

Padma Multipurpose Bridge Design Project

Final Report (Environmental Action Plan)

Vol. 0: Executive Summary (Technical Summary of EAP)
Bangladesh Bridge Authority

June 30, 2010

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Environmental Action Plan

Executive Summary (Technical Summary of EAP)

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Prepared for

Bangladesh Bridge Authority

Prepared by

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List of Abbreviations and Acronyms

ADB	Asian Development Bank
BBA	Bangladesh Bridge Authority
CEMP	Community Environmental Management Plan
CEAP	Contractors Environmental Action Plan
DOE	Department of Environment
EAP	Environmental Action Plan
ECP	Environmental Code of Practices
EIA	Environmental Impact Assessment
EEF	Environmental Enhancement Fund
EMMP	Environmental Management and Monitoring Plan
FGDs	Focus Group Discussions
GOB	Government of Bangladesh
IDB	Islamic Development Bank
IPCC	International Panel on Climate Change
ISO	International Organisation for Standardization
JICA	Japan International Cooperation Agency
KFAED	Kuwait Fund for Arab Economic Development
O/M	Operation & Maintenance
PMBP	Padma Multipurpose Bridge Project
PIU	Project Implementation Unit
PWD	Public Works Datum
RS	Resettlement Site
RTW	River Training Works
TOR	Terms of Reference
WB	World Bank

Units

cumec	Cubic meters per second
ha	Hectare
km/h	Kilometre per hour
m	meter
m ³	Cubic meters

1 Introduction

1.1 Project

1. The proposed Padma Multipurpose Bridge Project (PMBP) is a very important large scale infrastructure project in the communication sector of Bangladesh. The Bridge will provide a vital missing link in the national road network of Bangladesh, particularly for the southwest part of the country. The Bridge will provide a missing link on National Highway 8 at Mawa – Janjira points. The Project is co-financed by the Government of Bangladesh (GOB), the World Bank (WB), the Asian Development Bank (ADB), the Japan International Cooperation Agency (JICA), AND the Islamic Development Bank (IDB). Bangladesh Bridge Authority (BBA) is the executing agency of the Project. The bridge is designed to be an approximately 6.15 km long fixed crossing double deck composite steel truss bridge over the Padma river with provisions for four lane highway on the upper deck, and a rail line, gas pipeline, optic fibre cable and power transmission lines on the lower deck.

1.2 Environmental Assessment

2. Detailed environmental assessment studies have been carried for the Project based on the detailed design of the Project. Main objectives of the present environmental studies are to prepare all necessary environmental documentation to comply with the requirements of all co-financiers and to obtain environmental clearance certificate from the Department of Environment (DOE) of GOB. The present study builds on the previous environmental studies with additional focus in resettlement sites development, climate change, and ecological studies.

3. A harmonized framework for environmental safeguard is prepared to satisfy all the environmental safeguard requirements of the GOB as well as that of the Co-financiers, WB, ADB, JICA and IDB. Before carrying out environmental assessment of the Project, terms of reference (TOR) was prepared based on this harmonized framework. The TOR has been reviewed and approved by the BBA, POE, DOE and the co-financiers.

1.3 Environmental Documentation - EAP

4. The deliverables under environmental component of the Project are packaged as Environmental Action Plan (EAP) and consists of 5 volumes of standalone documents and an executive summary of all these 5 volumes as shown in Table 1.

Table 1: Environmental Action Plan (EAP)

Vol. 0: Executive Summary (Technical Summary of all EAP documents) Vol. 1 a/b: EA/IEE for RS Vol. 2: Environmental Impact Assessment Report* Vol. 3: Environmental Quality Baseline Monitoring Survey Vol. 4: Ecological Report Vol. 5: Factoring of Climate Change in the Design of the Project

* Includes all relevant Environmental Management Plans

5. The present **EAP Executive Summary** provides a broad overview of all environmental assessment studies carried out under the Project and provide a summary of all 5 volumes of EAP.

6. **Vol 1a/b: EA/IEE for RS** presents the environmental assessment and mitigation and compensation measures, planning norms to be considered in the design of the four Resettlement Sites (RS) to be developed for resettlement of Project affected households. The report also presents environmental management of the RS development and proposes community management in Operation and Maintenance (O/M) of the infrastructure facilities, such as water supply and sanitation facilities, to be provided in the RS.

7. **The Vol 2: Environmental Impact Assessment (EIA) Report** presents the Project information along with the detailed environmental baseline data of the Project area. The report also covers all the environmental impacts of the Project with the proposed management and mitigation plan, compensation and enhancement measures, and institutional strengthening measures. This report forms the basis for environmental approval from DOE and co-financiers.

8. **Vol 3: Environmental Quality Baseline Monitoring Survey** presents the results of the two rounds environmental quality monitoring (Surface and groundwater, air, noise and river bed materials) carried out under the Project during July and November 2009 covering both dry and monsoon seasons.

9. **Vol 4: Ecology Report** covers detailed baseline information on the flora and biodiversity of the Project area, including biodiversity of avi-fauna, fish, amphibians, reptiles, mammals and invertebrates. The report also presents the results of bi-monthly wildlife monitoring data carried out under the Project. The report also identifies the possible environmental impacts of the Project on various ecological resources and provides a mitigation and management plan.

10. **Vol 5: Factoring of Climate Change in the Design of the Project** presents the results of the climate change studies carried out under the project to assess the anticipated rise in future water levels and discharge levels in the Padma at the bridge site to come up with a “credible design scenario” and, consequently, toward helping formulate a climate responsive design for the bridge.

2 Description of the Project

2.1 Location

11. The Project area is located in the south-central part (Munshiganj, Shariatpur, and Madaripur Districts) of Bangladesh. The left bank (north bank) on Mawa side is located in Lauhajang *upazila* of Munshiganj District whereas the right bank (south bank) on Janjira side located in the Janjira *upazila* of Shariatpur District and Shibchar *upazila* of Madaripur District.

2.2 Project Components

12. The Project consists of the following components and their locations are shown in Figure 1:

- Main bridge (6.15km long) and transition structures (Bridge End Viaducts);
- River Training Works;
- Bridge Connecting Approach Roads (about 2.3km at Mawa side and 12.8km at Janjira side) and associated structures
- 6 bridges, 14 culverts, 7 underpasses, and 11 junctions;
- 2 Toll Plazas (1 at Mawa and other at Janjira);
- 2 Construction Yards (area at Mawa= 81ha and at Janjira=78ha);
- 2 Service Areas (area at Mawa=27.03ha and at Janjira=63.7ha);
- 4 Resettlement Sites (2 at Mawa: RS02: Jashaldia with area 13.96ha, RS03: Kumarbhog with 15.46ha and 2 at Janjira: RS04: Paschim Naodoba with area 19.95ha and RS05: Bakhorerkandi with area 18.45ha, respectively);
- Future provision of Railway on the lower deck of the bridge; and
- Provision of utility Crossings (high voltage power transmission line, high pressure gasmain and optical fiber telecommunication cable).

2.3 Project Boundaries

13. Both direct and indirect boundaries of the Project area are established for carrying out the environmental assessment studies. The direct Project impact area is shown in Figure 1 and presented below:

