ROADS & HIGHWAYS DEPARTMENT (RHD), MINISTRY OF COMMUNICATION (MOC)
PEOPLE'S REPUBLIC OF BANGLADESH

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

(Project name:

THE KANCHPUR, MEGHNA, GUMTI 2ND BRIDGES CONSTRUCTION AND EXISTING BRIDGES REHABILITATION PROJECT)

FINAL REPORT

VOLUME 2 : APPENDICES (2)

(APPENDIX 14 - 19)

March 2013

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.

KATAHIRA & ENGINEERS INTERNATIONAL

E I
CR(4)
13-032

ROADS & HIGHWAYS DEPARTMENT (RHD), MINISTRY OF COMMUNICATION (MOC)
PEOPLE'S REPUBLIC OF BANGLADESH

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

(Project name:

THE KANCHPUR, MEGHNA, GUMTI 2ND BRIDGES CONSTRUCTION AND EXISTING BRIDGES REHABILITATION PROJECT)

FINAL REPORT

VOLUME 2 : APPENDICES (2)

(APPENDIX 14 - 19)

March 2013

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.

KATAHIRA & ENGINEERS INTERNATIONAL

Preparatory Survey for Dhaka-Chittagong National Highway No.1 Bridge Construction and Rehabilitation Project

(Project Name: The Kanchpur, Meghna, Gumti 2nd Bridges Construction And Existing Bridges Rehabilitation Project)

VOLUME2: APPENDICES

- TABLE OF CONTENTS -

Appendiecs (1)

Appendiecs (2)

APPENDIX 14.

TERMS OF REFERENCE

FOR RAP IMPLEMENTING AGENCY

(RAP-IA)

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

RAP Implementing Agency (RAP-IA)

A. PROJECT BACKGROUBND

The Government of Bangladesh (GoB) has undertaken a project to construct three new Bridges on National Highway No.1 (NH-1) i.e. Kanchpur, Meghna and Gumti Bridge 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 approach road. The length of the bridges are Kanchpur 400 m, Meghna 930 m and Gumti 1,410 m respectively. The overall objective of the Project is to mitigate the increasing traffic demand of 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

According to the Resettlement Action Plan (RAP) prepared by the RHD in 2012, a total of 306 households will be affected by the project. This includes 274 households to be displaced and 32 households experiencing indirect or secondary impacts.

The Roads and Highways Department (RHD) of the Ministry of Communication (MOC) seeks to recruit and experienced NGO/consulting firm as a RAP Implementing Agency (RAP-IA) for implementation of resettlement activities. The RAP-IA will be engaged to assist RHD in updating the RAP during detailed design phase and will be continuing for implementation of the RAP thereafter.

B. SCOPE OF WORKS

Tasks of the RAP-IA include consultation/public information campaign for rapport building, issuance of ID cards to Entitled Persons (EPs), payment of eligible benefits to affected households/ individuals, institutional development, skill training/management training, community awareness and empowerment, among others. More specifically;

1. Information Dissemination and Feedback

(1) Ensure dissemination of the project and resettlement policy related information to the Project Affected Persons (PAPs) and others (community groups, local administration, etc.) that might be considered instrumental in the effective and transparent implementation of the RAP. Even though the RAP recommends some dissemination mechanisms, the RAP-IA can suggest more

in the process of its implementation and would gather information and disseminate it upward to the project authority.

(2) During implementation of the project, extensive consultation and collaboration with key stakeholders on a continued basis is planned. The RAP-IA will be required to assist RHD in organizing such consultation programs and facilitate consultation with local representatives like ward members, local leaders, participants group, etc.

2. Assisting Affected Persons (APs) in Resettlement Process

(1) The RAP-IA shall make APs aware of the acquisition process; assist them to claim the compensation to be paid by RHD. Some of the major activities are:

(i) Explain related laws and regulations and RAP then inform them the applied cut-off date;

(ii) Inform the APs about the legal documents required for claiming compensation from RHD and resettlement benefit from RHD to check the current status of legal documents, in order to minimize disputes over ownership, use rights and time to make the claims. This includes;

(a) Checking with the APs to make sure that they have all the required documents to claim compensation from RHD;

(b) Whether or not the ownership records are up-to-date in cases of purchase/sale and inheritance of the property being acquired and advising and assisting the EPs to procure them, and

(c) Whether or not there are usufruct rights of others on the properties under acquisition and informing the people with such rights about the compensation policies.

(2) Inform the AP households, especially the vulnerable ones, about the “compensation in cash and/or kind” option stipulated in the RAP and ensure fulfilment of the choices made by them.

(3) Assist the APs not covered by the laws and regulations of Bangladesh but covered by RAP Entitlement Matrix, such as wage labourers, owners of business on public lands, squatters and such others to get their entitlements from RHD.

(4) Counselling and helping the households, whose previous incomes have been seriously affected, to find alternative source of income.

(5) The RAP-IA will participate in the Property Assessment and Valuation Committee (PAVC) to verify the affected properties. In this process, the RAP-IA will record all the verified data in computer, document all disputes that might be faced and the problem cases that might need special attention by RHD.

(6) Together with RHD, the RAP-IA will pursue the other concerned offices to arrange on site payment of compensation and organize the APs in groups and accompany them to the concerned offices or the project sites.

3. Grievances Redress Procedure:

The RAP-IA will play vital role in the grievances redress process. The most important preconditions for doing this with maximum effectiveness are that the RAP-IA operatives will build personal report and confidence with the APs and will be fully aware of all socio-economic problems/issues arising from the acquisition. Among other things, the RAP-IA will:

(1) Ensure that the APs are fully aware of the grievance redress procedure and the process of bringing their complaints to the Grievance Redress Committees (GRCs).

(2) Assist the APs in any usual manner (e.g., preparing applications, accompanying them to the hearing and explaining the grievance to the GRCs and the like) to bring the complaints to the committee. The RAP-IA shall assist the illiterate APs with preparation of written applications.

(3) Impartially investigate the veracity of the complaints and try to settle them amicably, fairly and transparently before they go to the GRC or the courts of law.

(4) For more focused work in this area, the IA will prepare a list of problem cases (based on ownership and other disputes detected while checking the status of legal documents, information from the APs themselves and other sources) which would be updated as and when necessary, while RAP implementation progresses. In doing so, the IA will pay special attention to the problems and needs of the vulnerable APs.

4. Assistance to APs during Relocation:

The RAP-IA will assist the APs during pre and post relocation period in close coordination with GRCs. The RAP-IA will also assist APs, where necessary, in preparing grievance redress cases for consideration by the Committee.

5. Assistance to RHD in Payment of Resettlement Benefits to APs:

The RAP-IA will assist RHD in processing entitlements for the APs and making payment of resettlement benefits to them. The RAP-IA will compile and process data and develop and operate a menu driven computerized Management Information System (MIS). The RAP-IA will prepare Entitled Person (EP) files with type and quantity wise losses and Identification Card mentioning amount of compensation/benefits for each of the APs and prepare indent mentioning category wise amount of compensation/benefits. The indent would be approved by the Chief Resettlement Officer (CRO) before making payment. The Project Implementation Unit (PIU) will prepare payment debit voucher and cheque in the name entitled person. The debit voucher will be signed jointly by the RAP-IA and PIU representative and the cheque will be signed by Accounting Section of RHD and be issued by the PIU.

6. Information Management:

The RAP-IA will collect computerized Census and Social Economic Survey data related to the pre-acquisition condition of the AP households and the nature and magnitude of all categories of losses as well as the compensation thereof to be determined by PAVC working with RHD. They should update the data based on final design. All essential information will have to be generated by using one or more menu-driven Management Information System. Among other things, the RAP-IA will;

(1) Maintain computerized baseline socio-economic databases and collect supplementary information as and when necessary and update them, during the course of implementation.

(2) Collect and computerize data on individual losses and the compensation thereof, as determined by PAVC for all legally and socially recognized Entitled Persons.

(3) Collect and computerize all information on market survey and assessment of property and their owners, process data.

(4) Collect and computerize all information related to different types of payments and additional supports provided to the EP and update the EP file and ID Card.

(5) Prepare ID Card for the individual EP as per their types of losses and the amount of compensation due for each type of loss from legal title and the amount of compensation if any, to be paid by RHD through the RAP-IA as well as other non-monetary entitlements.

(6) Prepare and issue ID cards for each EP (head of the household-in case of those not covered by the law), containing his/her photograph and other vital information.

(7) Record and maintain details of the issues/ disputes causing delay in the disbursement/receipt of compensation and the persons involved in them, including the cases brought to the courts of law.

(8) Document information on the cases, with reasons, brought to and resolved by the GRC, with decisions going in favour of or against the complainants.

(9) Collect and maintain relocation information on the homestead losers by categories of EP households such as legal owners, licensees, squatters and others.

(10) Collect and maintain information on physical, social and institutional infrastructure and amenities (latrines, tube wells, etc.), if any, that might be provided by RHD.

7. Progress Reports:

The RAP requires that all APs are paid the stipulated compensations/entitlements before they are evicted from the properties and/or construction work begins. The selected RAP-IA will provide RHD and the JICA monthly report on the progress in RAP implementation, including

any issue that might be hindering progress, separately for each section. The report will be brief consisting of both quantitative and qualitative information on:

(1) Total number of EPs and the cumulative progress made in disbursement by loss categories under national law.

(2) Total number of EPs eligible for additional payment from RHD and cumulative progress made in payment by loss and entitlement categories.

(3) Total number of the EPs, who are not covered by the law (but are socially recognized owners/users of the affected properties), identified for compensation/entitlement from RHD and cumulative progress made in disbursement by loss and entitlement categories.

(4) Number of cases received by the GRC indicating the types of grievance made in favour of or against the complainants.

(5) Total number of home lot losers needing relocation and resettlement provisions are stipulated in the RAP.

(6) Any other issues that relevant to implementing the policies stipulated in the RAP.

(7) The RAP-IA will design tabular and other formats appropriate for reporting on the above information. To the extent possible, the tables will have to be pre-programmed in the menu-driven MIS and the quantitative reports will have to be generated directly.

8. Reporting Requirements:

The RAP-IA appointed by RHD for implementation of the RAP will report to the RIU under RHD and JICA. The IA shall provide 5 copies of Inception Report within 1 (one) month from the date of commencement, 10 copies of final report at the end of the project and 10 copies of monthly progress report on or before 10^{th} day of the following month. Each report shall set forth concise statement concerning the activities relevant to the jobs and will include:

(i) A clear and complete account of work performed in each project component;
(ii) Work planned for the next reporting period;
(iii) Status of funding and utilization;
(iv) Identification of any challenges encountered or anticipated that would affect the completion of the project within the time and money constraints set forth in the agreement, together with recommended solution to such problems.

The RAP-IA will be encouraged to produce working papers and technical papers throughout the implementation period after the project starts.

9. Implementation Arrangements:

The RAP-IA has to set up office near the concerned locality during the time of implementation of the RAP in order to ease contact with the APs, the cost of which will be specified in the budget.

C. TASKS ON RESETTLEMENT SCHEDULE BASIS

The tasks are scheduled to start from XX, 20XX (subject to change). The RAP will be deployed for a period of 6 years and will be responsible to implement all resettlement activities stated in the TOR. The Chief Resettlement Officer of PIU, in consultation with the RAP-IA will allocate manpower and provide time schedule as per the requirement of the resettlement program. The RAP-IA will assist PIU under RHD but not necessarily limited to the followings:

1. Preparation and Updating of RAP

Soon after the engineering design is finalized, the RAP-IA will conduct census and baseline socio-economic survey to finalize and/or update the RAP. The RAP-IA will compare the field level data with the established database for any discrepancies.

2. Preparation of Relocation Plans

The RAP-IA will assist PIU in the preparation of relocation plan during detailed design stage.

3. Approval of Relocation Plan:

In consultation with PIU, the RAP-IA will maintain liaison with the authorities/bodies during the process of relocation plan approval.

4. Joint Verification and Valuation of Property:

The RAP-IA will participate in the assessment of the affected properties and identification of their owners/users by the PAVC. Both PAVC and the person concerned should sign verification records for each affected person. Disputes on property right are also to be recorded.

5. Information Campaign and RAP Disclosure:

The RAP-IA will carry out consultation regarding policies and options and collection of legal documents required to claim compensation. Property owners require being advised/helped to gather all required documents. The affected people will be made aware of the GRC procedures for disputes over claims.

6. Circulation of a Booklet:

A booklet containing the total compensation package as was outlined in the RAP, procedures and places of payment and all other relevant information must be circulated by the RAP-IA within three months of field placement. This should be prepared by the RAP-IA before going to

the field, and be circulated during the 1st or 2nd week of field work. This will significantly help the RAP-IA for performing their activities in a better social environment. The main contents of RAP Information Booklet are:

(i) Background of the Project;
(ii) An overview of the Project;
(iii) Expected benefits to be derived;
(iv) Affected persons and properties;
(v) How the losses will be mitigated;
(vi) Principles of relocation and rehabilitation;
(vii) Compensations and rehabilitation assistance;
(viii) APs participation in implementation;
(ix) Procedure of payment for compensation;
(x) Grievance redress system;
(xi) Types of documents needed by the Entitled Persons (EPs);
(xii) The entitlement matrix; and
(xiii) Concluding remarks.
(xiiii) The name and addresses including cell numbers of the RAP IA and RHD PIU officials responsible for implementation of the project shall be included in the information booklet.

7. Assessment and Valuation of the Acquired Properties:

The RAP-IA with Resettlement Unit (RU) officials of RHD will maintain liaison with the Officer from Local Government to record the quantity assessed by PAVC through ID Card.

8. Disbursement of Compensation:

Payment of compensation to eligible persons will be processed and paid by the RAP-IA under direct supervision of the RHD. The RAP-IA will supervise the process and keep record of payment.

9. Computerization of Database and Entitled Persons (EPs) Files:

Data on land, structure, trees and other properties lost by the APs have to be computerized, including development of necessary software to prepare EP files and ID Card. The EP and ID Card files will be used for making payments to the EPs and monitoring the progress of resettlement work. The RAP-IA after joining the field must finalize the list of APs and EPs within three months; otherwise, they will be late in performing other activities.

10. Issuance of ID Cards to Eligible Persons:

The RAP-IA will assist RHD to issue ID cards to eligible persons who have no further disputes. The RA IA will be responsible to prepare and distribute ID card and keep records of ID card for the RHD, and the RHD will be responsible to issue it.

11. Disbursement of Cash Compensation:

When RHD starts payment of compensation covered by RAP, eligible persons will be asked to bring in all required documents at this stage and the RAP-IA will assist the APs in this connection.

12. Disbursement of Additional Grants:

RHD will process payment of grants to be paid to the Entitled Persons through the RAP-IA. The RAP-IA will prepare Entitled Persons and ID Card and indent to make payment to Entitled Persons which will need prior approval of the RHD before making payment.

13. Notice for Encumbrance Free:

At completion of payment of all compensation/entitlement from RHD given to individual affected persons, the RAP-IA and RHD will keep records of issuance date of notice for making ROW encumbrance free signed by both RHD and APs.

14. Land Hand-over to Contractors:

The RAP-IA will assist RHD to hand-over land to contractors. Contractors will move into sites the day following expiration of the encumbrance free notice.

D. MONITORING AND EVALUATION

The RAP-IA will ensure the following issues in implementation of the RAP:

1. General

For monitoring progress of RAP implementation, an appropriate monitoring format should be prepared with score / weight against each activities and sub-activities. A user-friendly menu driven software should be used to generate progress reports for monitoring the progress instantly.

2. Proper Training and Orientation

Proper training and orientation to be given to RHD staff so that they can oversight the RAP-IA activity appropriately from the very beginning and operate the menu driven MIS to remain updated about the progress and problem. Before making payment of entitlement census data will be compared with the payable amount, to avoid mistake or fraud.

3. Criteria for Evaluation

There are number of actions needed in- collecting compensation and grants. The RAP-IA operatives will investigate the steps completed so far in collecting compensation for a particular plot. Data collected through Focus Group meetings in this connection will be processed in a computerized system to monitor the progress and grant collection by the EPs. Performance evaluation of the IA operatives, especially the field staff will be judged by that progress. Production and application of RAP implementation tools, payment of grants and resettlement of APs should be the basis for calculating the RAP-IA performance.

4. Co-ordination

The RAP-IA will sit with the RHD on a regular basis, where discussion on progress and constraints of the previous month will be held. Actions to be taken and the key actors for the tasks concerned will be identified as tasks assigned from respective agencies. In case of any items are not covered by the RAP, the Co-ordination meeting should come up with recommendations, which should be approved and implemented through executive order of the RHD.

E. SELECTION CRITWERIA OF THE RAP-IA

H. Qualification of the RAP Implementing Agency

The RAP-IA must fulfil the following eligibility criteria:

a. NGOs registered with the Social Welfare Department of the GOB, Consulting Firms registered with the Joint Stock Company or Departments of any recognized university.

b. The applicant should have prior experience in social surveys in land based infrastructure projects and preparation of resettlement plans (RP, RAP, LARP) as per guidelines on involuntary resettlement of any of the ADB, World Bank, JICA, DAC-OECD.

c. Have a proven track record in the field of socio-economic development activities for at least 5 years in external supported program(s)

d. Have to submit five proven Project Data Sheet over last 5 years.

e. Have proven ability of implementation of three Resettlement Programs.

f. Have extensive involvement in poverty alleviation through income generation program and empowerment in urban or rural areas of Bangladesh.

g. Have proven ability to design and implement income restoration program for involuntary displaced of affected persons with an emphasis to micro-financing operation supported for income generation activities.

h. Have at least 5 years of experience(s) of working in land based Resettlement/ Rehabilitation programs and capacity to reconcile information from different databases and develop software packages for Computerized Management Information System (CMIS).

i. Have established office premises with adequate training facilities both in Dhaka City.

j. Should be willing to implement income restoration program for the APs after the project period, if needed.

F.STAFF REQUIREMENTS

The applicant is free to propose the number of members working in the team. A bar chart shall indicate the proposed timing of their input. Some of the important team members shall desirably meet the following criteria:

The three job titles mentioned above shall be evaluated based on their resume.

Position/expertise	Qualification and experience
1. Team Leader/ Resettlement Specialist	Masters in social science with 15 years working background in planning, implementation and monitoring of involuntary resettlement for infrastructure projects. Experience in institutional capacity analysis and implementation arrangement for preparation and implementation of resettlement plans, and knowledge in latest social safeguard policies of the international development financing institutions in Bangladesh are preferred and must be fluent in English.
2. Deputy Team Leader/ Resettlement Expert	Masters in social science with 10 years working background in planning, implementation and monitoring of involuntary resettlement for infrastructure projects. Experience in institutional capacity analysis and implementation arrangement for preparation and implementation of resettlement plans, and knowledge in latest social safeguard policies of the international development financing institutions in Bangladesh are preferred and must be fluent in English.
3. Gender Specialist	Masters in social science with 5 years working experience in relevant field; Thorough knowledge of gender issues and their implications in development projects; research and work experience relating to gender issues; and knowledge of techniques and their applications in mobilizing community participation in development programs.
4. MIS Specialist	Graduate with working experience and knowledge of software, preferably relational, those are most commonly used in Bangladesh; demonstrated ability to design and implement automated MIS(s) for monitoring progress, comparing targets with achieved progress and the procedural steps.

I. Budget and Logistics

The budget should include all expenses such as staff salary, office accommodation, training, computer/software, transport, field expenses and other logistics necessary for field activities, data collection, processing and analysis for monitoring and evaluation work. Additional expense

claims whatsoever outside the proposed and negotiated budget will not be entertained. VAT, Income Tax and other charges admissible will be deducted at source as per GOB laws.

(Engr. ----------)
Project Coordinator
Project Implementation Unit (PIU)
Roads and Highways Department, Dhaka

APPENDIX 15.

TERMS OF REFERENCE

FOR CONSULTING ENGINEERS SERVICE

TERMS OF REFERENCE
FOR
GENERAL CONSULTING SERVICES
OF
the KANCHPUR, MEGHNA, and GUMTI BRIDGES
REHABILITATION and CONSTRUCTION PROJECT

SEPTEMBER 2012

ROAD AND HIGHWAY DEPARTMENT
MINISTRY OF COMMUNICATION
THE PEOPLE'S REPUBLIC OF BANGLADESH

1. INTRODUCTION

The Government of the People's Republic of the Bangladesh (GOB), through the Road and Highway Department (RHD), intends to engage a qualified and experienced general consulting firm (the Consultant) to provide the necessary engineering services for detailed design, Bid assistance and construction supervision of the Kanchpur, Meghna and Gumti Bridges Rehabilitation and Construction Project (the Project) under the ODA Loan provided by the Japan International Cooperation Agency (JICA).

2. PROJECT INFORMATION

2-1. Background

The National Highway No.1, namely, Dhaka-Chittagong Highway, is the lifeline for economy of Bangladesh with a capacity of 25,000 Annual Average Daily Traffic (AADT). The National Highway No.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 Sitalakhya, 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. In 2011, the National Highway No.1 almost exceeded its traffic volume capacity to 25,000 AADT counted at the approach of Kanchpur, Meghna and Gumti bridges. Recently, the Government of Bangladesh has decided to widen the National Highway No.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 National Highway No.1. It is obvious the existing 2-lane bridges will fail to cope with increased traffic volume of the National Highway No.1 and cause serious traffic congestion. Therefore, the construction of new 2nd Kanchpur, 2nd Meghna and 2nd Gumti bridges are becoming an essential issue.

2-2. Objectives

The ~~overall~~ objective of the Project is to alleviate the traffic congestion of National Highway No.1, which can be possible by

- Construction of new 2nd Kanchpur, 2nd Meghna and 2nd Gumti bridges, thereby, contributing to economic development of Dhaka-Chittagong corridor
- Rehabilitation of existing Kanchpur, Meghna and Gumti bridges on the Dhaka-Chittagong National Highway No.1

Another important objective is to complete the whole project to ensure safe travelling on National Highway No.1 against further flood disaster since the tremendous damages for each respective bridge were caused of scouring by river flow.

The Project consists of the construction of above three (3) bridges and the rehabilitation of three (3) existing bridges with improvement of approach roads respectively within the section between Dhaka and Chittagong along National Highway No.1. Based on the

conduct of the preliminary design for the bridge components through the Preparatory Survey (F/S) of JICA in 2012, the implementation of the following three components was proposed under the financial assistance of Japanese ODA:

(1) Component-I: Construction of 2nd Kanchpur Bridge and Rehabilitation of the existing Kanchpur Bridge across the Lakhya River with Approach Roads and Intersection

(2) Component-II: Construction of 2nd Meghna Bridge and Rehabilitation of the existing Meghna Bridge across Meghna River with Approach Roads

(2) Component-III: Construction of 2nd Gumti Bridge and Rehabilitation of the existing Gumti Bridge across Gumti River with Approach Roads

And, the Project component was proposed to formulate the implementation of following components given in table.

Comp.	New Bridges	Existing Bridges
I	**Kanchpur Bridge**	
	■ Length: 396.5 m (41.6m+85.4m+97.6m+73.2m+54.9m+41.6m) ■ Width: 18.4m (4 Lanes) (14.6m (road) + 1.1m (sidewalk)+2.7m(sidewalk)) ■ Superstructure Type Continuous steel narrow box girder bridge ■ Substructure Type Abutment: Inverted T-type, 2 Nos. Pier: Columnar type, 5 Nos. Foundation: RC bored pile, 3 Nos Steel Pipe Sheet Pile (SPSP) 4 Nos.	■ Repair of cracks/ rebar exposures ■ Expansion joint replacement ■ Deck strengthening ■ Steel Brackets ■ Strengthening of pier including RC-lining and diaphragm wall ■ Strengthening of foundation including steel pipe sheet piles (SPSP)
II	**Meghna Bridge**	
	■ Length: 930.0m (47.4m+9@87.0m+73.5m+23.9m) ■ Width: 17.45m (4 Lanes) (15.25m (road) + 2x1.1m (sidewalk)) ■ Superstructure Type Continuous steel narrow box girder bridge ■ Substructure Type Abutment: Inverted T-type, 2 Nos. Pier: Columnar type, 11 Nos. Foundation: RC bored pile, 5 Nos Steel Pipe Sheet Pile (SPSP) 8 Nos.	■ Repair of cracks/ rebar exposures ■ Connecting girders (eliminating hinges/joints) ■ Center hinges rehabilitation ■ Expansion joint replacement ■ Steel Brackets ■ Strengthening of pier including RC-lining ■ Strengthening of foundation including RC casting reinforcement and steel pipe sheet piles (SPSP)
III	**Gumti Bridge**	
	■ Continuous steel narrow box girder ■ Length: 1410.0m (51.4m+7@87.0m+86.15m,86.15m+6@87.0m+51.4m) ■ Width: 17.45m (4 Lanes) (15.25m (road) + 2x1.1m (sidewalk)) ■ Superstructure Type Continuous steel narrow box girder bridge ■ Substructure Type Abutment: Inverted T-type, 2 Nos. Pier: Columnar type, 16 Nos. Foundation: RC bored pile, 10 Nos Steel Pipe Sheet Pile (SPSP) 8 Nos.	■ Repair of cracks/ rebar exposures ■ Connecting girders (eliminating hinges/joints) ■ Center hinges rehabilitation ■ Expansion joint replacement ■ Steel Brackets ■ Repair of pier including RC- lining ■ Repair of foundation including RC casting reinforcement and steel pipe sheet piles (SPSP)

Following the F/S study, the Government of Japan through the JICA has decided to extend its loan to finance for the Project comprising three components above under 34th Loan Package in March 2013.

3. GENERAL TERMS OF REFERENCE

3-1. Scope of Works of General Consulting Services

The main feature of the general consulting services is to lead the Project to be successfully completed timely. This will be achieved through the following:

- Engineering/Detailed Design
  - Review of the Feasibility Studies and relevant existing reports;
  - Preparation of the detailed design;
  - Cost estimates based on the detailed design; and
  - Financial analysis based on the revised cost estimation and toll policy.
- Bid Assistance
  - Preparation of bidding documents, assistance for RHD to select the Contractor: bid evaluation; award of the contract; contract negotiation; and finalizing the contract documents.
- Construction Supervision
  - Supervision of Works comprising aforementioned three components of bridge rehabilitation and construction;
  - Guidance on Operation and Maintenance measures (Preparation of Manual, Training plan, and others) for RHD officials and outsourcing;
  - Guidance on Weigh bridge and its Control for outsourcing, and;
  - Capacity building for Operation and Maintenance.
- Safeguards Assistance
  - Environmental and Social Considerations (updating, implementing, and facilitating the Resettlement Action Plan (RAP) , Environmental Management Plan (EMP), and the Environmental Monitoring Plan (EMoP), and other relevant considerations)
- Safety Considerations (Complying with Safety policy based on JICA policy)
- HIV/AIDS prevention
- Dispute Board (DB) assistance
- Transfer of Technology

- Others
  - Assistance in implementation of Information Campaign and Publicity (ICP) Program, and PR of the Project

3-2. Terms and References of the Consultant

1. The consulting services will be provided by an international consulting firm in association with national consultants in compliance with Guidelines for the Employment of Consultants under Japanese ODA Loans, April 2012. The Consultant will ensure that all of the procurement under the civil works contracts conforms with Guidelines for Procurement under Japanese ODA Loans, April 2012.

2. The services that the Consultant is responsible for carrying out on behalf of and in collaboration with RHD/PIU are stated below. Other government agencies and/or institutions, such as, local government and other organizations concerned will be extensively involved in the implementation of the consulting services. RHD/PIU will make all the coordination and arrangement with the said agencies/organizations concerned and provide necessary data/information to the Consultant.

3. The Consultant will coordinate with other agencies/organizations concerned in order to reach a common ground for the implementation of the activities at every stage of the consulting services.

3.2.1 Detailed Design

3.2.1.1 Review of Feasibility Study

JICA Preparatory Study comprising Preliminary Design, Environmental Impact Assessment (EIA) and Resettlement Action Plan (RAP) has been conducted by Oriental Consultants Co., Ltd in association with Katahira & Engineers International under JICA (hereinafter, “JICA F/S”) (January 2012) The study report provides the design conditions, preliminary studies and feature of bridge structure undertaken. The Consultant shall review the contents of report and verify any technical, economic, or commercial findings given in them that may affect directly project cost. To develop the alternatives in accordance with the design criteria and standards to prove technical feasibility and permit costing to the required level of accuracy with review of the following points;

- Evaluation/analysis of investigated and surveyed data for hydrology, geology, hydraulic ,etc;
- Scale and Technical Standards applied to the Project;
- Alignment for Approach Roads;
- Alignment for Main Bridges, approach bridges;
- Structural Alternatives for the Main Bridge;
- Alternatives for interchanges and Structural Alternatives for the approach roads

3.2.1.2 Preparation of Detailed Design

The Consultant will prepare the detailed design for the Project. More specifically, the Consultant will provide the following:

(a) Preparatory for Detailed Design

1) To collect and review all of the available existing data to be utilized, and determine its adequacy and appropriateness;

2) To review the preliminary engineering design prepared under JICA Preparatory Study, and to conduct the site survey to confirm if the current conditions on site will influence the design previously carried out;

3) To define the work to be done and data required to be collected to progress the services; to identify the points and areas where the topographical survey, the soils/materials survey and any other surveys are to be conducted;

4) To prepare detailed work plan, progress reports and implementation schedule for the Project to ensure effective monitoring and timely project outputs, and regularly update the same;

5) To seek RHD/PIU's comments on the Inception Report in references to the items 1), 2), 3) and 4) stated above.

(b) Survey and Study

1) To assess the stability of the foundation and substructure for existing bridges (pier cap, wall, revetment, and others.) in JICA F/S, to determine which sections need to be rehabilitated and/or strengthened;

2) To undertake the topographical survey including the followings to prepare the topographic map and all other necessary data for the detailed engineering design;

- Establishment of horizontal and vertical control monuments
- Topographic profile survey along the center line
- River cross-section survey (Interval of cross-sections will be 20 m for straight and uniform river reaches, 10 m at minor bends and 5 to 10 m at sharp bends.)
- Topographic survey to reflect all natural changes and man-made structures with contour lines

3) To undertake the soils/materials survey and the geotechnical investigation;

- To undertake test pitting, boring and corresponding laboratory tests.
- To collect materials samples at candidate material sources, and to undertake necessary laboratory tests for samples.
- To study utilization of materials for concrete, asphalt, and embankment, etc.

4) To study possibility of liquefaction, and existence of soft ground based on the surveys above; to study necessary countermeasures to be incorporated in the detailed engineering design if liquefaction layers and soft ground layers are confirmed;

5) To find the level and quality of groundwater for existing wells located adjacent to each bridge site, the survey shall be carried out by local consultant. Data is to be used as a baseline of monitoring during the construction. Terms of reference for survey shall be prepared by the Consultant for numbers of wells located in the presumed area affected by the construction;

6) To review environmental impact analysis;

7) To review the project's expected costs and revenues;

8) To recommend other alternative than that the feasibility is to be confirmed from engineering, environmental, and economical points of view;

(c) Detailed Design

1) To conduct further surveys and investigations as necessary;

2) To conduct the design in accordance with the design criteria and standards established and the agreed implementation approach;

3) To prepare all necessary design drawings at an appropriate scale for the civil works to be implemented;

4) To estimate quantities in accordance with the construction pay items;

5) To provide the design of weigh station for over loading vehicle to be installed at Meghna and Gumti bridges with its operation guide. The countermeasures for overloading vehicle at Kanchpur bridge shall be studied and provided for the design of necessary facilities;.

