.	-	Included in construction cost	-	-
27)Landscape	During Construction	Inspection of landscape from vessel mooring station	-	Included in Monitoring cost	-	-
Environmental management cost (B)						*3,000,000*
Monitoring (C)						
1) Involuntary Resettlement	Before Construction	Compensation for impact	-	Included in RAP cost	-	-
	During Construction	Compensation for impact	-	Included in RAP cost	-	-
2) Local Economies such as employment, livelihood etc.	Before Construction	Compensation for impact	-	Included in RAP cost	-	-
	During Construction	Compensation for impact	-	Included in RAP cost	-	-
3) Land use and utilization of local resources	Before Construction	Proper occupation	-	Included in RAP cost	-	-
	During Construction	Proper occupation	-	Included in RAP cost	-	-
4) Social institutions such as social infrastructures and decision-making institutions	Before Construction	Compensation for impact	-	Included in RAP cost	-	-
	During Construction	Compensation for impact	-	Included in RAP cost	-	-
5) Existing social infrastructures and Services	During Construction	Construction for diversion	-	Included in RAP cost	-	-

6) Poor, indigenous people or ethnic minority	Before Construction	Compensation for impact Direct survey in the field by interviews with the poor people in order to ensure that groundwater is available for them..	-	Included in RAP cost	-	-
	During Construction	Compensation for impact Direct survey in the field by interviews with the poor people in order to ensure that groundwater is available for them..	-	Included in RAP cost	-	-
7) Maldistribution of benefits and damages	Before Construction	Compensation for impact	-	Included in RAP cost	-	-
	During Construction	Compensation for impact	-	Included in RAP cost	-	-
8) Local conflicts of interest	Before Construction	Direct survey in the field by interviews with the locals in order to ensure that local people, especially PAPs, are satisfied with their jobs.	-	Included in RAP cost	-	-
	During Construction	Direct survey in the field by interviews with the locals in order to ensure that local people, especially PAPs, are satisfied with their jobs.	-	Included in RAP cost	-	-
10) Accident	During Construction	Ensuring that HSMP works right on the track	-	Included in the construction cost	-	-
	During Operation	Installing traffic signs, road mark, bump, zebra mark, guard rail and pole, and curb stones etc	-	Included in the construction cost	-	-
11) HIV/AIDS	During Construction	Ensuring that contractor's personnel and local community understand HIV-AIDS awareness campaign	-	Included in the EMP cost	-	-
12) Gender	During Construction	Direct survey in the field by interviews with the women in order to ensure that there is no any gaps between man and women.	-	Included in the construction cost	-	-
13) Children's right	During Construction	Regular inspection of children's laborer	-	Included in the construction cost	-	-
15) River Transport	During Construction	Giving adequate illumination	-	Included in the construction cost	-	-
16) Hydrological condition	During Operation	Inspection of river bottom condition for scouring	-	Included in the construction cost	-	-
17) Fauna and flora	During Construction	Restoration of construction development area and	-	Included in the construction cost	-	-

		Counting the number of River Dolphin				
19) Air pollution	During Construction	Measurement of SPM, NOx, SO2, CO and inspection of brick, bitumen and cement facilities (spot check)	Set	33	75,000	2,475,000
	During Operation	Measurement of SPM,NOx,SO2,CO	Set	3	750,000	2,250,000
20) Water Pollution	During Construction	Measurement of pH, EC, Turbidity, DO, Coliform, BOD, NH4-N, Oil, Grease, fecal coliform, Fe, and As	Set	33	10,000	330,000
	During Operation	Measurement of pH, EC, Turbidity, DO, Coliform, BOD, NH4-N, Oil, Grease, fecal coliform, Fe, and As	Set	6	10,000	60,000
21) Soil pollution	During Construction	Visual inspection, or measurement of Cd, Pb, As, oil, grease and so forth	-	Included in the construction cost	-	-
	During Operation	Visual inspection, or measurement of Cd, Pb, As, oil, grease and so forth	Set	6	50,000	300,000
22) Waste	During Construction	Inspection of waste disposal sites and construction camps	-	Included in the construction cost	-	-
23) Noise	During Construction	Visual inspection to ensure that good standard equipment is in use and sound insulation cover is installed.	Set	15	20,000	300,000
	During Operation	Measurement of noise dB(A)	Set	3	20,000	60,000
25) Offensive odor	During Construction	Odor inspection to ensure harmful odor is not released from equipments and waste	-	Included in the construction cost	-	-
26) Bottom sediment	During Construction	Bottom sampling of Cd, Pb, As, oil, grease and so forth	-	Included in the construction cost	-	-
27)Landscape	Before and During Construction	Vessel mooring station for 2 times at 3 sites	Set	6	50,000	300,000
Monitoring Costs (C)						*6,075,000*
Environmental training (D)						
Environmental Training	During Operation	Orientation Workshop and follow up training program for capacity building/ institutional development programme of SEC	LS	1	1,000,000	1,000,000