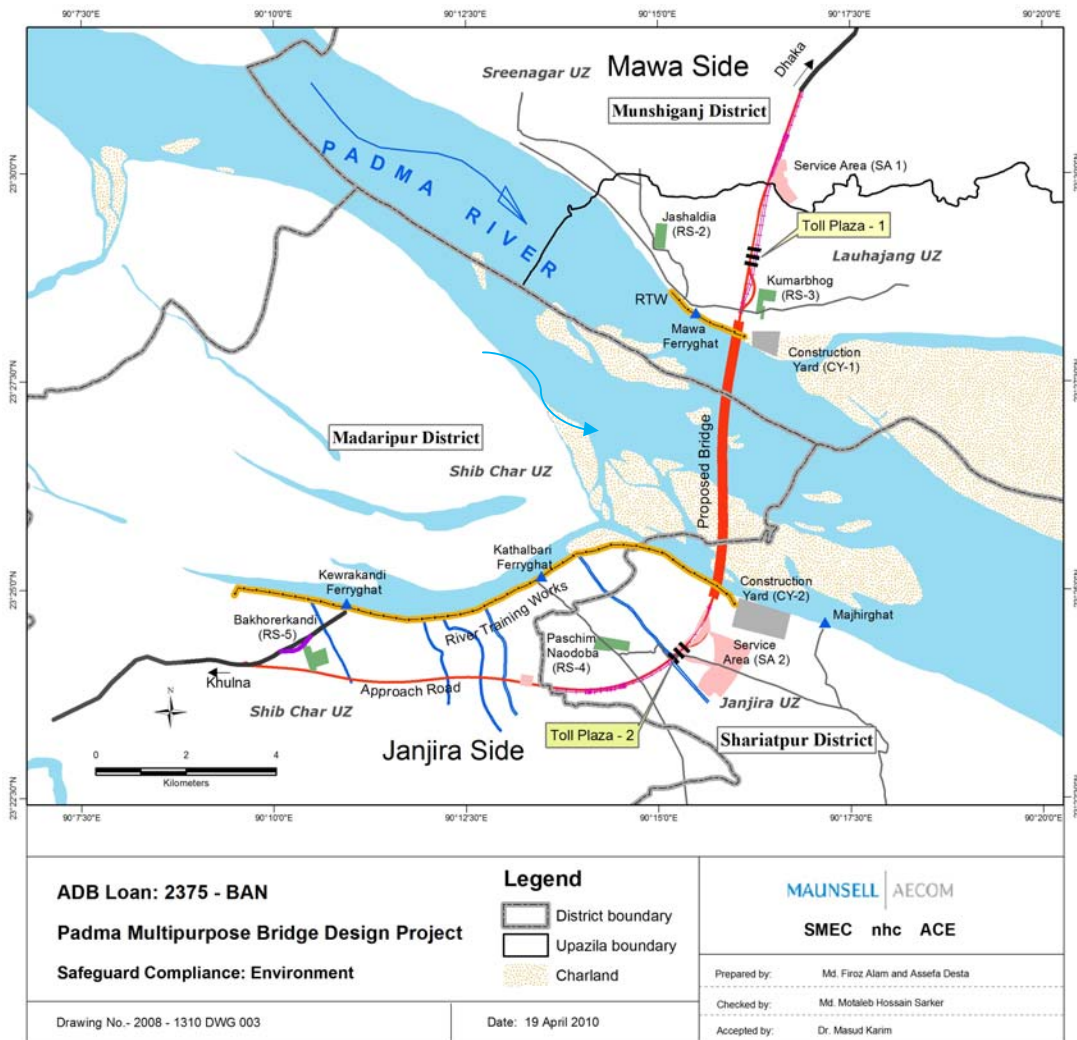


Figure 1: Project Components

- Longitudinally to the River 15 km upstream and 7 km downstream (totaling 22km) from the center location of the main bridge, which will essentially cover two Charland that are expected to receive impacts from the project directly;
- Laterally to the River 6 km from the River bank at Mawa side and 4 km from the River bank at Janjira side, totaling to 16.15 km including the River width at the bridge location; this will essentially include bridge end facilities, approach roads and railways, railway stations, resettlement sites, construction yards, and service areas.
- In addition, based on the morphological study for structural intervention (Updated RTW Scheme Design, Annex C, Section 9.4, submitted on April 15, 2010), it is identified that for different types of channel development due to the construction of river training works, three locations (Figure 2-2) could be vulnerable to erosion and the extent and magnitude are considered indicative. There is no confirmed analysis on these erosion predictions. Compare is not the boundaries based on natural envelope for the next 50 years and the maximum erosion extent for the structural interventions shows that additional erosion for the structural interventions would be about 900 ha along the right bank, located at about 15 km downstream of the bridge crossing. Since, these changes are not immediate, a monitoring program for the downstream river (for example as part of the regular annual monitoring program ending at

Chandpur) can be undertaken by BBA/BWDB under the Charland Management and Monitoring Program and accordingly prepare mitigation plan. Therefore, the EIA boundary along the river (east-west) will be unchanged and is 15km by 7km.

14. The indirect zone of influence will broadly cover the associated activities of the Project, viz. (a) the corridor of the Asian Highway 1 (Tamabil-Sylhet-Sorail-Kanchpur-Dhaka-Mawa-Bhatiapara-Norail-Jessore-Benapole), (b) the corridor of Trans-Asian railway network and the railway missing link from Gendaria-Mawa through the bridge to Bhanga-Kashiani-Narail-Jessore and (c) high pressure gas transmission line from Bakharabad – Siddirganj – Khulna, and (d) high voltage power transmission line from Siddirganj to Khulna.

3 Description of the Resettlement Sites

15. Four resettlement sites are proposed in both side of the river to accommodate affected population who are willing to settle project sponsored resettlement sites. Brief descriptions of the facilities proposed in each RS are given in the following paragraphs:

16. Housing Layout: Three categories of plot sizes have been designed. In all, the four sites have provisions for 1,944 housing plots and 80 commercial plots for shops and small businesses. Broad principles for plot distribution are: (i) Category A is for landless and squatters (free of cost); Category B is for affected households losing homestead and structures; and Category C is for those losing large homestead plots (20 dec or more).

17. Schools: A primary school (up to class 5) will be constructed in all RS. The total floor area of the proposed school building (one storied) including corridor/verandah will be designed adequately for about 500 children in 2 shifts. The school building will be designed to have 5 class rooms, one headmaster room attached with toilet, one teacher /office room and one multipurpose room.

18. Health Centers: A health center (Medical Sub-center and Union Health and Family Welfare Center) will be established in all RS sites. The infrastructure in each centre would include: examination rooms, delivery room, pharmacy, waiting room, toilets, etc. The staff at the each health centre will include a Physician (1) Medial Assistant (2), Pharmacists (1), and Health visitor (1) Cleaner/Janitor (1), and Night guard (1).

19. Mosque: Two storied mosque will be provided at all RS. The total floor area of the proposed mosque buildings including corridor/verandah will be designed adequately for about 500 people. Allowance for future extension vertically will be kept. Water supply and sanitation facilities will be provided to the mosques.

20. Playground/ Common Meeting Places/Eidgah: All the RS will have open play ground/common meeting area at suitable location of each RS for multi purposes such as for playing various games (say football, cricket, athletics etc.), meeting as well as eidgah during eid festivals.

21. Markets/Shops: All RS will have market and shop areas for the purpose of selling and buying essential goods (foods, clothing, cosmetics etc.). The market areas/shops will be located close to the main roads to facilitate easy communication.

22. Internal roads: Adequate road network facilities will be required in all five RS for easy and comfortable road communication. All civic amenities such as residential house, school, mosque, playground/common meeting area, green belt area, pond, market/shop, waste disposal site and health centre will be linked with internal roads.

23. Ponds: Big size ponds (minimum size 55 m X 52m) will be provided in all RS at its central location for fishing, keeping good environment and other recreational purposes for the RS areas. All ponds will be excavated deeply so that ponds can retain water for a year. High flood embankment around the ponds will be built so that even during high flood, water cannot pass over the embankment.

24. Greenbelts/Tree Plantations: Program of massive tree plantation is done planned at all suitable locations such as at the boundary slopes, around the school, mosque, pond, market, health centre, and playground. Green belt areas proposed for each RS for exclusive development of plantations. About 20 hectares of land will be developed by planting about 37,708 trees.

25. Storm Water Drainage: Storm water drains are designed for all the five RS. The drains will be designed to handle a peak rainfall intensity of 130 mm/hour. The drains will have a longitudinal gradient enough to facilitate the flow and permit a non silting velocity ($> 0.6\text{m/sec}$). The drains will be constructed at both sides of all the internal roads.

26. Water Supply: A piped water supply system through deep tube wells is designed for each RS. The depth of each well is about 300 m to draw arsenic free groundwater. A per capita demand of 50 liters per day (standard practice of water supply schemes in Bangladesh) is considered for the design of water supply scheme. Prior to the design of water supply system, water sources will be established and quality of water will be examined to conform to the national water quality standards.

27. Sewerage: Common sewerage facilities for household latrines and domestic waste from kitchen and bathrooms. The sewerage system will be connected to a septic tank and then to a soak pit consists of various layers of filter media.

28. Household Solid Waste Management: The composition of the major part of household wastes will be predominantly organic wastes (mainly fish waste, vegetable skins, fruit skins and seeds, egg shells, food preparation remains, garden wastes) and inorganic wastes (mainly waste papers, plastics, glasses and package materials).

29. Market Solid Waste Management: Waste generated at market sites, generally consists of both organic wastes (vegetable wastes, food leftovers wastes and food grains) and inorganic wastes (mainly fibers, clothing, plastics, glasses, and waste papers). These wastes will be collected from the market and stored by the cleaners in different bins at the corner of the market separately.

69. Composting: In Bangladesh, composting of solid waste is widely used. From the discussions with the PAPs it was understood that a total of about 180 kg/household/year organic solid wastes are generated for each household (per person @ about 0.1kg/capita/day) in rural areas. In all RS, aerobic composting of individual household organic waste is recommended.

30. Improved cook stoves: Improved cook stoves for PAPs are recommended in all RS in order to reduce indoor air pollution.

31. Power Supply: Substations will be provided in each RS to distribute power supply. The substation will get power from 11 kV REB (Rural Electrification Board) Low power transmission (LT) lines. Each housing plot will get power from the feeder panel. Each housing plot will have its own distribution board within the house constructed on it. Similarly markets, shops, schools, mosques, health centers and other establishments will have their own distribution board(s) consuming power from the feeder panel.