6) To prepare the construction execution plan covering construction procedures, construction schedule, location and size of construction camp and equipment motor pool/workshop, safety measures, methodologies to mitigate environmental impacts, disposal sites of dredged materials, materials sources, material transport routes and traffic control measures along the transport routes, and environmental monitoring system;

7) To study inflow of construction materials and outflow of construction waste and disposal materials and identify all negative impacts; to specify possible mitigation measures in the special provision of the construction contract;

8) To prepare the Traffic Management Plan during construction to avoid or at least mitigate traffic congestion, traffic accidents, traffic disturbance to school children, commuters, local business, etc, that is to be specified in the special provisions of the construction contract;

9) To undertake unit price analysis classified into labor, material, equipment, tax, overheads, profit, and others; to estimate cost based on the established unit prices;

10) To perform price analysis and cost estimates as construction proceeds

11) To perform constructability review and value engineering review;

12) To prepare the Detailed Design Report, as a minimum, include construction drawings, detailed cost estimates, necessary calculations to determine and justify the engineering details for the Project, associated contract documentation to include detailed specifications, bill of quantities (BOQ), implementation schedule for the Project. Such detailed specifications will contain those in relation to i) quality control of plant materials and workmanship, ii) safety, and iii) protection of the environment;

13) To seek RHD/PIU's comments on the Detailed Design Report, and to obtain RHD/PIU's and JICA's approval.

3.2.1.3 Updating Economic/Financial Analysis and the Project cost

estimation and its toll policy

4. The Consultant shall review and revise Economic and Financial Analysis prepared by the JICA Study team 2012 based on the result of Detailed Design.

5. The Consultant shall review the toll policy currently applied to the bridges, and propose the toll plan for the bridges to operate financially viable and sustainability. For the planning, the Consultant will consider any possibility to utilize Road Fund to be installed in 20XX.

3.2.2 Bid Assistance

3.2.2.1 Preparation of Pre-Qualification (PQ) and Bidding Documents

6. The Consultant shall prepare all the bidding documents for the Project including Pre-qualification documents taking into account the following points;

- PQ evaluation criteria taking into consideration technical feature of the Project
- PQ documents in accordance with the latest version of Standard Prequalification Documents under Japanese ODA Loans
- Bidding documents including the followings in accordance with the latest version of Standard Bidding Documents under Japanese ODA Loans and Bid evaluation criteria
  a. Instruction to Bidders
  b. Form of Contract
  c. General Conditions of Contract
  d. Special Provisions of Contract
  e. Form of Bid
  f. Technical Specifications
  g. Plans
  h. Environmental Management Plan (EMP) and JICA Guidelines for environmental and social considerations (April 2010)
- Detailed cost estimate

7. When preparing bidding documents for procurement of works, the Consultant shall confirm the followings:

Bidding documents for procurement of works require that:

(a) The personnel for key positions to be proposed by bidders shall include an accident prevention officer. (Refer to Clause 2.3 Personnel, Section III. Evaluation and Qualification Criteria (following prequalification) or Clause 2.5 Personnel, Section III. Evaluation and Qualification Criteria (without prequalification) of the Sample Bidding Documents under Japanese ODA Loans (Procurement of Works), April 2012)

(b) Bidders shall furnish a safety plan. (Refer to Clause 16. Documents Comprising the Technical Proposal, Section I Instructions to Bidders of the Sample Bidding Documents under Japanese ODA Loans (Procurement of Works), April 2012)

(c) Contractors shall include concrete safety measures in the programme stipulated in the Clause 8.3 Programme, Section VII General Conditions of the Sample Bidding Documents under Japanese ODA Loans (Procurement of Works), April 2012 (hereinafter referred to as “the Programme”), reflecting the contents of safety plan mentioned above.

(d) Contactors shall furnish a Health Safety Management Plan (HSMP) based on the EIA report and the Environmental Management Plan (EMP) attached as Appendix XX.

8. The Consultant shall clearly state in bidding documents that the consultant for construction supervision function on behalf of the Government as the “Engineer” of the Phase III Project as stated in Paragraph (1), Section 4.04 of the Guidelines for Procurement under Japanese ODA Loans, April 2012, and perform his duties in compliance with Clause 4.1 Engineer’s Duty and Authority, Section VII General Conditions of the Sample Bidding Documents under Japanese ODA Loans (Procurement of Works), April 2012.

3.2.2.2 PQ Evaluation Assistance

9. The Consultant shall assist RHD/PIU in PQ announcement, addendum / corrigendum, and clarifications to the applicants' queries;

10. The Consultant shall evaluate PQ applications in accordance with the criteria set forth in PQ documents; and

11. The Consultant shall prepare a PQ evaluation report for approval of the PQ evaluation committee.

3.2.2.3 Bidding Assistance

12. The Consultant shall assist RHD/PIU in issuing bid invitation, conducting pre-bid conferences, issuing addendum/corrigendum, and clarifications to bidders' queries.

13. The Consultant shall evaluate the bids in accordance with the criteria set forth in the bidding documents and confirm its substantial responsive to the bid.

14. The Consultant shall prepare the bid evaluation report for approval of the bid evaluation committee;

15. The Consultant shall assist RHD/PIU in contract negotiation by preparing agenda and facilitating negotiations including preparation of minutes of clarification meeting; and

16. The Consultant shall prepare the draft and final contract agreement.

3.2.3 Construction Supervision

3.2.3.1 Supervision of Construction Works

(1) Supervision of Works

17. The Consultant shall act as the “Engineer” and perform his duties and task during the construction in accordance with the Contracts to be concluded between the Employer and the Contractors.

18. More specifically, the Consultant shall provide the following:

1) To act as “The Engineer” to carry out duties exercising authority, specified or implied by the Contract with the Contractors; the Consultant shall be deemed to act as the Employer (i.e. RHD/PIU) shall make fair determination in accordance with the Contract wherever required for any consent or determination;

2) To issue to the Contractor instructions and additional or modified drawings which may be necessary for the execution of the Works and rectification of any defects, all in accordance with the Contract;

3) To provide assistance to the Employer concerning variations and claims which are to be ordered/issued at the initiative of the Employer;

4) To issue the commencement order to the Contractors;

5) To provide recommendation to RHD/PIU for acceptance of the Contractor Performance security, advance payment security and required insurances;

6) To review and approve the proposals submitted by the contractors which include work program, method statements, material sources, manpower and equipment deployment. In light of Section 3.03 of Guidelines for the Employment of Consultants under Japanese ODA Loans, April 2012, the Consultant shall pay attention, in particular, to whether such proposals will meet the safety requirements set forth in the applicable laws and regulations, the specifications or other parts of the contract;

7) To explain and/or adjust ambiguities and/or discrepancies in the Contract Documents and issue any necessary clarifications or instructions;

8) To assess the adequacy of all inputs such as materials and labor provided by the contractor and his methods of works in relation to the required rate of progress; to keep and regularly update a list of the Contractor’s equipment (and its condition) to ensure compliance with the list of equipment which the Contractor provided in his bid;

9) To organize the supervision of the works with proper locations and supervise their work in order to ensure that it is effectively executed;

10) To organize and operate materials laboratory on the basis of the provisions in the construction contract and perform all laboratory and field testing of materials and products needed to ensure the quality as required by the plans and specifications is obtained;

11) To check shop works and tests of contractors/suppliers in their factories before shipment and issue necessary certificates of inspection, if it is requested by RHD/PIU;

12) To maintain a representative at the site at all times to supervise all the works of the contractor and to issue site instruction as required;

13) To review and recommend for approval all of contractor's working drawings and drawings for temporary works;

14) To perform verification surveys of the Contractor's stake-out surveys for alignment of river channel, location of structures and facilities, and vertical control bench marks;

15) To monitor the strict adherence to the safety plan during construction as follows;

i) The Consultant shall review the Programme submitted by contractors from the point of views of securing the safety during construction and require them to submit further details, if necessary.

ii) During the supervision of construction works, the Consultant shall confirm that an accident prevention officer proposed by contractor is duly assigned at the project site and that construction works are carried out according to the safety plan as well as the safety measures prescribed in the Programme. If the Consultant recognizes any questions regarding the safety measures in general including the ones mentioned above, the Consultant shall require contractors to make appropriate improvements.

iii) During the supervision of construction works, the Consultant shall patrol construction site weekly to keep the construction work safe.

16) To compute quantities of approved and accepted works and materials and check, certify the contractor's monthly and final payment certification;

17) To prepare and submit reports to RHD/PIU monthly on the progress of the work, the contractor's performance, quality of works, and the project's financial status and forecasts;

18) To furnish timely assistance and direction to the Contractors in all matters related to the interpretation of the contract documents, ground survey controls, quality control testing, and other matters relating to contract compliance and progress of the report;

19) To prepare and maintain inspection and engineering reports and records to adequately document the progress and performances of the works;

20) To carry out field inspections on the contractor's setting out to ensure that the works are carried out in accordance with drawings and other design details.

21) To supervise the works so that all the contractual requirements will be met by the contractors, including those in relation to i) quality of the works, ii) safety and iii) protection of the environment. In light of Section 3.03 of Guidelines for the Employment of Consultants under Japanese ODA Loans (April 2012), the Consultant shall confirm that an accident prevention officer proposed by contractor is duly assigned at the project site and that construction works are carried out according to the requirements set forth in the applicable laws and regulations, the specifications or other parts of the contract;

22) To inspect the construction method, equipment to be used, workmanship at the site, and attend shop inspection and manufacturing tests in accordance with the specifications;

23) To survey and measure the work output performed by the contractors and issue payment certificates such as interim payment certificates and final payment certificate as specified in the contract;

24) To coordinate the works among different contractors employed for the Project;

25) To assure the receipts of, and maintain as permanent records, all warrants required under the terms of the contract documents for materials and equipment accepted and incorporated in the Project. All local materials incorporated in the Project and their sources are also to be approved, and the as-built drawings will be prepared for all works completed;

26) To examine and determine after obtaining an approval of RHD/PIU, if required in the Contract, all claims/requests of Contractors for time extensions, extra compensations for works or expenses and other similar matters;

27) To propose and present to the RHD/PIU for approval any changes in the plans that may deem necessary for the completion of works including information or any effect the changes may have on the contract amount and time of completion of the project, and prepare and issue, after obtaining an approval of RHD/PIU, if required in the Contract, all necessary variation orders including alterations on the plans and specifications and other details; to inform RHD/PIU of problems or potential problems, which may arise in connection with any construction contract and suggests or make recommendations to the RHD/PIU of possible solutions; to prepare and endorse for approval the revised design plans incorporating major changes in original design;

28) To liaise with the appropriate authorities to ensure that all the affected utility services are promptly relocated, if necessary;

29) To prepare disbursement schedule on a quarterly basis for submission to JICA, through RHD/PIU;

30) To monitor physical and financial progress regularly against the milestones as per the contract so as to ensure completion of contract in time;

31) To compile all information on the Project in a database, and to continuously update and incorporate those in the Monthly and Quarterly Progress Reports to be prepared by the Consultant for submission to RHD/PIU and JICA;

32) To assist RHD/PIU in providing the Monitoring Indicators during the construction, which are to be stated in the Quarterly Progress Reports once a year, and to transfer the methodology of monitoring those Indicators to RHD/PIU through the on-the-job training;

(1) Completion and Taking Over

33) To carry out the necessary inspection, specify and supervise any remedial works to be carried out by the contractor prior to the issuance of a Taking-Over Certificate ;

34) To check and certify as-built drawings for the parts of the works designed by the contractors, if any

35) To prepare construction completion reports for all the construction works of the Project including as-built drawings which is prepared by contractors of all the works completed;

36) To carry out inspections/preparing punch lists and certification on completion of the works;

37) To supervise commissioning and carrying out testing during commissioning;

38) To monitor contractor's work during commissioning period;

39) To verifying that RHD/PIU's staff are appropriately trained and receive specified certificates during the training period;

40) To perform the inspection of the works and to issue certificates such as the Taking-Over Certificate, Performance Certificate as specified in the civil works contract, prepare a Taking-Over Certificate

41) To provide periodic or continuous inspection service; to arrange for remedial work as required, prepare all necessary close-out documentation, assist with negotiations to settle final account and/or prepare a Performance Certificate during Defect Liability Period;

42) To inspect and check the existing bridges before the commencement of the rehabilitation work and propose the modified designs as may be necessary in accordance with the actual site conditions, and issue variation orders upon the prior consent with RHD/PIU

3.2.3.2 Transfer of Technology

19. The consultant shall conduct the transfer of knowledge on the related field to the RHD/PIU's officers concerned during the whole services period.

20. The Consultant shall conduct, but not limited to, the following technical transfer program:

- Providing training to the RHD/PIU and other concerned officials of MOC and relevant bodies in terms of the bridge project management, operation and maintenance and organize study tours for them to bridges/roads projects which are similar to the Project.
- Providing the technical training and technology transfer to Bangladesh engineers/workers in design, construction, operation and maintenance of bridge.
- Instructing the contractor in making reports on technology summarization of each bridge;
- Preparing and submitting summary technology transfer report of the whole project;

21. The Consultant shall conduct the overseas training during the construction stage. The training course is composed of site visit, presentation by and discussion with related agencies, who are involved in planning, design and supervision of similar bridge construction and rehabilitation works.

3.2.3.3 Guidance on Operation and Maintenance measures (Preparation of Manual, Training plan, and others) for RHD officials

22. The Consultant shall prepare the operation and maintenance plan for bridges.

The O/M plan shall include the detailed guidance for procurement of major spare parts, and emergency maintenance kit

3.2.3.4 Operation Plan of Weigh Bridge Station

23. The Consultant shall draft the operation plan for weigh bridge station. The plan shall include the detailed guidance how to operate the station such as establishment of organization, inspection methods and control of road users for over loaded vehicles, etc..

24. The Consultant shall prepare the draft loading control plan for implementation of weigh bridge station. The Consultant shall also assist RHD/PIU in coordination with the Police authority to enforce the regulation of overloading. The planning of "RHD Operation and Maintenance Plan" approved by MOC dated 18 September 2012.

3.2.3.5 Capacity Building for Operation and Maintenance

25. The consultant shall support RHD/PIU to improve capacity of counterparts in terms of operation and maintenance of the bridges.

3.2.4 Safeguard Consideration

3.2.4.1 Environmental and Social Considerations [Before Construction]

1. The Consultant shall conduct the study on the site and its surroundings concerning adverse environmental impact, and carefully prepare/update environmental consideration activities through the preparation of detailed engineering design, bidding documents, the Environmental Management Plan (EMP) and the Environmental Monitoring Plan (EMoP) to ensure that the Project comply with the JICA's Environmental and Social Considerations Guidelines (April 2010).

2. More specifically, the Consultant shall provide the following:

1) To review Environment Impact Assessment (EIA) and revise/update EMP and EMoP if necessary;

2) To assist RHD in discussing with JICA on the revision of the EMP and EMoP, if necessary;

3) To assist RHD in obtaining clearance/permits, if necessary, in accordance with the planned implementation schedule;

4) To prepare EMP and EMoP regarding the disposal site of construction sludge, if necessary;

5) To prepare the Pre-qualification Documents and Bid Documents which includes the clauses to have Contractor comply with the requirement of the EMP and EMoP, the conditions set on EIA Approval and JICA Environmental Guidelines;

6) To prepare specifications and Bill of Quantities (BOQ) for environmental matters including the toxicity test to be conducted by the Contractor. At least, the following contents will be included in the Specifications and the Cost for those activities will be shown explicitly in the BOQ;

    a "The Contractor shall test the quantity of Arsenic in wells for drinking. The Contractor shall submit the results to the Consultant for approval."

b "The Contractor shall ensure that the results of Arsenic test satisfy the proper regulations.
c "The Contractor shall reuse the construction sludge following technical specifications and dispose the rest of construction sludge, if any, in a manner not to cause environmental adverse impact."
d "The Contractor shall take necessary measures to prevent the soil waste from running off."
e "The Contractor shall install facilities such as silt basin to strictly follow the regulations."

7) To monitor the compliance of the Project with conditions set on EIA approval, and make recommendations on environmental mitigation measures to RHD and the Contractors if necessary;

8) To provide workshops/on-the-job-trainings to RHD staffs in implementation of monitoring of environmental management plans;

9) To assist RHD in preparation of environmental monitoring report which is to be submitted to JICA as a part of quarterly progress report, by filling in the monitoring form attached as Appendix XX.

3.2.4.2 Review and Implementation of Resettlement Action Plan (RAP)

1. The consultant shall review and update existing Resettlement Action Plan (RAP) based on the related laws and regulations of Bangladesh and JICA Guidelines for Environmental and Social Considerations. RAP implementation will be undertaken by RAP Implementing Agency (RAP IA) sub-contracted by the Consultant while external monitoring that keeps track of the RAP implementation activities will be carried out by External Monitoring Agent (EMA) procured by RHD/PIU.

2. With above RAP preparation (review) and implementation arrangements, the Consultant shall assist RHD/PIU in close coordination with the RAP IA under the Consultant in finalizing and implementing the RAP entirely, fairly and timely with full transparency, and in monitoring of implementation of RAP and livelihood restoration of Project Affected Persons (PAPs). The Consultant shall prepare necessary livelihood restoration program, and assist RHD/PIU in provision of necessary assistances to PAPs.

3. More specifically, the Consultant shall provide the following:

1) To review existing Resettlement Action Plan (RAP);

2) To review all the data/information of PAPs collected during preparation of RAP to establish the correct Inventory of Loss. In case new areas to be required, carry out census for additional areas;

3) To assist RHD in identifying the Entitled PAPs, and in preparation/updating of the list of Entitled PAPs and 'Payment Statement' for individual Entitled PAPs. The places where each Entitled PAPs will relocate to are necessary to be recorded so that RHD/PIU can implement monitoring on income and living conditions of resettled people;

4) To assist RHD/PIU in discussing with JICA on the revision of the RAP, if necessary;

5) To assist RHD/PIU and Property Assessment and Valuation Committee (PAVC) in evaluation of compensation and ensure that the amount is equivalent to full replacement cost;

6) To review the existing income restoration plan and special assistance plan for vulnerable PAPs and revise/update the contents of the plans if necessary based on priorities identified through the census and socioeconomic surveys during detailed design stage with support of relevant government agencies and Non-Governmental Organizations (NGOs). The following contents need to be included in the plans;

    a Skills Training
    b Project related Job Opportunities
    c Provision of the special allowance to vulnerable PAPs

7) To assist RHD/PIU in facilitating stakeholder participation for newly identified PAPs during additional survey, if any, and providing feedback their comments on the RAP;

8) To assist RHD/PIU in facilitating focus group discussion for vulnerable PAPs and providing feedback their comments on income restoration plan and special assistance plan for vulnerable PAPs. To assist RHD/PIU in informing entitled PAPs about resettlement benefits adequately;

9) To make necessary revision/updates of RAP, based on the results of Detailed Design and the activities above;

10) To assist RHD/PIU in discussing with JICA on the revision/updates of the RAP if necessary;

11) To contract with RAP Implementing Agency (IA). Sample ToR for RAP IA is attached as Appendix XX;

12) To assist RHD/PIU in establishment of Grievance Redress Committee (GRC);

13) To assist RHD/PIU in procurement of External Monitoring Agency (EMA). Sample ToR for EMA is attached as Appendix XX;

14) To conduct workshops/on-the-job-trainings for staffs from RHD/PIU, RAP IA, GRC and relevant agencies (community groups, local administration, NGOs etc.) in implementation of activities based on the final RAP;

15) To assist RHD/PIU in payment of compensations and delivering assistances with RAP IA, following recommendation of PAVC, and ensures that all resettlement benefits are paid accordingly, and provide technical services for keeping and updating records related to resettlement activities such as entitled people's file, calculation and processing of payment, progress, and performance of participatory monitoring;

16) To assist RHD/PIU in the physical resettlement activities of PAPs such as informing the PAPs about the documents required for collecting compensation and resettlement benefit;

17) To ensure dissemination of information on the project and resettlement policy to the PAPs and others (community groups, local administration, etc.) who are instrumental in effective and transparent implementation of the RAP;

18) To assist RHD in organizing public consultations and/or focus group discussions and recording the outcome of the meetings;

19) To ensure that the PAPs are fully aware of the grievance redress procedure and the process of bringing their complaints, investigate the veracity of the complaints, and recommends actions/measures to settle them amicably, fairly and transparently before they go to the redress committee or the courts of law;

20) To provide technical services with GRC for keeping and updating records when necessary;

21) To monitor and supervise resettlement activities, with RAP IA, including utilization of manpower input, updates of RAP, progress, grievance redress, and restoration of income and living conditions of PAPs, etc;

22) To prepare of monthly and annual monitoring reports on resettlement;

23) To assist RHD/PIU in preparation of quarterly monitoring reports on resettlement, which is to be submitted to JICA as a part of quarterly progress report, based on the monitoring plan described in RAP and by filling in the monitoring form attached as Appendix XX;

24) To assist RHD/PIU in preparation of the answer to the request from JICA's advisory committee if necessary;

25) To assist RHD/PIU in causing JICA to be furnished with project related information on resettlement and social issues as JICA may reasonably request.

3.2.4.3 Monitoring of Environmental Management Plan (EMP)

1. The Consultant shall monitor the site and its surroundings regarding adverse environmental impact through the environmental survey and evaluation to be carried out by the contractor, and shall monitor any changes which might arise during construction in compliance with the JICA Guidelines for Environmental and Social Considerations.

2. More specifically, the Consultant will provide the following:

1) To review the EMP and make necessary revision with the consent of RHD/PIU, or provide RHD/PIU with complementary materials such as operation plan or implementation procedure in order to ensure the effective and efficient environmental management;

2) To assist RHD/PIU to review the Health and Safety Management Plan (HSMP) to be prepared by the Contractor in accordance with the approved Environmental Impact Assessment (EIA) report, and make recommendations to RHD/PIU regarding any necessary amendments for RHD's approval;

3) To assist RHD/PIU in supervision and monitoring of the implementation of EMP;

4) To monitor the environmental impacts and provide technical advice, including a feasible solution, for RHD/PIU to improve situation when necessary;

5) To assist RHD/PIU in supervision and monitoring the compliance with conditions set on EIA approval, the requirements under EMP and the JICA Environmental Guidelines;

6) To assist RHD/PIU in facilitating stakeholder participation and providing feedback their comments on EMP;

7) To be the focal point, together with RHD/PIU, for the management of project related environmental impacts, and to support RHD/PIU bringing the grievances, where grievances regarding environmental impact are planned to be dealt with;

8) To assist RHD/PIU in preparation of the answer to the request from JICA's advisory committee if necessary;

9) To assist RHD/PIU in causing JICA to be furnished with all environmental relevant information on the Project as JICA may reasonably request;

10) To prepare monthly and annual environmental status report;

11) To assist RHD/PIU in preparation of environmental monitoring report which is to be submitted to JICA as a part of quarterly progress report, by filling in the monitoring form attached as Appendix XX.

3.2.4.4 Implementation of Resettlement Action Plan (RAP)

1. The Consultant shall be responsible for implementing the RAP entirely fairly and timely with full transparency, and in monitoring of implementation of RAP and livelihood restoration of Project Affected Persons (PAPs), in close coordination with RAP IA and shall assist RHD in this regard . The Consultant shall prepare necessary livelihood restoration program, and assist RHD/PIU in provision of necessary assistances to PAPs.

2. More specifically, the Consultant will provide the following:

1) To assist RHD/PIU and the local representatives in organizing consultation and recording the outcome of the meetings, when necessary;

2) To assist RHD/PIU, with RAP IA, in provision of necessary assistances for restoration of income and living conditions of PAPs, in coordination with related organizations, when necessary;

3) To monitor and supervise resettlement activities, such as progress, grievance redress, and restoration of income and living conditions of PAPs, etc;

4) To prepare monthly and annual monitoring reports on resettlement;

5) To assist RHD/PIU in preparation of quarterly monitoring reports on resettlement, which is to be submitted to JICA as a part of quarterly progress report, based on the monitoring plan described in RAP and by filling in the monitoring form attached as Appendix XX.;

6) To assist RHD/PIU in preparation of the answer to the request from JICA's advisory committee if necessary;

7) To assist RHD/PIU in causing JICA to be furnished with project related information on resettlement and social issues as JICA may reasonably request.

3.2.5 HIV/AIDS Prevention Activities

The Consultant shall carry out, but not limited to, the followings:

1) Review and approve the prevention activity plan prepared by contractors;

2) Supervising HIV/AIDS prevention activities implemented by contractors;

3) Proposing specific actions and program to issues related to the HIV/AIDS;

4) Recommending additional program when necessary;

5) Preparing and submitting the HIV/AIDS Monitoring Reports periodically.

3.2.6 Safety Considerations (Complying with Safety policy based on JICA policy)

The Consultant shall comply with RHD Safety policy based on JICA policy in construction. In consultation with the Contractor, the Consultant will prepare safety manual and safety kit, and prepare any necessary training for RHD officials and the concerned agencies.

3.2.7 Dispute Board (DB) assistance

The Consultant will assist any process in terms of Dispute Board mechanism which to be set by RHD/PIU and the Contractor during the construction.

3.2.8 Defect Liability Period

1. The Consultant shall be responsible for, but not limited to, the following task and duties during Defect Liability Period (twelve (12) months) after substantially completion of each respective bridges.

1) Provision of periodic or continuous inspection services;

2) Arrangement of remedial work as required;

3) Preparation of all necessary close-out documentation;

4) Assist with negotiations to settle final account;

5) Inspection of defects and control of punch-lists;

6) Preparation of defect liablity certificate.

2. The Consultant shall secure the insurance to cover the design failure during the above defects liability period.

4. Expected Time Schedule

The total duration of consulting services will be 102 months. The implementation schedule expected is as shown in the following table:

Key Activities	Date	Duration in Months
Commencement of Consulting Services	1 February 2014	12
Completion of detail design, preparation of drawings and Bid documents	31 January 2015	
Bid process including prequalification	February 2015 to July 2016	18
Commencement of Civil works	1 August 2016	60
End of Civil works	31 July 2021	
Defect Liability Period	1 August 2021 to 31 July 2022	12
Termination of Consulting Services	31 July 2022	-

5. STAFFING

The following experts will be required to carry out the consulting services. 84 international consultants and 94 local consultants be engaged, over the 102-month period of the consulting services, for a total of 1,253 person-months for international and 2,394 person-months for national consultants. Total consulting input is 3,647 person-months. Tentative assignment schedule is attached Appendix -1

5.1. Phase wise input in months

The Consultant Team for the design, Bid assistance, construction supervision and other miscellaneous consulting services consist of following key personnel together with supporting staff. The allocation of person-month for the respective phases of consulting services is as shown in Table below.

5.1.1. Detailed Design Stage (February 2014 - January 2015)

Designation	No.	Man-Months
Professional (A) Staff		
Team Leader	1	12
Geological Engineer	1	6
Topographical Engineer	1	6
Highway Engineer (s)	1	12
Bridge Engineer (s)/ Superstructure	1	24
Bridge Engineer (s)/ Substructure	1	24
Bridge Engineer (s)/ Foundation	1	24
Bridge Engineer (s)/ Rehabilitation	1	24
Construction Planner/ On Land	1	18
Construction Planner/ Inside of River	1	18
Structure Engineer	1	12
Pavement Engineer (s)	1	6
Material Engineer (s)	1	12
Electrical Engineer (s)	1	6
Hydraulic Engineer/ Drainage	1	12

River Training Engineer	1	6
Cost Estimator	1	18
Contract Specialist (s)	1	18
Traffic Management Specialist	1	3
Overloaded Vehicle Countermeasure Specialist	1	3
Environmental Specialist	1	3
Resettlement Specialist	1	3
HIV/ STD Preventive Coordinator		
Professional (B) Staff		
Deputy Team Leader	1	12
Geotechnical Engineer	1	6
Topographic Engineer	1	6
Highway / Pavement Engineer	1	12
Bridge Engineer	1	24
Construction Planner	1	24
Hydraulic Engineer/ Drainage	1	12
Material Engineer	1	12
Electrical Engineer	1	6
Cost Estimator	1	36
Contract Engineer	1	36
Resettlement Expert	1	36
Environmental t Expert	1	6

5.1.2. Bid Assistance Stage (February 2015 - January 2016)

Designation	No.	Man-Months
Professional (A) Staff		
Team Leader	1	9
Procurement Specialist (s)	1	9
Bridge Engineer (s)/ Superstructure	1	3
Bridge Engineer (s)/ Substructure	1	3
Construction Planner	1	5
Resettlement Specialist	1	3
Professional (B) Staff		
Deputy Team Leader	1	18
Procurement Specialist (s)	1	18
Bridge Engineer	1	5
Construction Planner	1	6
Resettlement Expert	1	11

5.1.3. Construction Supervision and Post Construction Stage (August 2016 – July 2022)

Designation	No.	Man-Months
Professional (A) Staff		
Team Leader	1	60
Area Leader (Kanchpur)	1	42
Area Leader (Meghna)	1	60
Area Leader (Gumti)	1	60
Geotechnical Engineer (s)	1	15
Highway Engineer (s)	1	40
Bridge Engineer (s)/ Superstructure(Kanchpur)	1	20
Bridge Engineer (s)/ Superstructure (Meghna)	1	24
Bridge Engineer (s)/ Superstructure (Gumti)	1	27
Bridge Engineer (s)/ Substructure (Kanchpur)	1	29
Bridge Engineer (s)/ Substructure (Meghna)	1	38
Bridge Engineer (s)/ Substructure (Gumti)	1	38
Pavement Engineer (s) (Kanchpur)	1	6
Pavement Engineer (s) (Meghna)	1	6
Pavement Engineer (s) (Gumti)	1	7
Material Engineer (s) (Kanchpur)	1	22
Material Engineer (s) (Meghna)	1	26
Material Engineer (s) (Gumti)	1	23
Contract Specialist (s) (Kanchpur)	1	22
Contract Specialist (s) (Meghna)	1	26
Contract Specialist (s) (Gumti)	1	23
Electric Engineer	1	27
Traffic Management / Safety Engineer (Kanchpur)		
Traffic Management / Safety Engineer (Meghna)		
Traffic Management / Safety Engineer (Gumti)		
Overloaded Vehicle Countermeasure Specialist	1	12
Environmental Specialist	1	20
Resettlement Specialist	1	3
HIV/ STD Preventive Coordinator	1	2
Professional (B) Staff		
Deputy Team Leader	1	60
Assistant Area Leader (Kanchpur)	1	42
Assistant Area Leader (Meghna)	1	60
Assistant Area Leader (Gumti)	1	60
Geotechnical Engineer	1	20
Highway Engineer (Kanchpur)	1	40
Highway Engineer (Meghna)	1	40
Highway Engineer (Gumti)	1	40
Bridge Engineer(s)/ Superstructure	1	71
Bridge Engineer(s)/ Substructure	1	105
Pavement Engineer	1	19
Material Engineer (Kanchpur)	1	22

Material Engineer (Meghna)	1	26
Material Engineer (Gumti)	1	23
Electric Engineer	1	28
Contract Engineer (Kanchpur)	1	22
Contract Engineer (Meghna)	1	26
Contract Engineer (Gumti)	1	23
Quantity Surveyor (Kanchpur)	1	40
Quantity Surveyor (Meghna)	1	58
Quantity Surveyor (Gumti)	1	58
Inspector 1 (Kanchpur) / Superstrcutre	1	20
Inspector 2 (Kanchpur) / Substructure	1	29
Inspector 1 (Meghna)/ Superstructure	1	24
Inspector 2 (Meghna)/ Substructure	1	38
Inspector 1 (Gumti) / Superstructure	1	27
Inspector 2 (Gumti) / Substructure	1	38
Inspector 3 (Gumti) / SPSP		
Surveyor (Kanchpur)	1	40
Surveyor (Meghna)	1	58
Surveyor (Gumti)	1	58
Environmental Expert	1	40
Resettlement Expert	1	6
HIV/ STD Preventive Coordinator	1	10

5.2. Qualification of key Team Members

The qualification of key Team Members is shown in below

5.2.1 International Consultant

(1) International Team Leader(Project Management Specialist / Bridge Engineer)

International Team Leader, who should hold a suitable degree (International undergraduate academic qualification) in civil engineering at least 20 years of professional experiences in related fields with preferably 10 years professional experience in developing countries. He/ she also should have experiences as project manager and/or deputy project manager more than three (3) bridge projects in which he/she has provided at least one (1) year consecutive service and one of them shall be steel bridge project.