Environmental Training Costs (D)	*1,000,000*
Total (A+B+C+D)	11,075,000
Contingency @ 10%	1,107,500
Grand Total	12,182,500

CHAPTER 9 PUBLIC PARTICIPATION

9.1 Overview of Consultation Process

9.1.1 Background

The Executing Agency (EA) process included public participation, consultation and focus group discussions to help RHD achieve public acceptance of the Project. The views, needs and aspirations of the affected people as expressed during these consultations have been incorporated in the project design and the proposed mitigating measures with the objective to maximize benefits and minimize adverse social and environmental effects.

During the project preparatory stage, three tiered consultation meetings were conducted with the following objectives:

- Expert Consultation: Experts were consulted through individual and group meetings, including the Project Panel of Experts, selected individuals and organizations with professional knowledge of EIA processes. The meetings were conducted at a very early stage (EIA Scoping Stage) with the objective to identify people to be consulted, to brief stakeholders about the project components, and to discuss potential environmental impacts of the Project. The outcomes of those consultations were used to finalize the scoping framework and prepare the draft TOR for the EIA study

- Focus Group Discussions (FGDs): FGDs were conducted at various stages (EIA Scoping to the draft EIA disclosure) with the affected communities at various locations of three bridge sites. The purpose was to discuss specific issues, such as launch *ghat* displacement during construction, access to local roads from the bridge and approach roads, livelihood restoration, compensation and resettlement, community involvement and sustainable environmental management.

- Public Consultation: As per harmonized safeguard requirements of JICA Guidelines for Environmental and Social Considerations 2010, two public consultations were conducted for the Project as part of the environmental assessment procedure. The first public consultation was conducted at two locations during EIA TOR and scoping and the second public consultation was conducted at 3 locations to disclose draft EIA. The public consultations were conducted by the RHD, with assistance of Study Team involving a wide range of participants representing

affected persons, union and Upazila leaders, NGOs, and national and local government representatives. The public consultations were meant to achieve the following objective:

- to make the public aware of the project
- to ensure that the public was provided with opportunities to participate in the decision making process and to influence decisions that would affect them;
- to identify the widest range of potential issues about the Project as early as possible and in some cases, have those resolved;
- to ensure that government departments were notified and consulted early in the process; and
- to ensure a board range of perspectives were considered in any decision

9.1.2 Overview of the Consultation Meetings

The expert consultations were held in Dhaka during February – August 2012.

Eight FGDs were held or planned in various locations (2 at the Kanchpur bridge location of Dhaka end, 1 at the Kanchpur bridge location of Chittagong end, 1 at the Meghna bridge location of Dhaka end, 1 at the Meghna bridge location of Chittagong end, 2 at the Gumti bridge location of Chittagong end and 1 at the Gumti bridge location of Dhaka end) from February to August and will continue throughout the Project.