32. Safety and Security: A solid or net fence (height minimum 1.5m) with provision of main gate to exit to the road is designed around the boundary line of each RS for security purpose.

4 Description of the Environment

33. Baseline environmental conditions of the Project area are established for all physical (topography, soils, landuse, climate, geology, geomorphology, hydrology, groundwater, and bathymetry), ecological (flora, fauna, fisheries, insects, and benthos) and socioeconomic (cultural resources, economic activities, health, tourism, water supply and sanitation, roads and communications) resources through field investigations, analysis of spatial database and satellite imageries, and review of previous studies.

4.1 Physical Resources

34. Padma River is the confluence of two mighty Rivers, the Ganges and the Brahmaputra (Jamuna) and hence the flow in the Padma River is affected by the flow regime of both these Rivers. Padma is both meandering and a braided river with dynamic and simultaneous processes of erosion and accretion. Many Charland (sand bars) are eroded and formed due to this process. Further, there is a continuous erosion of the river banks, especially on the south bank and hence width of the Padma at the Project site varied between 2 and 6 km from 1968 to 2009. There are two main channel flows in the Padma, one on north side and the other on south side. The main flow of Padma oscillates between the two channels with currently North Channel is more active while the south channel is silting up.

35. The Project area is located in the flood plain of the Padma, which is part of the active delta system consisting of flat alluvial plains. The topography in the Project area is almost flat with elevations on the left bank along the approach road ranges from 6.7m PWD to 7.7m PWD, while elevations of the right bank along the approach road ranges from 3.6 to 7.7m PWD. Elevation in the Charland ranges from 1.5 to 6m PWD.

36. Soils in the Project area are mostly alluvium with the presence of non-calcareous minerals (calcite and dolomite) from the Ganges River deposits and mica and biotitic from Jamuna River sediments. Due to the braiding character of Padma River with its shifting position, the subsoil normally consisted of an intercalation of sands, medium fine sands to silt, and sometimes clay.

37. Landuse in the Project area is mostly comprises of agricultural land, homestead land, homestead vegetation and water bodies rich with aquatic habitats. On both sides of the river, agriculture is the major landuse with 65% in left bank and 86% in right bank. While in the Charland, about 34% is agriculture, 43% is fallow land, 20% wetland and only 3% is used for housing and settlement.

38. Other major surface water resources located in the Project area are Naodoba River, the tributary of Padma, five canals from Padma and several ponds. The Project area has a huge groundwater potential and groundwater occurs both in unconfined and confined conditions. Groundwater is widely used for drinking as well as for irrigation purposes in the Project areas. The water table from flood plains in the shallow aquifers is almost close to ground level, while depth to the water table from the deeper aquifers ranges from 3 to 8m.

4.2 Ecological Resources

39. Wildlife surveys covering flora, fauna and fisheries are being conducted to inventory the terrestrial and aquatic ecosystem in the flood plains, Padma River and in Charland in the Project area on a bi-monthly basis for one whole year. Inventory on habitats and species, breeding ground, migration routes of commercial important fishes and aquatic animals, spawning and feeding grounds of key aquatic and terrestrial animals, seasonal movement and life cycle status of key species like Hilsa, gharial and dolphin, avifauna (especially migratory species), etc. are established. Detailed information on the flora and biodiversity of the Project area, including biodiversity of avi-faua, fish, amphibians, reptiles, mammals and invertebrates are in Volume 4: Ecological Report.

40. Monitoring results of some of the important wildlife are given in Table 2.

Table 2: Wildlife monitoring survey results

Name	IUCN/ CITES Status	Local Status	Local Name	Number Sighted ¹	Location Sighted
Birds					
Brown Fish Owl	Vulnerable	Uncommon Resident	Khoira Mechopecha	2	Lauhajang village 3.5 km d/s of bridge side, Kumarbhog, 1.5 km d/s of bridge side
Comb Duck	Critically Endangered	Vagrant (Critically)	Badi Hansh	1	Approx. 5km u/s from bridge

Name	IUCN/ CITES Status	Local Status	Local Name	Number Sighted ¹	Location Sighted
		Endangered- IUCN BD)			
River Lapwing	Endangered	Uncommon Resident	Nodi Titi	7	8km in u/s from the bridge
Black-winged Kite	CITES II	Uncommon Resident	Katua Chil	35	Bhaggyakul, 6.5km u/s from the bridge alignment
Brahminy Kite	CITES II	Common Resident	Shonkho Chil	9	Kathalbari Char, 2km u/s of the bridge alignment
Crested Serpent Eagle	CITES II	Common Resident	Tila Nag-eegol	2	Char Janajat 10km d/s of bridge side, Bhaggyakul 6 km u/s of bridge side
Spotted Owllet	CITES II	Common Resident	Khuruley Kutipecha	3	Char Janajat 10.5 km d/s of bridge side, Medini Mandal 1.5 km u/s of bridge alignment
Mammals					
Ganges River Dolphin	Endangered	Common Resident	Shushuk	33	River up and down stream of the bridge
Fishing Cat	Endangered	Endangered- IUCN BD	Macho Bagh	13	Charland both u/s and d/s of the bridge
Smooth Otter	Endangered	Uncommon Resident	Ud Biral	3	Homestead grove on Janjira within 3.5km u/s from the bridge
Common Otter	Critically Endangered	Rare Resident	Ud Biral	2	Homestead grove on Janjira within 3km u/s from the bridge
Indian Crested Porcupine	Endangered	Uncommon Resident	Shojaru	1	Homestead grove on Janjira within 2.5km u/s from the bridge
Golden Jackal	Vulnerable	Common Resident	Pati Shial/Shial	1	Bhaggyakul 6 km u/s of bridge alignment, Lauhajang village 3 km d/s of bridge side
Jungle Cat	Endangered	Rare Resident	Ban Biral	2	Bhaggyakul, 6 km u/s from the bridge alignment
Large Indian Civet	Endangered	Uncommon Resident	Bagdash	1	Char Janajat 11 km d/s of bridge side
Small Indian Civet	Vulnerable	Uncommon Resident	Khatash/Choto bagdash	1	Lauhajang village 3.5 km d/s of bridge alignment
Reptiles					
Gangetic Gharial	Critically Endangered	Rare Resident (Endangered -IUCN BD)	Gharial	1	8km u/s from the bridge
Ganges soft- shell Turtle	Vulnerable	Uncommon Resident	Khulua Kasim	6	4km from the bridge
Brown Roofed Turtle	Endangered	Uncommon Resident	Barokori Kaitta	4	Charland both u/s and d/s
Median Roofed Turtle	Endangered	Common Resident	Majhari Kaitta	6	Charland both u/s and d/s
Brooks House Gecko	Vulnerable	Common Resident	Gui Shap	1	Charland both u/s and d/s
Yellow-bellied House Gecko	Endangered	Rare Resident	Sona Gui	3	Charland both u/s and d/s
Striped Keel back	Endangered	Uncommon Resident	Kal-keute Shap	2	Charland both u/s and d/s
Common Smooth Water Snake	Endangered	Common Resident	Khoiya Gokhra Shap	2	Charland both u/s and d/s
Common Wolf Snake	Vulnerable	Rare Resident	Gokhra Shap	2	Charland both u/s and d/s
Spotted Flapshell	Vulnerable	Common Resident	Patapori/ Shundi Kasim	2	Char Janajat 9 km d/s from Bridge alignment

Name	IUCN/ CITES Status	Local Status	Local Name	Number Sighted ¹	Location Sighted
Turtle					
Yellow Monitor	<i>Endangered</i>	Common Resident	Sona Gui	6	Homestead groove of Janjira side 3 km u/s from the bridge alignment
Bengal Monitor	Vulnerable	Common Resident	Gui Shap	6	Lauhajang Village, 3 km d/s from Bridge alignment
Olive Keel back	CITES III	Common Resident	Matia Shap	7	Lauhajang Village, 3 km d/s from Bridge alignment
Spectacled Cobra	CITES II	Common Resident	Khoiya Gokhra Shap	1	Bhaggyakul, 6 km u/s from the bridge alignment
Monocled Cobra	CITES II	Rare Resident	Gokhra Shap	2	Bhaggyakul, 6.5 km u/s from the bridge alignment
Indian Snake	Rat CITES II	Common Resident	Gharhinni Shap	1	Bhaggyakul, 6 km u/s from the bridge alignment
Amphibians					
Green Frog	Endangered	Uncommon Resident	Sabuj Bang	3	Charland both u/s and d/s and other wetlands
Ornate Microhylid	Vulnerable	Common Resident	Cheena Bang	1	Charland both u/s and d/s and other wetlands
Pointed-headed Frog	Vulnerable	Uncommon Resident	Pana Bang	1	Charland both u/s and d/s and other wetlands
Two-striped Grass Frog	Endangered	Uncommon Resident	Kaad Bang	5	Charland both u/s and d/s and other wetlands
Large Tree Frog	Vulnerable	Uncommon Resident	Baro Gecho Bang	2	Charland both u/s and d/s and other wetlands
Indian Bull Frog	CITES II	Common Resident	Sona Bang	26	Charland both u/s and d/s and other wetlands

Source: Consultant's Bi-monthly Survey, 2009-2010.