(2) International Area Leader (Construction Management Specialist)

International Area Leader, who should hold a suitable degree (international undergraduate academic qualification) in civil engineering at least 18 years of professional experiences in related fields with preferably 10 years professional experience in developing countries, He/She should have managed the projects of similar nature as project manager or resident engineer, preferably 3 bridge projects and preferably as resident engineer of 2 bridge projects in developed and developing counties,

as well as he/she has proven capacity, skills and competency of applying FIDIC condition into contract management and other related tasks of the project.

(3) International Bridge Engineer (s)

International Bridge Engineer, who should hold a suitable degree in civil/structural engineering at least 13 years professional experiences including preferably 5 years experiences in developing countries on similar bridge design and construction supervision.

(4) International Highway Engineer (s)

International Highway Engineer, who should hold a suitable degree in civil engineering at least 8 years professional experience including preferably 3 years experiences in developing countries on similar highway design and construction supervision assignment.

(5) International Geotechnical Engineer (s)

International Geotechnical Engineer, who should hold a suitable degree in civil engineering at least 13 years professional experience including preferably 5 years experiences in developing countries on similar assignment.

(6) International Pavement Engineer (s)

International Pavement Engineer, who should hold a suitable degree in civil engineering, at least 13 years professional experience including preferably 8 years experiences as pavement engineer working for preparation of pavement design and quality control of pavement works and establishment of job mix formula for AC deign mix in developing countries on similar assignment.

(7) International Electrical Engineer (s)

International Electrical Engineer, who should hold a suitable degree in civil engineering, at least 13 years professional experience including preferably 8 years' experiences as electrical engineer working in developing countries on similar assignment.

(8) International Material Engineer (s)

International Material Engineer, who should hold a suitable degree in civil engineering including at least 13 years professional experience including preferably 8 years' experiences as material engineer working in developing countries on similar assignment.

(9) International Contract Specialist (s)

International Contract Specialist, who should hold a suitable degree in civil engineering, at least 13 years professional experiences and be shown to have 8 years' in-depth-experiences in contract administration for FIDIC contract of civil works, document preparation, and contract procurement.

(10) International Environmental Specialist (s)

International Environmental Specialist, who should have a degree in civil engineering and addition, an appropriate post-graduate degree/diploma in environmental related subject, preferably 10 years professional experience, including extensive experience of environmental impact assessment/monitoring of mitigation measures for road development projects in rural environments in developing countries.

(11) International Resettlement Specialist (s)

International Resettlement Specialist, who should have a first degree in social science and also an appropriate post graduate degree/diploma in sociology, anthropology, human geography, or related field, preferably 10 years professional experience, in involuntary resettlement and social impact assessment including census and socioeconomic surveys, stakeholders' consultation, and analyzing social impacts to identify mitigation measures in compliance with social safeguard policies of the international development financing institutions and national legislations. He/she shall have experience of preparing resettlement framework and action plans and implementation of plans for externally financed projects including prefer more than 5 years demonstrative experience of working with social resettlement, gender and indigenous people on similar assignment in developing countries.

(12) International HIV/ STD Preventive Coordinator

International HIV/ STD Preventive Coordinator shall have at least one (1) experience in the assistance of establishing campaign for HIV/STD Preventative program which is to prevent HIV and Sexual Transmitting Disease at the project site and close coordination among Non-Government Organization (NGO) or Non-profitable organization (NPO) and local community concerned to tackle on disaster issues and/or to support the smooth project implementation.

5.2.2 National Consultant

(1) National Deputy Team Leader (Project Management Specialist / Bridge Engineer)

National Team Leader, who should hold a suitable degree (International undergraduate academic qualification) in civil engineering at least 15 years of professional experiences in related fields with preferably 8 years professional experiences. He/ she also should have experiences as project manager and/or deputy project manager more than three (3) bridge projects in which he/she has proven capacity, skills and competency of project management of bridge construction project.

(2) National Assistant Area Leader (Construction Management Specialist)

National Assistant Area Leader, who should hold a suitable degree (undergraduate academic qualification) in civil engineering, preferably 13 years of professional experiences in related fields with preferably 7 years professional experience, He/She should have managed the projects of similar nature as project manager or resident engineer, preferably 3 projects and preferably as resident engineer of 2 projects in his/her country, as well as he/she has proven capacity, skills and competency of applying FIDIC condition into contract management and other related tasks of the project.

(3) National Bridge Engineer (s)

National Bridge Engineer, who should hold a suitable degree in civil/structural engineering, preferably 13 years professional experience including 5 years experience on similar bridge design and construction supervision assignment.

(4) National Highway Engineer (s)

National Highway Engineer who should have a suitable degree in civil engineering, preferably 8 years professional experience, including 5 years' experiences in similar assignment.

(5) National Contract Engineer (s)

International Contract Specialist, who should hold a suitable degree in civil engineering, at least 8 years professional experiences and be shown to have 5 years' in-depth-experiences in contract administration for FIDIC contract of civil works, document preparation, and contract procurement.

(6) National Topographic Surveyor (s)

National Topographic Surveyor, who should hold a suitable degree in civil years engineering at least 8 years professional experience including 5 years experiences as topographic surveyor for road and bridge construction projects.

(7) National Inspector (s) (Quality Control Engineer)

National Inspector, who should hold a suitable degree in civil engineering, preferably 8 years professional experience including 5 years experiences as inspector for road and bridge construction projects.

(8) National Material Engineer (s)

National Material Engineer, who should hold a suitable degree in civil engineering, preferably 8 years professional experience including 5 years experiences as material engineer for road and bridge construction projects.

(9) National Quantity Surveyor (s)

National Quantity Surveyor, who should hold a suitable degree in civil engineering, preferably 8 years professional experience including 5 years experience as quantity surveyor for road and bridge construction projects.

(10) National Geotechnical Engineer (s)

National Geotechnical Engineer, who should hold a suitable degree in civil engineering, preferably 8 years professional experience including 5 years experiences as geotechnical engineer for road and bridge construction projects.

(11) National Pavement Engineer (s)

National Pavement Engineer, who should hold a suitable degree in civil engineering, at least 8 years professional experiences including 5 years experiences as pavement engineer for road construction project in preparation of pavement design and the quality control of pavement works including establishment job mix formula for AC design mix.

(12) National Environmental Specialist

National Environmental Specialist, who should have a suitable degree in environmental management and addition, an appropriate post-graduate degree/diploma in an environmental related subject, at least 10 years professional experience including extensive experience of environmental impact assessment/monitoring of mitigation measures for road development projects.

(13) National Resettlement Specialist

National Resettlement Specialist, who should have a first degree in social science and also an appropriate post graduate degree/diploma in sociology, anthropology, human geography, or related field, at least 10 years professional experience, including preferably more than 5 years demonstrative experiences of social resettlement, gender and indigenous people on similar assignment.

(14) National HIV/ STD Preventive Coordinator

The HIV/ STD Preventive Coordinator shall have at least one (1) experience in the assistance of establishing campaign for HIV/STD Preventative program which is to prevent HIV and Sexual Transmitting Disease at the project site and close coordination among Non-Government Organization (NGO) or Non-profitable organization (NPO) and local community concerned to tackle on disaster issues and/or to support the smooth project implementation.

Consultant may propose other experts and supporting staffs required to accomplish the tasks outlined in the TOR. It is the Consultant's responsibility to select the optimum team and to propose the professionals which he believes best meets the needs of RHD/PIU.

6. REPORTING

The Consultant will prepare and submit the following reports and documents to RHD/PIU.

6.1. Monthly Progress Report and Inception Report

6.1.1. Monthly Progress Report (20 copies): The Consultant will submit a Monthly Progress Report in the accepted form describing briefly and concisely all activities and progress for the previous month by the 10th day of each month. Problems encountered or anticipated will be clearly stated, together with actions to be taken or recommendations on remedial measures for correction. It will also indicate the work to be performed during the coming month.

6.1.2. Inception Report (20 copies), to be submitted in the 1st month after the commencement of the services, presenting the methodologies, schedule, organization, etc.

6.2. Detailed Engineering Design

6.2.1. Project Definition Report (20 copies), to be submitted in 3rd month after the commencement of the services, presenting the design criteria and standards.

6.2.2. Draft Detailed Design Report (20 copies), to be submitted in 8th month after the commencement of the services, presenting detailed engineering design.

6.2.3. Cost Estimate Report (20 copies), to be submitted in 9th month after the commencement of the services, presenting detailed cost estimate.

6.2.4. Final Detailed Design Report (20 copies), to be submitted in 10th month after the commencement of the services, compiling all the items carried out during the services.

6.2.5. Final Design Report (20 copies), to be submitted in the 12th month after the commencement of the services, finalizing detailed design, cost estimate, bid plan, bid evaluation criteria, technical evaluation criteria and bidding documents through the incorporation of comments on the Draft Design Report, provided by RHD/PIU and the Consultant.

6.2.6. Environmental Monitoring Report (20 copies), to be submitted quarterly after the commencement of the services, presenting the environmental impacts and implementation of environmental mitigation measures during and after the construction stage. Environmental monitoring forms attached as Appendix XX will be filled and attached to the Report.

6.2.7. Resettlement Monitoring Report (20 copies), to be submitted quarterly during RAP implementation period. RAP monitoring form attached as Appendix XX will be filled and attached to the Report.

6.2.8. Environmental and Social Plan Report (20 copies), to be submitted by the end of the detailed design stage, presenting the revised EMP and revised RAP.

6.3. Bidding Assistance (Two Envelope System with Prequalification)

6.3.1. Pre-qualification Document with Evaluation Criteria (20 copies), to be submitted within one month after the commencement of the services, presenting the pre-qualification documents and its evaluation criteria.

6.3.2. Bidding Document Report (20 copies), to be submitted within six month after the commencement of the services, presenting the bidding documents

6.3.3. Pre-qualification Evaluation Report (15 copies) to present the results of the evaluation and to select the qualified applicants.

6.3.4. Technical Evaluation Report (15 copies) to present the results of technical evaluation and to recommend the qualified applicants.

6.3.5. Bid Evaluation Report (15 copies) to present the results of the Bids to select the most responsible contractors.

6.4. Construction Supervision

6.4.1. Quarterly Progress Report (15 copies) to be submitted quarterly during construction, presenting the progress status of the Project.

6.4.2. Operation and Maintenance Manual (20 copies) containing technical procedures for the appropriate operation and maintenance of all project facilities.

6.4.3. Environmental Monitoring Report (15 copies) to be submitted quarterly, presenting the environmental impacts and implementation of environmental mitigation measures during and after the construction stage. Environmental monitoring forms attached as Appendix XX will be filled and attached to the report.

6.4.4. RAP Monitoring Report (15 copies) to be submitted quarterly during resettlement. RAP monitoring form attached as Appendix XX will be filled and attached to the report.

6.4.5. Construction Completion Report (20 copies), to be submitted within three (3)

month after completion of construction, which comprises a full size of as-built drawings for all the structures and facilities completed, and the final details of the construction completed together with all data, records, material tests results, field books, etc.

6.4.6. Service Completion Report (20 copies), at the completion of all the general consulting services.

7. Obligations of the RHD, PIU and GOB

[Detailed Design] and [Bid Assistance]

1. RHD/PIU will coordinate the implementation of the services between the representatives of relevant organizations of the Government of the People's Republic of Bangladesh, as a sole counterpart agency of JICA.

2. A Technical Advisory Committee will be established in order to examine and confirm the process and technical details of the services. The Technical Advisory Committee will be constituted by RHD/PIU and authorities concerned for bidding procedure of the ODA Loan Project in the GOB.

3. The Technical Advisory Committee will be responsible in following technical aspects in order to ensure smooth procurement procedure (approval) of the Phase III Project by RHD/PIU;

(a) To examine and analyze the technical aspects of the services based on the reports and explanation by the Consultant in the course (on the each stage) of the services,

(b) To summarize the comments and requests to the services and notify them to the Consultant, and

(c) To confirm the revision by the Consultant based on the comments and requests thereof.

4. The operational detail of the Technical Advisory Committee will be settled between RHD/PIU and the Consultant.

5. GOB is prepared to provide the following to the Consultant in support of the general consulting services:

(1) Office space in the Headquarters of the RHD with necessary equipment, furniture and utility. However, the Consultant's requirement for office space, including necessary equipment, furniture and utilities, should be clearly stated in the proposal with its rental cost for the case where RHD/PIU would be unable to provide such facilities

(2) Existing reports, data, information and available documents relevant to the Project.

(3) Appointment of the counterpart officials, agent and representative as may be necessary for effective implementation of the Consulting Services

(4) Tax exemption for materials, machines, tools, equipment, stationery and others which will be required to conduct the engineering services.

(5) Arrangement of all necessary immigration procedures for the foreign experts.

(6) Assistance for giving security of life and property of the experts during their stay in the Bangladesh.

[Construction Supervision]

1. The Government of the People's Republic of the Bangladesh is prepared to provide the following to the Consultant in support of the general consulting services:

(1) Existing reports, data, information and available documents relevant to the Project.

(2) Appointment of the counterpart officials, agent and representative as may be necessary for effective implementation of the Consulting Services

(3) Tax exemption for materials, machines, tools, equipment, stationery and others which will be required to conduct the engineering services.

(4) Arrangement of all necessary immigration procedures for the foreign experts.

(5) Assistance for giving security of life and property of the experts during their stay in the Bangladesh.

8. APPLICABILITY OF SPECIFIC PROVISIONS OF JICA GUIDELINES TO THE CONSULTANCY CONTRACT

In compliance with the JICA Guidelines for the Employment of Consultants under the Japanese ODA Loans, April 2012, the following sections will be applied:

Section 2.02 Responsibilities of Consultants

(3) In the case of a difference of opinion between RHD/PIU and the Consultant on any important matters involving professional judgment that might affect the proper evaluation or execution of the project, RHD/PIU shall allow the Consultant to submit promptly to RHD/PIU a written report and, simultaneously, to submit a copy to JICA. RHD/PIU shall forward the report to JICA with its comments in time to allow JICA to study it and communicate with RHD/PIU before any irreversible steps are taken in the matter. In cases of urgency, the Consultant shall have the right to request RHD/PIU and/or JICA that the matter be discussed immediately between RHD/PIU and JICA.

Section 2.06 monitoring by JICA

(1) RHD/PIU is responsible for supervising the Consultant's performance and ensuring that the consultant carries out the assignment in accordance with the contract. Without assuming the responsibilities of RHD/PIU or the Consultant, JICA may monitor the work as necessary in order to satisfy itself that it is being. Carried out in accordance with appropriate standards and is based on acceptable data.

(2) As appropriate, JICA may take part in discussions between RHD/PIU and the Consultant. However, JICA shall not be liable in any way for the

implementation of the project by reason of such monitoring or participation in discussions. Neither RHD/PIU nor the Consultant shall be released from any responsibility for the project by reason of JICA's monitoring or participation in discussion.

Appendix 1: Environmental Management Plan and Environmental Monitoring Plan
Appendix 2: Environmental Monitoring Form
Appendix 3: Draft ToR for RAP Implementing Agency
Appendix 4: Draft ToR for RAP External Monitoring Agency
Appendix 5: RAP Monitoring Form

APPENDIX 16.

ECONOMIC AND FINANCIAL EVALUATION

APPENDIX 16 ECONOMIC AND FINANCIAL EVALUATION

A.16.1 Economic Analysis

A.16.1.1 Methodology

The methodology for economic analysis is adopted as follows:

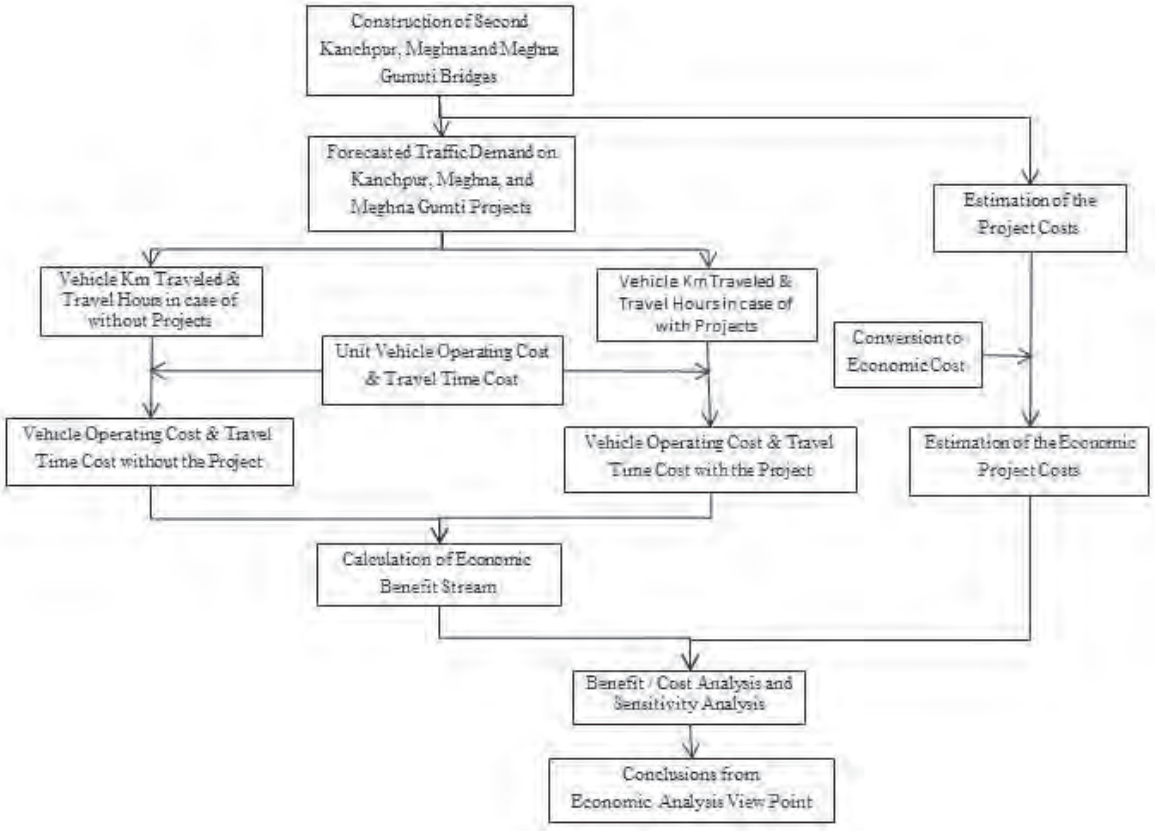


Figure A.16.1 Procedure for Economic Analysis

A.16.1.2 Benefit Calculation

(1) Input Data

Table A.16.1 Input Data and calculation formula used for travel time and VOC

No.	Item	Abbrevia-tion	Unit	Input /Output	Formula	Notes
1	Daily traffic volume	TV_D	PCU/day	○	Input data	Traffic demand forecasting
2	Hourly variation	TC_H	%	○	Input data	Traffic count survey
3	Hourly traffic volume	TV_H	PCU/hour		$TV_H = TV_D \times TC_H$	
4	Traffic capacity	$RC_{H/l}$	PCU/hour/lane	○	Input data	Calculated by service level
5	Number of lanes	L	Number	○	Input data	
6	Road capacity	RC_H	PCU / hour		$RC_H = RC_{H/l} \times L$	
7	Hourly congestion degree	CD_H	-		$CD_H = TV_H / RC_H$	
8	Travel speed	TS_H	km/h		$TS_H = 104 - 80\ CD_H$	
9	Average Travel Speed	ATS	Km/h		$ATS = \Sigma (TS_H \times TC_H)$	
10	Road length	RL	Km	○	Input data	Downstream from bridge on NH 1
11	Travel Time	TT_H	Min		$TT_H = RL / TS \times 60 \times TV_H$	
12	Unit VOC_H	UVC_H	BDT/km		$UVC_H = 0.003\ TS_H^2 - 0.3706\ TS_H + 18.799$	
13	VOC by hour	VC_H	BDT		$VC_H = UVCH \times RL \times TV_H$	
14	Total VOC	TVOC	BDT		$TVOC = \Sigma (TS_H \times TC_H)$	
15	Unit TTC	UTTC	BDT/hour	○		
16	TCC	TCC	BDT		Output	
17	Accident cost	ACC	BDT		Output	
18	Riprap cost	RRC	BDT		Output	
19	Discount rate	DR	%	○	12 %	
20	Annualized factor	AF	Days/year	○	1 year = 340day	
21	Economic construction cost	ECC	BDT	○		
22	Economic O&M cost	EOC	BDT	○		

(2) Step 1 : Calculation of Travel Time and VOC

The travel time and VOC is computed as following excel file.

Excel File A.16.1.1: Travel Time and VOC Calculation

Travel Time and VOC Calculation									
2020	1.Traffic Volume		4. Capacity		8. QV Formula	10.Length	12.VOC Formla		
W/O Project	100,123	**PCU/Lane**	1,700	a	-80	14.08	a	0.0083	
		No. of Lane	2	b	104		b	-1.005	
							c	50.422	
	2.Hourly Distribution	3.Traffic Volume	6. Road Capacity	7. Congestion Degree	8. Travel Speed	10.Average Travel Speed	11.Travel Time	12.UVOC	13.VOC
6:00 - 7:00	0.0317	3,170	3,400	0.9322	29.4	0.93	758.37	28.0	156,402.3
7:00 -8:00	0.0301	3,012	3,400	0.8859	33.1	1.00	640.20	26.2	139,106.3
8:00 - 9:00	0.0453	4,533	3,400	1.3333	8.0	0.36	3,989.33	42.9	342,389.6
9:00 -10:00	0.0465	4,655	3,400	1.3692	8.0	0.37	4,096.52	42.9	351,589.2
10:00 - 11:00	0.0460	4,606	3,400	1.3546	8.0	0.37	4,052.99	42.9	347,853.6
11:00 - 12:00	0.0480	4,809	3,400	1.4145	8.0	0.38	4,232.11	42.9	363,226.7
12:00 - 13:00	0.0679	6,798	3,400	1.9995	8.0	0.54	5,982.52	42.9	513,458.3
13:00 - 14:00	0.0500	5,006	3,400	1.4724	8.0	0.40	4,405.44	42.9	378,103.1
14:00 - 15:00	0.0474	4,749	3,400	1.3968	8.0	0.38	4,179.19	42.9	358,685.2
15:00 - 16:00	0.0507	5,076	3,400	1.4929	8.0	0.41	4,466.74	42.9	383,364.3
16:00 - 17:00	0.0456	4,564	3,400	1.3423	8.0	0.36	4,016.26	42.9	344,700.9
17:00 - 18:00	0.0427	4,275	3,400	1.2574	8.0	0.34	3,762.26	42.9	322,900.8
18:00 - 19:00	0.0427	4,271	3,400	1.2563	8.0	0.34	3,758.71	42.9	322,596.7
19:00 - 20:00	0.0440	4,409	3,400	1.2968	8.0	0.35	3,879.90	42.9	332,997.5
20:00 - 21:00	0.0357	3,572	3,400	1.0506	20.0	0.71	1,260.27	33.7	211,694.0
21:00 - 22:00	0.0354	3,546	3,400	1.0429	20.6	0.73	1,213.58	33.3	207,573.1
22:00 - 23:00	0.0343	3,438	3,400	1.0112	23.1	0.79	1,047.73	31.6	191,423.9
23:00 - 24:00	0.0375	3,756	3,400	1.1047	15.6	0.59	1,692.45	36.7	242,913.0
24:00 - 1:00	0.0415	4,157	3,400	1.2227	8.0	0.33	3,658.37	42.9	313,985.1
1:00 - 2:00	0.0387	3,879	3,400	1.1408	12.7	0.49	2,143.80	39.0	266,011.7
2:00 - 3:00	0.0393	3,930	3,400	1.1559	11.5	0.45	2,400.88	39.9	276,287.8
3:00 - 4:00	0.0359	3,598	3,400	1.0583	19.3	0.69	1,310.33	34.1	215,925.3
4:00 - 5:00	0.0314	3,143	3,400	0.9244	30.0	0.94	736.41	27.7	153,329.8
5:00 - 6:00	0.0317	3,169	3,400	0.9321	29.4	0.93	758.03	28.0	156,355.1
Total	1.0000	100,123	81,600	1.2270		13.21	68,442.38	916.2	6,892,873.3

Benefit Calculation									
2020	1.Traffic Volume		4. Capacity		8. QV Formula	10.Length	12.VOC Formla		
W/ Project	117,202	**PCU/Lane**	1,900	a	-80	14.08	a	0.0083	
Road to be Improved		**No. of Lane**	6	b	104		b	-1.005	
							c	50.422	
	2.Hourly Distribution	3.Traffic Volume	6. Road Capacity	7. Congestion Degree	8. Travel Speed	10.Average Travel Speed	11.Travel Time	12.UVOC	13.VOC
6:00 - 7:00	0.0317	3,170	11,400	0.2780	80.0	2.28	278.92	23.1	129,094.4
7:00 -8:00	0.0301	3,012	11,400	0.2642	80.0	2.17	265.08	23.1	122,687.4
8:00 - 9:00	0.0453	4,533	11,400	0.3977	72.2	2.94	442.11	21.1	168,549.8
9:00 -10:00	0.0465	4,655	11,400	0.4083	71.3	2.98	459.43	21.0	171,774.5
10:00 - 11:00	0.0460	4,606	11,400	0.4040	71.7	2.97	452.35	21.0	170,461.4
11:00 - 12:00	0.0480	4,809	11,400	0.4219	70.3	3.04	481.94	20.8	175,903.0
12:00 - 13:00	0.0679	6,798	11,400	0.5963	56.3	3.44	850.21	20.1	241,089.1
13:00 - 14:00	0.0500	5,006	11,400	0.4391	68.9	3.10	511.75	20.6	181,284.2
14:00 - 15:00	0.0474	4,749	11,400	0.4166	70.7	3.02	473.07	20.9	174,284.4
15:00 - 16:00	0.0507	5,076	11,400	0.4452	68.4	3.12	522.58	20.5	183,220.8
16:00 - 17:00	0.0456	4,564	11,400	0.4003	72.0	2.95	446.42	21.1	169,357.2
17:00 - 18:00	0.0427	4,275	11,400	0.3750	74.0	2.84	406.74	21.5	161,794.6
18:00 - 19:00	0.0427	4,271	11,400	0.3747	74.0	2.84	406.20	21.5	161,689.7
19:00 - 20:00	0.0440	4,409	11,400	0.3868	73.1	2.90	424.85	21.3	165,284.4
20:00 - 21:00	0.0357	3,572	11,400	0.3133	78.9	2.53	318.58	22.8	143,380.1
21:00 - 22:00	0.0354	3,546	11,400	0.3110	79.1	2.52	315.51	22.9	142,681.2
22:00 - 23:00	0.0343	3,438	11,400	0.3016	79.9	2.47	303.04	23.1	139,787.8
23:00 - 24:00	0.0375	3,756	11,400	0.3295	77.6	2.62	340.57	22.4	148,251.9
24:00 - 1:00	0.0415	4,157	11,400	0.3647	74.8	2.80	391.13	21.7	158,722.8
1:00 - 2:00	0.0387	3,879	11,400	0.3402	76.8	2.68	355.63	22.2	151,467.8
2:00 - 3:00	0.0393	3,930	11,400	0.3448	76.4	2.70	362.06	22.1	152,813.6
3:00 - 4:00	0.0359	3,598	11,400	0.3156	78.7	2.55	321.69	22.8	144,082.8
4:00 - 5:00	0.0314	3,143	11,400	0.2757	80.0	2.26	276.59	23.1	128,014.8
5:00 - 6:00	0.0317	3,169	11,400	0.2780	80.0	2.28	278.88	23.1	129,078.0
Total	1.0000	100,123	273,600	0.3659		65.99	9,685.32	523.9	3,814,756.0

Notes: **Input Data** : **Output Data** **Parameters in formula**

(3) Step 2: Calculation of TTC, VOC, ACC and RRC

TTC, VOC, ACC and RRC can be calculated as following file:

Excel File A.16.1.2 Benefit Calculation

Benefit Calculation

Unit TTC	149.70

Plan 1: Road to be Improved

		Travel Time	TTC	VOC	ACC	RRC
2020	W/O	68,442.38	10,245,825	6,892,873		
	W/	9,685.32	0	3,814,756		
	Benefit		10,245,825	3,078,117		
	Annualized		340	340	1.0	276.9
	Yearly		3,483.6	1,046.6	1.0	276.9
					Total	4,808.0

Plan 2: Road not to be Improved

		Travel Time	TTC	VOC	ACC	RRC
2020	W/O	68,442.38	10,245,825	6,892,873		
	W/	12,502.20	1,871,579	4,026,078		
	Benefit	55,940.19	8,374,246	2,866,796		
	Annualized		340	340	1.0	276.9
	Yearly		2,847.2	974.7	1.0	276.9
					Total	4,099.9

Unit TTC	149.70

Plan 1: Road to be Improved

		Travel Time	Travel Time Cost	VOC	ACC	RRC
2025	W/O	111,425.72	16,680,430	9,683,206		
	W/	14,221.11	2,128,900	4,686,936		
	Benefit		14,551,530	4,996,270		
	Annualized		340	340	1.6	276.9
	Yearly		4,947.5	1,698.7	1.6	276.9
					Total	6,924.8

Plan 2: Road not to be Improved

		Travel Time	TTC	VOC	ACC	RRC
2025	W/O	111,425.72	16,680,430	9,683,206		
	W/	23,321.56	3,491,237	5,760,078		
	Benefit	88,104.16	13,189,193	3,923,128		
	Annualized		340	340	1.6	276.9
	Yearly		4,484.3	1,333.9	1.6	276.9
					Total	6,096.7

3,823.0

(4) Step 3 Economic Cost and OM Cost

- **Escalation factor**: Price inflation was not taken into account for either construction cost or operation/maintenance cost.
- **Administrative cost, VAT and import duty**: Imposition of value added tax and import duty was excluded.
- **Standard conversion factor**: Standard conversion factor (0.85)1 is applied to the price of non-tradable goods and services.
- **Land acquisition cost and compensation cost**: Resettlement cost estimated in the Resettlement Action Plan (RAP) is used in the economic and financial analysis.
- **Stream of construction and operation/maintenance costs** are set up in each Bridge based on the Project implementation schedule.
- **Operation and maintenance cost** consists of three: routine maintenance, periodic maintenance and toll levying cost.

[1] "Project Appraisal Framework" Transport Sector Coordination Wing, Planning Commission, 2005

Table A.16.1.2 Economic Operation and Maintenance Cost

1) Economic and Financial Cost Estimation

(a) Annual Fund Requirement

This table is the project cost without price escalation.