The first public consultations about TOR for EIA were held at Senpara near Kanchpur bridge and Tetuitala bazaar near Meghna bridge on 15th March 2012. The second public consultation was held in 1st August 2012. The outcomes of the consultations and discussions were positive, with participants convinced that the three new bridges will bring significant economic benefits to the region. Nonetheless, the participants suggested that mitigation measures be taken to preserve the environment and avoid any social disturbances.

9.1.3 Outlines of Consultation Meetings and Discussion

Expert Consultations

Consultations were conducted in Dhaka with professionals who had expert knowledge of Fisheries, wildlife, River ecology, morphology etc., and government officials responsible for reviewing the EIA and make decisions on environmental clearance. Table 9.1 gives the list of

experts consulted.

Table 9.1 List of experts consulted

Sl. No	Name	Position	Organization
1	Md. Shahjahan	Director (EIA Clearance)	Department of Environment, Agargaon, Dhaka
2	Dr. Hafiza Khatun	Professor, Department of Geography and Environment	Dhaka University
3	Dr. A.S.M. Woobaidullah	Professor, Department of Geology	Dhaka University
4	Mamun Chowdhury	Assistant Professor	Dhaka University
5	Moonira Akhter Chowdhury	Director General	Geological Survey of Bangladesh, Ministry of Energy and Mineral Resources
6	Dr. Md. Fazlur Rahman	Chairman, Department of Zoology	Dhaka University
7	Mr. Haque Mahbub Morshedi	Assistant Conservator	Wildlife and Nature Conservation Circle, Forest Department, Bangladesh
8	Sudhir Kumar Ghoosh	Superintending Engineer, Ground Water Circle	Department of Public Health Engineering , Kakrail Dhaka
9	Dr. Firoz e Ahmed	Professor, Environmental Engineering Department	BUET, Dhaka
10	Kazi Farhed Iqubal	Head, Department of Environmental Science	State University of Bangladesh, Dhaka
11	Md. Khorshed Alam	Director,	Soil Research Develpment Institute, Mrittika Bhaban, Dhaka
12	Giasuddin Ahmed Chowdhury	Executive Director	CEGIS, Gulshan 1, Dhaka
13	Dr. S. M. A. Rashid	Chief Executive	CARINAM, Center for Advanced Research in, Natural Resources Management,
14	Md.Istiak Sobhan,PhD	Programme Coordinator	IUCN Bangladesh

The summary of expert consultations are shown as below:

Date: 15 February 2012

Consulted experts: Ph.D. Hafiza khatun, Geograph and Environment, Dhaka University

Comments	Reflection of the Comments to the RAP
Since informal residents, who are usually very poor, are displace by the project without compensation as per Bangladesh Rules, consideration has to be made.	Even if for landless people, following compensations are provided: - Structures and trees with replacement cost - Transfer and reconstruction of structures - Business restoration grant for 3 months (employer and employees) - Moving assistance for rentee

	- Grant for employees for loss of employment - Transition allowance for 3 months - Rental allowance for house/room renter - Sifting allowance for residents - Vulnerable allowance for poor and widowed - Job training
Information disclosure is very weak and please provide as much information to project affected people and stakeholders	Stakeholders meeting, group discussion, door to door consultation (census and socioeconomic survey) were implemented
Preference of affected for relocation shall be incorporated into RAP so far feasible	Request of "self-relocation" by the affected residents is incorporated to RAP according to the meetings held on 1st August 2012. It is noted at the meeting on 15th March held at the village along the Alternative Route C for Meghna Site, some of the possible affected residents requested that they want to move to nearby location or, if not possible, to change the alignment so that no need to move. Finally this Alternative was discarded and these residents have become no more affected people by the project.
Livelihood Impact	The Resettlement team will prepare a livelihood restoration plan including (1) business loss allowance for 3 months, (2) residential loss allowance for 3 months, and (3) provision of job training.
Social issues needs to be addressed such as conflict between migrated workers with local people, spread of communicable diseases such as skin, HIV/AIDS etc. due to migrant workers;	The contractor provides clear information on plans for project activities though public consultations. EMP is prepared for prohibiting exploit of local resources such as fire/ fruit wood, herbs, fish or tube well water by immigrant workers. Also, the seminar is planned for both immigrant workers and local residents to prevent the spread of STD/HIV.