Note: ¹Number sighted during the months of July, September, November, 2009 and January, March 2010.

4.3 Environmental Quality

41. Baseline environmental quality of the Project area is established through environmental quality monitoring by two survey programs during July and November 2009 (covering both dry and wet seasons). Parameters for baseline quality monitoring are chosen based on the requirements of national standards and as well as by the expert consultations. The following parameters are measured in the different locations of the Project boundary:

- *Surface Water Quality:* pH, total dissolved and suspended solids, conductivity, chloride, ammonia-nitrogen, iron, arsenic, dissolved oxygen, biological and chemical oxygen demand, and oil and grease.
- *Ground Water Quality:* pH, manganese, iron, arsenic, conductivity, ammonia-nitrogen, total hardness, chloride, total coliform, and fecal coliform
- *River-Bed Materials:* Metals (arsenic, cadmium, chromium, copper, mercury, nickel, lead, selenium, manganese and zinc) and Multiresidue Pesticide (Carbamates, Pyrthelods, Organochlorines, and Organophosphates)
- *Air Quality:* Sulfur oxides, nitrous oxides, particulate matter and suspended particulate matter
- *Noise:* 4 sets of 15 min records for day and night time i.e., between 6 AM to 9 PM and 9 PM to 6 AM.

42. The complete environmental quality data along with the methodology of field sampling and laboratory analysis is given in Vol. 3: Environmental Quality Baseline Monitoring Survey.

43. Groundwater from shallow tube wells contains high arsenic concentrations than the national standards; while deep tube wells of more than 90 m depth contains low arsenic concentrations. In

addition, high manganese concentration found in tubewell with depth more than 274m. Hence, all the proposed water supply wells in the Project will be deep tube wells of minimum 300 m depth.

44. RTW in the Project generate a huge volume of dredge materials of about 44 million m³, and some of this material will be used for filling of the Project sites. Hence, the quality of riverbed materials is critical for its suitability for filling purposes. It was found that river bed materials do not contain any heavy metals or pesticide residue.

45. Noise and air quality levels at some locations in the Project area exceeded the national standards.

4.4 Social and Economic Profile

46. The total population of the three Project districts is about 9 million. The population of the Char Janajat, the big Charland located just upstream side of the bridge site is about 200,000. Since the project area is located in the floodplain, people usually do not construct permanent houses and ready to move safer places in the event of major flood or erosion.

47. There are no designated historical or archaeological resources within the Project area. The general cultural resources in the Project area are mosques, school/madrassa, mazaar, club/society, and grave. Among 30 structures, 12 of them are temporary mosques, 2 private school/madrassa, 1 mazaar, 11 club/society, 2 Jamey mosques, and 2 graves.

48. Principal occupations of the households in the Project area are mainly agriculture and business. Other occupations are transportation, labor, industry, service etc. Business through trade/business is the major profession of the heads of the affected households at Mawa Side (42.6% male and 0.2% female), while agriculture is the primary profession at Janjira Side (49.55% male and 0.44% female).

49. Though only 1.68% of the affected households depend on the fishing, significant part of the economy in the Project area is generated through fish marketing. A whole sale fish market is located in Mawa side at Dakhin Medinimondal in Munshiganj district. About 9,000 people are directly dependant on the fish market for their earning. In 2003-2004, the total fish produced from the Padma basin was 7.928 tons, in which 16.5% (1, 307 tons) was from the Project districts. The people in the Charland are poor and live mainly on agriculture and fishing.

50. Three ferry ghats are located near the Project area, Mawa ferry ghat on Mawa side, Kathalbari and Kewrakandi ferry ghats on the Janjira side. About 20,000 people are directly or indirectly dependent on the different economic activities in and around the ferry ghats.

5 Scoping and Prioritization of Impacts

51. A detailed scoping analysis has been carried to assess the impact of the various project activities on the various environmental components such as physical, ecological, social and environmental quality.

52. A methodology was developed and used to prioritize all environmental components to identify key and significant environmental impacts during various stages of the Project that need to be thoroughly addressed for mitigation and management. The prioritization process includes scoring of various environmental impacts and dividing them into six categories, viz. low, medium and high significant positive impact, low, medium and high significant negative impact.

53. The high significant negative environmental impacts of the Project are:

- Land acquisition and resettlement
- Loss of homestead vegetation
- Reduction of fish breeding areas due to filling of flood plains, impact on hilsa migration during pile driving
- Generation of huge quantity of dredge materials
- Loss of crop production

- High noise and vibration
- Health, hygiene and sanitation of construction workers and public
- Huge quantity of material transport
- Erosion and scour

54. The medium negative environmental impacts of the Project are:

- Generation of excess materials
- Blocking of flood water flows and natural drainage
- Impacts on wildlife and aquatic habitats
- Increase in water turbidity
- Impact on Charland
- Noise and air pollution due to construction activities
- Traffic havoc and road safety

55. The significant positive benefits of the Project are:

- Development of new plantations along the approach roads and in all Project sites
- Development of resettlement sites with all necessary infrastructure facilities
- Regional development through connection of the southwest of part of the country with the rest of country, which is now connected only through ferry
- Huge potential for employment during construction and O/M stages as well as from induced economic growth and activities

56. The induced development, due to post Project development in the region, has both negative and positive impacts. The positive impacts are increase in the socio-economic conditions of the region through employment generation and poverty reduction. The negative impacts are (i) air and noise pollution due to construction activities, increase in traffic levels and industrial development, (ii) generation of wastes due to increased living standards, (iii) consequent health impacts due to pollution and waste generation, (iv) loss of biodiversity, and (v) land acquisition and resettlement.

6 Climate Change Considerations

57. A climate change study was conducted as part of the EIA. The study outcome on observed and projected trend or statistics in climatic parameters is presented in Vol 4: Factoring Climate change in the Design of the Project. These parameters facilitated the design team for adopting a climate response design of the bridge and RTW.

58. Three major sea level scenarios are considered for estimating the sea level rise at Bay of Bengal. The three scenarios are:

- Global sea level rise as Projected by IPCC 2007
- Local sea level rise in the Bay of Bengal as per IPCC 2007, and
- Additional ice sheet contribution to the global sea level rise

59. Based on these three scenarios, the following three sea level rises are considered for modelling of the river water levels at the Project site

- A high end low probability estimate of sea level rise of 0.98 m
- A low end estimate of sea level rise of 0.26 m
- A pragmatic mid-range estimate of sea level rise of 0.60 m

60. Based on the outcome of the climate change modelling, the following recommendations are made to include in the Padma Bridge Design:

- For the maximum sea level rise of 1.00m, rise in the water level at the bridge site is considered 0.47m. Combining the effects of sea level rise and increase basin rainfall, 0.63m rise in water level or maximum water level 7.44m PWD should be considered.
- It is recommended to consider the maximum temperature of 46.6°C and minimum temperature of 9.3°C in the design.

- The design should consider either the 1-day or 2-day consecutive maximum rainfall of 372 mm and 514 mm for a 1 in 100 year return period event.
- The predicted peak discharge of 151,100 cumec and lowest flow as 7,345 cumec should be considered in the hydrological analysis.
- Maximum wind speed is predicted as 126 km/h.
- The risk of salinity intrusion in the Padma Bridge is considered to be nil or insignificant and hence excluded from the design considerations.

7 Analysis of Alternatives

7.1 Framework of Alternative Assessment

61. Alternative assessment has been carried out for the various options for main bridge, RTW and transition structures. The alternative assessment for bridge location has already been carried out during Feasibility Study stage (JICA, 2005). A framework of has been developed with the following criteria for comparative analysis of various alternatives:

- Technical Robustness
- Constructability
- Maintenance
- Cost
- Social and Resettlement Aspect
- Environment
- Proven Previous Use

7.2 Alternatives for Project Location

62. Feasibility Study has identified following four possible sites for the bridge construction and recommended Site 3: Mawa – Janira as the preferred alignment.