	Item	Total			2,012			2,013			2,014			2,015			2,016			2,017			2,018			2,019			2,020			2,021			2,022			2,023			Total		
		FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
	A. ELIGIBLE PORTION																																									
A	Ⅰ) Procurement / Construction	32,264	17,563	50,962	0	0	0	0	0	0	0	0	0	0	0	0	5,493	3,001	8,688	5,480	2,985	8,658	5,480	2,985	8,658	5,480	2,985	8,658	5,480	2,985	8,658	3,207	1,741	5,061	23	0	24	1,624	878	2,559	32,267.4	17,561.5	50,965
	Bridge Civil Work	29,182	15,966	46,175	0	0	0	0	0	0	0	0	0	0	0	0	4,985	2,728	7,888	4,961	2,714	7,850	4,961	2,714	7,850	4,961	2,714	7,850	4,961	2,714	7,850	2,894	1,583	4,579	0	0	0	1,465	798	2,315	29,188.0	15,965.0	46,180
	Dispute Board	149	0	154	0	0	0	0	0	0	0	0	0	0	0	0	9	0	9	21	0	22	21	0	22	21	0	22	21	0	22	21	0	22	21	0	22	11	0	11	146.0	0.0	151
	Base cost for JICA financing	29,331	15,966	46,329	0	0	0	0	0	0	0	0	0	0	0	0	4,994	2,728	7,898	4,982	2,714	7,871	4,982	2,714	7,871	4,982	2,714	7,871	4,982	2,714	7,871	2,915	1,583	4,601	21	0	22	1,476	798	2,326	29,334.0	15,965.0	46,331
	Price escalation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0
	Physical contingency	2,933	1,597	4,633	0	0	0	0	0	0	0	0	0	0	0	0	499	273	790	498	271	787	498	271	787	498	271	787	498	271	787	292	158	460	2	0	2	148	80	233	2,933.4	1,596.5	4,633
B	Ⅱ) Consulting services	2,969	2,018	5,092	0	0	0	0	0	0	720	264	1,009	97	58	158	245	161	414	336	300	648	415	365	795	492	429	939	410	285	708	233	147	388	11	5	16	11	4	15	2,968.4	2,018.1	5,091
	Base cost	2,828	1,922	4,850	0	0	0	0	0	0	686	251	961	92	55	150	233	153	394	320	286	617	395	348	757	469	409	895	390	271	675	222	140	370	10	5	15	10	4	14	2,827.0	1,922.0	4,849
	Price escalation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0
	Physical contingency	141	96	242	0	0	0	0	0	0	34	13	48	5	3	8	12	8	20	16	14	31	20	17	38	23	20	45	20	14	34	11	7	18	1	0	1	1	0	1	141.4	96.1	242
C	Total (Ⅰ + Ⅱ)	35,234	19,581	56,054	0	0	0	0	0	0	720	264	1,009	97	58	158	5,738	3,161	9,101	5,816	3,286	9,307	5,895	3,351	9,453	5,973	3,415	9,598	5,890	3,270	9,367	3,440	1,888	5,449	34	5	40	1,634	882	2,574	35,235.8	19,579.6	56,056
	B. NON ELIGIBLE PORTION																					0																					
D	a Procurement / Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0
	Base cost for JICA financing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0
	Price escalation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0
	Physical contingency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0
E	b Land Acquisition	0	83	83	0	0	0	0	0	0	0	20	20	0	21	21	0	21	21	0	20	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	81.4	81
	Base cost	0	75	75	0	0	0	0	0	0	0	18	18	0	19	19	0	19	19	0	18	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	74.0	74
	Price escalation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0
	Physical contingency	0	8	8	0	0	0	0	0	0	0	2	2	0	2	2	0	2	2	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7.4	7
F	c Administration cost	0	5,614	5,614	0	0	0	0	0	0	0	103	103	0	18	18	0	912	912	0	933	933	0	945	945	0	960	960	0	937	937	0	545	545	0	4	4	0	257	257	0.0	5,614	5,614
G	d VAT	0	3,411	3,411	0	0	0	0	0	0	0	154	154	0	27	27	0	515	515	0	548	548	0	567	567	0	589	589	0	554	554	0	319	319	0	2	2	0	134	134	0.0	3,410.1	3,410
H	e Import Tax	0	9,679	9,679	0	0	0	0	0	0	0	0	0	0	0	0	0	1,648	1,648	0	1,644	1,644	0	1,644	1,644	0	1,644	1,644	0	1,644	1,644	0	962	962	0	7	7	0	487	487	0.0	9,680.2	9,680
I	Total (a+b+c+d+e)	0	18,786	18,786	0	0	0	0	0	0	0	277	277	0	66	66	0	3,096	3,096	0	3,145	3,145	0	3,156	3,156	0	3,193	3,193	0	3,135	3,135	0	1,826	1,826	0	13	13	0	878	878	0.0	18,785.4	18,785.4
J	TOTAL (A+B)	35,234	38,367	74,840	0	0	0	0	0	0	720	541	1,286	97	124	223	5,738	6,258	12,198	5,816	6,430	12,451	5,895	6,507	12,610	5,973	6,607	12,790	5,890	6,405	12,502	3,440	3,715	7,275	34	19	53	1,634	1,760	3,452	35,235.8	38,365.0	74,841
	C. Interest during Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
	Interest during Construction(Const.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
	Interest during Construction (Consul.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
	D. Commitment Charge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
	GRAND TOTAL (A+B+C+D)	35,234	38,367	74,840	0	0	0	0	0	0	720	541	1,286	97	124	223	5,738	6,258	12,198	5,816	6,430	12,451	5,895	6,507	12,610	5,973	6,607	12,790	5,890	6,405	12,502	3,440	3,715	7,275	34	19	53	1,634	1,760	3,452	35,236	38,365	74,841

(b) Economic and Financial Cost Estimation

Unit:BDT	Total			2,012			2,013			2,014			2,015			2,016			2,017			2,018			2,019			2,020			2,021			2,022			2,023			Total		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
Economic Cost	36,474	16,714	53,187	0	0	0	0	0	0	746	241	986	100	67	167	5,940	2,705	8,645	6,021	2,810	8,831	6,102	2,848	8,951	6,183	2,903	9,085	6,097	2,779	8,876	3,561	1,605	5,166	35	4	39	1,692	750	2,441	36,476	16,712	53,188
Financial Cost	36,474	38,367	74,840	0	0	0	0	0	0	746	541	1,286	100	124	224	5,940	6,258	12,198	6,021	6,430	12,451	6,102	6,507	12,610	6,183	6,607	12,790	6,097	6,405	12,502	3,561	3,715	7,275	35	19	53	1,692	1,760	3,452	36,476	38,366	74,842

Economic cost

FC=J/0.966, LC=(C+E)*0.85

Financial cost

FC=J/0.966, LC=C+E+F+G+H

(c) Economic Cost Estimation

		Rate	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Economic	Kanchpur	0.141	0	0	139	24	1,222	1,249	1,266	1,285	1,255	730	6	345	7,521
	Meghna	0.371	0	0	366	62	3,208	3,277	3,321	3,371	3,294	1,917	15	906	19,735
	Gumti	0.488	0	0	481	81	4,215	4,305	4,364	4,430	4,328	2,519	19	1,190	25,932
	Total	1.000	0	0	986	167	8,645	8,831	8,951	9,085	8,876	5,166	39	2,441	53,188

2) Economic and Financial Operation and Maintenance Cost

(a) Base Operation and Maintenance Cost of Kanchpur Bridge

Kanchpur Bridge (without Toll Collection)

Routine Maintenance Unit: million

	Particulars					2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total
A	Routine inspection/ maintenance		2,770,000 BDT	Annual		2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	72.0
B	VAT		15% BDT			0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	10.8
	Economic					2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	61.2
	Financial					3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	82.8

Periodic Maintenance Unit: million

						2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total
	Approach Road																															
	Pavement	m2	21,000	10,200 BDT	1/20years																				214							214
	Axle load scale	each	2	20,000,000 JPY	1/20years																				40							40
	Weigh Bridge	each	1	20,000,000 JPY	1/20years																				20							20
	New Bridge																															
	Repainting	L.S	1	108,695,700 BDT	1/20years																				109							109
	Joint (Material)	m	37	525,000 JPY	1/20years																				19							19
	Joint (Construction)	m	37	168,700 BDT	1/20years																				6							6
	Pavement	m2	6,595	6,200 BDT	1/10years										41										41							82
	Water proof layer	m2	6,595	3,500 BDT	1/10years										23										23							46
	Periodical check	m	397	35,200 BDT	1/5years					14					14					14					14					14		70
	Exisiting Bridge																															
	Carbonation	m2	2,400	2,100 BDT	1/30years																											0
	Joint (Material)	m	115	184,000 JPY	1/20years																					21						21
	Joint (Construction)	m	115	168,700 BDT	1/20years																					19						19
	Pavement	m2	5,079	6,200 BDT	1/10years											31										31						63
	Water proof layer	m2	5,079	3,500 BDT	1/10years											18										18						36
	Periodical check	m	397	35,200 BDT	1/5years						14					14					14					14						14	70
C	Sub total: Local currency					0	0	0	0	14	14	0	0	0	78	63	0	0	0	14	14	0	0	0	407	83	0	0	0	14	14	715
D	Sub total: Foreign currency					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79	21	0	0	0	0	0	101
E	VAT			15% BDT		0.0	0.0	0.0	0.0	2.1	2.1	0.0	0.0	0.0	11.7	9.5	0.0	0.0	0.0	2.1	2.1	0.0	0.0	0.0	61.1	12.4	0.0	0.0	0.0	2.1	2.1	107
F	CDST (Custom Duty and Sales Tax)			30% BDT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.8	6.3	0.0	0.0	0.0	0.0	0.0	30
	BDT	Economic		BDT		0.0	0.0	0.0	0.0	11.9	11.9	0.0	0.0	0.0	66.2	53.7	0.0	0.0	0.0	11.9	11.9	0.0	0.0	0.0	422.7	90.7	0.0	0.0	0.0	11.9	11.9	704.6
		Financial		BDT		0.0	0.0	0.0	0.0	16.1	16.1	0.0	0.0	0.0	89.6	72.7	0.0	0.0	0.0	16.1	16.1	0.0	0.0	0.0	568.7	121.8	0.0	0.0	0.0	16.1	16.1	949.1

Toll operation cost Unit: million

					2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total
G	Toll operation cost		BDT	Annual																											0
H	VAT		15%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
	Economic				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
	Financial				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

Other Unit: million

						2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total
I	Axle load scale	each	2	5,293,000 BDT	Annual	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	275
J	Weigh Bridge	each	1	0 BDT	Annua	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
K	VAT			15%		1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	41
	Economic					9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	234.0
	Financial					12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	316.5

Economic cost

Routine maintenance=A*0.85, Periodic maintenance=C*0.85+D/0.966, Toll operation cost=G*0.85, Other=(I+J)*0.85

Financial cost

Routine maintenance=A+B, Periodic maintenance=C+D/0.966+E+F, Toll operation cost=G+H, Other=I+J+K

(b) Base Operation and Maintenance Cost of Meghna Bridge

Meghna Bridge

Routine Maintenance Unit: million

						2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total
A	Routine inspection/ maintenance		6,450,000 BDT	Annual		6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45	161.3
B	VAT		15%			0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	24.2
	Economic					5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	137.1
	Financial					7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	185.4

Periodic Maintenance Unit: million

						2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total
	Approach Road																															
	Pavement	m2	21,000	10,200 BDT	1/20years																					214						214
	Axle load scale	each	2	20,000,000 JPY	1/20years																					40						40
	Weigh Bridge	each	1	20,000,000 JPY	1/20years																					20						20
	New Bridge																															
	Repainting	L.S	1	263,975,200 BDT	1/20years																					264						264
	Joint (Material)	m	36	600,000 JPY	1/20years																					22						22
	Joint (Construction)	m	36	168,700 BDT	1/20years																					6						6
	Pavement	m2	13,869	6,200 BDT	1/10years											86										86						172
	Water proof layer	m2	13,869	3,500 BDT	1/10years											49										49						97
	Periodical check	m	930	35,200 BDT	1/5years						33					33					33					33						33	164
	Exisiting Bridge																															
	Carbonation	m2	8,025	2,100 BDT	1/30years																											0
	Joint (Material)	m	22	600,000 JPY	1/20years																						13					13
	Joint (Construction)	m	22	168,700 BDT	1/20years																						4					4
	Pavement	m2	6,696	6,200 BDT	1/10years												42										42					83
	Water proof layer	m2	6,696	3,500 BDT	1/10years												23										23					47
	Periodical check	m	930	35,200 BDT	1/5years							33					33					33					33						131
C	Local currency						0	0	0	0	33	33	0	0	0	167	98	0	0	0	33	33	0	0	0	652	101	0	0	0	33	1182
D	Foreign currency						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	82	13	0	0	0	0	95
E	VAT			15% BDT			0.0	0.0	0.0	0.0	4.9	4.9	0.0	0.0	0.0	25.1	14.7	0.0	0.0	0.0	4.9	4.9	0.0	0.0	0.0	97.7	15.2	0.0	0.0	0.0	4.9	177
F	CDST (Custom Duty and Sales Tax)			30% BDT			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.5	4.0	0.0	0.0	0.0	0.0	28
	BDT	Economic		BDT			0.0	0.0	0.0	0.0	27.8	27.8	0.0	0.0	0.0	142.2	83.0	0.0	0.0	0.0	27.8	27.8	0.0	0.0	0.0	632.6	98.9	0.0	0.0	0.0	27.8	1095.9
		Financial		BDT			0.0	0.0	0.0	0.0	37.6	37.6	0.0	0.0	0.0	192.4	112.3	0.0	0.0	0.0	37.6	37.6	0.0	0.0	0.0	852.5	133.3	0.0	0.0	0.0	37.6	1478.8

Toll operation cost Unit: million

						2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total
G	Toll operation cost			BDT	Annual		23	25	26	27	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	689
H	VAT			15%			3.45	3.75	3.90	4.05	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	103
	Economic						19.55	21.25	22.10	22.95	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	585.7
	Financial						26.45	28.75	29.90	31.05	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	792.4

Other Unit: million

						2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total
I	Axle load scale	each	2	5,293,000 BDT	Annual		10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	265
J	Weigh Bridge	each	1	0 BDT	Annua		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
K	Bridge inspection ca	each	1	4,000,000 BDT	Annua		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	100
L	VAT			15%			2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	55
	Economic						12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	310.0
	Financial						16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	419.3

Economic cost

Routine maintenance=A*0.85, Periodic maintenance=C*0.85+D/0.966, Toll operation cost=G*0.85, Other=(I+J+K)*0.85

Financial cost

Routine maintenance=A+B, Periodic maintenance=C+D/0.966+E+F, Toll operation cost=G+H, Other=I+J+K+L

(c) Base Operation and Maintenance Cost of Gumti Bridge

Gumti Bridge

Routine Maintenance Unit: million

						2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total
A	Routine inspection/ maintenance		9,780,000	Annual		9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	9.78	244.5
B	VAT		15%			1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	36.7
	Economic					8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	207.8
	Financial					11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	281.2

Periodic Maintenance Unit: million

						2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total
	Approach Road																															
	Pavement	m2	31,000	10,200 BDT	1/20years																					316						316
	Axle load scale	each	2	20,000,000 JPY	1/20years																					40						40
	Weigh Bridge	each	1	20,000,000 JPY	1/20years																					20						20
	New Bridge																															
	Repainting	L.S	1	414,078,700 BDT	1/20years																					414						414
	Joint (Material)	m	53	600,000 JPY	1/20years																					32						32
	Joint (Construction)	m	53	168,700 BDT	1/20years																					9						9
	Pavement	m2	21,033	6,200 BDT	1/10years											130										130						261
	Water proof layer	m2	21,033	3,500 BDT	1/10years											74										74						147
	Periodical check	m	1,410	35,200 BDT	1/5years						50					50					50					50					50	248
	Exisiting Bridge																															
	Carbonation	m2	12,690	2,100 BDT	1/30years																											0
	Joint (Material)	m	29	600,000 JPY	1/20years																						17					17
	Joint (Construction)	m	29	168,700 BDT	1/20years																						5					5
	Pavement	m2	10,152	6,200 BDT	1/10years												63										63					126
	Water proof layer	m2	10,152	3,500 BDT	1/10years												36										36					71
	Periodical check	m	1,410	35,200 BDT	1/5years							50					50					50					50					199
C	Local currency						0	0	0	0	50	50	0	0	0	254	148	0	0	0	50	50	0	0	0	993	153	0	0	0	50	1796
D	Foreign currency						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	92	17	0	0	0	0	109
E	VAT			15% BDT			0.0	0.0	0.0	0.0	7.4	7.4	0.0	0.0	0.0	38.0	22.2	0.0	0.0	0.0	7.4	7.4	0.0	0.0	0.0	148.9	22.9	0.0	0.0	0.0	7.4	269
F	CDST (Custom Duty and Sales Tax)			30% BDT			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.5	5.2	0.0	0.0	0.0	0.0	33
	BDT	Economic		BDT			0.0	0.0	0.0	0.0	42.2	42.2	0.0	0.0	0.0	215.6	125.9	0.0	0.0	0.0	42.2	42.2	0.0	0.0	0.0	932.6	146.9	0.0	0.0	0.0	42.2	1631.9
		Financial		BDT			0.0	0.0	0.0	0.0	57.1	57.1	0.0	0.0	0.0	291.7	170.3	0.0	0.0	0.0	57.1	57.1	0.0	0.0	0.0	1258.0	198.0	0.0	0.0	0.0	57.1	2203.4

Toll operation cost Unit: million

						2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total
G	Toll operation cost			BDT	Annual		23	25	26	27	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	689
H	VAT			15%			3.45	3.75	3.90	4.05	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	103
	Economic						19.55	21.25	22.10	22.95	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	585.7
	Financial						26.45	28.75	29.90	31.05	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	792.4

Other Unit: million

						2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total
I	Axle load scale	each	2	5,293,000 BDT	Annual		10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	265
J	Weigh Bridge	each	1	0 BDT	Annua		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
K	VAT			15%			1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	40
	Economic						9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	225.0
	Financial						12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	304.3

Economic cost

Routine maintenance=A*0.85, Periodic maintenance=C*0.85+D/0.966, Toll operation cost=G*0.85, Other=(I+J)*0.85

Financial cost

Routine maintenance=A+B, Periodic maintenance=C+D/0.966+E+F, Toll operation cost=G+H, Other=I+J+K

(d) Economic Operation and Maintenance Cost

		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total
Kanchpur Bridge	Routine Maintenance Cost	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35		58.86
	Periodic Maintenance Cost	0.00	0.00	0.00	0.00	11.86	11.86	0.00	0.00	0.00	66.24	53.74	0.00	0.00	0.00	11.86	11.86	0.00	0.00	0.00	422.73	90.67	0.00	0.00	0.00	11.86		692.70
	Toll operation cost	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
	Other Cost	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00		224.95
	O/M	11.35	11.35	11.35	11.35	23.22	23.22	11.35	11.35	11.35	77.59	65.09	11.35	11.35	11.35	23.22	23.22	11.35	11.35	11.35	434.08	102.02	11.35	11.35	11.35	23.22		976.51
Meghna Bridge	Routine Maintenance Cost	0.00	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	137.06
	Periodic Maintenance Cost	0.00	0.00	0.00	0.00	0.00	27.83	27.83	0.00	0.00	0.00	142.18	83.03	0.00	0.00	0.00	27.83	27.83	0.00	0.00	0.00	632.61	98.94	0.00	0.00	0.00	27.83	1,095.89
	Toll operation cost	0.00	19.55	21.25	22.10	22.95	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	585.65
	Other Cost	0.00	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	12.40	309.95
	O/M	0.00	37.43	39.13	39.98	40.83	69.51	69.51	41.68	41.68	41.68	183.86	124.71	41.68	41.68	41.68	69.51	69.51	41.68	41.68	41.68	674.29	140.62	41.68	41.68	41.68	69.51	2,128.55
Gumti Bridge	Routine Maintenance Cost	0.00	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31	207.83
	Periodic Maintenance Cost	0.00	0.00	0.00	0.00	0.00	42.19	42.19	0.00	0.00	0.00	215.60	125.89	0.00	0.00	0.00	42.19	42.19	0.00	0.00	0.00	932.62	146.86	0.00	0.00	0.00	42.19	1,631.91
	Toll operation cost	0.00	19.55	21.25	22.10	22.95	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	23.80	585.65
	Other Cost	0.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	224.95
	O/M	0.00	36.86	38.56	39.41	40.26	83.30	83.30	41.11	41.11	41.11	256.72	167.00	41.11	41.11	41.11	83.30	83.30	41.11	41.11	41.11	973.73	187.97	41.11	41.11	41.11	83.30	2,650.34
All Bridge	Routine Maintenance Cost	2.35	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15	13.80	403.75
	Periodic Maintenance Cost	0.00	0.00	0.00	0.00	11.86	81.88	70.01	0.00	0.00	66.24	411.52	208.92	0.00	0.00	11.86	81.88	70.01	0.00	0.00	422.73	1,655.90	245.80	0.00	0.00	11.86	70.01	3,420.49
	Toll operation cost	0.00	39.10	42.50	44.20	45.90	47.60	47.60	47.60	47.60	47.60	47.60	47.60	47.60	47.60	47.60	47.60	47.60	47.60	47.60	47.60	47.60	47.60	47.60	47.60	47.60	47.60	1,171.30
	Other Cost	9.00	30.39	30.39	30.39	30.39	30.39	30.39	30.39	30.39	30.39	30.39	30.39	30.39	30.39	30.39	30.39	30.39	30.39	30.39	30.39	30.39	30.39	30.39	30.39	30.39	21.40	759.86
	O/M	11.35	85.64	89.04	90.74	104.31	176.02	164.16	94.14	94.14	160.38	505.66	303.07	94.14	94.14	106.01	176.02	164.16	94.14	94.14	516.87	1,750.05	339.94	94.14	94.14	106.01	152.80	5,755.40

(5) Benefit Cost Stream

Cost-benefit stream can be shown in the following excel file. This benefit cost stream is computed as discounted cost -benefit stream. And the following economic indicators are calculated:

- Economic internal rate of return (EIRR)
- Net present value (NPV)
- Cost benefit rate (CBR)

Excel File A.16.1.3:

Benefit - Cost Stream

Meghna Bridge	Discount Rate	Construction Cost
Road Plan not to be Implemented	0.12	18,829.6

	Growth Rate			
	TTC	VOC	ACC	RRC
2020	2,847.2	974.7	1.0	276.9
2025	4,484.3	1,333.9	1.6	276.9
2019-2025	1.095102	1.064749	1.098561	1
2026-2030	1	1	1	1
2031-2044	1	1	1	1

SQ	Year	Discount Rate	Cost			Benefit					Net Benefit
			Cost	O & M Cost	Cost Total	TTC	VOC	Accident Cost	Riprap Cost	Total	
1	2012	1.000	0		0.0						0.0
2	2013	1.120	0		0.0						0.0
3	2014	1.254	366		366.0						-366.0
4	2015	1.405	62		61.9						-61.9
5	2016	1.574	3,208		3,207.8						-3,207.8
6	2017	1.762	3,277		3,276.6						-3,276.6
7	2018	1.974	3,321		3,321.1						-3,321.1
8	2019	2.211	3,371		3,371.2						-3,371.2
9	2020	2.476	3,294	37.4	3331.1	2,847.2	974.7	1.0	276.9	4,099.9	768.8
10	2021	2.773	1,917	39.1	1955.9	3,118.0	1,037.8	1.1	276.9	4,433.8	2,478.0
11	2022	3.106	15	40.0	54.5	3,414.6	1,105.0	1.2	276.9	4,797.7	4,743.1
12	2023	3.479		40.8	40.8	3,739.3	1,176.6	1.3	276.9	5,194.1	5,153.2
13	2024	3.896		69.5	69.5	4,094.9	1,252.7	1.5	276.9	5,626.0	5,556.5
14	2025	4.363		69.5	69.5	4,094.9	1,252.7	1.5	276.9	5,626.0	5,556.5
15	2026	4.887		41.7	41.7	4,094.9	1,252.7	1.5	276.9	5,626.0	5,584.3
16	2027	5.474		41.7	41.7	4,094.9	1,252.7	1.5	276.9	5,626.0	5,584.3
17	2028	6.130		41.7	41.7	4,094.9	1,252.7	1.5	276.9	5,626.0	5,584.3
18	2029	6.866		183.9	183.9	4,094.9	1,252.7	1.5	276.9	5,626.0	5,442.1
19	2030	7.690		124.7	124.7	4,094.9	1,252.7	1.5	276.9	5,626.0	5,501.3
20	2031	8.613		41.7	41.7	4,094.9	1,252.7	1.5	276.9	5,626.0	5,584.3
21	2032	9.646		41.7	41.7	4,094.9	1,252.7	1.5	276.9	5,626.0	5,584.3
22	2033	10.804		41.7	41.7	4,094.9	1,252.7	1.5	276.9	5,626.0	5,584.3
23	2034	12.100		69.5	69.5	4,094.9	1,252.7	1.5	276.9	5,626.0	5,556.5
24	2035	13.552		69.5	69.5	4,094.9	1,252.7	1.5	276.9	5,626.0	5,556.5
25	2036	15.179		41.7	41.7	4,094.9	1,252.7	1.5	276.9	5,626.0	5,584.3
26	2037	17.000		41.7	41.7	4,094.9	1,252.7	1.5	276.9	5,626.0	5,584.3
27	2038	19.040		41.7	41.7	4,094.9	1,252.7	1.5	276.9	5,626.0	5,584.3
28	2039	21.325		674.3	674.3	4,094.9	1,252.7	1.5	276.9	5,626.0	4,951.7
29	2040	23.884		140.6	140.6	4,094.9	1,252.7	1.5	276.9	5,626.0	5,485.4
30	2041	26.750		41.7	41.7	4,094.9	1,252.7	1.5	276.9	5,626.0	5,584.3
31	2042	29.960		41.7	41.7	4,094.9	1,252.7	1.5	276.9	5,626.0	5,584.3
32	2043	33.555		41.7	41.7	4,094.9	1,252.7	1.5	276.9	5,626.0	5,584.3
33	2044	37.582		69.5	69.5	4,094.9	1,252.7	1.5	276.9	5,626.0	5,556.5
Total			18,829.6	2,128.6	20,958.2	99,111.9	30,601.9	35.2	6,922.5	136,671.4	115,713.3

Discounted Benefit - Cost Stream

SQ	Year	Discounted Cost			Discounted Benefit					Net Benefit
		Construction Cost	O & M Cost	Cost Total	TTC	VOC	ACC	RRC	Benefit Total	
1	2012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0
2	2013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0
3	2014	291.8	0.0	291.8	0.0	0.0	0.0	0.0	0.0	-291.8
4	2015	44.1	0.0	44.1	0.0	0.0	0.0	0.0	0.0	-44.1
5	2016	2,038.6	0.0	2,038.6	0.0	0.0	0.0	0.0	0.0	-2,038.6
6	2017	1,859.2	0.0	1,859.2	0.0	0.0	0.0	0.0	0.0	-1,859.2
7	2018	1,682.6	0.0	1,682.6	0.0	0.0	0.0	0.0	0.0	-1,682.6
8	2019	1,525.0	0.0	1,525.0	0.0	0.0	0.0	0.0	0.0	-1,525.0
9	2020	1,330.2	15.1	1,345.4	1,150.0	393.7	0.4	111.8	505.9	-839.5
10	2021	691.2	14.1	705.3	1,124.4	374.2	0.4	99.9	1,598.9	893.6
11	2022	4.7	12.9	17.6	1,099.4	355.8	0.4	89.2	1,544.7	1,527.2
12	2023	0.0	11.7	11.7	1,075.0	338.2	0.4	79.6	1,493.2	1,481.4
13	2024	0.0	17.8	17.8	1,051.1	321.5	0.4	71.1	1,444.1	1,426.2
14	2025	0.0	15.9	15.9	1,027.7	305.7	0.4	63.5	369.5	353.6
15	2026	0.0	8.5	8.5	837.9	256.3	0.3	56.7	1,151.2	1,142.7
16	2027	0.0	7.6	7.6	748.1	228.9	0.3	50.6	1,027.8	1,020.2
17	2028	0.0	6.8	6.8	668.0	204.4	0.2	45.2	917.7	910.9
18	2029	0.0	26.8	26.8	596.4	182.5	0.2	40.3	819.4	792.6
19	2030	0.0	16.2	16.2	532.5	162.9	0.2	36.0	199.1	182.9
20	2031	0.0	4.8	4.8	475.4	145.5	0.2	32.1	653.2	648.4
21	2032	0.0	4.3	4.3	424.5	129.9	0.2	28.7	583.2	578.9
22	2033	0.0	3.9	3.9	379.0	116.0	0.1	25.6	520.7	516.9
23	2034	0.0	5.7	5.7	338.4	103.5	0.1	22.9	464.9	459.2
24	2035	0.0	5.1	5.1	302.2	92.4	0.1	20.4	113.0	107.8
25	2036	0.0	2.7	2.7	269.8	82.5	0.1	18.2	370.7	367.9
26	2037	0.0	2.5	2.5	240.9	73.7	0.1	16.3	330.9	328.5
27	2038	0.0	2.2	2.2	215.1	65.8	0.1	14.5	295.5	293.3
28	2039	0.0	31.6	31.6	192.0	58.7	0.1	13.0	263.8	232.2
29	2040	0.0	5.9	5.9	171.5	52.5	0.1	11.6	64.1	58.2
30	2041	0.0	1.6	1.6	153.1	46.8	0.1	10.4	210.3	208.8
31	2042	0.0	1.4	1.4	136.7	41.8	0.0	9.2	187.8	186.4
32	2043	0.0	1.2	1.2	122.0	37.3	0.0	8.3	167.7	166.4
33	2044	0.0	1.8	1.8	109.0	33.3	0.0	7.4	149.7	147.9
Total		9,467.4	228.4	9,695.8	13,439.8	4,203.9	4.8	982.4	15,447.1	5,751.4

	Evaluation Indicators
IRR	21.4%
CBR	1.59
NPV	5,751.4

Excel File A.16.1.4:

Benefit – Cost Stream

Gumti Bridge	Discount Rate	Construction Cost
Road Plan not to be Implemented	0.12	24,741

Year	Growth rate			
	TTC	VOC	ACC	RRC
2020	2,730.0	934.6	1.5	246.2
2025	4,299.6	1,278.9	1.9	246.2
2019–2025	1.0950997	1.0647468	1.0484132	1
2026–2030	1	1	1	1
2031–2044	1	1	1	1

SQ	Year	Discount Rate	Cost			Benefit					Net Benefit
			Cost	O & M Cost	Cost Total	TTC	VOC	ACC	RRC	Total	
1	2012	1.0000	0		0.0						0.0
2	2013	1.1200	0		0.0						0.0
3	2014	1.2544	481		481.0						−481.0
4	2015	1.4049	81		81.3						−81.3
5	2016	1.5735	4,215		4,214.9						−4,214.9
6	2017	1.7623	4,305		4,305.3						−4,305.3
7	2018	1.9738	4,364		4,363.9						−4,363.9
8	2019	2.2107	4,430		4,429.6						−4,429.6
9	2020	2.4760	4,328	36.9	4,364.6	2,730.0	934.6	1.5	246.2	3,912.3	−452.3
10	2021	2.7731	2,519	38.6	2,557.1	2,989.6	995.1	1.6	246.2	4,232.5	1,675.4
11	2022	3.1058	19	39.4	58.5	3,273.9	1,059.5	1.6	246.2	4,581.3	4,522.7
12	2023	3.4785		40.3	40.3	3,585.3	1,128.1	1.7	246.2	4,961.3	4,921.0
13	2024	3.8960		83.3	83.3	3,926.2	1,201.1	1.8	246.2	5,375.4	5,292.1
14	2025	4.3635		83.3	83.3	3,926.2	1,201.1	1.8	246.2	5,826.6	5,743.3
15	2026	4.8871		41.1	41.1	3,926.2	1,201.1	1.8	246.2	5,375.4	5,334.3
16	2027	5.4736		41.1	41.1	3,926.2	1,201.1	1.8	246.2	5,375.4	5,334.3
17	2028	6.1304		41.1	41.1	3,926.2	1,201.1	1.8	246.2	5,375.4	5,334.3
18	2029	6.8660		256.7	256.7	3,926.2	1,201.1	1.8	246.2	5,375.4	5,118.7
19	2030	7.6900		167.0	167.0	3,926.2	1,201.1	1.8	246.2	5,375.4	5,208.4
20	2031	8.6128		41.1	41.1	3,926.2	1,201.1	1.8	246.2	5,375.4	5,334.3
21	2032	9.6463		41.1	41.1	3,926.2	1,201.1	1.8	246.2	5,375.4	5,334.3
22	2033	10.8038		41.1	41.1	3,926.2	1,201.1	1.8	246.2	5,375.4	5,334.3
23	2034	12.1003		83.3	83.3	3,926.2	1,201.1	1.8	246.2	5,375.4	5,292.1
24	2035	13.5523		83.3	83.3	3,926.2	1,201.1	1.8	246.2	5,375.4	5,292.1
25	2036	15.1786		41.1	41.1	3,926.2	1,201.1	1.8	246.2	5,375.4	5,334.3
26	2037	17.0001		41.1	41.1	3,926.2	1,201.1	1.8	246.2	5,375.4	5,334.3
27	2038	19.0401		41.1	41.1	3,926.2	1,201.1	1.8	246.2	5,375.4	5,334.3
28	2039	21.3249		973.7	973.7	3,926.2	1,201.1	1.8	246.2	5,375.4	4,401.6
29	2040	23.8839		188.0	188.0	3,926.2	1,201.1	1.8	246.2	5,375.4	5,187.4
30	2041	26.7499		41.1	41.1	3,926.2	1,201.1	1.8	246.2	5,375.4	5,334.3
31	2042	29.9599		41.1	41.1	3,926.2	1,201.1	1.8	246.2	5,375.4	5,334.3
32	2043	33.5551		41.1	41.1	3,926.2	1,201.1	1.8	246.2	5,375.4	5,334.3
33	2044	37.5817		83.3	83.3	3,926.2	1,201.1	1.8	246.2	5,375.4	5,292.1
Total			24,741.4	2,650.3	27,391.7	95,029.4	29,341.3	44.5	6,155.0	131,021.5	103,629.7