Date: 15 February 2012

Consulted experts: Mr. Haque Mahbub Morshedi, Assistant Conservator Wildlife and Nature Conservation ,

Comments	Reflection of the Comments to the EIA/RAP
It was suggested that an emergency response plan must be prepared for accidents spills of petrochemicals	An emergency response plan will be prepared in the EIA
It was suggested to quantify sensitive species in three River and in project influence area.	Ecological survey was conducted within 2 km radius for each bridge alignment
Discussions were held on construction materials, quarries and sources, transport of construction materials and ship impact; impact of noise, vibration, dust and road crossings, roadside tree plantations (not at the inner curve sides), and road safety;	TOR of the EIA study considered a wide range of parameters and covered those commented items.
Suitable local tree plantation should be done such as Neem, Blackberry, Amloki, Amla, Olive, Lychee, Mehogoni, Orjun, Raintree, Hortoki, Jackfruits, Akasmoni and Bohera. It was suggested that fuel trees	In case vegetation/plantation is required for certain area, trees shall be planted as recommended.

should be avoided in the tree plantation plan, and proportion of roadside trees should: 50% wood trees, 30% fruit trees and 20% medicine trees	
Environmental pollution such as air/dust and noise pollution will be there especially during construction. Air/dust can be reduced/eliminated by sprinkling water etc. & noise pollution by installing temporary noise barrier & not permitting noisy activities during night time	During construction, noise and air pollution including measures are taken by (1) maintenance/ prohibition of overloading of heavy equipment, (2) installation of tentative noise barrier for noise protection, and (3) canvas covering of stock piles and spraying of water during earth filling for dust suspension
Traffic congestion may occur especially at toll plaza. This issue should be addressed by developing a traffic management plan (e.g. road safety sign, skilled traffic police,etc.).	Proper traffic management will be considered.

Date: 15 February 2012

Consulted experts: Kazi Farhed Iqubal, Head, Department of Environmental Science, State University of Bangladesh

Comments	Reflection of the Comments to the EIA/ RAP
Special consideration should be given on mitigation measures for River bank erosion, global warming	As a conclusion of impact prediction, the streamline shows almost the same profile.
Effect, Hilsa migration. Consideration should be made to reduce the disturbance of fish movement by huge water transports (specially construction barges, dredgers etc) during construction	As a conclusion of impact prediction, River Dolphin is imposed by passing construction vessels. The mitigation measure is suspension of vessel movement.
Identify the impacts of geo bags on aquatic wild life	There is no known impact of geo-bags* on aquatic life based on other experience in Bangladesh. In case that the impacts are identified, it is desirable that geo-bags are installed. ＊Geo-bags: Geotextile Engineered Fabric Bags with high abrasion resistance. It is used for river bank protection and embankment strengthening.
Back water effect due to piers and RTWs; biodiversity such as fish, migratory birds etc.	As a conclusion of impact prediction, back water does not have an adverse effect on aquatic creatures.

Date: 27 July 2012

Consulted experts: Dr. S. M. A. Rashid, Chief Executive of CARINAM, Center for Advanced Research in Natural Resources Management,

Comments	Reflection of the Comments to the EIA/ RAP
Nature of River Dolphin and its mitigation measure:	Mitigation measure such as suspension of pile driving/ boat driving/ suppression of strong nighttime illumination

Focus Group Discussion

Discussions were held with the affected communities and businesses at Kanchpur Bridge, Siddhirganj Municipality of Siddhirganj, Narayangnaj (Dhaka end), at Chittagong end of the Kanchpur Bridge under Sonargaon Thana of Narayanganj district, at Meghna Bridge Dhaka end Sonargaon, Narayanganj, Jamaldi Bazaar Bus stand (Meghna Bridge, Chittagong end), Baliakandi, Gazaria, Munshiganj, at Bausia near Pakhir Mour, Gazaria, Munshiganj and at new Ferry ghat, Daudkandi, Comilla of Gumti (Chittagong end). Date, location and the number of participants of each discussion is listed in Table 9.2. The local people attended the focused group discussion meeting include truck drivers, sand and stone carrying laborers of ships and trucks, tea stall operators, grocery shop keepers, handicraft artisans, hotel managers and waiters, etc. Local NGO officers were also present in the meeting to know about the project so that they can plan about allocating loan for the potential displaced persons. The summary of focused group meeting (FGM) is shown in Table 9.3.