- Site 1: Paturia – Goalundo: narrow River section located just downstream of the Jamuna – Ganges confluence at Paturia ferry port to connect National Highway 7 (left bank) and National Highway 5 (right bank).
- Site 2: Dohar – Charbhadrasan: narrow River section located at about 35 km downstream of Site 1. Presently, there is no ferry crossing available at this site.
- Site 3: Mawa – Janjira: narrow River section at Mawa ferry ghat to connect National Highway 8 on both the banks. Ferry crossing is already operational.
- Site 4: Chandpur – Bhedarganj: narrow River section located just downstream of the Meghna – Padma confluence at Chandpur to connect regional road 140 (left bank) and 180 (right bank).

7.3 Alternatives for Main Bridge

63. Feasibility study has recommended a single level concrete extradosed bridge, while the detailed design consultants recommended a two level steel truss bridge. These two options are considered for detailed alternative analysis.

64. **Concrete Extradosed Bridge:** A prestressed concrete extradosed bridge with both road and rail are located on the same upper deck. Rail track is located at the centre while two road carriage ways are located on both sides. Associated facilities such as gas and cable lines are located at the bottom of the deck. Length of the bridge is 5.58 m with span lengths varying from 60 m to 180m and total piers are 44.

65. **Composite Steel Truss Bridge:** A composite steel truss bridge with the road on the upper level and the rail at the lower level. Rail line is located on the centre of the lower deck while associated facilities such as gas and cable lines are located on the lower deck on either side of the rail line. The lower deck is steel, while the upper deck is concrete. Total length of the bridge is 6.15

km with a span length of 150 m and total piers of 41. The span length is 150m and overall depth is 13.6m, the span-to-depth ratio is 11, which is typical for steel truss structure.

66. The composite steel truss bridges considered the preferred alternative due to the following key advantages over an extradosed concrete bridge:

- It has a lower estimated construction cost;
- It uses a proven form of structure for a combined road and rail bridge;
- Construction time would be reduced and is more suited to the seasonal nature of the site;
- It provides the opportunity for high quality of construction with a significant part of the work being constructed off site;
- It best accommodates the major services to be carried on the bridge;
- It provides better safety provision by separating road from railway and utility crossings;
- It provides the most direct access for future inspection and maintenance.

7.4 Alternatives for River Training Works

67. The key objective of RTW on both sides of the River at bridge location is to protect the river bank from erosion so that the bridge, approach roads and railways can remain integrated and functional during the operation and maintenance phase of the Project. For the north bank at Mawa, the risk of erosion is estimated to very low and hence only modifications and refinement of Feasibility Study suggested RTW option is recommended without conducting any alternative analysis. However for south bank at Janjira, due its vulnerability to frequent erosion, following alternatives are considered for alternative analysis.

68. **Alternative 1: Revetment on Bank of Southside Channel:** A 12 km continuous revetment is proposed along the south bank for protection of all project components. The 6 km section of the revetment near the bridge will be raised above the flood level to prevent overtopping or outflanking from floodplain flows.

69. **Alternative 2: Guide Bund and Upstream Hard Points on South Bank:** A guide bund near the bridge landing site to protect the main bridge and viaduct structures with two hard points on the upstream to protect other Project components. These hard points will not prevent bank erosion between the two hard points and between the hard point and guide bund.

70. **Alternative 2 Modified – Hard Points in Char:** Alternative 2 Modified is an optimization of Alternative 2 by shifting of the two hard points across the south channel on the char, while the guide bund at the main bridge is unchanged from Alternative 2.

71. Based on the alternative assessment, Alternative 1, revetment along south bank, is the preferred scheme for RTW. The advantages of this option compared to other options are:

- Less sensitive to future changes - (i) situated along the existing bank, (ii) leaves room for a river with higher discharge, (iii) less sensitive to channel shifting as guiding the flow parallel to the bank.
- Less impact on the river downstream, as opposed to solutions aggressively narrowing down the channel.
- Lower scour depth: revetments are associated with less river depth, which means less adaptation and maintenance as opposed to short structures.
- Less negative social impact.
- Less impact on river and floodplain ecology
- Less impact on the floodplain - no disturbance of flow patterns along upstream approach road as revetment ends at floodplain.

8 Assessment of Impacts of Preferred Alternative

72. The following detailed investigations are carried to assess the magnitude of the environmental impacts identified in the scoping process:

- Census survey to assess the extent of land acquisition and resettlement, loss of vegetation, occupation, income and poverty levels of the affected households, etc.
- Noise modeling using FHWA TNM 2.5 (Federal Highway Administrators Traffic Noise Model) to predict the traffic noise levels.
- Estimates of railway noise and vibration using 'Transit Noise and Vibration Impact Assessment', Federal Transit Administration.
- Emission inventories of various criteria pollutants and greenhouse gases using USEPA (United States Environmental Protection Agency) and IPCC guidelines.
- Air Quality Dispersion Modeling using CALINE4/CAL3QHCR to predict the pollutant concentrations.
- Hydrological modeling using MIKE 11 and MIKE 21 to map the configuration of river morphology and flow pattern due to the Project intervention and to simulate the impacts of climate change on water levels at the Project site.
- Satellite image processing using remote sensing technology for landuse mapping.
- Environmental quality baseline monitoring of air, noise, surface water, groundwater and river bed sediments,
- Ecological surveys comprising vegetation, wildlife and fisheries covering both mainland and Charland,
- Charland surveys comprising socioeconomic status and environmental settings,
- Expert consultations focus group discussions, and public consultations.

8.1 Project Related Significant Impacts

73. **Land Acquisition and Resettlement:** About 1,062 ha of land will be required for construction of the Project components. All land required for the Project will be acquired during the pre-construction stage. Only the sites designated for the construction yards (163 ha) will be acquired through leasing for about 6 years period. About 4,511 households require resettlement due to lose structures (includes housing, business and other structures). Total affected persons of the Project area 74,143. This includes, (i) 24,970 persons to be physically displaced due to loss of residential/commercial structures, (ii) 46,637 persons from 8,526 households affected by loss of agriculture land only (i.e., economically affected), and (iii) 2,536 persons indirectly affected by the closure of ferry, etc. Acquisition of about 640 ha of agriculture land will lead to the reduction of about 5209 tons of crops per year.

Table 3: Land Affected for Padma Bridge Project

Components	Land Acquisition and Requisition (in ha) by District			Charland ¹	Total
	Munshiganj	Shariatpur	Madaripur		
Main Bridge				190	190
Approach Road – acquisition	30.8	78.93	66.36		176.09
Service Area – acquisition	27.03	63.7	0		90.73
RTW – acquisition	114.72	190.53	203.5		508.75
Toll Plaza – acquisition	17.5	4.78	6.6		28.88
Resettlement sites – acquisition	30.26	19.95	18.45		68.66
Construction Yard	81	0	0		81
Subtotal – acquisition	301.31	357.89	294.91		1,144
Construction Yard – requisition ²			0	78	78

TOTAL Affected Land	301.31	357.89	294.91	268	1,222
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Note:

- (1) Land affected for creating access/transit channel for barge and heavy equipment movement. This land is government khas land and does not require acquisition
- (2) Land for construction yard in the Mawa site has been chosen in an alternative location which is an adjacent Charland. This land is proposed to be procured through acquisition for future potential use of the BBA for maintenance of goods movement and storage, visitor center (display and archiving of the bridge construction). The construction yard in the Janjira site has also been shifted and proposed for requisition of about 78 ha land.

Table 4: Project Affected People by Census type

Types of losses	Affected households (AHs)				Affected Persons (APs)			
	RS	AR and BEF	RTW	Total	RS	AR and BEF	RTW	Total
Agricultural land	436	6,072	2,018	8,526	2,385	33,214	11,038	46,637
Structures (includes housing, business and other structures)	31	1,542	3,402	4,975	196	7,874	18,622	26,692
Total	565	7,614	5,420	13,501	2,679	41,088	31,437	73,329
Physical cultural resources	1	27	63	91				
Indirect impacts (wage earners and others)					98	1,007	1,777	2,882

Source: RAP I, II and III 2010

74. **Vegetation:** About 211,273 trees will be cut during site clearance of various Project components. However extensive tree plantation (about 405,461 trees in about 100 hectares) will be taken up along the approach roads and in all Project components. About 25 m of plantation strip on both sides of the approach road will be developed. Exclusive green belt areas are proposed for development of plantations in RS.

