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TA-8128 BAN (PPTA): Preparing Coastal Towns Infrastructure Improvement Project

DRAFT FINAL REPORT
VOLUME 1: MAIN REPORT

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Cover Photographs

Latrine, Amtali Pourashava	Damaged outfall flapgate, Galachipa Pourashava
Possible site for boat landing station, Pirojpur Pourashava	Water supply pond, and pond sand filter unit, Mathbaria Pourashava

This report consists of six volumes:

Volume 1	**Main Report**
Volume 2	Appendices
Volume 3	Project Administration Manual
Volume 4	Annex: Climate Change Assessment and Adaptation Strategy
Volume 5	Annex: Infrastructure, Water Resources
Volume 6	Annex: Financial and Economic Analyses

PREPARING COASTAL TOWNS INFRASTRUCTURE IMPROVEMENT PROJECT
PPTA - TA-8128 BAN

DRAFT FINAL REPORT

VOLUME 1: MAIN REPORT

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GLOSSARY OF BANGLADESHI TERMS

crore	10 million (= 100 lakh)
ghat	boat landing station
hartal	nationwide strike/demonstration called by opposition parties
khal	drainage ditch/canal
khas, khash	belongs to government (e.g. land)
katcha	poor quality, poorly built
lakh, lac	100,000
madrasha	Islamic college
mahalla	community area
mouza	government-recogized land area
parashad	authority (pourashava)
pourashava	municipality
pucca	good quality, well built, solid
thana	police station
upazila	subdistrict

ACRONYMS

ABD	Asian Development Bank
ADP	annual development plan
ADSL	Associates for Development Services
AIFC	average incremental financial cost
AP	affected person (resettlement)
BBS	Bangladesh Bureau of Statistics
BC	bitumous carpeting
BCCRF	Bangladesh Climate Change Resilience Fund
BDT	Bangladesh Taka
bgl	below ground level
BLS	boat landing station
BMD	Bangladesh Meteorological Department
BMDF	Bangladesh Municipal Development Fund
BMGF	Bill and Melinda Gates Foundation
BRAC	Bangladesh Rural Advancement Committee
BRM	Bangladesh Resident Mission (ADB)
BT	bitumen topped (road)
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CAG	Comptroller and Auditor General
CAGR	compounded annual growth rate
CARE	An NGO
CBO	community-based organization
CC	city corporation; cement concrete; climate change
CCA	climate change adaptation
CCF	Climate Change Fund
CCR	climate change resilience
CCRIP	Climate Change Resilient Infrastructure Project
CDIA	Cities Development Initiative for Asia
CDMP	Comprehensive Disaster Management Programme
CDTA	capacity development technical assistance
CEIP	Coastal Embankment Improvement Program
CEP	Coastal Embankment Project
CLTS	Community-Led Total Sanitation
CQS	Consultants' Qualification Selection
CTIIP	Coastal Towns Infrastructure Improvement Project
CUIDG	