Table 9.2 Details of FGD Meetings

Sl.	Date	Location of the meeting	**Participants**	**Category of participants**
1	23.03.12	Kanchpur Bridge, (Dhaka end, near abutment of the existing bridge) Shimrail, Siddhirganj, Narayanganj	21	Shop owners, truck drivers and helpers, laborers, women businessmen, barge operators, etc
2	17.04.12	Kanchpur Bridge (Dhaka end), beside the abutment, Simrail, Siddhirganj, Narayanganj	20	Shop owners (both squatters and tenants), truck drivers and helpers, laborers, women businessmen, barge operators, etc
3	17.04.12	Kanchpur Bridge, (Chittagong end), Kanchpur union, Sonargaon, Narayanganj	21	Residential household heads, tenants, Shop owners (squatters and tenants), truck drivers and helpers, laborers, barge operators, etc
4	17.04.12	Gumti Bridge, (Chittagong end), Daudkandi Municipality Comilla	19	Residential household heads, Shop owners (squatters and tenants), truck drivers and helpers, laborers, barge operators, etc
5	17.04.12	Gumti Bridge, (Dhaka end), near Pakhir Morh, Baushia, Gajaria Upazila of Munshigan district	8	Coal businessmen, Shop owners (squatters), truck drivers and helpers, laborers, barge operators, etc
6	23.03.12	Meghna Bridge, (Dhaka end), Pirojpur union, Sonargaon, Narayangonj	19	Shop owners (squatters and tenants), laborers, etc.
7	17.04.12	Meghna Bridge (Chittagong end), Jamaldi Bazaar Bus stand, Baliakandi, Gazaria, Munshigonj	19	Shop owners (squatters and tenants), truck drivers and helpers, laborers, barge operators, etc
Total			127	

Table 9.3 Summary of Focussed Group Meeting

Issues Discussed	Participant's Opinion , Comments and Suggestions	Response to Questions/Action Point
General perception about the project and the awareness about the proposed project.	Most of the participants are in favor of the project and have been made aware of the proposed project through the various surveys that have taken place	Acceptance of the project
Support of local people for the proposed project?	Almost everybody said that they will support the project and advised the Consultants to take precautions in the environmental mitigation to avoid the various impacts anticipated during the preconstruction, construction and operation stages of the project and to ensure protection of the natural water bodies of the areas.	The Consultants informed that during the study, the design and layout of all infrastructures have been considered the anticipated adverse impacts. EMP covers specific measures to follow during the construction process in protecting natural water bodies
Impact of the project on water bodies, streams, wetlands, drainage system, etc.	By constructing the bridge, local flood flows will be blocked. Proper design will be required to avoid any localized flood.	Proper hydrological analysis will be considered (100 years design flood) to design the bridge and drainage structures. As a result, no impact is assumed on water body, streams, wetland (there is no wet land) and drainage system
Does the proposed Project create any problem with ambient air, noise quality, soil quality, or water quality?	Waste water discharge, Noise, vibration and dust will be major issues during construction and operation	Impact of the project upon ambient air, noise quality, soil quality, water quality has been assessed during draft EIA report. EMP has provided instructions limiting environmental qualities to comply with the standards and penalties for violations.
Land Acquisition and Resettlement	Land acquisition and resettlement will be the major issue. According to the participants, this can be mitigated through proper compensation and assistance to the affected persons	New land acquisition is not required for construction of the proposed bridges. As a result, overall impact on the community will be minimized. These bridges will be constructed in RHD land which was acquired for the existing bridges. Some residential houses, commercial enterprises and common properties are found within the proposed area those are required to be relocated before starting civil construction. As per JICA Environmental and Social considerations, in spite of lack of legal rights to the land all of the affected households/people would be paid compensation for structure including shifting allowance and reconstruction grants.
Any critical issue or concern by	Respondents requested that environmental hotspots (like	Wish to minimize effects on common resources property.