Table 5: Loss of trees by all project components

Project Component	Sizes	Number of Trees ¹				Total	
		Large	Medium	Small	Saplings		
	Garth Size	>100cm	50-100cm	<50cm			
Resettlement Sites	Mawa		190	379	454	582	1,605
	Janjira		2,995	843	1,837	665	6,340
	<i>Subtotal</i>		<i>3,185</i>	<i>1,222</i>	<i>2,291</i>	<i>1,247</i>	<i>7,945</i>
Approach Road, transition structure, toll plaza	Mawa		5,476	3,971	8,055	7,203	24,705
	Janjira		11,074	11,179	22,771	10,528	55,552
	<i>Subtotal</i>		<i>16,550</i>	<i>15,150</i>	<i>30,826</i>	<i>17,731</i>	<i>80,257</i>
Service Area	Mawa (SA1)		46	105	191	76	418
	Janjira (SA2)		244	532	1,030	2,719	4,525
	<i>Subtotal</i>		<i>290</i>	<i>637</i>	<i>1,221</i>	<i>2,795</i>	<i>4,943</i>
Construction Yards	Mawa (CY1)		0	0	0	0	0
	Janjira (CY2)		196	331	366	148	1,041
	<i>Subtotal</i>		<i>196</i>	<i>331</i>	<i>336</i>	<i>148</i>	<i>1,041</i>
River training works ²	Mawa		6,430	4,495	18,463	25,447	54,835
	Janjira		2,783	5,847	20,872	22,750	52,252
	<i>Subtotal</i>		<i>9,213</i>	<i>10,342</i>	<i>39,335</i>	<i>48,197</i>	<i>107,087</i>
Total:		29,434	27,682	74,039	70,118	201,273	

Source: BIDS Survey 2009-2010 and BBA Study 2006.

Notes:

1. Number of trees without bamboo and banana
2. Data based on BBA 2006 study.

75. **Crop Loss:** A total of about 764 ha agriculture land will be permanently acquired for various project components. It is estimated that yearly crop production loss will be about 21,972 tons due to the project interventions. In Mawa side, the loss will be about 1,079 tons and in Janjira side it is about 20,893 tons (Table 6). Major crops in Mawa side are rice and potato and in Janjira side they are onion, sugarcane, garlic and wheat.

Table 6: Loss of agriculture crops by the project components

Crops	Mawa	Janjira
Rice	539.53	1,591.18
Potato	539.53	0
Wheat	-	1,911.77
Mustard	-	1,567.02
Jute	-	1,828.20
Onion	-	5,223.42
Garlic	-	2,918.17
Coriander	-	804.93
Cumin seeds	-	103.45
Sugarcane	-	4,178.73
Banana	-	766.60
Total	1,079.06	20,893.47

Source: The Consultant's Estimate, 2009-2010

76. **Fisheries and Aquatic Life:** Filling of about 767 ha of construction sites in the flood plain areas to the design flood level will reduce the fish-breeding area of flood plain. Filling of 12 ha of fish ponds impact the 22.95 tons of fish production per year. In addition, underwater aquatic habitats of about 20ha in Charland and 468ha in Padma River will be completely destroyed during the construction work. Construction of approach roads on flood plain will restrict free movement of fisheries. Pile driving works will create noise and vibration that will affect breeding and migration of aquatic life. Hilsa in the bridge sites migrates from March to May through deep waters. Two such deep channels are located on Mawa side and any piling works in these channels during hilsa migration season will affect their movement. In addition, breeding time of dolphin is during April to July. Therefore, it is recommended that piling activities will be stopped in all deep channels with water column depth more than 7m during March to July.

Table 7: Affected aquatic habitats by project components

Footprints	Affected Habitats (ha)		
	Mawa	Janjira	Total (ha)
Main Bridge (Charland)		20.00	20
Construction Yard (Padma River)	173.00	0.00	173
River Training Works (Padma River)	24.90	270.00	294.9
Floodplains	154.78	612.70	767.48
Ponds	2.53	9.52	12.05
		Total	1,267.43

77. **Dredge Materials:** Dredging works will be carried out during dry season along river banks up to a depth of -25 m PWD to remove the river bed sediments for construction of RTW. In addition, dredging will be carried out on the shallow river beds along the bridge alignment to provide adequate depths for the barges carrying cranes and other heavy construction equipment for the main bridge substructure and superstructure works. Dredging is also required for smooth ferry operations during construction. Further, additional dredging may also be required for filling up of some of the project sites, which will be developed before RTW. It is estimated that about 44 million m³ of dredge materials will be generated over two seasons due to the construction of RTW alone. In addition, dredging will be required for temporary bank protection works of Mawa construction yard, access/transit channel in Charland for floating barges and cranes, and heavy equipment maneuvering

in pier locations. Due to its high turbidity, direct disposal of these dredged materials in the river flow in the dry season will create negative impacts on the aquatic life. Disposal of the materials on the land, for reclamation purposes or filling of project sites to flood free level, generates a huge outflow of wet materials that contain very high turbidity and potentially impact the soil fertility of nearby agricultural lands.

Table 8: Quantity of materials generated from dredging operations

No	Project Components	Quantity (M m ³)
1	Mawa Construction Yard (CY1)	1.73
2	Mawa RTW	10
3	Janjira RTW	34
4	Access/Transit Channel in Charland	2.37
5	Maneuvering Areas in Charland	6.75

78. **Landuse:** Landuse in the Project area will be completely changed due to filling of flood plains for Project activities and due to future induced development.

79. **Transport:** About 381,741m³ concrete, 2,600,000m³ concrete block, 84,000 tons stell truss, 29,600 tons reinforcements, and 6,050,000tons of rock, 9,431tons of bitumen, and 296,880m³ of aggregates will be required for the major construction activities. These materials will be transported by both water and road. These additional transports will cause traffic congestion on the existing transportation system and safety hazards. In addition, the local roads are not designed to heavy axle loads and as such may suffer damage from being used by these heavy transports. During O/M stage of the project the bridge will carry road and rail traffics which will have potential significant positive impact on transport by reducing travel times. These travel time savings are expected to be in the order of 2 hours for cars and bus, to 10+ hours for trucks by 2014. Opening year traffic is expected to be 12,056 vehicles per day, growing over 75,636 in thirty two years. The country as a whole will enjoy uninterrupted transport network between all the major cities and ports, on both sides of the River Padma, as a result of the Project, directly benefiting more than 30 million people south western part of the country.

Table 9: Indicative quantities of material for major project components

Component	Material	Unit	Quantity
<i>Bridge</i>			
	Concrete	m ³	163,000
	Reinforcement	ton	13,600
	Fabricated steel truss	ton	84,000
<i>Approach Viaducts</i>			
	Concrete	m ³	104,000
	Reinforcement	ton	16,000
<i>River Training Works</i>			
	Concrete Block	m ²	2,600,000
	Rock ¹	ton	6,050,000
<i>Approach Road</i>			
	Bitumen	ton	9,431
	Concrete	m ³	114,741
	Aggregates	m ³	296,880

Note: (1) Rock quantities do not take account of probable increase in geobags quantities and corresponding reduction in rock quantities which is likely after the results of the Geobag Model Study are known in August 2010.

80. **Noise Quality:** Noise pollution from various construction activities such as pile driving, vehicle movements, crushing of stones/rocks, generators for electricity, and similar other construction activities, etc. Noise and vibration due to usage of different construction equipment are assessed. During O/M noise quality along the Project road will be increased due to the increase in the traffic volumes. Noise modeling suggests that the roadside receptors will be exposed to high noise level; however the noise levels in most cases are within the acceptable limit. The noise quality in the Project area will be improved due to closure of ferry and development of plantation on both sides of the approach road.

81. **Employment and Poverty Reduction:** There is a huge potential for employment during construction and O/M stages as well as from induced economic growth and activities.

82. **Health, Hygiene and Sanitation:** Large immigrant work force during construction works and their camp sites are hot spots for sanitation, health and hygiene. Construction yards and construction sites will have impacts occupation health and safety of the workers. Establishment of health centres in the resettlement sties and implementation of public health action plan will improve the health conditions in the Project area.

83. **Scour:** Natural scour occurs at certain points on a natural channel under the influence of varying flows, sediment transport, channel shifting and other fluvial processes. Local structure-induced scour results from interference with natural flows by bridge piers and abutments, RTW structures etc. Where a structure is in place, it is not always easy to distinguish between natural and structure-induced effects. The deepest scour is usually, but not always, associated with the highest flows in the river, at least up to the bank-full stage. Once bankfull conditions are exceeded the flow may tend to straighten out and the velocity may not increase appreciably. Therefore, on braided or highly anabranching Rivers the worst scour condition may occur near bankfull conditions. Provisional estimates of natural scour have been determined as (i) lowest bed level outside of the flood season: -37m PWD, (ii) provisional estimate natural scour level (2 year) -39m PWD, and (iii) Provisional estimate natural scour level (100 year) -50m PWD

8.2 Project Related Medium Impacts

84. **Excess Wastes:** Improper management of wastes and excess materials from the construction sites will lead to soil and water pollution. Improper management of hazardous waste will lead to health hazards and environmental impacts. Materials used in construction have a potential to be a source of contamination. Improper storage and handling of fuels, lubricants, chemicals and hazardous goods/materials on-site, and potential spills from these goods may harm the environment or health of construction workers.