Discounted Benefit – Cost Stream

SQ	Year	Discounted Cost			Discounted Benefit					Net Benefit
		Construction Cost	O & M Cost	Cost Total	TTC	VOC	ACC	RRC	Benefit Total	
1	2012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	−0.0
2	2013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	−0.0
3	2014	383.4	0.0	383.4	0.0	0.0	0.0	0.0	0.0	−383.4
4	2015	57.9	0.0	57.9	0.0	0.0	0.0	0.0	0.0	−57.9
5	2016	2,678.6	0.0	2,678.6	0.0	0.0	0.0	0.0	0.0	−2,678.6
6	2017	2,443.0	0.0	2,443.0	0.0	0.0	0.0	0.0	0.0	−2,443.0
7	2018	2,210.9	0.0	2,210.9	0.0	0.0	0.0	0.0	0.0	−2,210.9
8	2019	2,003.7	0.0	2,003.7	0.0	0.0	0.0	0.0	0.0	−2,003.7
9	2020	1,747.9	14.9	1,762.8	1,102.6	377.5	0.6	99.4	1,580.1	−182.7
10	2021	908.2	13.9	922.1	1,078.1	358.8	0.6	88.8	1,526.3	604.1
11	2022	6.2	12.7	18.8	1,054.1	341.1	0.5	79.3	1,475.0	1,456.2
12	2023	0.0	11.6	11.6	1,030.7	324.3	0.5	70.8	1,426.3	1,414.7
13	2024	0.0	21.4	21.4	1,007.8	308.3	0.5	63.2	1,379.7	1,358.3
14	2025	0.0	19.1	19.1	985.4	293.1	0.4	56.4	1,335.3	1,316.2
15	2026	0.0	8.4	8.4	803.4	245.8	0.4	50.4	1,099.9	1,091.5
16	2027	0.0	7.5	7.5	717.3	219.4	0.3	45.0	982.1	974.6
17	2028	0.0	6.7	6.7	640.5	195.9	0.3	40.2	876.8	870.1
18	2029	0.0	37.4	37.4	571.8	174.9	0.3	35.9	782.9	745.5
19	2030	0.0	21.7	21.7	510.6	156.2	0.2	32.0	699.0	677.3
20	2031	0.0	4.8	4.8	455.9	139.5	0.2	28.6	624.1	619.3
21	2032	0.0	4.3	4.3	407.0	124.5	0.2	25.5	557.2	553.0
22	2033	0.0	3.8	3.8	363.4	111.2	0.2	22.8	497.5	493.7
23	2034	0.0	6.9	6.9	324.5	99.3	0.1	20.3	444.2	437.4
24	2035	0.0	6.1	6.1	289.7	88.6	0.1	18.2	396.6	390.5
25	2036	0.0	2.7	2.7	258.7	79.1	0.1	16.2	354.1	351.4
26	2037	0.0	2.4	2.4	231.0	70.7	0.1	14.5	316.2	313.8
27	2038	0.0	2.2	2.2	206.2	63.1	0.1	12.9	282.3	280.2
28	2039	0.0	45.7	45.7	184.1	56.3	0.1	11.5	252.1	206.4
29	2040	0.0	7.9	7.9	164.4	50.3	0.1	10.3	225.1	217.2
30	2041	0.0	1.5	1.5	146.8	44.9	0.1	9.2	200.9	199.4
31	2042	0.0	1.4	1.4	131.0	40.1	0.1	8.2	179.4	178.0
32	2043	0.0	1.2	1.2	117.0	35.8	0.1	7.3	160.2	159.0
33	2044	0.0	2.2	2.2	104.5	32.0	0.0	6.6	143.0	140.8
Total		12,439.8	268.3	12,708.1	12,886.2	4,030.7	6.2	873.5	17,796.6	5,088.5

	Evaluation Indicators
IRR	16.5%
CBR	1.40
NPV	5,088.5

A.16.2 Financial Analysis

The project revenue can be calculated based on the following input:

Table A.16.2.1 Input Data for Financial Analysis

No.	Item	Abbrevia-tion	Unit	Input /Output	Formula	Notes
1	Daily traffic volume	TV_D	Vehicle/day	○	Input data	Traffic demand forecasting
2	Toll Rate	TR	BDT/vehicle	○	Input data	Traffic count survey
3	Toll Revenue	TR	BDT		$TR = TV_D \times TR$	
4	Discount rate	DR_F	%	○	8%	
5	Financial cost	FC	BDT	○		
6	O & M cost	OMC	BDT	○	Financial O/M cost consists of routine maintenance, periodic maintenance, toll operation and other operation costs	
7	Annualized factor	AF	Days/year	○	340 days/year	

(1) Calculation of Toll Revenue

The toll revenue can be calculated as follows:

$$TR = TV_D \times TR$$

Where: TV_D : Daily traffic volume in terms of vehicle

TR: Toll rate per vehicle

(2) Financial Construction Cost and OM Cost

- **Escalation factor:** Price inflation is not taken into account for either construction costs or operation/maintenance cost.
- **Tax and import duty:** Those taxes are included.
- Resettlement cost: Resettlement cost estimated in the Resettlement Action Plan (RAP) is used in the economic and financial analysis.
- **Operation and maintenance cost** consists of three: routine maintenance, periodic maintenance and toll levying cost.
- **Implementation schedule** is adopted for same as Table 16.1.1 in main report.

Table A.16.2.2 Financial Project Cost Stream by Bridges

Unit: Million BDT

Unit:BDT	Total			2,012			2,013			2,014			2,015			2,016			2,017			2,018			2,019			2,020			2,021			2,022			2,023			Total		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
Economic Cost	36,474	16,714	53,187	0	0	0	0	0	0	746	241	986	100	67	167	5,940	2,705	8,645	6,021	2,810	8,831	6,102	2,848	8,951	6,183	2,903	9,085	6,097	2,779	8,876	3,561	1,605	5,166	35	4	39	1,692	750	2,441	36,476	16,712	53,188
Financial Cost	36,474	38,367	74,840	0	0	0	0	0	0	746	541	1,286	100	124	224	5,940	6,258	12,198	6,021	6,430	12,451	6,102	6,507	12,610	6,183	6,607	12,790	6,097	6,405	12,502	3,561	3,715	7,275	35	19	53	1,692	1,760	3,452	36,476	38,366	74,842

Notes: All costs are 2012 prices

Table A.16.2.3 Financial Operation and Management Cost by Bridges

Unit: Million BDT

		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total
Kanchpur Bridge	Routine Maintenance Cost	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19		79.64
	Periodic Maintenance Cost	0.00	0.00	0.00	0.00	16.05	16.05	0.00	0.00	0.00	89.62	72.71	0.00	0.00	0.00	16.05	16.05	0.00	0.00	0.00	568.68	121.81	0.00	0.00	0.00	16.05		933.06
	Toll operation cost	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
	Other Cost	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77		419.35
	O/M	19.96	19.96	19.96	19.96	36.01	36.01	19.96	19.96	19.96	109.58	92.67	19.96	19.96	19.96	36.01	36.01	19.96	19.96	19.96	588.64	141.77	19.96	19.96	19.96	36.01	0.00	1,432.04
Meghna Bridge	Routine Maintenance Cost	0.00	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	185.44
	Periodic Maintenance Cost	0.00	0.00	0.00	0.00	0.00	37.65	37.65	0.00	0.00	0.00	192.36	112.34	0.00	0.00	0.00	37.65	37.65	0.00	0.00	0.00	852.55	133.32	0.00	0.00	0.00	37.65	1,478.79
	Toll operation cost	0.00	26.45	28.75	29.90	31.05	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	792.35
	Other Cost	0.00	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77	419.35
	O/M	0.00	50.64	52.94	54.09	55.24	94.04	94.04	56.39	56.39	56.39	248.75	168.73	56.39	56.39	56.39	94.04	94.04	56.39	56.39	56.39	908.94	189.71	56.39	56.39	56.39	94.04	2,875.93
Gumti Bridge	Routine Maintenance Cost	0.00	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	281.18
	Periodic Maintenance Cost	0.00	0.00	0.00	0.00	0.00	57.08	57.08	0.00	0.00	0.00	291.70	170.32	0.00	0.00	0.00	57.08	57.08	0.00	0.00	0.00	1,258.02	197.98	0.00	0.00	0.00	57.08	2,203.40
	Toll operation cost	0.00	26.45	28.75	29.90	31.05	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	32.20	792.35
	Other Cost	0.00	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	12.17	304.35
	O/M	0.00	49.87	52.17	53.32	54.47	112.70	112.70	55.62	55.62	55.62	347.32	225.94	55.62	55.62	55.62	112.70	112.70	55.62	55.62	55.62	1,313.64	253.60	55.62	55.62	55.62	112.70	3,581.28
All Bridge	Routine Maintenance Cost	3.19	21.85	21.85	21.85	21.85	21.85	21.85	21.85	21.85	21.85	21.85	21.85	21.85	21.85	21.85	21.85	21.85	21.85	21.85	21.85	21.85	21.85	21.85	21.85	21.85	18.66	546.25
	Periodic Maintenance Cost	0.00	0.00	0.00	0.00	16.05	110.77	94.72	0.00	0.00	89.62	556.76	282.66	0.00	0.00	16.05	110.77	94.72	0.00	0.00	568.68	2,232.37	331.30	0.00	0.00	16.05	94.72	4,615.26
	Toll operation cost	26.45	79.35	86.25	89.70	93.15	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60	64.40	2,371.30
	Other Cost	16.77	45.72	45.72	45.72	45.72	45.72	45.72	45.72	45.72	45.72	45.72	45.72	45.72	45.72	45.72	45.72	45.72	45.72	45.72	45.72	45.72	45.72	45.72	45.72	45.72	28.95	1,143.04
	O/M	46.41	146.92	153.82	157.27	176.77	274.95	258.89	164.17	164.17	253.79	720.93	446.83	164.17	164.17	180.22	274.95	258.89	164.17	164.17	732.85	2,396.55	495.47	164.17	164.17	180.22	206.74	8,675.85

Notes: All costs are 2012 prices

Excel File A.16.2.1 Calculation of Toll Revenue

Projected Traffic on Meghna/Gumti

Vehicle Category		1 Heavy Truck	2 Medium Truck	3 Small Truck	4 Large Bus	5 Mini bus	6 Microbus	7 Utility	8 Car /Taxi	9 Baby-taxi /Tempo	10 Motor Cycle	Total
Toll Rate		1,000.00	400.00	400.00	400.00	150.00	70.00	50.00	50.00	20.00	10.00	
Growth Rate		1.0700	1.0700	1.0700	1.0327	1.0327	1.0327	1.0819	1.0819	1.0791	1.1087	
1	2012	3,320	4,919	1,788	4,117	1,976	2,914	2,727	2,923	2,497	259	27,438
2	2013	3,527	5,225	1,900	4,213	2,022	2,982	2,930	3,141	2,676	285	28,902
3	2014	3,751	5,557	2,020	4,317	2,072	3,055	3,153	3,379	2,871	315	30,491
4	2015	3,997	5,922	2,153	4,432	2,127	3,137	3,399	3,644	3,087	348	32,248
5	2016	4,193	6,212	2,258	4,479	2,150	3,170	3,608	3,867	3,268	379	33,584
6	2017	4,554	6,746	2,453	4,695	2,254	3,323	3,962	4,247	3,579	427	36,239
7	2018	4,958	7,344	2,670	4,933	2,368	3,492	4,361	4,675	3,930	481	39,211
8	2019	5,403	8,004	2,910	5,189	2,491	3,673	4,806	5,152	4,319	544	42,492
9	2020	5,896	8,734	3,175	5,465	2,623	3,868	5,303	5,684	4,754	614	46,117
10	2021	6,276	9,298	3,380	5,615	2,695	3,974	5,709	6,119	5,104	678	48,849
11	2022	6,663	9,871	3,589	5,764	2,766	4,079	6,125	6,565	5,463	744	51,631
12	2023	7,082	10,491	3,814	5,922	2,843	4,192	6,579	7,052	5,853	818	54,646
13	2024	7,526	11,150	4,054	6,085	2,921	4,307	7,067	7,575	6,271	900	57,855
14	2025	7,999	11,850	4,308	6,253	3,001	4,425	7,590	8,136	6,719	989	61,271
15	2026	8,501	12,594	4,579	6,425	3,084	4,547	8,153	8,739	7,199	1,088	64,908
16	2027	9,012	13,351	4,854	6,595	3,165	4,668	8,730	9,358	7,691	1,191	68,615
17	2028	9,563	14,167	5,151	6,777	3,253	4,797	9,358	10,031	8,224	1,305	72,627
18	2029	10,148	15,034	5,466	6,965	3,343	4,929	10,032	10,753	8,795	1,430	76,895
19	2030	10,769	15,954	5,800	7,157	3,435	5,065	10,753	11,526	9,406	1,568	81,435
20	2031	11,428	16,930	6,155	7,355	3,530	5,205	11,527	12,356	10,059	1,718	86,264
21	2032	12,099	17,924	6,517	7,552	3,625	5,345	12,322	13,207	10,728	1,876	91,194
22	2033	12,810	18,977	6,899	7,755	3,722	5,489	13,172	14,119	11,442	2,048	96,433
23	2034	13,565	20,095	7,306	7,964	3,823	5,637	14,082	15,095	12,206	2,237	102,009
24	2035	14,366	21,282	7,738	8,181	3,926	5,790	15,058	16,141	13,023	2,443	107,948
25	2036	15,217	22,543	8,196	8,404	4,034	5,948	16,105	17,262	13,896	2,668	114,274
26	2037	16,177	23,823	8,413	8,627	4,302	6,344	17,139	18,786	14,680	2,684	120,974
27	2038	17,200	25,179	8,637	8,856	4,589	6,767	18,242	20,446	15,511	2,700	128,128
28	2039	18,277	26,744	9,154	9,109	4,733	6,980	19,569	21,970	16,594	2,945	136,075
29	2040	19,424	28,410	9,703	9,371	4,883	7,201	20,995	23,610	17,755	3,212	144,563
30	2041	20,646	30,184	10,287	9,641	5,038	7,430	22,528	25,376	18,999	3,504	153,632
31	2042	21,947	32,073	10,907	9,921	5,199	7,667	24,177	27,278	20,333	3,822	163,324
32	2043	23,334	34,085	11,566	10,210	5,366	7,913	25,949	29,326	21,764	4,171	173,685
33	2044	24,812	36,228	12,267	10,509	5,539	8,168	27,856	31,533	23,299	4,552	184,762

Projected Revenue on Meghna/Gumti Bridge

Vehicle Category		1 Heavy Truck	2 Medium Truck	3 Small Truck	4 Large Bus	5 Mini bus	6 Microbus	7 Utility	8 Car /Taxi	9 Baby-taxi /Tempo	10 Motor Cycle	Total
Toll Rate		1,000	400	400	400	150	70	50	50	20	10	
Growth rate		1.0700	1.0700	1.0700	1.0327	1.0327	1.0327	1.0819	1.0819	1.0791	1.10418	
1	2012	564	334	122	280	50	35	23	25	8	0	1,441
2	2013	600	355	129	287	52	35	25	27	9	0	1,519
3	2014	638	378	137	294	53	36	27	29	10	1	1,603
4	2015	680	403	146	301	54	37	29	31	10	1	1,692
5	2016	713	422	154	305	55	38	31	33	11	1	1,763
6	2017	774	459	167	319	57	40	34	36	12	1	1,899
7	2018	843	499	182	335	60	42	37	40	13	1	2,052
8	2019	919	544	198	353	64	44	41	44	15	1	2,223
9	2020	1,002	594	216	372	67	46	45	48	16	1	2,407
10	2021	1,067	632	230	382	69	47	49	52	17	1	2,546
11	2022	1,133	671	244	392	71	49	52	56	19	1	2,688
12	2023	1,204	713	259	403	72	50	56	60	20	1	2,838
13	2024	1,280	758	276	414	74	51	60	64	21	2	3,000
14	2025	1,360	806	293	425	77	53	65	69	23	2	3,173
15	2026	1,360	806	293	425	77	53	65	69	23	2	3,173
16	2027	1,360	806	293	425	77	53	65	69	23	2	3,173
17	2028	1,360	806	293	425	77	53	65	69	23	2	3,173
18	2029	1,360	806	293	425	77	53	65	69	23	2	3,173
19	2030	1,360	806	293	425	77	53	65	69	23	2	3,173
20	2031	1,360	806	293	425	77	53	65	69	23	2	3,173
21	2032	1,360	806	293	425	77	53	65	69	23	2	3,173
22	2033	1,360	806	293	425	77	53	65	69	23	2	3,173
23	2034	1,360	806	293	425	77	53	65	69	23	2	3,173
24	2035	1,360	806	293	425	77	53	65	69	23	2	3,173
25	2036	1,360	806	293	425	77	53	65	69	23	2	3,173
26	2037	1,360	806	293	425	77	53	65	69	23	2	3,173
27	2038	1,360	806	293	425	77	53	65	69	23	2	3,173
28	2,039	1,360	806	293	425	77	53	65	69	23	2	3,173
29	2,040	1,360	806	293	425	77	53	65	69	23	2	3,173
30	2,041	1,360	806	293	425	77	53	65	69	23	2	3,173
31	2,042	1,360	806	293	425	77	53	65	69	23	2	3,173
32	2,043	1,360	806	293	425	77	53	65	69	23	2	3,173
33	2,044	1,360	806	293	425	77	53	65	69	23	2	3,173

Excel File A.16.2.2 Cash Flow of Cost and Toll Revenue

Cash Flow of Cost and Toll Revenue of Meghna Bridge

Meghna Bridge	Discunt Rate	Project Cost
Road Plan to be	8.0%	26,489.3

SQ	Year	Discount Rate	Cost			Toll Revenue	Net Revenue	Cummulative Net Revenue
			Construction	O & M Cost	Total			
1	2012	1.000	0		0.0		−0.0	−0.0
2	2013	1.080	0		0.0		−0.0	−0.0
3	2014	1.166	477		477.3		−477.3	−477.3
4	2015	1.260	83		83.1		−83.1	−560.4
5	2016	1.360	4,526		4,526.1		−4,526.1	−5,086.4
6	2017	1.469	4,620		4,620.0		−4,620.0	−9,706.5
7	2018	1.587	4,679		4,678.8		−4,678.8	−14,385.3
8	2019	1.714	4,746	0.0	4,745.9	0.0	−4,745.9	−19,131.1
9	2020	1.851	4,639	50.6	4,689.5	2,408.1	−2,281.4	−21,412.5
10	2021	1.999	2,699	52.9	2,752.4	2,546.0	−206.5	−21,619.0
11	2022	2.159	20	54.1	73.9	2,685.7	2,611.8	−19,007.1
12	2023	2.332	1,281	55.2	1,336.1	2,836.1	1,500.0	−17,507.2
13	2024	2.518		94.0	94.0	2,995.4	2,901.4	−14,605.8
14	2025	2.720		94.0	94.0	2,995.4	2,901.4	−11,704.4
15	2026	2.937		56.4	56.4	2,995.4	2,939.0	−8,765.4
16	2027	3.172		56.4	56.4	2,995.4	2,939.0	−5,826.3
17	2028	3.426		56.4	56.4	2,995.4	2,939.0	−2,887.3
18	2029	3.700		248.7	248.7	2,995.4	2,746.7	−140.6
19	2030	3.996		168.7	168.7	2,995.4	2,826.7	2,686.1
20	2031	4.316		56.4	56.4	2,995.4	2,939.0	5,625.1
21	2032	4.661		56.4	56.4	2,995.4	2,939.0	8,564.1
22	2033	5.034		56.4	56.4	2,995.4	2,939.0	11,503.1
23	2034	5.437		94.0	94.0	2,995.4	2,901.4	14,404.5
24	2035	5.871		94.0	94.0	2,995.4	2,901.4	17,305.9
25	2036	6.341		56.4	56.4	2,995.4	2,939.0	20,244.9
26	2037	6.848		56.4	56.4	2,995.4	2,939.0	23,184.0
27	2038	7.396		56.4	56.4	2,995.4	2,939.0	26,123.0
28	2039	7.988		908.9	908.9	2,995.4	2,086.5	28,209.5
29	2040	8.627		189.7	189.7	2,995.4	2,805.7	31,015.2
30	2041	9.317		56.4	56.4	2,995.4	2,939.0	33,954.2
31	2042	10.063		56.4	56.4	2,995.4	2,939.0	36,893.3
32	2043	10.868		56.4	56.4	2,995.4	2,939.0	39,832.3
33	2044	11.737		94.0	94.0	2,995.4	2,939.0	42,771.3
	Total		27,770.1	2,875.9	30,646.1	73,379.7	42,771.3	

SQ	Yaer	Cost			Toll Revenue	Net Revenue	Cummulative Net Revenue
		Construction	O & M	Total			
1	2012	0.00		0.0		−0.0	−0.0
2	2013	0		0.0		−0.0	−0.0
3	2014	409		409.2		−409.2	−409.2
4	2015	66		66.0		−66.0	−475.1
5	2016	3,327		3,326.8		−3,326.8	−3,801.9
6	2017	3,144		3,144.3		−3,144.3	−6,946.3
7	2018	2,948		2,948.5		−2,948.5	−9,894.7
8	2019	2,769	0.0	2769.2	0.00	−2,769.2	−12,663.9
9	2020	2,506	27.4	2533.6	1301.02	−1,232.5	−13,896.4
10	2021	1,350	26.5	1376.9	1273.61	−103.3	−13,999.7
11	2022	9	25.1	34.2	1244.02	1,209.8	−12,789.9
12	2023		23.7	23.7	1216.34	1,192.7	−11,597.3
13	2024		37.3	37.3	1189.52	1,152.2	−10,445.1
14	2025		34.6	34.6	1101.41	1,066.8	−9,378.3
15	2026		19.2	19.2	1019.82	1,000.6	−8,377.6
16	2027		17.8	17.8	944.28	926.5	−7,451.1
17	2028		16.5	16.5	874.34	857.9	−6,593.2
18	2029		67.2	67.2	809.57	742.3	−5,850.9
19	2030		42.2	42.2	749.60	707.4	−5,143.5
20	2031		13.1	13.1	694.08	681.0	−4,462.5
21	2032		12.1	12.1	642.66	630.6	−3,832.0
22	2033		11.2	11.2	595.06	583.9	−3,248.1
23	2034		17.3	17.3	550.98	533.7	−2,714.4
24	2035		16.0	16.0	510.17	494.2	−2,220.3
25	2036		8.9	8.9	472.38	463.5	−1,756.8
26	2037		8.2	8.2	437.39	429.2	−1,327.6
27	2038		7.6	7.6	404.99	397.4	−930.3
28	2039		113.8	113.8	374.99	261.2	−669.1
29	2040		22.0	22.0	347.21	325.2	−343.9
30	2041		6.1	6.1	321.49	315.4	−28.4
31	2042		5.6	5.6	297.68	292.1	263.7
32	2043		5.2	5.2	275.63	270.4	534.1
33	2044		8.0	8.0	255.21	247.2	781.3
Total		16,529.7	592.5	17,122.1	17,903.4	781.3	

	Value
NPV (Million BDT)	781.3
FIRR (%)	8.1%

Excel File A.16.2.2 Cash Flow of Cost and Toll Revenue

Cash Flow of Cost and Toll Revenue of Gumti Bridge

Gumti Bridge	Discunt Rate	Project Cost
Road Plan to be Implemented	8.0%	36,489

SQ	Year	Discount Rate	Cost			Toll Revenue	Net Revenue	Cummulative Net Revenue
			Construction	O & M Cost	Total			
1	2012	1.000	0	0	0.0		-0.0	-0.0
2	2013	1.080	0	0	0.0		-0.0	-0.0
3	2014	1.166	627	0	627.1		-627.1	-627.1
4	2015	1.260	109	0	109.2		-109.2	-736.3
5	2016	1.360	5,947	0	5,947.1		-5,947.1	-6,683.4
6	2017	1.469	6,071	0	6,070.5		-6,070.5	-12,753.9
7	2018	1.587	6,148	0	6,147.8		-6,147.8	-18,901.8
8	2019	1.714	6,236	0.0	6,235.9	0.0	-6,235.9	-25,137.6
9	2020	1.851	6,095	49.9	6,145.1	2,408.1	-3,737.0	-28,874.6
10	2021	1.999	3,547	52.2	3,599.2	2,546.0	-1,053.3	-29,927.9
11	2022	2.159	26	53.3	79.3	2,685.7	2,606.4	-27,321.5
12	2023	2.332	1,683	54.5	1,737.5	2,836.1	1,098.6	-26,222.9
13	2024	2.518		112.7	112.7	2,995.4	2,882.7	-23,340.2
14	2025	2.720		112.7	112.7	2,995.4	2,882.7	-20,457.5
15	2026	2.937		55.6	55.6	2,995.4	2,939.8	-17,517.7
16	2027	3.172		55.6	55.6	2,995.4	2,939.8	-14,577.9
17	2028	3.426		55.6	55.6	2,995.4	2,939.8	-11,638.1
18	2029	3.700		347.3	347.3	2,995.4	2,648.1	-8,990.0
19	2030	3.996		225.9	225.9	2,995.4	2,769.5	-6,220.5
20	2031	4.316		55.6	55.6	2,995.4	2,939.8	-3,280.7
21	2032	4.661		55.6	55.6	2,995.4	2,939.8	-340.9
22	2033	5.034		55.6	55.6	2,995.4	2,939.8	2,598.9
23	2034	5.437		112.7	112.7	2,995.4	2,882.7	5,481.7
24	2035	5.871		112.7	112.7	2,995.4	2,882.7	8,364.4
25	2036	6.341		55.6	55.6	2,995.4	2,939.8	11,304.2
26	2037	6.848		55.6	55.6	2,995.4	2,939.8	14,244.0
27	2038	7.396		55.6	55.6	2,995.4	2,939.8	17,183.8
28	2039	7.988		1,313.6	1,313.6	2,995.4	1,681.8	18,865.6
29	2040	8.627		253.6	253.6	2,995.4	2,741.8	21,607.4
30	2041	9.317		55.6	55.6	2,995.4	2,939.8	24,547.2
31	2042	10.063		55.6	55.6	2,995.4	2,939.8	27,487.0
32	2043	10.868		55.6	55.6	2,995.4	2,939.8	30,426.8
33	2044	11.737		112.7	112.7	2,995.4	2,882.7	33,309.5
Total			36,489.0	3,581.3	40,070.2	73,379.7	33,309.5	
				3581.27717				

3%

SQ	Yaer	Cost			Toll Revenue	Net Revenue	Cummulative Net Revenue
		Construction	O & M	Total			
1	2012	0.0	0.0	0.0		-0.0	-0.0
2	2013	0.0	0.0	0.0		-0.0	-0.0
3	2014	537.6	0.0	537.6		-537.6	-537.6
4	2015	86.7	0.0	86.7		-86.7	-624.3
5	2016	4,371.3	0.0	4,371.3		-4,371.3	-4,995.6
6	2017	4,131.5	0.0	4,131.5		-4,131.5	-9,127.1
7	2018	3,874.2	0.0	3,874.2		-3,874.2	-13,001.3
8	2019	3,638.6	0.0	3,638.6	0.00	-3,638.6	-16,639.9
9	2020	3,293.1	26.9	3,320.0	1301.02	-2,019.0	-18,658.9
10	2021	1,774.4	26.1	1,800.5	1273.61	-526.9	-19,185.7
11	2022	12.1	24.7	36.8	1244.02	1,207.3	-17,978.5
12	2023	721.8	23.4	745.2	1216.34	471.2	-17,507.3
13	2024		44.8	44.8	1189.52	1,144.8	-16,362.5
14	2025		41.4	41.4	1101.41	1,060.0	-15,302.6
15	2026		18.9	18.9	1019.82	1,000.9	-14,301.7
16	2027		17.5	17.5	944.28	926.7	-13,374.9
17	2028		16.2	16.2	874.34	858.1	-12,516.8
18	2029		93.9	93.9	809.57	715.7	-11,801.1
19	2030		56.5	56.5	749.60	693.1	-11,108.1
20	2031		12.9	12.9	694.08	681.2	-10,426.9
21	2032		11.9	11.9	642.66	630.7	-9,796.2
22	2033		11.0	11.0	595.06	584.0	-9,212.2
23	2034		20.7	20.7	550.98	530.2	-8,681.9
24	2035		19.2	19.2	510.17	491.0	-8,190.9
25	2036		8.8	8.8	472.38	463.6	-7,727.3
26	2037		8.1	8.1	437.39	429.3	-7,298.1
27	2038		7.5	7.5	404.99	397.5	-6,900.6
28	2039		164.5	164.5	374.99	210.5	-6,690.1
29	2040		29.4	29.4	347.21	317.8	-6,372.2
30	2041		6.0	6.0	321.49	315.5	-6,056.7
31	2042		5.5	5.5	297.68	292.1	-5,764.6
32	2043		5.1	5.1	275.63	270.5	-5,494.1
33	2044		9.6	9.6	255.21	245.6	-5,248.5
Total		22,441.2	710.7	23,151.9	17,903.4	-5,248.5	

	Value
NPV (Million BDT)	-5,248.5
FIRR (%)	5.4%

APPENDIX 17.

EIA REPORT

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
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

SEPTEMBER 2012

ORIENTAL CONSULTANTS CO., LTD.
KATAHIRA & ENGINEERS INTERNATIONAL

ORICONSUL

Oriental Consultants Co., Ltd.

CONSULTING ENGINEERS

Date : September 20, 2012
Ref. No. OCDAC-RHD010

Attn:
Mr. Md. Saidul Hoque
Additional Chief Engineer
Bridge Management Wing
Roads and Highways Department
Sarak Bhaban, Ramna
Dhaka-1000

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

Subject: Submission of draft final report on EIA

Dear Mr. Hoque,
We are pleased to submit herewith the Draft Final Report (5 hard copies) on Environmental Impact Assessment (EIA) prepared for the "Preparatory Survey for Dhaka-Chittagong National Highway No.1 Bridge Construction and Rehabilitation Project".

The report contents the executive summary of study, the main report consisting of 9 chapters and the annexes. The EIA is prepared on the basis of proposed engineering works, highlighting the potential environmental impacts, necessary mitigation measures and environmental management plan for each of the identified impacts. And also be informed that the draft final of EIA report is fully revised considering with valuable comments and quarries received from 'JICA advisory committee' and Roads and Highways Department. Therefore, we would like to request you please proceed an approval process at DOE with this draft final report.

We wish to express grateful acknowledgement to the personnel of Roads and Highways Department (RHD) and also to officials of the Ministry of Communications, Government of Bangladesh for their assistance extended to the Study Team.

Yours faithfully,

Dr. Masaaki Tatsumi
Project Team Leader,
Oriental Consultants Co., Ltd.,
Tokyo, Japan.