Issues Discussed	Participant's Opinion , Comments and Suggestions	Response to Questions/Action Point
the local people regarding the project? Or Any criteria you would like to see considered during project design, construction and operation stage?	school, hospital, graveyard etc.) are avoided as much as possible Dust suppression, noise mitigation and road safety should be considered. Engineers should design the bridges in accordance with good engineering practices so as to improve water flow. .	Dust suppression measures and noise mitigation are considered in the EMP. Proper hydrological analysis has been done to design the drainage structures.
Do you have any problem with the existing bridge?	Long journey times for travel	Dissatisfaction with existing condition of the road
Is the proposed project going to reduce accidents and provide better traffic system?	All the participants felt that the proposed bridge construction project will facilitate a better traffic system. However, it was felt that accidents might increase in number if a high standard of engineering design is not followed. Participants mentioned that safety measures are especially important for social institutions like schools, hospitals	Some concerns over safety, supporting design measures such as increased number of sign board, road mark, bump etc.
Protected areas (national parks protected forest, religiously sensitive sites, historical or archaeological sites), if any	The proposed bridge construction project do not pass any protected or ecological critical area. The area [passes with several commercial, industrial and residential areas	No concerns over the park, the nearest sites with terms of cultural or religious significance are far from the road. Bridges are designed to avoid most of those structures
Employment Status: Percentage of employment/unemployment /underemployment	Unemployment is common in the project area	Job chance and employment will be enhanced and promoted once the construction has been stared.
Impact of the project on the aquatic environment	The livelihood of the fishermen community should be taken into consideration	As a conclusion of impact prediction, fishery is not affected and aquatic diversity remains same since water quality or hydrological condition is not affected (or worsen) by the project. By scouring, river bottom around piers may be deepened and this may increase/ strengthen the diversity of ecosystem.
Any river dolphin, whales, brackish water crocodile, or other important species may pass the bridges area	No river dolphin, whales, brackish water crocodile, or other important species pass the kanchpur bridges area; but the people are seen fresh water river dolphin around 2 km area of the Meghna and Gumti Bridges. In the wet season it is seen almost every week in and around the bridge area	It is necessary to study and find river dolphin's habitat: breeding ground and movement path. As a consequence of impact prediction, river dolphin can pass Meghna and Gumti Bridges during construction. Following mitigation measures are planned. (1) piling suspension, (2) suspension of vessel movement, and (3) minimum of night lighting on river.
If this bridges are improved, there may be large groups of workers living temporarily in the	The respondents strongly welcome the bridge construction activities. Many observed that the measures are temporary and besides there will be more chances for	Residents understand that construction impacts can be expected and do not have an issue with these, provided safety measures are taken.

Issues Discussed	Participant's Opinion , Comments and Suggestions	Response to Questions/Action Point
area, and construction operations that generate noise and dust. Are there any other issues about construction, including noise and dust that might worry you?	local communities to be employed during construction, providing both skilled and unskilled labor. Participants did not mention any other problems which might bother them other then following basic safety rules.	
Given that the new approach road will be wider and smoother, enabling higher driving speeds, what Road Safety Issues/measures would you propose?	Participants suggested signage (speed limits, warnings etc.), pedestrian crossings in front of social institutions and to ensure that there are footpaths along the road	Suggested signage and marking will be installed.

Besides the above issues, the social and resettlement issues are raised by the participants which are described in the RAP report separately.

Public Consultation

Three public consultations were held: (1) the 1st stakeholders' meeting for TOR discussion in 15th March 2012, (2) the 2nd stakeholders' meeting for supplementary to the 1st public consultations regarding RAP and EIA draft in 1st August 2012, and (3) the 3rd stakeholder's meeting for explanation of RAP and EIA draft final reports.