85. **Drainage:** The flood plains will be submerged during high floods. The raising of the road embankment to a flood free height will cause additional runoff to be held behind the embankment. The flood plain is of major significance to the maintenance of fish stocks and provides a rich feeding area for fish that move in and out of the floodplain. The raised embankments will restrict the movement of fish.

86. **Water Quality:** Turbidity of River water will increase due to the dredging activity and disposal of dredged materials. Materials from superstructure formworks and other activities, and solid waste into the river will deteriorate water quality in the river. Accidental spillage of fuels, lubricants, chemicals/solvents will contaminate soils and water.

87. **Air Quality:** Local air quality will be deteriorated from the emission of vehicles, construction equipments, dusts generated from carrying and dumping of soils, crushing of stones/rocks, etc. During O/M, the increased road traffics will emit air pollutants, which will increase with the increase of road traffics year after year. On the other hand, due to construction of bridge the ferry operation will stop which will improve ambient air quality and reduce the green house gas emissions.

88. **Top Soil:** Loss of fertile topsoil and soil erosion due to construction activities and subsequent siltation to immediate vicinity affecting agricultural lands during rainy season at construction stage.

8.3 Project Related Significant Risks

89. **Traffic Accidents:** During operation of the bridge, roads, and railway major traffic accidents will cause short-term closure of the road, railway and bridge operation. Towing of damaged vehicles, locomotives and cars will be required quickly to resume operation.

90. **Terrorist Event/Threats:** During a Credible Terrorist Threat or events increased security and police presence and/or military action, security check points, or closure of the Bridge and approach road will be required.

91. **Flooding:** Major flooding may cause the closure of approach road and bridge (including railway).

9 Environmental Management and Monitoring Plan

9.1 Management of Project Related Impacts

92. An EMMP has been prepared for each identified high and medium ranked impact/risk and included in the EIA report. This EMMP is divided into three sections, pre-construction, construction, and O/M. Again each section is further divided into Project activity to address activity wise impacts. Each impact in the EMMP is addressed by the following steps

- Activity
- Impact
- Mitigation measures
- Monitoring means
- Frequency of Monitoring
- Budget
- Implementation agency
- Supervision Agency

9.2 Environmental Code of Practices

93. A standard Environmental Code of Practice (ECP) has been prepared to address all general construction related environmental impacts of the PMBP. The ECPs will provide guidelines for best operating practices and environmental management guidelines to be followed by the contractors for sustainable management of all environmental issues. This ECP will be annexed in the general conditions of all the contracts carried out under the PMBP.

94. The list of ECPs prepared for the PMBP is given below:

- ECP 1: Waste Management
- ECP 2: Fuels and Hazardous Goods Management
- ECP 3: Water Resources Management
- ECP 4: Drainage Management
- ECP 5: Soil Quality Management
- ECP 6: Erosion and Sediment Control
- ECP 7: Top Soil Management
- ECP 8: Topography and Landscaping
- ECP 9: Borrow Areas Development & Operation
- ECP 10: Air Quality Management
- ECP 11: Noise and Vibration Management
- ECP 12: Protection of Flora
- ECP 13: Protection of Fauna
- ECP 14: Protection of Fisheries
- ECP 15: Road Transport and Road Traffic Management
- ECP 16: River Transport management
- ECP 17: Construction Camp Management
- ECP 18: Cultural and Religious Issues
- ECP 19: Workers Health and Safety

95. It is recommended that all major contractors to be procured under the Project will be a compliant of ISO 14000. This will be done by BBA imposing the requirements of ISO certification

during prequalification of contractors. In addition, all subcontractors under the major contractors will be subject to ISO 14001 audit provisions by the major contractor during the course of the project. These Contractors will prepare a 'Construction Environmental Action Plan' (CEAP) demonstrating the manner in which they will comply with the requirements of ECPs and the mitigation measures proposed in the EMMP of the EIA Report. The CEAP will form the part of the contract documents and will be used as monitoring tool for compliance. Violation of the compliance requirements will be treated as non-compliance leading to the corrections or otherwise imposing penalty on the contractors.

9.3 Dredge Material Management Plan

96. Dredging works will be carried out during dry season along river banks up to a depth of -25 m PWD to remove the river bed sediments for construction of RTW. In addition, dredging will be carried out (i) on the shallow river beds along the main bridge alignment to provide adequate depths for the barges carrying cranes and other heavy construction equipment for the main bridge substructure and superstructure works; (ii) for temporary RTW works for operation of construction yard near Mawa side, and (iii) for equipment maneuvering operations in the Charland during construction. Further, additional dredging may also be required to source borrow material for filling up of some of the project sites, which will be developed before RTW. A dredge material management plan is prepared to address the management of dredge materials generated from the dredging works of RTW and other project components. Dredge materials will be used in the filling of the Project sites to a flood free level. However, due to differences in the sequence of dredging operations and filling activities (e.g. service areas and construction yards will be developed prior to the dredging works) it may not be feasible to use all the dredging material for filling up of the Project components. Low lying, non-habitable and recently formed Charland are ideal sites for disposal of dredged materials in dry season. Dredge materials can be placed on low lying Charland located on the downstream side of the Bridge in confined disposal facilities to contain the sediments during the dry season and allowing them to erode during subsequent monsoon seasons. Disposal of materials into the river in the monsoon is not considered problematic since the natural turbidity of the river is very high in monsoon. Alternatively, these materials from disposal facilities can also be used by the other contractors for filling up of the Project sites. Further, owing to the huge demand of the dredge materials, both public and private agencies can be provided access to collect the materials for their own use at free of cost or nominal charges.

9.4 Emergency Response Plan

97. An Emergency Response Plan to use in the O/M stage is prepared for seven emergency events that may potentially affect the operation of the Bridge and other project assets. These events are: flooding, traffic accidents (road and rail), spill/leak of hazardous materials in land & water, civil disturbance/riot, terrorist event/threat, and gas leak/ explosion. The objective of the plan is to facilitate a rapid and effective emergency response and recovery; provide assistance to emergency and security services; implement an effective evacuation plan if required, and communicates vital information to all relevant persons involved in the transport emergency (both internal personnel and external agencies) with a minimum of delay. The plan outlines the necessary resources, personnel, and logistics, which allow for a prompt, coordinated, and rational approach to a transport accident. The plan contains sufficient detail to enable those involved in the response to effectively carry out their duties.

9.5 Adaptation of EMMP during Implementation

98. Though EMMP developed for the Project in this EIA report by providing key preventive, mitigatory and enhancement measures and processes to ensure compliance with safeguards - for a project as big as PMBP, some adaptation/changes are possible during implementation. These changes may not be known at this stage. In such instances, modifications in the EMMP will be carried out by the construction supervision consultants or BBA.

9.6 Compensation and Environmental Enhancement Plans

99. The following compensation and environmental enhancement plans are prepared for the Project to improve the environmental conditions of the Project affected households, the community and the Project area:

- Community environmental management plan (CEMP) for design and development of Resettlement Sites (RS)
- Tree plantation and greenbelt development plan
- Public Health Action Plan
- Wildlife Management Plan for the loss of aquatic habitats
- Agriculture development plan, and
- Income and livelihood restoration plan

100. **Community Environmental Management Plan:** A community environmental management plan is prepared to enhance the environmental and socioeconomic conditions of the project affected households by developing 4 resettlement sites (RS) with all basic infrastructure and environmental improvement facilities to relocate the Project affected households. The Plan is presented in the Vol 5: Community Environmental Management Plan. The objective of the plan is to improve the quality of the life of the affected households through.

- Improved living standards by providing basic necessary infrastructure facilities like schools, health centres, religious places, markets, playground, and roads.
- Safe drinking water supply and sanitation facilities.
- Development of greenbelt and plantation.
- Enhancement of fish production in the ponds.
- Income generation through access to markets.
- Solid waste and liquid waste management.
- Access to schools and health centres.
- Increased awareness health and hygiene.

101. **Tree Plantation and Greenbelt Development Plan:** About 211,000 trees will be cut due to clearing of sites for various construction activities to be carried out under the Project. A tree plantation and greenbelt development plan is proposed to compensate the lost vegetation and to improve the environmental and ecological status of the Project area. About 100 hectares of land will be exclusively used for development of about 405,461 trees.

102. **Wildlife Management Plan:** Charland and bankline in Padma within the project boundary provide habitat for a wide range of fauna species and are of high conservation significance for birds, amphibians, reptiles, mammals, and grassland dwelling avifauna species including migratory birds. Charland with their reeds, mudflats and sandy beaches are the major staging grounds for migratory birds. Chars act as breeding grounds for endangered species such as turtles and gharials. The Charland, main channels, and bankline in the Project area are under stress by the human encroachment and activities, and will be temporarily disturbed due to construction works of the Project. A conservation plan is proposed to support the wildlife in the project affected area as a measure of environmental compensation under the Project. The plan will cover the following:

- Wildlife monitoring for the continued baseline establishment and monitor the changes during the construction and operation stages.
- Establish a protected sanctuary to support breeding grounds of wildlife and aquatic habitats including fish to compensate the habitat loss by the implementation of the project.
- Develop a visitor center in the bridge end facilities from where tourists and day trippers can visit the protected sanctuary.
- Create awareness among the surrounding people about the protection of wildlife.
- Implement appropriate mitigation measures for the protection of fauna during construction activities.
- Study and monitor both the resident and migratory species of wildlife during construction and O/M stages.