SUMITOMO FUDOSAN NISHI SHINJUKU BLDG.NO:6 8F
12-1 HONMACHI 3-CHOME SHIBUYA-KU, TOKYO, 151-0071, JAPAN
Tel: +81-3-6311-7570 Fax: +81-3-6311-8020

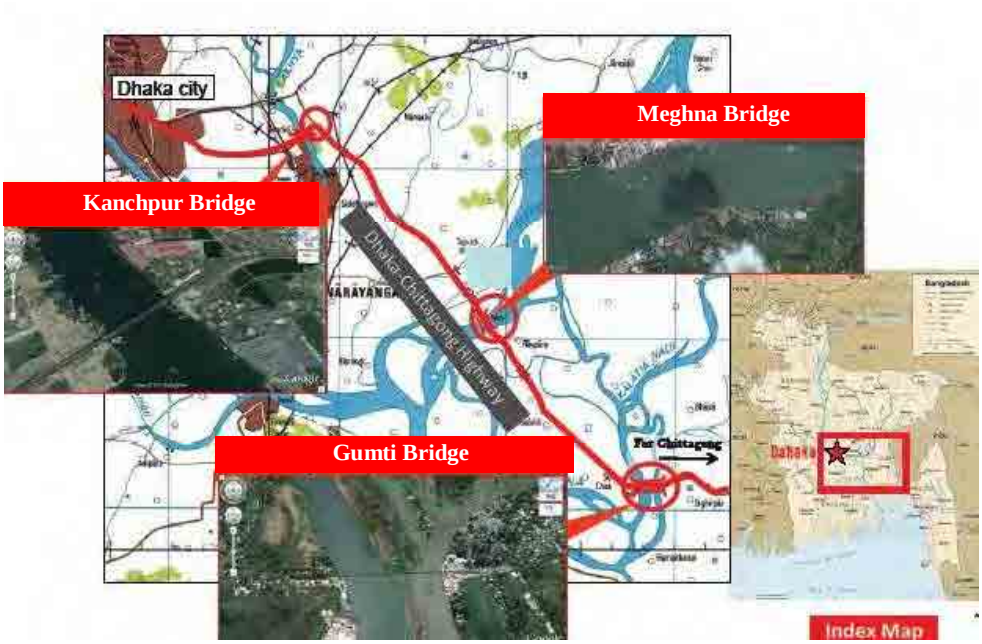
Executive Summary

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:

	Kanchpur	Meghna	Gumti
Start of construction /rehabilitation	October 2016	October 2016	October 2016
End of construction	September 2019	February 2020	August 2020
End of rehabilitation	August 2020	January 2021	September 2021

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 Kanchpur 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	Moderate: Social	• Proper resettlement action Plan (RAP)

such as social infrastructures and decision-making institutions	institutions are affected by relocation and noise	• 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	• Good maintenance and operation of equipment and vehicles • Use environmentally-friendly material

	during construction	• 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 driving, 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 construction work 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. • Refuelling 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 sub-ground • 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 dumped 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	Before Construction	Compensation for impact	-	ditto	-	-

decision-making institutions	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) Landscape	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	-	Included in RAP cost	-	-

		poor people in order to ensure that groundwater is available for them..				
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, Fe, and As	Set	33	10,000	330,000
	During Operation	Measurement of pH, EC, Turbidity, DO, Coliform,	Set	6	10,000	60,000

		BOD, NH4-N, Oil, Grease, fecal coliform, Fe, and As				
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 program 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.

TABLE OF CONTENTS

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

ANNEXES

LIST OF TABLE

LIST OF FIGURE

LIST OF PICTURE

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

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.

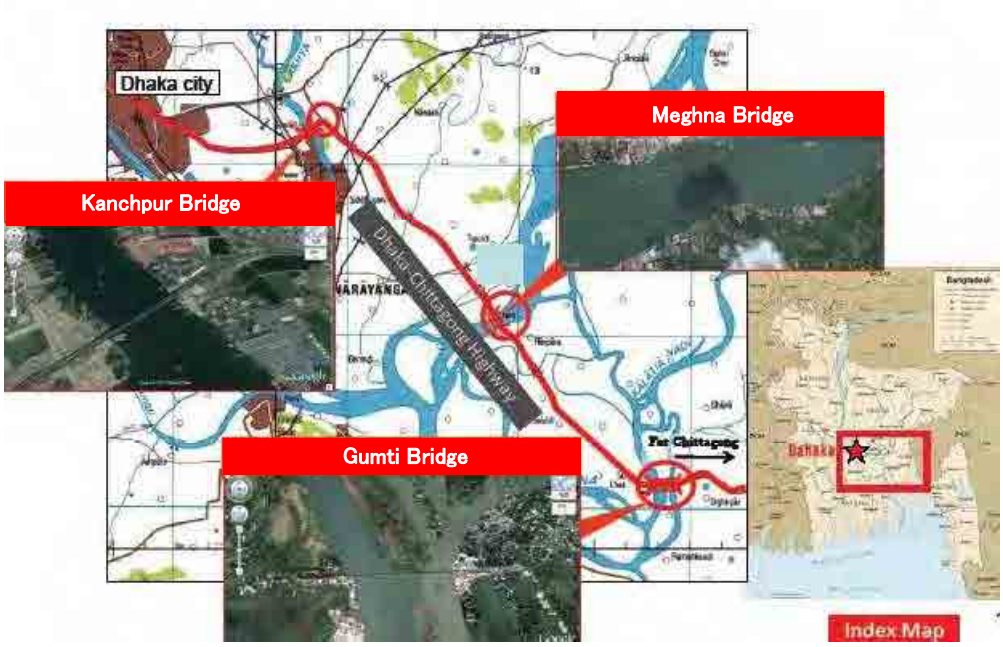


Figure2.1 Locations of the three Bridges

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

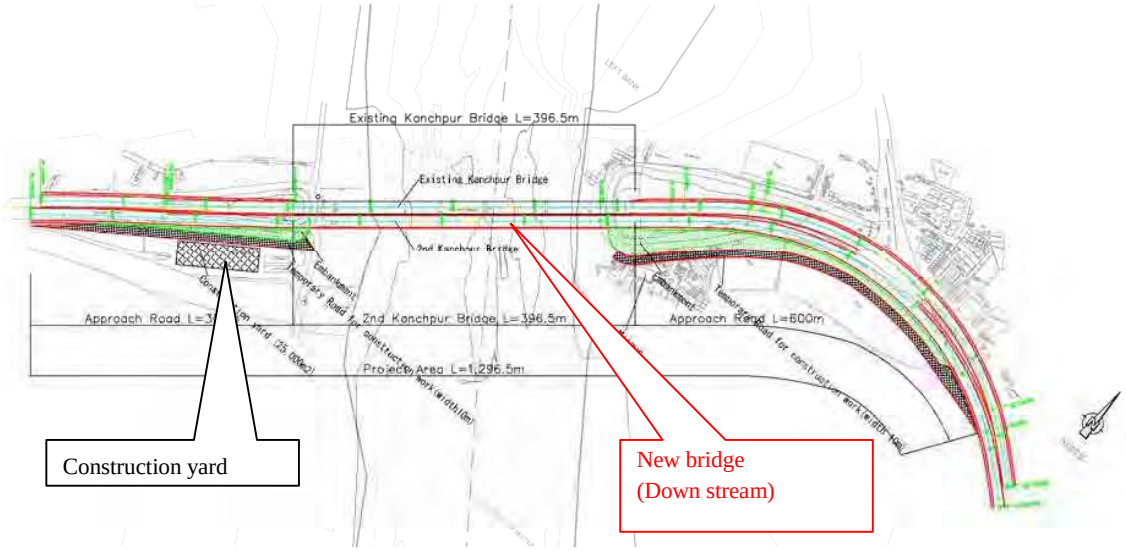


Figure 2.2 Locations of New and Existing Kanchpur Bridge with Construction Yards

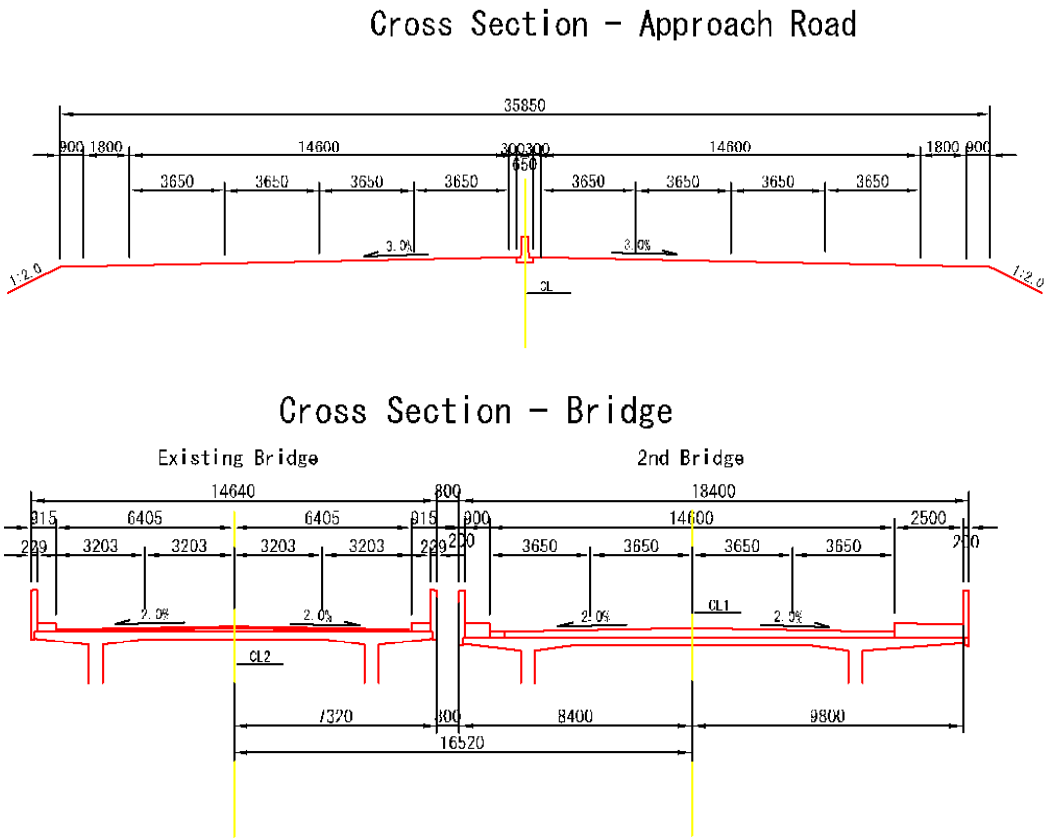


Figure 2.3 Typical Cross Sections of New and Existing Kanchpur Bridge

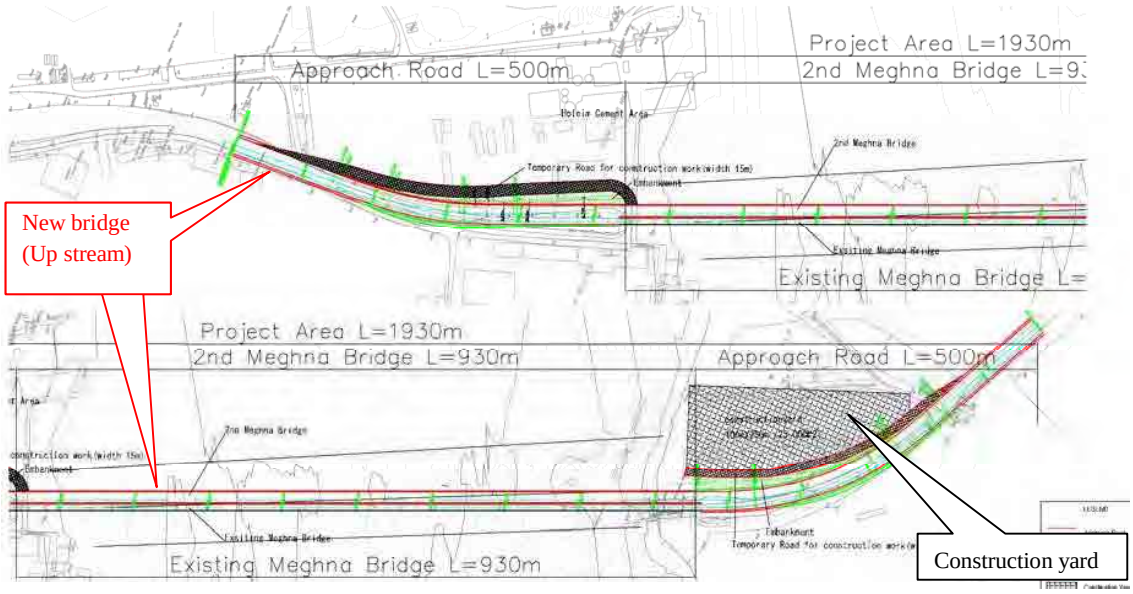


Figure 2.4 Locations of New and Existing Meghna Bridge with Construction Yards

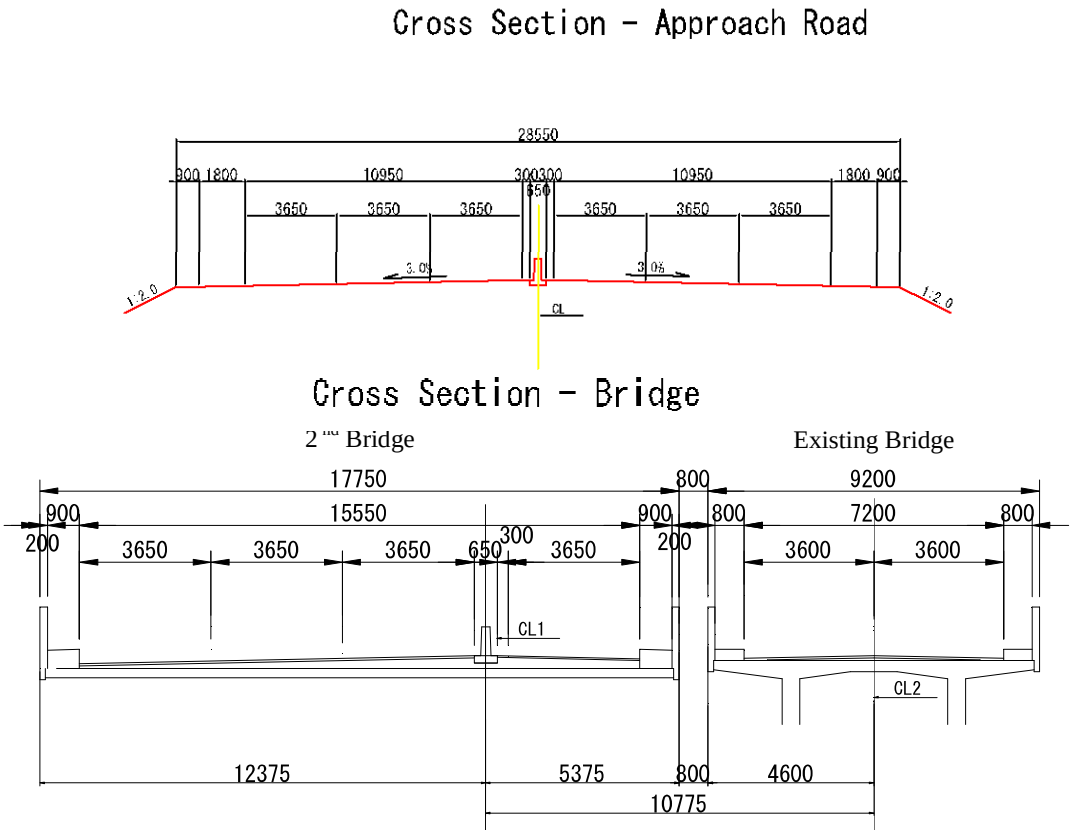


Figure 2.5 Typical Cross Section of New and Existing Meghna Bridge

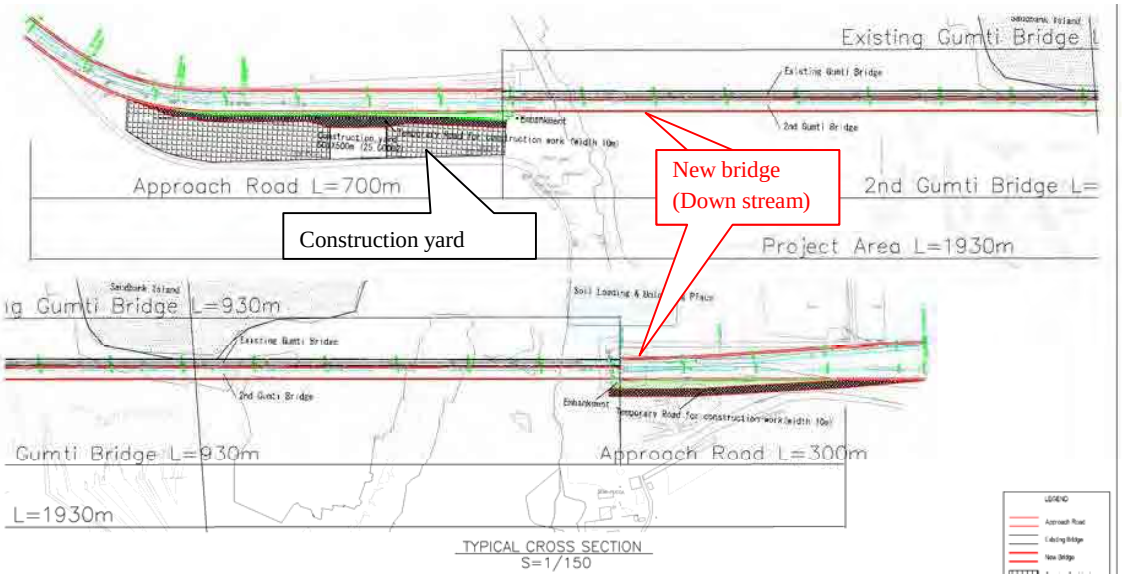


Figure 2.6 Locations of New and Existing Gumti Bridge with Construction Yards

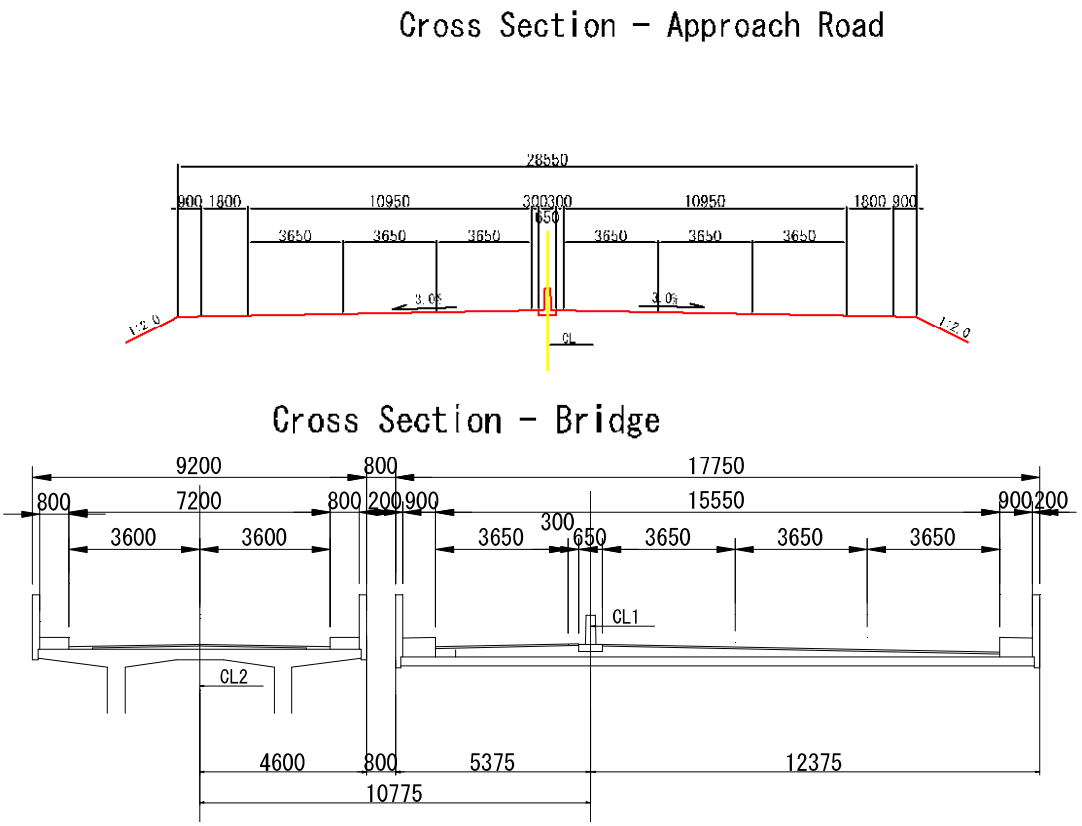


Figure 2.7 Typical Section s of New and Existing Gumti Bridge

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	Gumti Bridge
Start of construction / rehabilitation	October 2016	October 2016	October 2016
End of construction	September 2019	February 2020	August 2020
End of rehabilitation	August 2020	January 2021	September 2021

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 Labour.

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 Moderate annoyance, daytime and evening	55 50	16 16	- -
Dwelling, indoors Inside bedrooms	Speech intelligibility and moderate annoyance, daytime and evening Sleep disturbance, night-time	35 30	16 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 Sleep disturbance, daytime and evenings	30 30	8 16	40 -
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) Hearing impairment (children)	- -	- -	140 # 2 140 # 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.

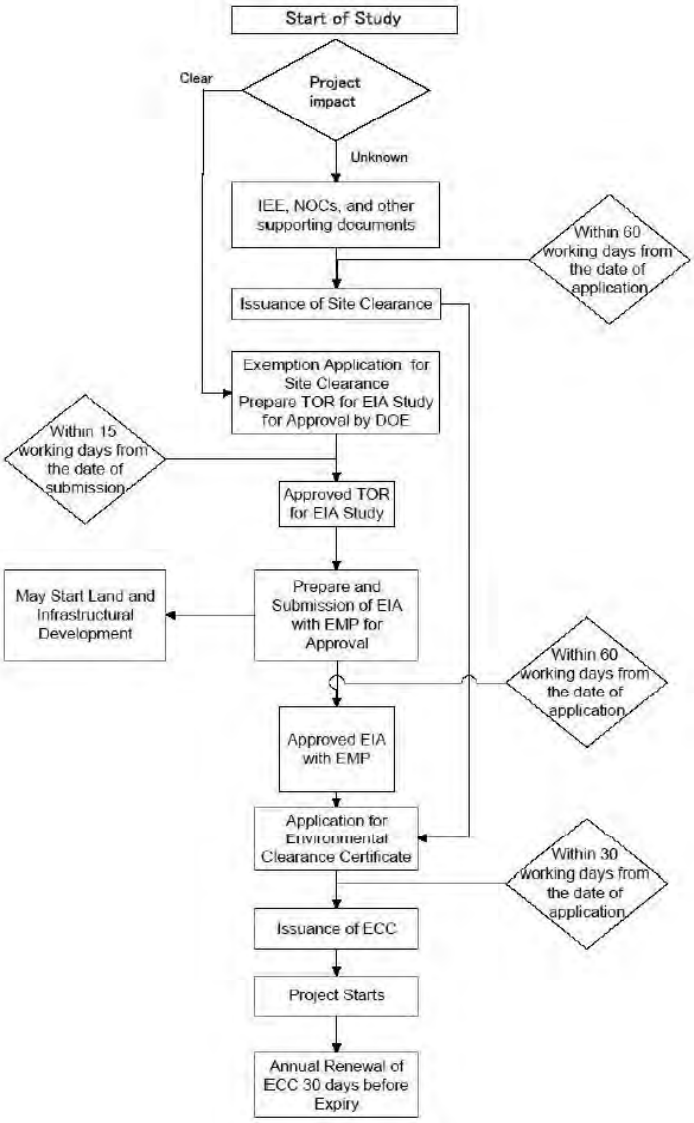


Figure 3.1 Steps to be followed for Environmental Clearance Certificate for Red Category Project[1]

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).

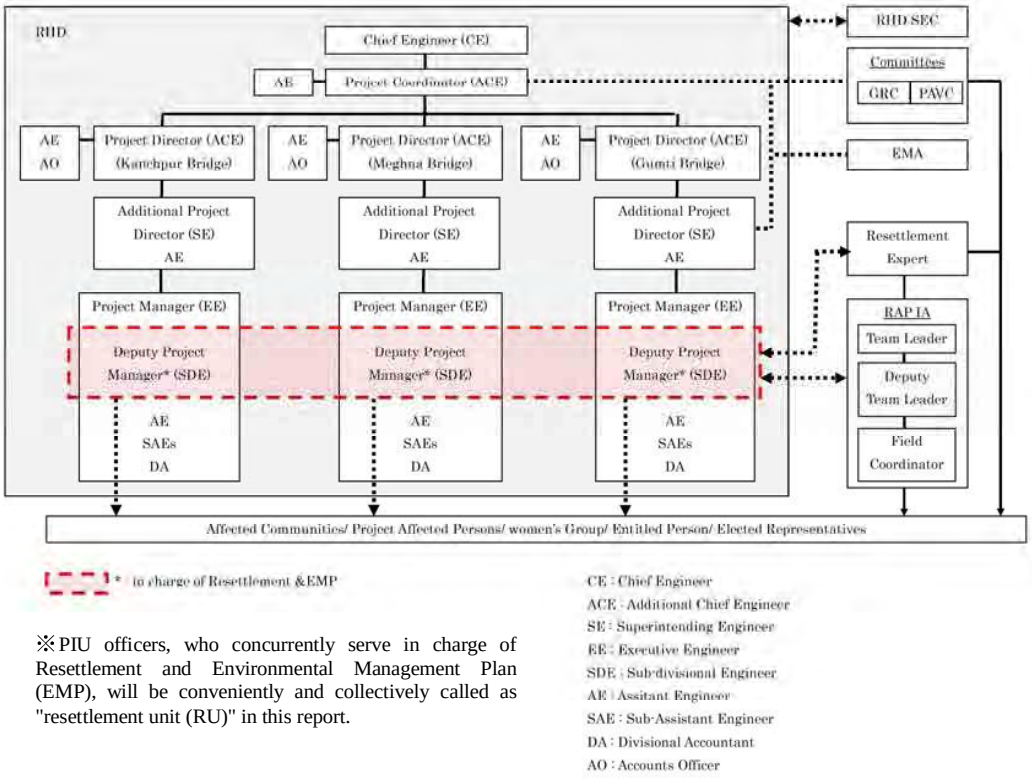
Roads and Highways Department (RHD)

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. Project Implementation Unit (PIU) of construction stage and of design and tender stage are shown in Figure 3.2 and 3.3 respectively.

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:

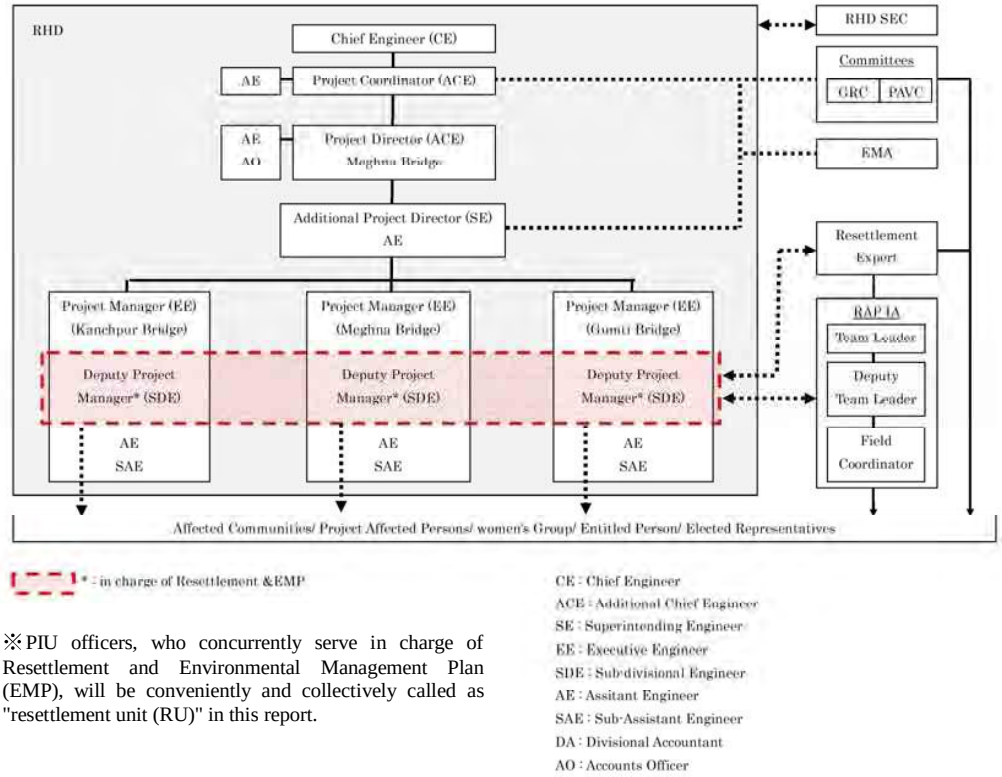
- Promoting environmental best practice in all day-to-day project activities.
- Contributing to the development of clauses about environmental standards for consultants' TOR, of contract conditions and of environmental management plan for contractors.



※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.

CE : Chief Engineer
ACE : Additional Chief Engineer
SE : Superintending Engineer
EE : Executive Engineer
SDE : Sub-divisional Engineer
AE : Assitant Engineer
SAE : Sub-Assistant Engineer
DA : Divisional Accountant
AO : Accounts Officer

Figure 3.2 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 3.3 PIU of design and tender stage

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 development 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.

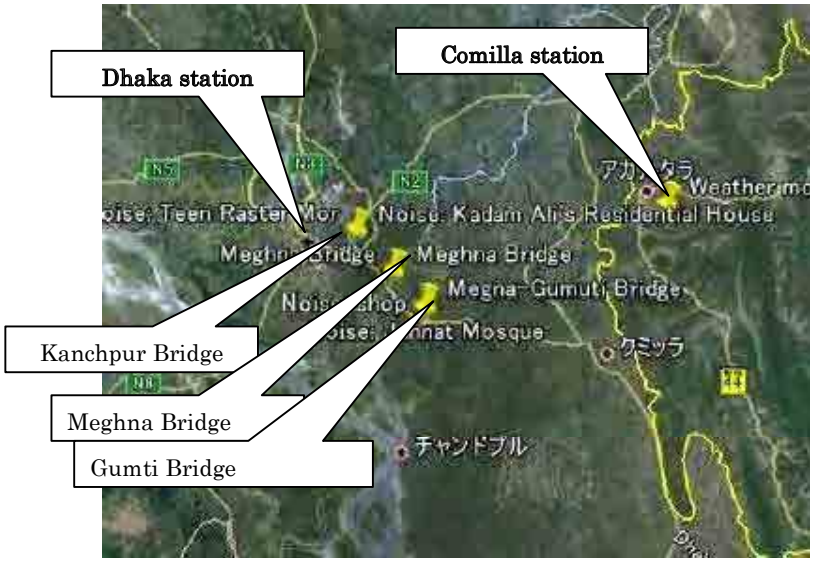


Figure 4.1 Locations of Monitoring Stations

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℃.

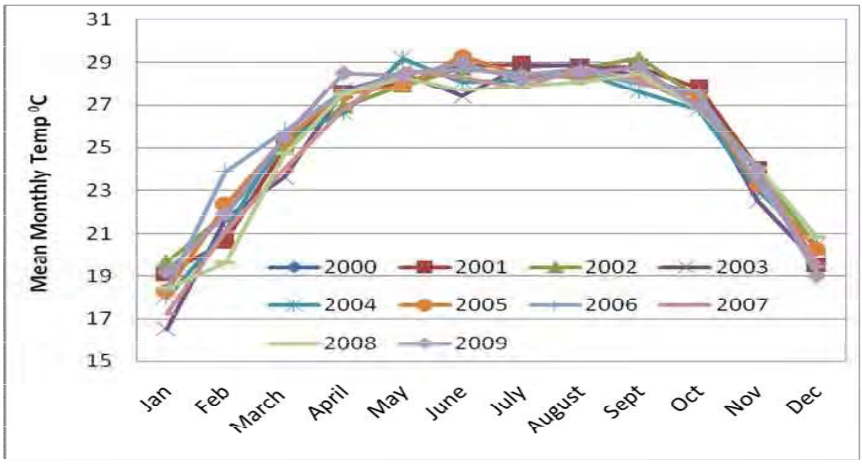


Figure 4.2 Mean Monthly Temperatures in Dhaka Station

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℃. January is the coldest month having average minimum temperature of 12.1℃. The average maximum temperature occurs in the month of May being 32.5℃.