Implementations of meetings were disseminated as:

- Invitation letter were sent to stakeholders concerned
- Advertised in Newspapers in English and Bengali respectively
- Verbal explanation by Union Parishad Chairman to inform residents of shop keeper at the affected area for who are illiterate.
- Verbal announcement at Mosque

The brief overviews of 1st, 2nd and 3rd meeting are shown in table 9.4, 9.5 and 9.6. Additionally, the attendance sheets of 1st, 2nd and 3rd meeting are shown in Annex-4, Annex-5 and Annex-6 respectively.

Table 9.4(1) Brief Overview of the 1st Stakeholder's Meeting

Dates	15 March, 2012	
Time	10:30 am	2:30 pm
Venue	Open space along old NH-1 Shenpara, Kanchpur, Sonargaon,	Open space along old NH-1 Tetuitala Bazar, Meghnaghat,

	Narayangonj	Baliakandi, Gazaria, Munshiganj
How accessible the venue was to the stakeholders	Meetings were held in the center of most probable settlements to be displaced by the project	
Method of notification	Invitation letters, advertisement on newspaper, mosque announcement and personal contact	
Method of consultation	Verbal explanation first in general by the host and individual question/ answer by the participants	
Language spoken	Bengali	
Contents/agenda of the presentation	The goals and objectives of the project, relocation requirements, tentative timeline of project execution, roles and responsibilities of the stakeholders and project authorities, alternative design options, cut-off dates etc. were discussed in the meeting. The Social and Natural Environmental Engineers of the consultant team discussed the issues using flip chart and sought opinion of the participants on the project needs, probable impacts and mitigation measures.	
Used documents/materials for the explanation	Flip-chart (shown yellow circle in below picture)	

Table 9.4(2) Number of the Participants at the 1st Stakeholder's Meeting

Place	Kanchpur	Meghna / Gumti
Governmental Institutions	6 (2)	6 (2)
Local People	28 (0)	10 (0)
NGOs	0	0
Media	0	0
Consultant/Study Team	6 (0)	6 (0)
Total	40 (2)	22 (2)

* (Number of females) Females did not put signature on the attendants list although many were paticipated

1st Stakeholder's Meeting (Meghna / Gumti)

In 1st stakeholder's meeting, the comments from participants are about resettlement. Hence, the details of discussions are described in RAP.

Table 9.5(1) Brief Overview of the 2nd Stakeholder's Meeting

Dates	1 August 2012		
Time	2:30 pm	12:00 am	10:00 am
Venue	(Kanchpur Site) Shenpara, Kanchpur, Sonargaon, Narayangonj	(Meghna Site) Tetuitala Bazar, Meghnaghat, Baliakandi, Gazaria, Munshiganj	(Gumti Site) Chittagong end, Under abattment, Daudkand, Comilla
How accessible the venue was to the stakeholders	Meetings were held in the center of most probable settlements to be displaced by the project		
Method of notification	Invitation letters, advertisement on newspaper, mosque announcement and personal contact		
Method of consultation	Verbal explanation first in general by the host and individual question/ answer by the participants		
Language spoken	Bengali		
Contents/agenda of the presentation	In the consultation meeting the RAP and EIA policy (mitigation measures of the project impacts) were disclosed to the affected people using flip chart. The affected people were informed about the meeting through publishing in the newspaper, personal contact from Union leaders verbally, announcement in the mosque, etc. The issues disclosed in the meeting were project components and revised alignment by which some people who were registered by previous census as affected people, become as not affected , cut off-date declared during the survey (informed as finally revised to 16th March from 08th March 2012), Methodologies adopted during survey, findings of the survey, entitlement matrix as prescribed in the RAP, Grievance redress mechanism, compensation payment procedure, relocation requirements & options, timeline of relocation after payment of compensation, etc. The findings of the environmental survey and proposed mitigation measures of any adverse impacts were also disclosed in the meeting.		
Used documents/materials for the explanation	Flip-chart		