103. **Agriculture Development Plan:** To compensate the loss of agricultural land and associated crop production, an agricultural development plan is proposed to (i) bring barren/fallow lands into cultivation, (ii) Increase crop yield on the existing farmlands by introducing high yield variety crops, (vi) modifying cropping pattern i.e. towards the cash crops, and (v) By converting one-crop lands into two or three crop lands and two-crop lands into three-crop lands.

104. **Income and Livelihood Restoration Plan:** For restoration of income of the APs to the pre-project level, an income and livelihood restoration plan (ILRP) is proposed under Resettlement Action Plan of the Project. The plan has provisions for alternative income generation/skill development and other enabling strategies through which AP can either continue their previous occupation or can start a new venture or undertake an alternative occupation.

9.7 Environmental Enhancement Fund

105. It is proposed that BBA should create an Environmental Enhancement Fund (EEF) for promotion of environmental development activities and to assist in protection and conservation of environment in the Project area. The EEF will be developed by collecting 1% from vehicle tolls of the Padma Bridge. The fund supports projects linked to the PMBP infrastructure that directly enhance, restore or protect environmental resources and O/M of environmental enhancement facilities proposed under the Project.

9.8 EMMP Budget

106. The total environmental budget proposed for the Project is US\$ 18.6 million, which includes (i) contractors budget for environmental monitoring and mitigation measures, (ii) PIU budget for implementation of compensation and enhancement plans, (iii) environmental consultants for Construction Supervision Consultant, (iv) institutional strengthening and capacity building, (v) environmental monitoring during O/M, (vi) O/M of compensation and enhancement plans including community environmental management plan, and (vii) emergency response plan.

10 Institutional Arrangement and Capacity Building

107. The institutes responsible for implementing the EMMP are.

- Bangladesh Bridge Authority
- Project Implementation Unit
- Environmental Unit
- Environmental Management Committee
- Department of Environment
- Construction Supervision Consultant,
- Contractor

108. Following institutional strengthening and capacity building programs are proposed for BBA for strengthening their capacity in EMMP implementation.

109. **Step A: Creation of Safeguard Department:** It is recommended to create an environment and social Unit, called as “Safeguard (Environment and Resettlement) Department”, in BBA directly under Executive Director’s office. This will give due importance to the issues and pressures that the scale of projects undertaken by BBA have on society and environment. This unit will be staffed by 3 environmental specialists and 3 social/resettlement specialists.

110. **Step B: Association with Twinning Institutions:** PIU will be associated with set of esteemed organizations and training institutes like Bangladesh University of Engineering Technology and CEGIS, etc. which will act as ‘twinning institutions’ for capacity building and development. These institutions will support PIU with providing their laboratories for analysis and other technical facilities available with them.

111. **Step C: Capacity Building Programs:** Continuous and oriented trainings on developing capacity of the implementing agencies on social and environmental issues of the Project and their management.

112. **Step D: Third Party Engagements:** Engagement of consultants for independent monitoring, external monitoring and evaluation, and auditing.

113. **Step E: Establishment of Environmental Management System:** BBA is committed to ensure that its operations will not create adverse environmental impacts. In this regard, the BBA will need to establish and effectively operate an appropriate Environmental Management System (EMS).

114. **Step F: Establishment of GIS and MIS:** A GIS/MIS will be established to monitor social and environmental issues of the Project.

11 Public Consultations and Information Disclosure

115. Three tiered consultation meetings were conducted with the following objectives in various locations:

116. **Expert Consultation:** Twenty two experts were consulted through individual and group meetings, including the Project Panel of Experts, selected individuals and organizations with professional knowledge of EIA processes. The meetings were conducted at a very early stage of the EA with the objective to brief stakeholders about the project components, and to discuss potential environmental impacts of the Project. The consultations offered the opportunity to collect available secondary data and information on environmental parameters. Also these consultations facilitated in identifying the parameters for baseline environmental monitoring survey. In addition, the regulatory requirements for environmental clearance, and the public consultations were discussed in detail. The outcomes of those consultations were used to finalize the scoping framework and prepare the draft TOR for the EIA study.

117. **Focus Group Discussions (FGDs):** Thirteen FGDs were conducted (5 at the resettlement sites, 2 on the Charland, two at RTW alignments, 2 at service areas, and 2 at construction yards) with the affected communities at all resettlement sites, service areas, construction yards, Charlands and ferry ghats. These discussions were attended by 293 people including representations from women. The purpose was to discuss specific issues, such as ferry *ghat* displacement during construction, access to district and local roads from the bridge and approach roads, livelihood restoration, land acquisition, compensation and resettlement, civic amenities at resettlement sites, community involvement and sustainable environmental management. The outcome of those discussions was used to prioritize impacts and risks, and to structure the CEMP.

118. **Public Consultation:** As per harmonized safeguard requirements, two public consultations are required for the Project as part of the environmental assessment procedure. Extensive consultations have been conducted and public participations are sought during the project preparation since 2000. Awareness about the project among the affected community is well established. The public consultations were conducted at seven locations involving 718 participants (including teachers, students, entrepreneurs, employed person, farmers, drivers, housewife, masons, public representatives, and government officials) representing affected persons, union and upazila leaders, NGOs, and national and local government representatives. It was found that most of the participants were aware of the proposed Project, which they fully supported. The participants requested that a sound environmental mitigation plan be prepared to address the various impacts anticipated during the pre-construction, construction and implementation stages and to ensure the protection of sensitive locations. A major concern for the participants was land acquisition and the need for proper compensation, access to family graves underneath the bridge transition structure, livelihood restoration, and civic amenities at resettlement sites. The recommendations from the public consultations are incorporated in the engineering design e.g., proper drainage structures and facilities around the resettlement sites, avoiding construction close to sensitive locations, access to

River from RTW, landings for speedboat and country boats, livelihood development, least land acquisition, and proper compensation plan for the affected community.

12 Economic Assessment

119. The bridge will support development in an area that has till date been poorly serviced by the road network, thereby reducing transport costs and inducing additional trips that would have previously thought it too expensive to make the trip. The benefits of the Project will include:

- The bridge will provide significant travel time savings to the traffic in the corridor, particularly between the Dhaka to the southwest of Bangladesh and possibly onto India. These travel time savings are expected to be of the order of 2 hours for cars and bus to 10+ hours for trucks when the bridge is operational by 2014.
- The construction and operation of the Padma Bridge, will result in significant economic benefits to the southwest region, in the form of increased production, goods and services; relocation and generation of new economic activities.
- Increased economic activity and consumption expenditure will lead to poverty alleviation in Khulna and Barisal Divisions.

120. The quantified benefits of the bridge investment are measured incremental to the 'without bridge' case, i.e., they are measured as the difference between the 'without project' and 'with project' cases. The benefits are:

- annual savings in vehicle operating costs and travel time to existing passengers and freight crossing the Padma River;
- annual value of new trips from the regional economic development induced by the improved accessibility provided by the bridge – this value can be approximated by the benefits associated with the new trips provided by the transport model by incorporating this generated demand;
- savings in economic costs associated with non-operation of the ferry service
- savings generated by provision of utilities through river crossing;
- avoided costs of having to build a separate rail bridge when the Dhaka-Jessore railway line had to be constructed sometime in the future;
- capitalized value of annual rental returns from land provided in the service areas and agricultural land to be reclaimed or protected by the river training works; and
- revenue from bridge structure usage fees levied on utilities for provision of bridge area for installation of their facilities.

121. Based on the quantified benefits, the project is economically viable, with a net present value of US\$ 5,942 million, a benefit-cost ratio of 4.4 and an economic internal rate of return of 27%, in excess of the economic opportunity cost of capital of 12%.

13 Conclusions

122. All EAP documents are prepared based on the harmonized environmental safeguard requirements of the co-financiers and the Government of Bangladesh. The EIA reveals that the Project will have overall positive impacts and some negative impacts. Most of these negative impacts are mainly construction related and can be mitigated by the successful implementation of the EMMP. There will be some residual impact for significant negative impacts, which will be compensated, in addition environmental enhancement measures are also recommended in the EMMP. Therefore, the completion of this environmental assessment fully meets the harmonized environmental safeguard requirement of the co-financiers and the Government of Bangladesh.