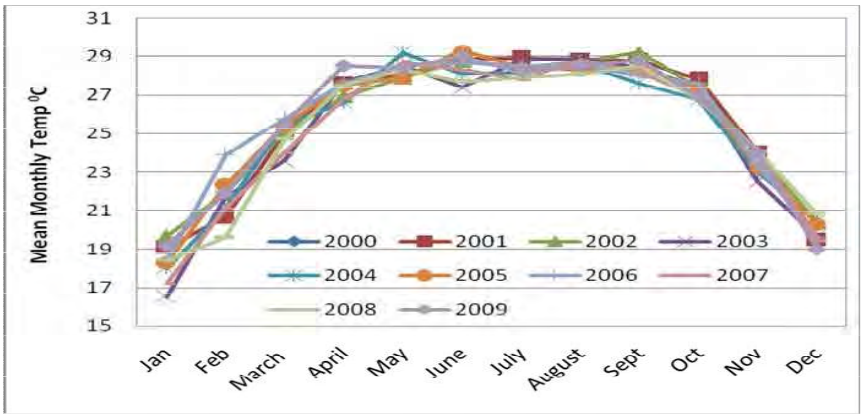


Figure: 4.3 Mean Monthly Temperatures in Comilla Station

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.

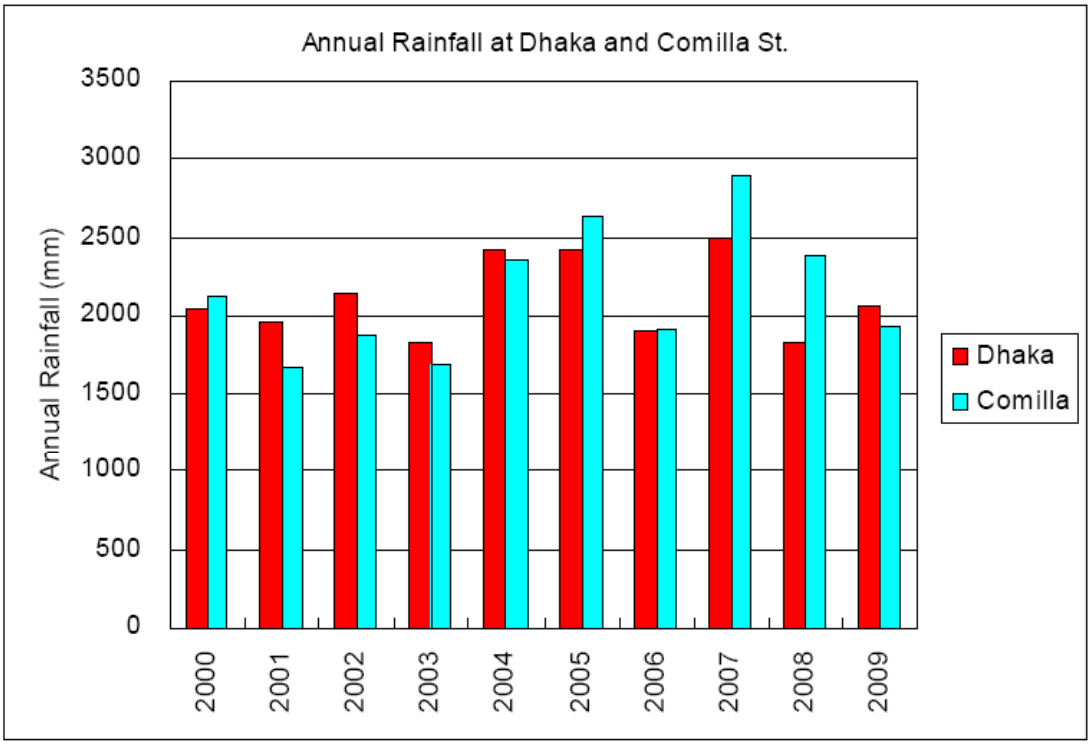


Figure 4.4 Annual Rainfall at Dhaka and Comilla Meteorological Station

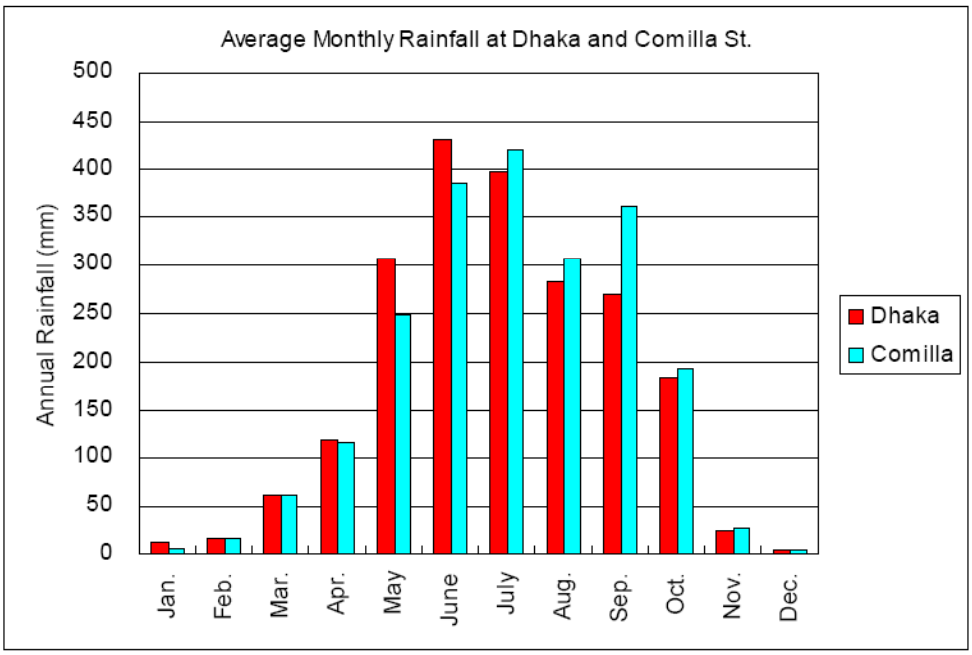


Figure 4.5 Average Monthly Rainfall at Dhaka and Comilla Meteorological Station

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 tectonically.

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 tectonically.

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 .

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.

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.

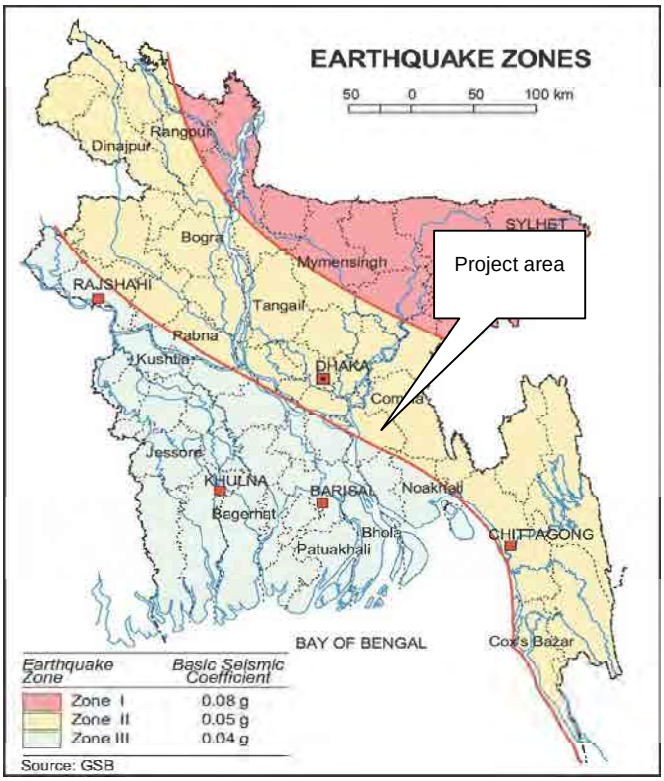


Figure 4.6 Earthquake Zones of Bangladesh

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 downstream 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-kilometer 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

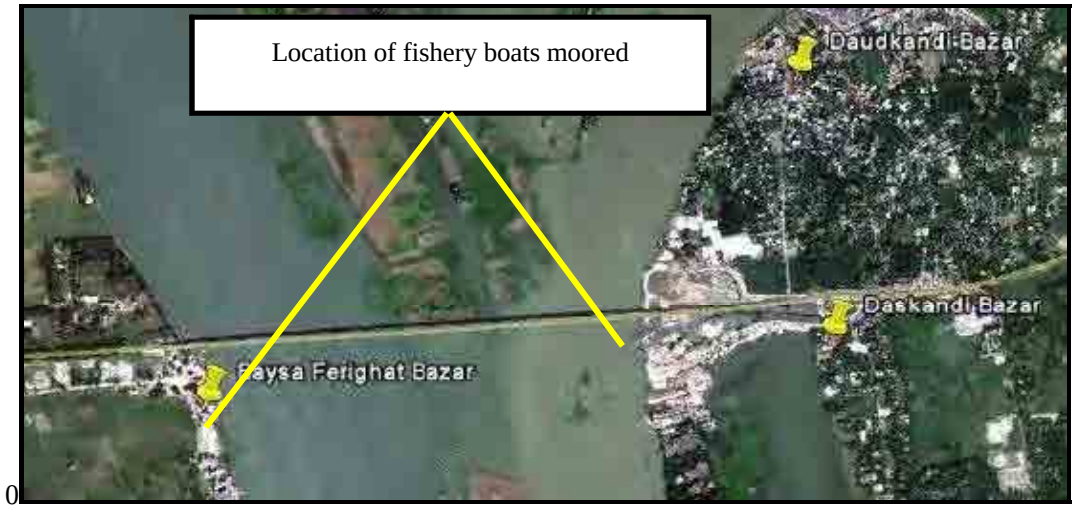


Figure 4.11 Locations of Fish Markets at Gumti Bridge Site

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

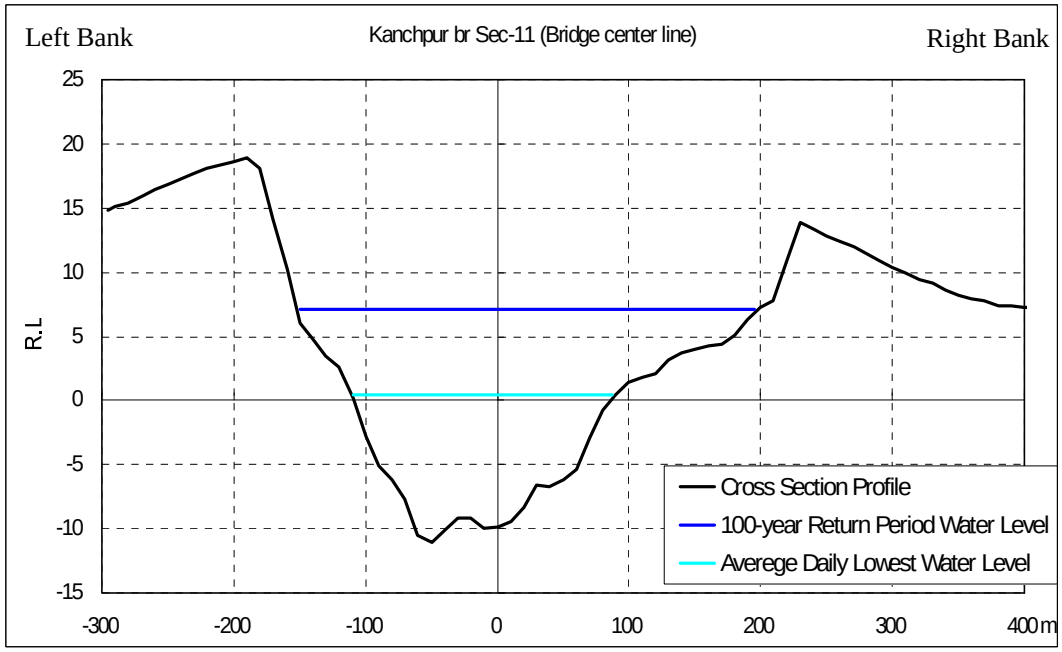


Figure 4.12 Shitalakshya River Section at Kanchpur Bridge

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
Average Daily Lowest	0.40	1459.3	0.20	292

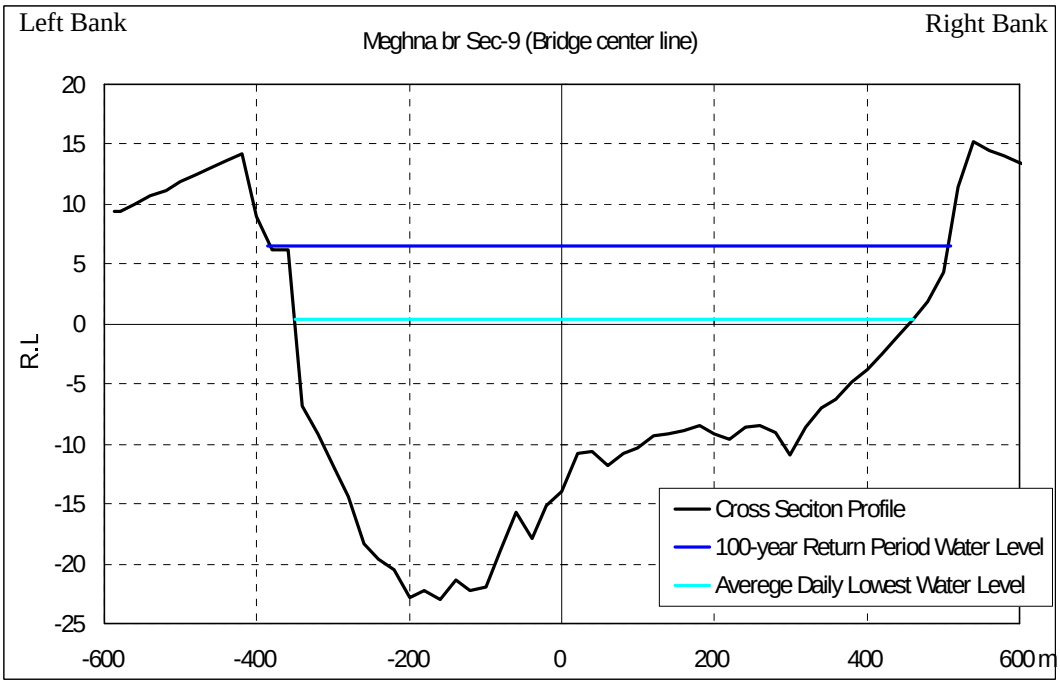


Figure 4.13 Meghna River Section at Meghna Bridge

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

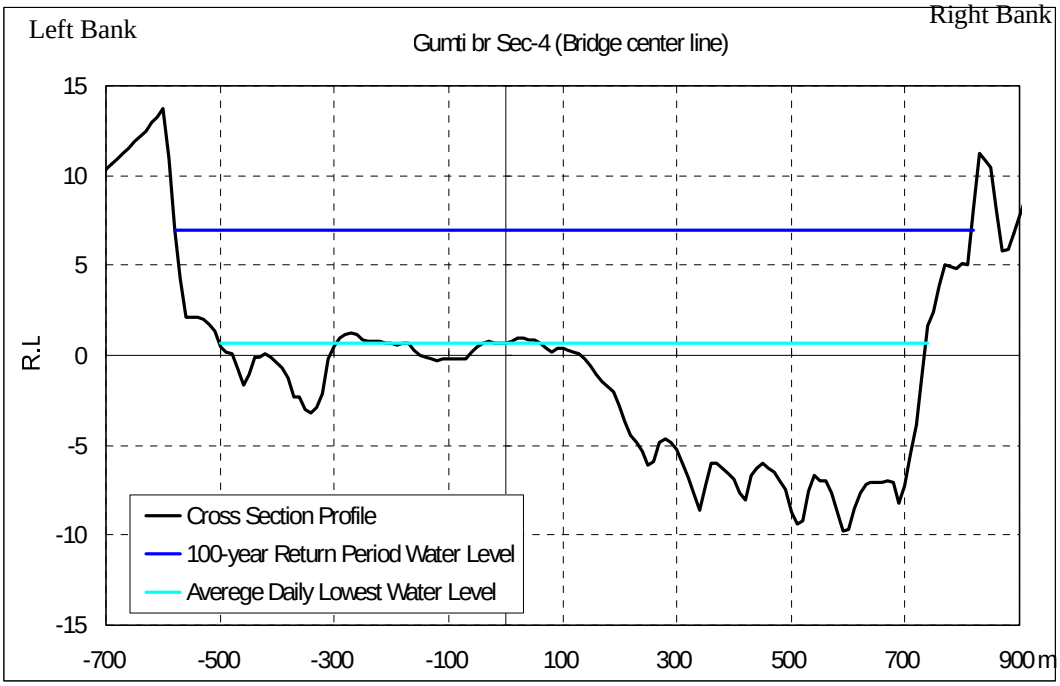


Figure 4.14 Gumti River Section at Gumti Bridge

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 2,705 km^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:

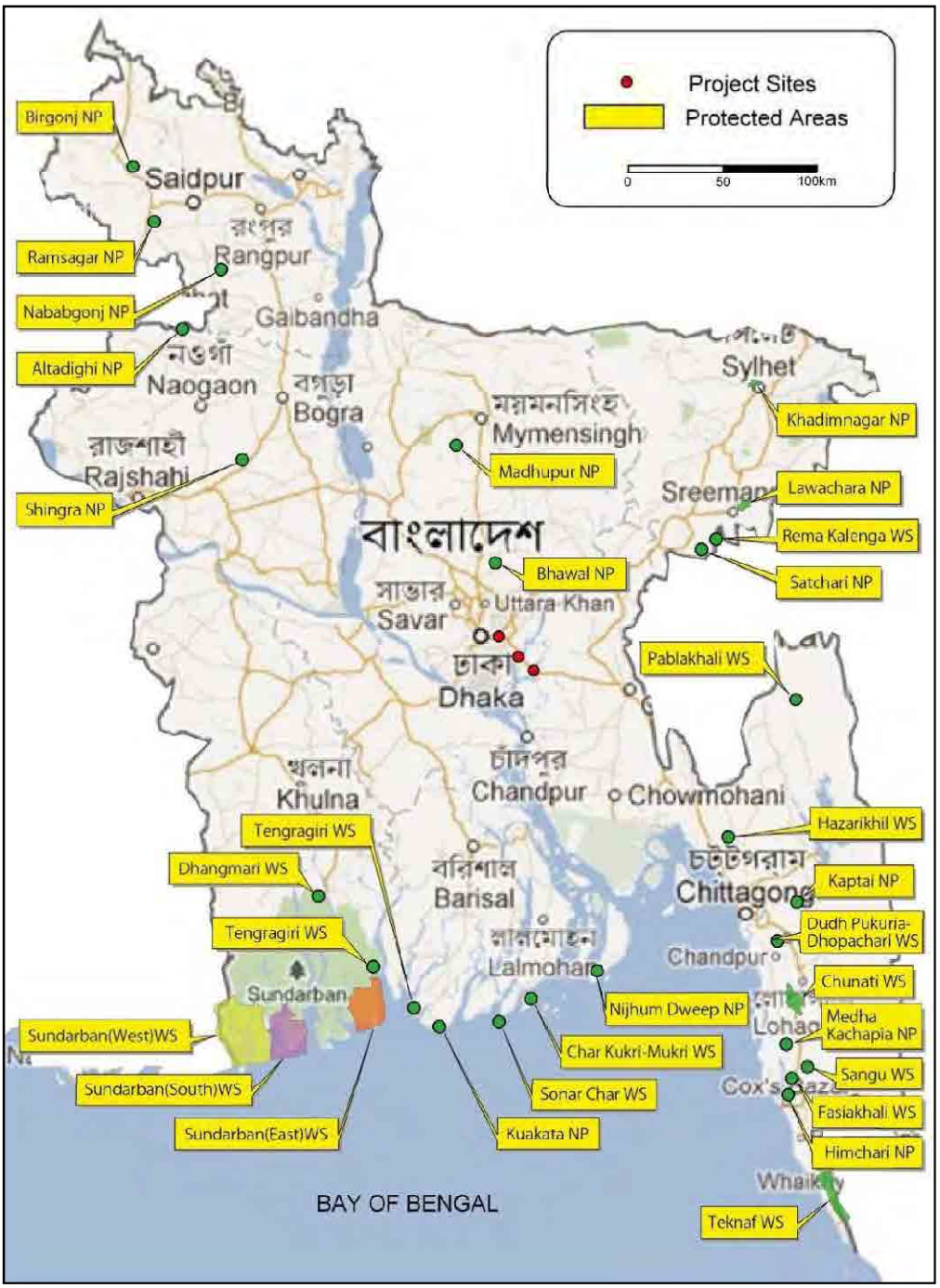
"(IPAC) STATE OF BANGLADESH'SFOREST PROTECTED AREAS'S2010 INTEGRATED PROTECTED AREA CO-MANAGEMENT"

“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 act 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

	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

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

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

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

	Plant species iGu mti 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

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

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

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
VU- Vulnerable
EN-Endangered
CR- Critically Endangered
LC-Least Concern

Birdlife Global Status
Same as IUCN Status

Local Status
CR-Common Resident
UR-Uncommon Resident
CWV- Common Winter Visitor
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	Common Myna	Bhat	LC	CR	LC	√		

	tristis		Shalik				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

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

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

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

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

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

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:

Platamista gangetica (roxburgh, 1801)

[2] Ph.D.Mr. S. M. A. Rashid, Chief Executive of CARZINAM, Center for Advanced Research 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

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 navigated 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 throughout 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.

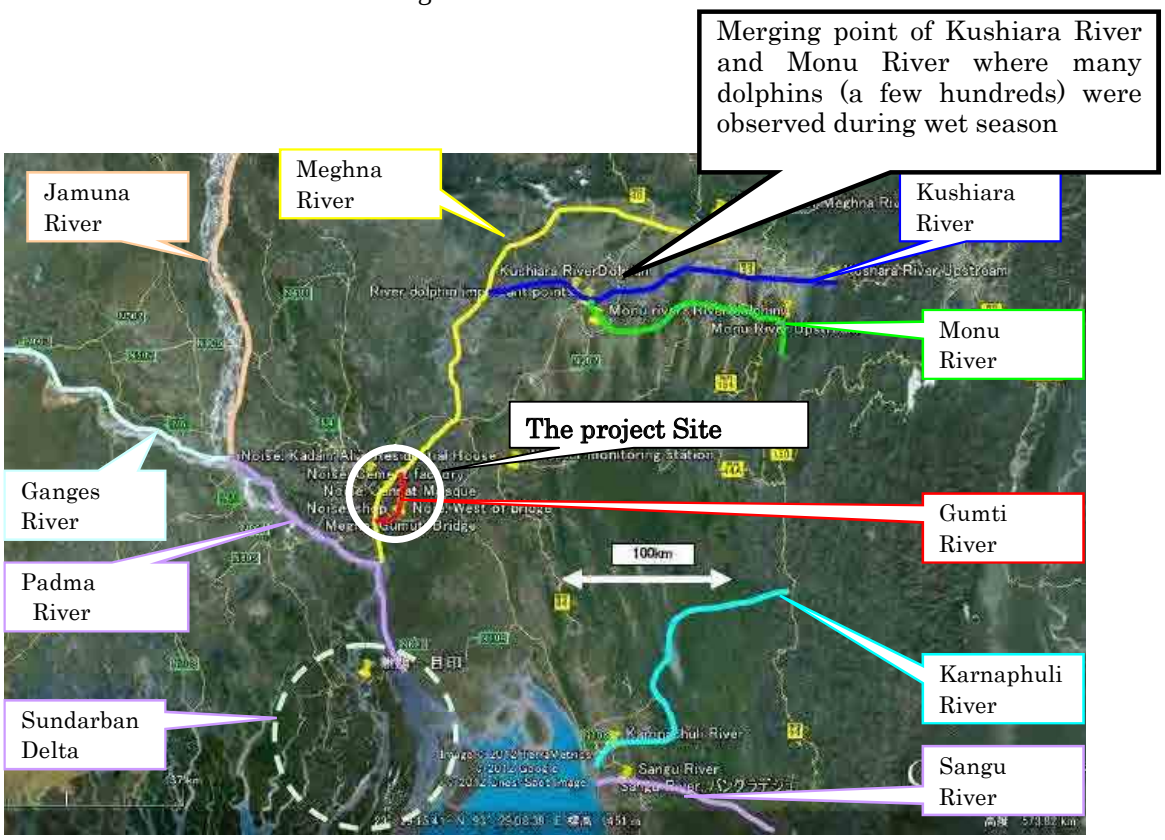


Figure 4.16 Rivers and Area where River Dolphin is Commonly Observed

Ecological role:

Shushuks (local name of South Asian River Dolphin) are vulnerable to changes in their habitat

4 South Asian River Dolphin in local name

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

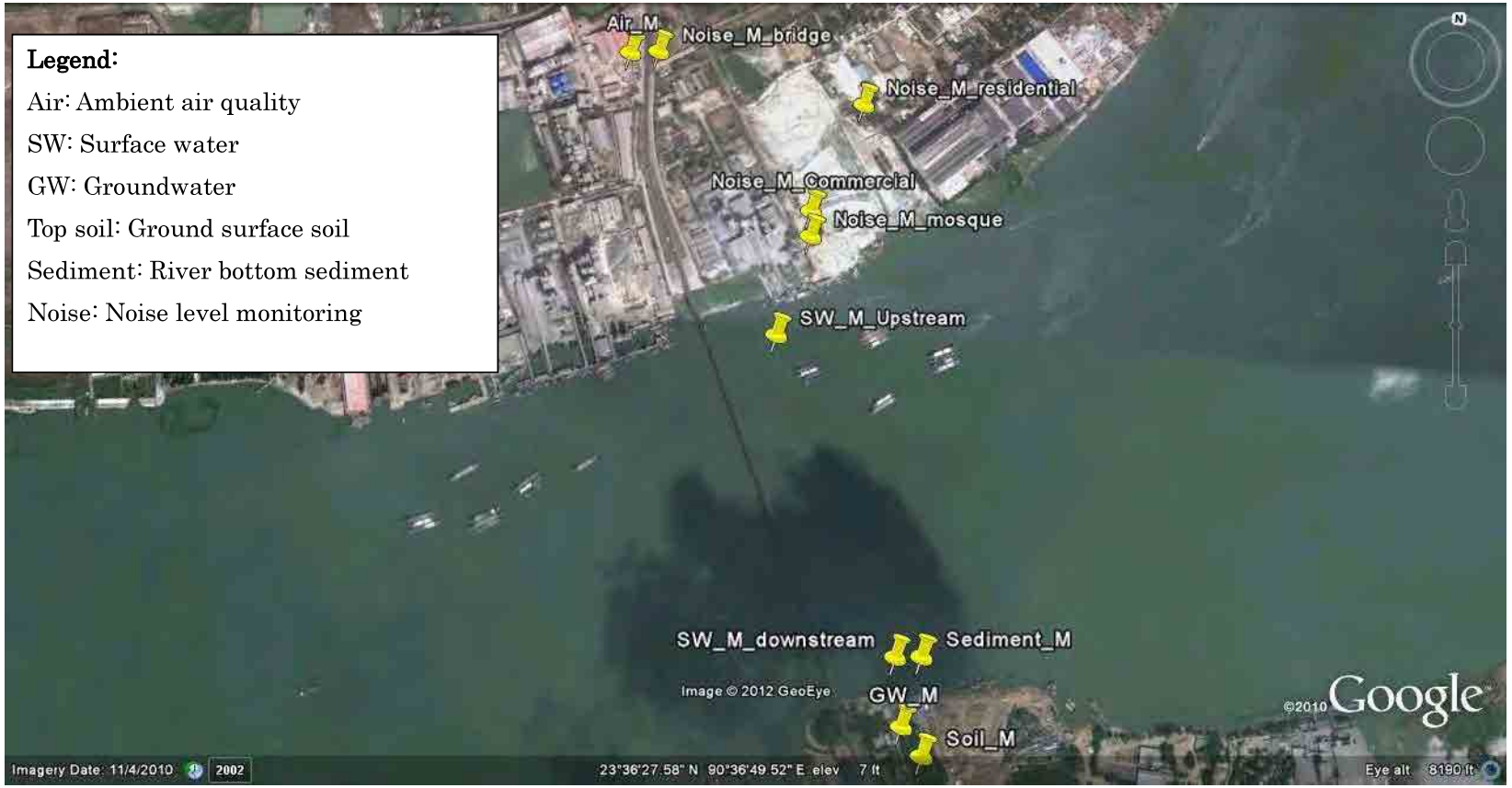


Figure 4.18 Locations of Samplings for Chemical Analyses at Meghna Bridge

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

AP17-105

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
p H	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

AP17-107

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.

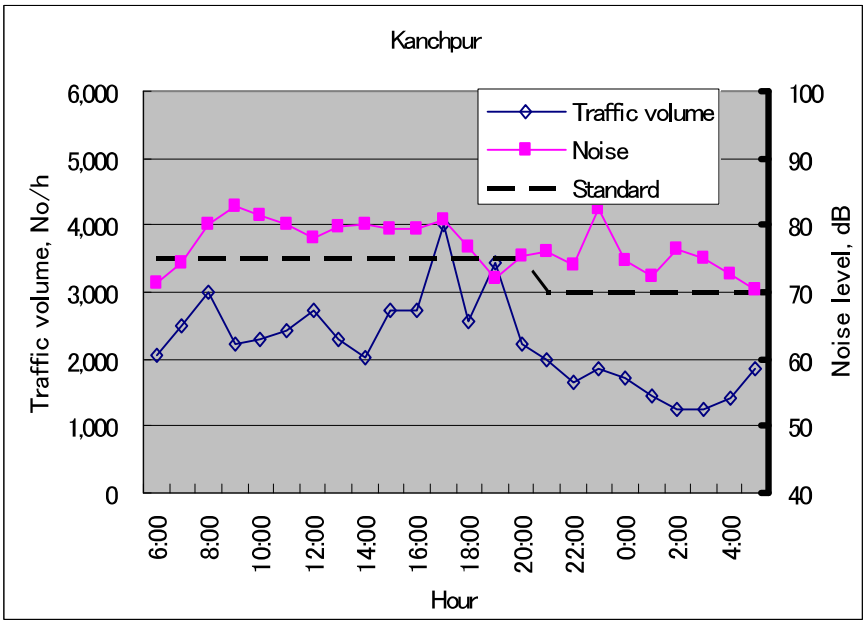


Figure 4.20 Noise and Hourly Traffic Volume at Kanchpur

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

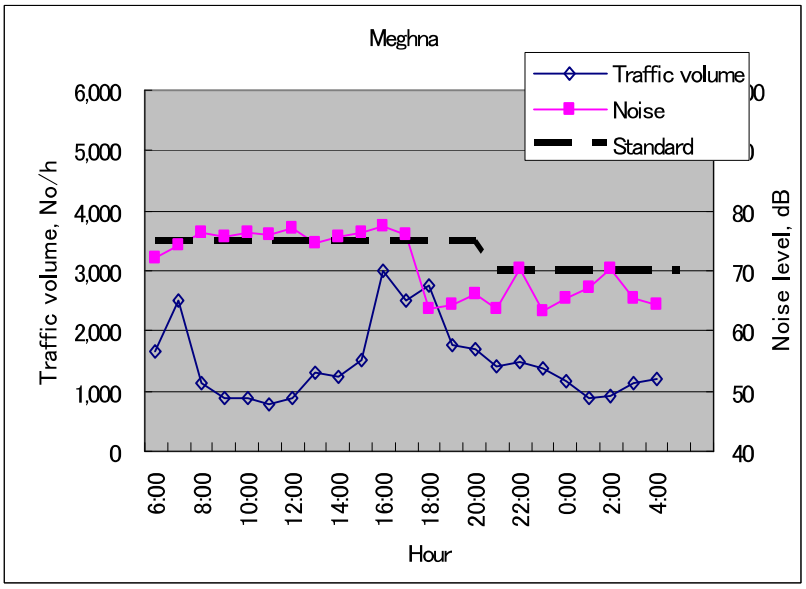


Figure 4.21 Noises and Hourly Traffic Volume at Meghna Bridge

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 horn is related especially in day time.