Table 9.5(2) Number of the Participants at the 2nd Stakeholder's Meeting

Place	Kanchpur	Meghna	Gumti
Governmental Institutions	3(1)	3 (1)	3(1)
Local People	71(25)	18 (0)	30 (0)
NGOs	0	0	0
Media	0	0	0
Consultant/Study Team	2(0)	2 (0)	2(0)
Total	76 (26)	23 (1)	35 (1)

* (Number of females)

In 2st stakeholder's meeting, the comments from participants are almost about resettlement except the below comments. The details of other discussions are described in RAP.

Table 9.5(3) The 2nd Stakeholders' meeting at Gumti Bridge Site

Position	Sex	Comments/Question	Answer and Policy of Countermeasure
Shop keeper	Male	How many months will require to start civil construction of the project? How many times we may continue business at present location? How is the size and outlook of the proposed bridge.	The project Project id scheduled to be started in early 2014 and you have at least 18 months time in hand to vacate the project site. Before construction is started every one will have to leave the place and encumbrance free land will be handed over to the contractor. The length of the proposed bridge is 1410 meter and width is 17.45 meter. This will be constructed a very closed to the existing one and distance between these two bridges will be less than one meter.
Shop keeper	Male	The local people especially the affected people should get opportunity to work in civil construction. Is there any provision in the project to engage affected people in civil construction?	According to the policy of the Resettlement Action Plan, the affected people will be preferentially employed in civil construction where possible. During implementation of the project labor contracting society will be formed to bargain collectively for seeking job and getting salary while they are in job.

Table 9.6(1) Brief Overview of the 3rd Stakeholder's Meeting

Dates	1 September, 2012		
Time	2:30 pm	12:00 am	10:00 am
Venue	(Kanchpur Site) Shenpara, Kanchpur, Sonargaon, Narayangonj	(Meghna Site) Chittagong end, Baliakandi, Gazaria, Munshiganj	(Gumti Site) Chittagong end, Daudkand, Comilla
How accessible the venue was to the	Meetings were held in the center of most probable settlements to be		

stakeholders	displaced by the project
Method of notification	Invitation letters, advertisement on newspaper, mosque announcement and personal contact
Method of consultation	Verbal explanation first in general by the host and individual question/ answer by the participants
Language spoken	Bengali
Contents/agenda of the presentation	In the consultation meeting, policies of the RAP and EIA (mitigation measures of the project impacts) were disclosed to the affected people using flip chart. On August 01, 2012, these policies were disclosed, but due to JICA requirements and some changes in the policy, disclosure of the policy requires again. The affected people were informed about the meeting through publishing in the national daily newspaper (Both Bengali and English daily), personal contact, announcement in the mosque, etc. The disclosed issues in the meeting were project components and alignment, cut off-date declared during the survey (16 March 2012), methodologies adopted during survey, findings of the survey, entitlement matrix as prescribed in the RAP, grievance redress mechanism, compensation payment procedure, relocation requirements & options, timeline of relocation after payment of compensation, etc. The findings of the environmental survey and proposed mitigation measures of any adverse impacts were also disclosed in the meeting.
Used documents/materials for the explanation	Flip-chart

Table 9.6(2) Number of the Participants at the 3rd Stakeholder's Meeting

Place	Kanchpur	Megna	Gumti
Governmental Institutions	1(0)	1 (0)	1(0)
Local People	72(40)	79 (61)	56 (28)
NGOs	0	0	0
Media	0	0	0
Consultant/Study Team	5(0)	5 (0)	5(0)
Total	78 (40)	85 (61)	62 (28)

(Number of females)

In 3rd stakeholder's meeting, the comments from participants are about resettlement. Hence, the details of discussions are described in RAP.

In view of gender, since woman seldom discloses her mind in public, women were gathered and expressed their opinions each venue at the last half of the 3rd stakeholder's meetings. The minutes are shown in Annex-7.