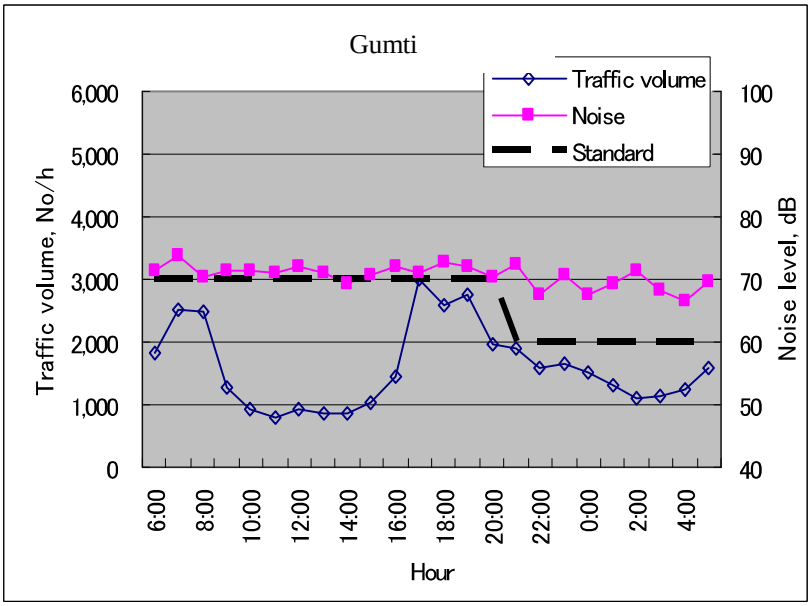


Figure 4.22 Noise and Hourly Traffic Volume at Gumti Bridge

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

Table 4.19 Locations of Bridges

[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*

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).

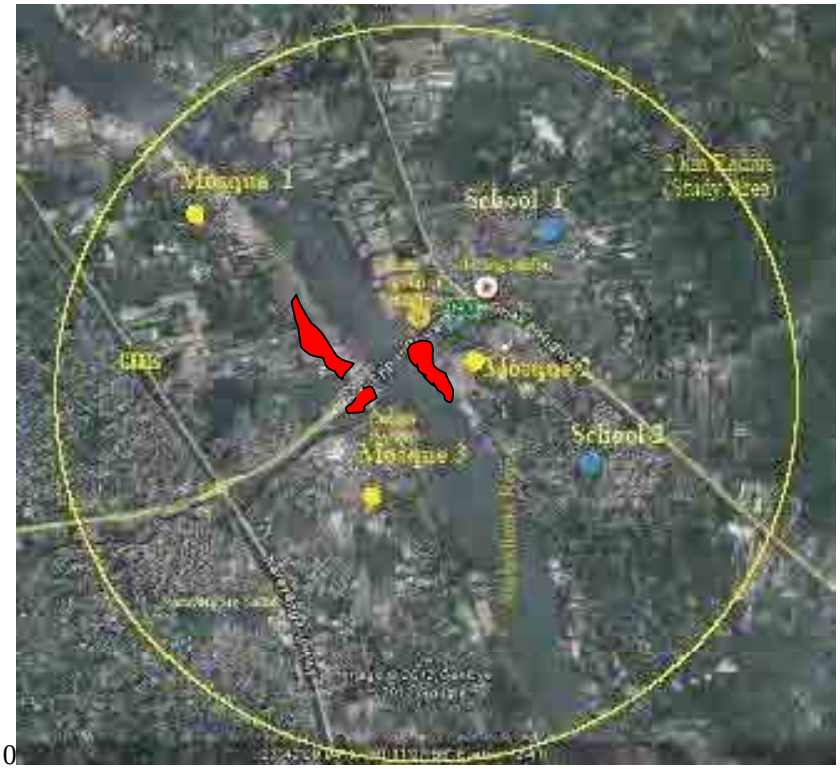


Figure 4.23(1) Location (red colored) of Sand loading/unloading workers working at Kanchpur Site

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

0

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: Study 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 kilometer 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.

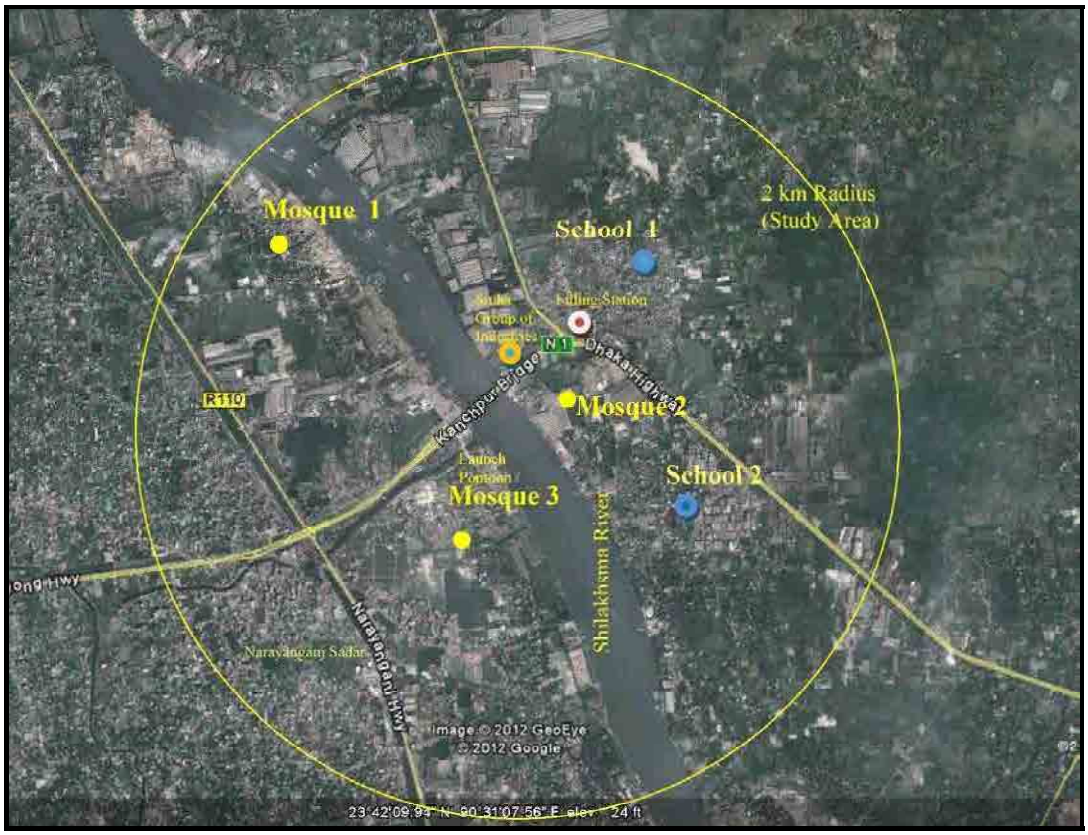


Figure 4.25 Land Use Map at Kanchpur Bridge

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

Figure 4.26 Land Use Map at Meghna Bridge

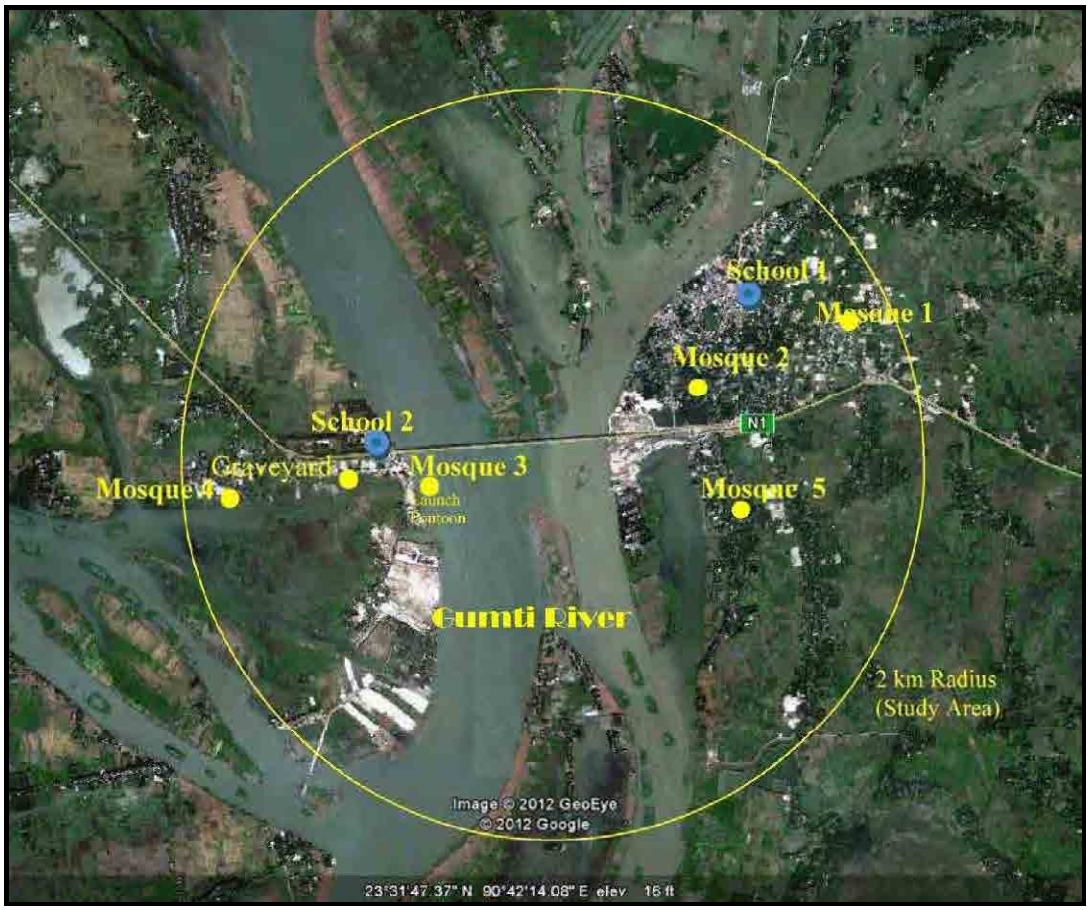


Figure 4.27 Land Use Map at Gumti Bridge

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 and the nearby cultural heritage, Goaldi Mosque at Goaldi in Sonargaon, is located 1 km away from NH-1. Thus, there is not any adverse impact 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:

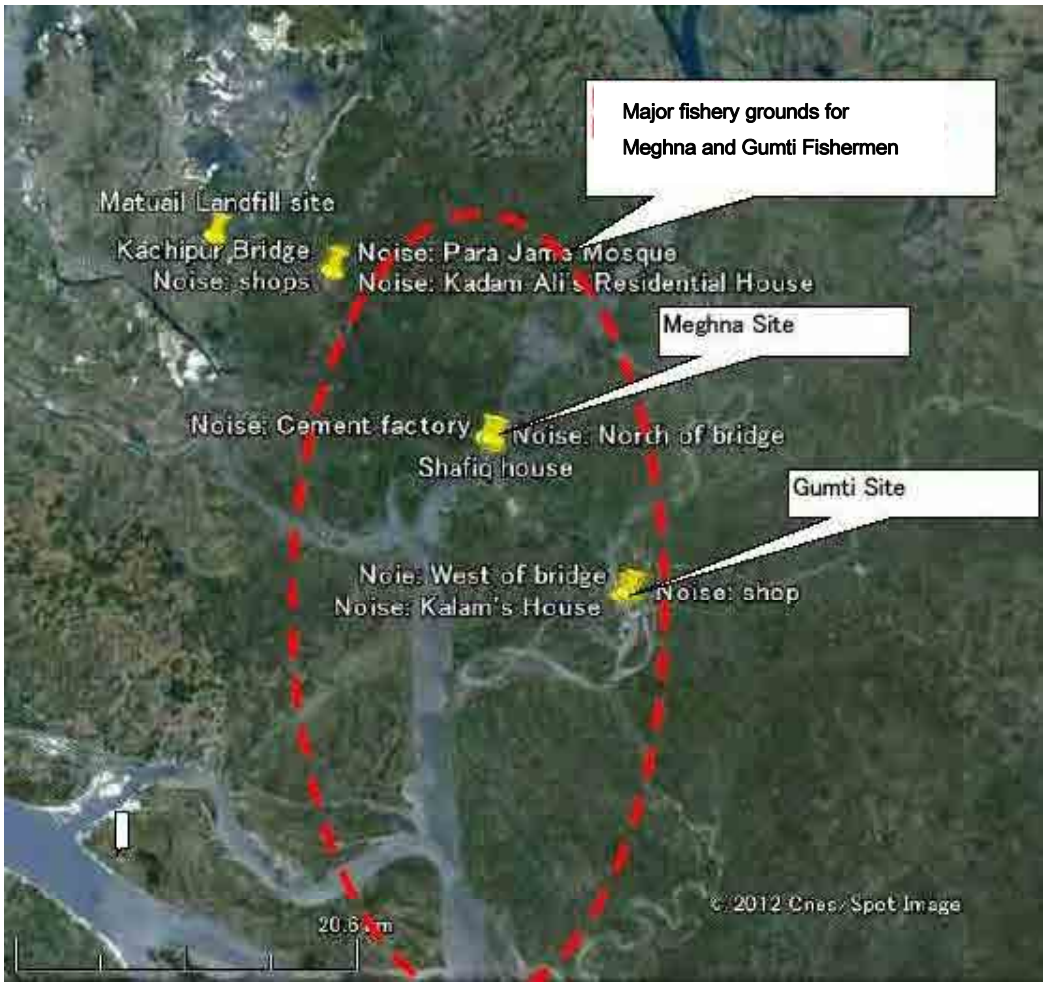


Figure4.29 Major fishing grounds

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 baskets 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.

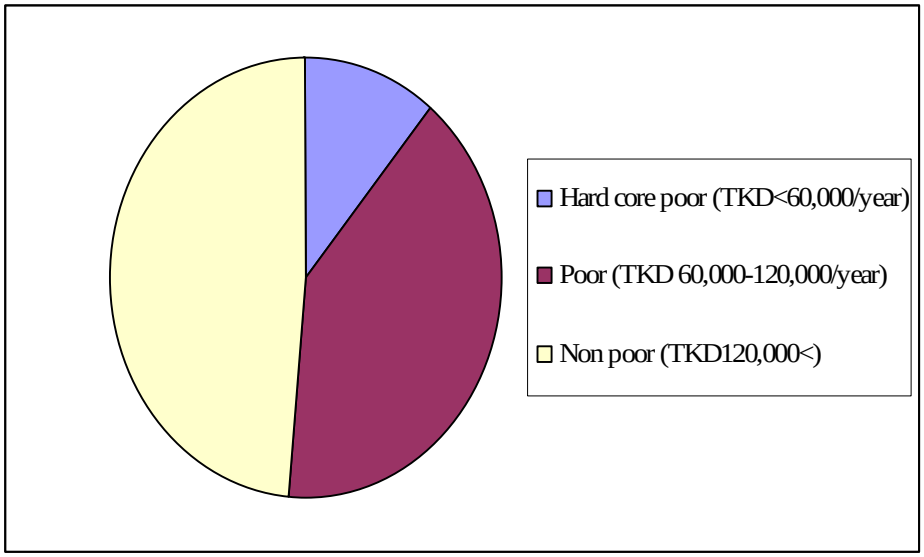


Figure 4.30 Income of Households at the Project sites

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

[12] Baseline Fisheries Study, AES Meghna ghat, 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

On land traffic accident

Presently land traffic accident reported between Gumti and Kanchpur 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: 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.

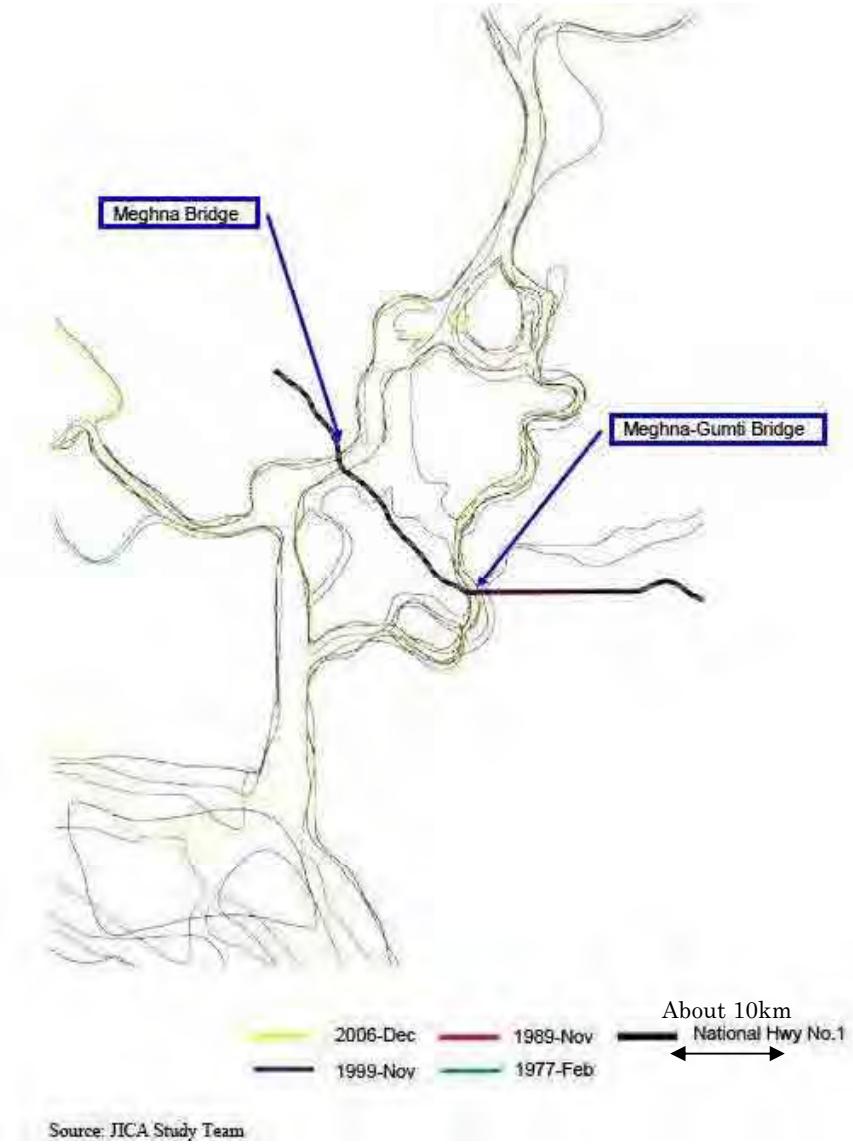


Figure 4.31 Change of River Banks

Scouring

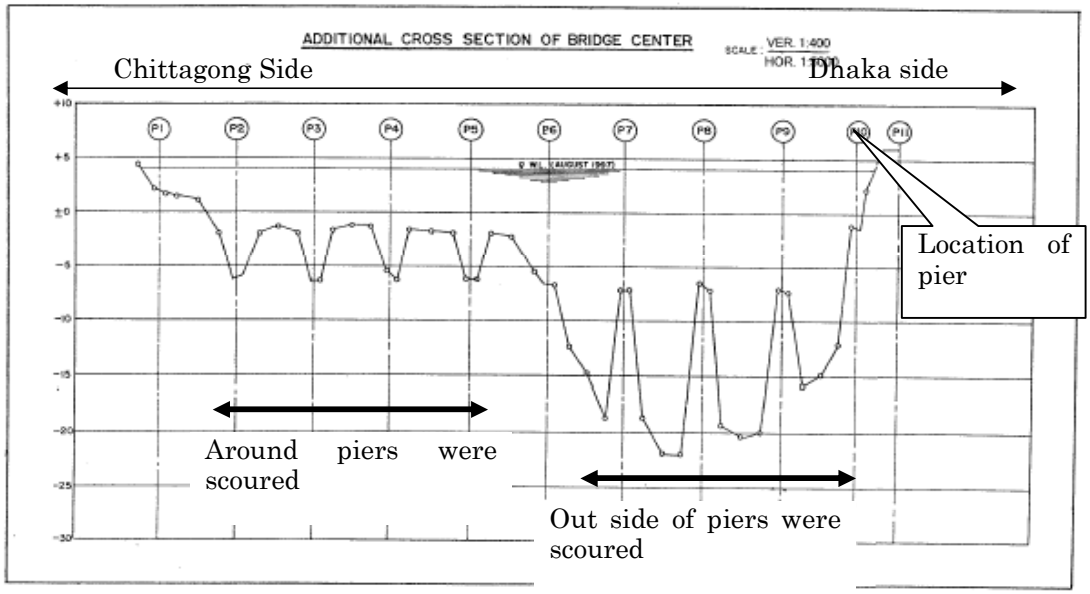
River bed scouring around the piers can be expected based on the fact that serious scoring have been taken place in. Table 4.31 presents the Maximum depths of scouring taken place in the past.

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.

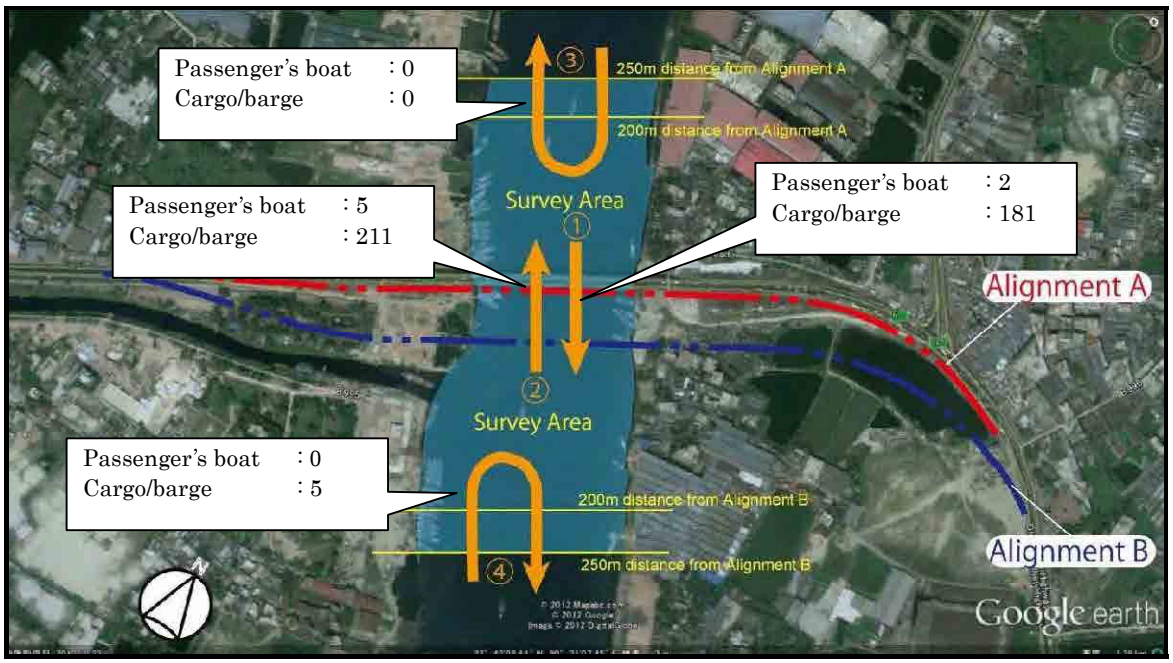


Figure 4.34 Number of Passing Vessels in Day Time at Kanchpur Bridge

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.

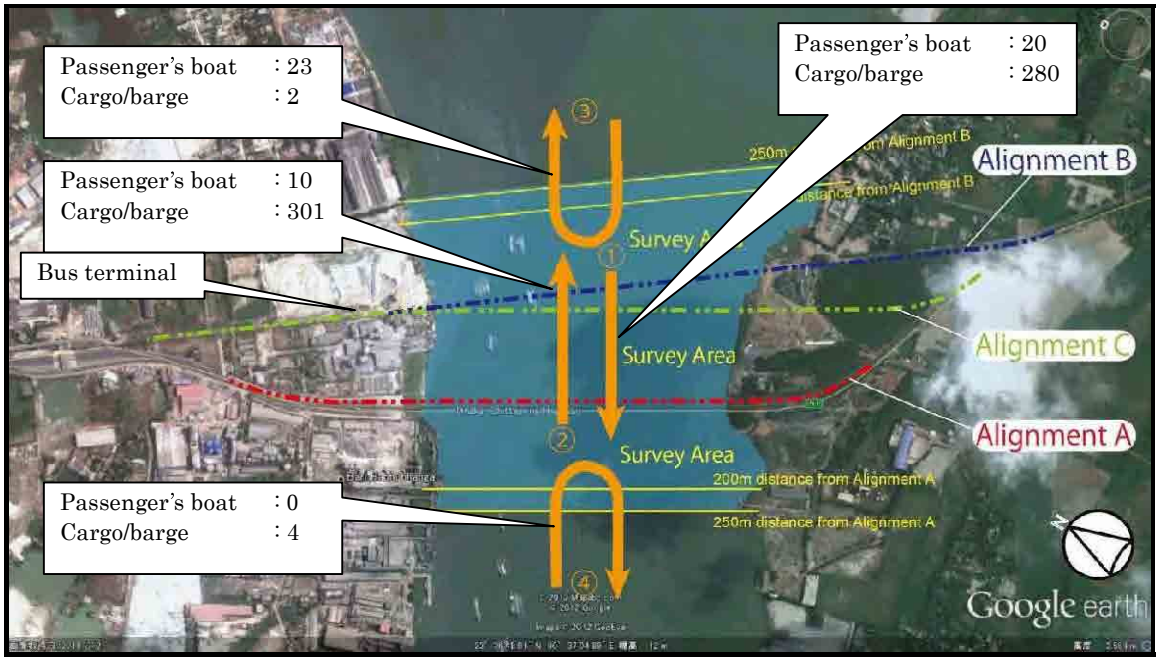


Figure 4.35 Number of Passing Vessels in Day Time at Meghna Bridge

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

0251727360251726336

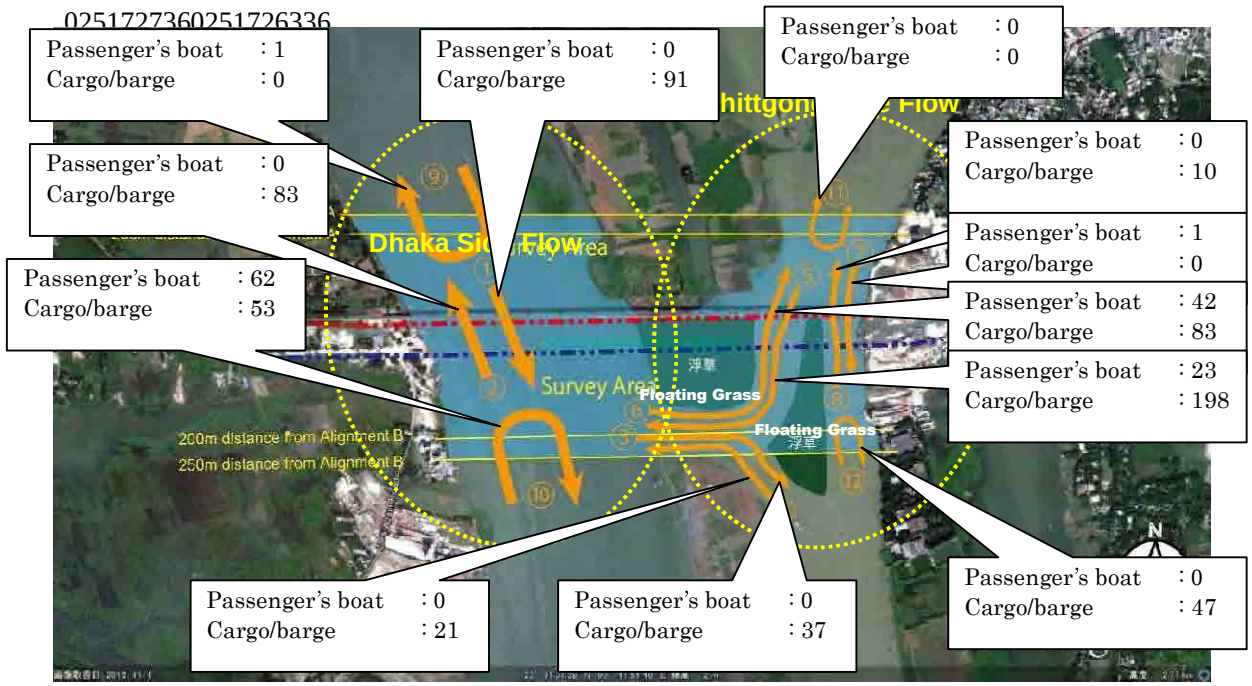


Figure 4.36 Number of Passing Vessels in Day Time at Gumti

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
	Kanchpur	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 (Organics content)	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.

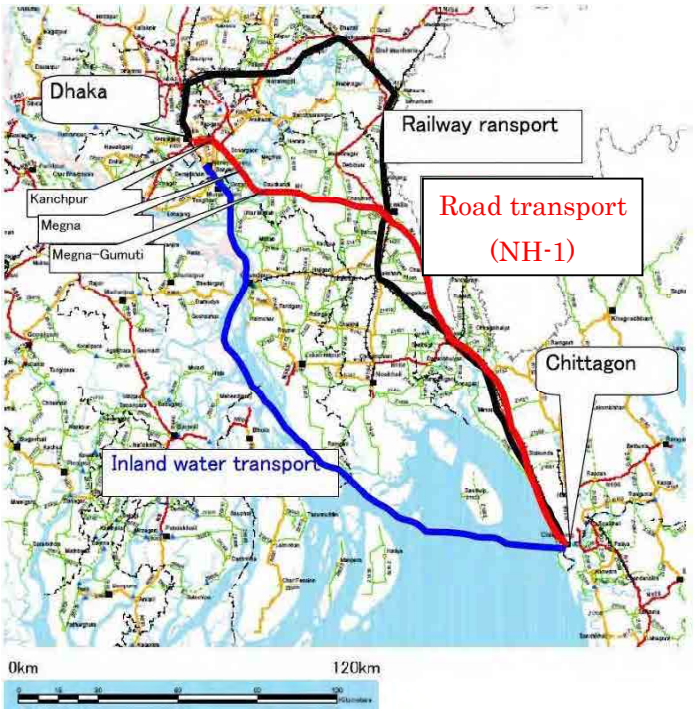


Figure 5.1 Modes of Mass Transportation

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.

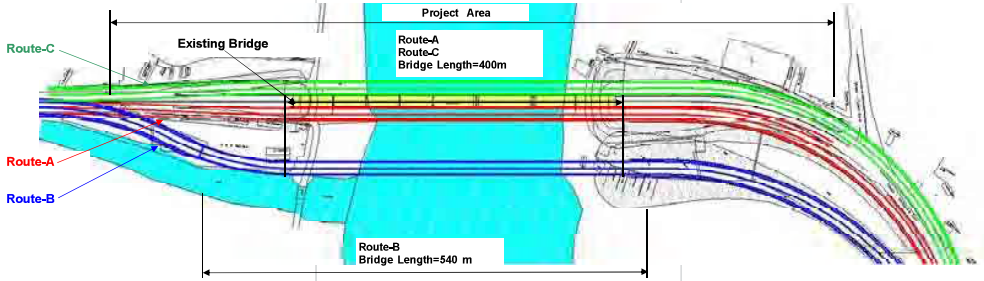
Meghna Bridge
Route A: Next to existing bridge (up stream); low resettlement; land acquisition occurs; low impacts to economic activities; good construction condition; low project cost.

Route B: Secure distance of 250m upstream near old ferry route; high resettlement; no land acquisition; high 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 (downstream); high resettlement; no land acquisition; high impacts to economic activities; normal construction condition; slightly high project cost.
Route C: Next to existing bridge (upstream); 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.