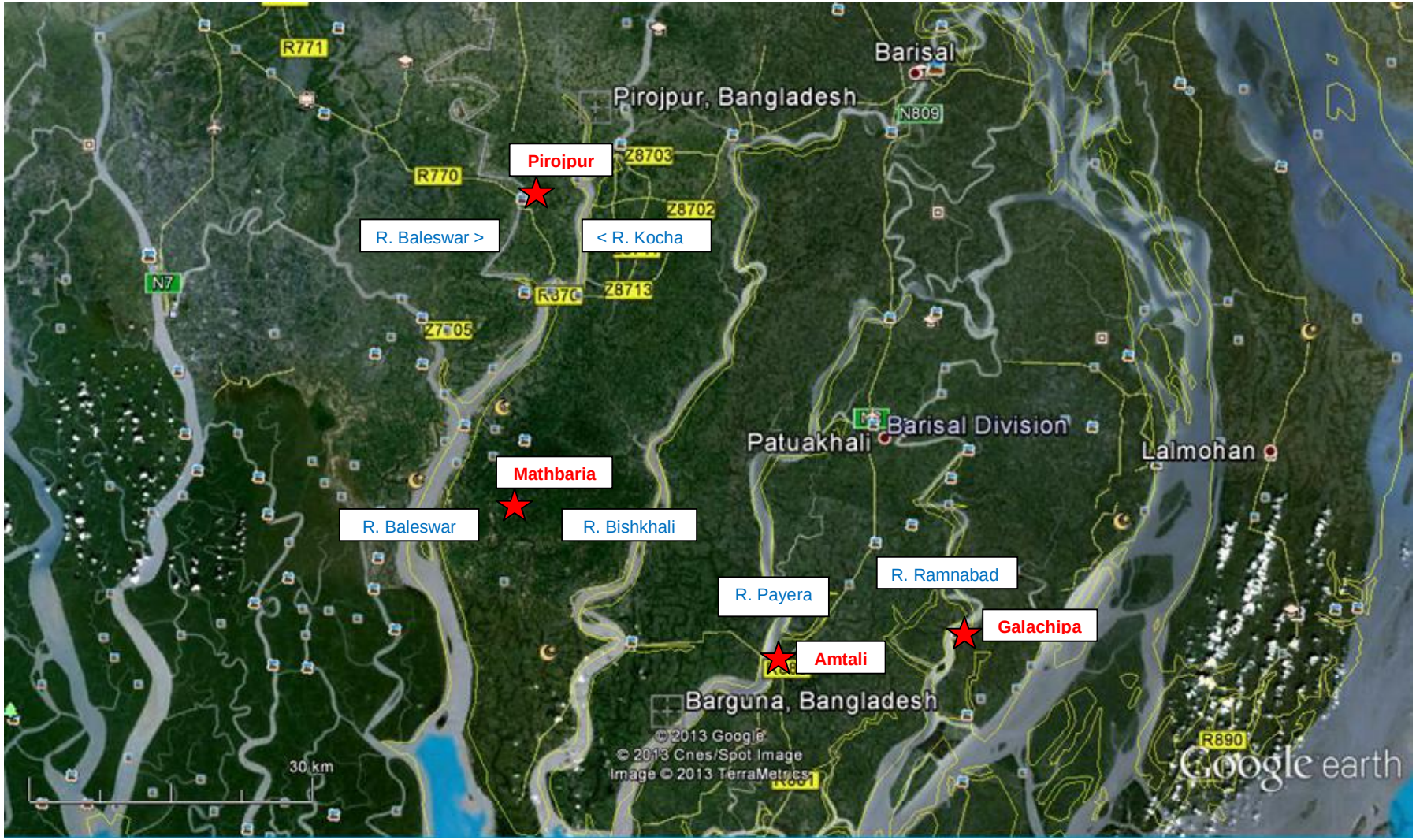
DANIDA	Danish International Development Agency
DED	detailed engineering design
DEM	digital elevation models
DEWATS	decentralized wastewater treatment system
DFID	Department for International Development (UK)
DFR	draft final report
DM	disaster management
DMC	developing member country
DMF	design and monitoring framework
DP	development partner
DPHE	Department of Public Health Engineering
DPP	development project proforma
DRM	disaster risk management
DRR	disaster risk reduction
DSCR	debt service coverage ratio
DSK	Dushthya Shasthya Kendra (an NGO)
DSP	deep set pump (in tubewell)
DTIDP	District Towns Infrastructure Development Project
DWASA	Dhaka Water Supply and Sanitation Authority
EA	executing agency
EARF	environmental assessment review framework
EIA	environmental impact analysis
EIRR	economic internal rate of return
EMP	environmental management plan
EOCC	economic opportunity cost of capital
EU	European Union
FAPAD	Foreign Aided Project Audit Directorate
FGD	focus group discussion
FMAQ	financial management assessment questionnaire
forex	foreign exchange
FS	feasibility study
FY	fiscal year (1 July – 30 June)
GBM	Ganges-Brahmaputra-Meghna river basin
GCM	General Circulation Model
GHG	greenhouse gas
GHK	GHK Consulting Limited (ICF GHK)
GIS	geographic information system
GIZ	German Society for International Cooperation
GOB	Government of Bangladesh
HBB	herring bone bond (road)
HH	household
IA	implementing agency
ICB	international competitive bidding
IEC	information-education-communication
IEE	initial environmental examination
IIED	International Institute of Economic Development
IOL	inventory of losses
IPCC	International Panel on Climate Change
IPPF	indigenous peoples planning framework
IT	information technology
IUCN	International Union for Conservation of Nature
IWA	International Water Association
JFPR	Japan Fund for Poverty Reduction

JICA	Japan International Cooperation Agency
KfW	German development funding agency
KPI	key performance indicators
LARP	land acquisition and resettlement plan
LBDT	lakh Bangladesh taka (BDT100,000)
LDRRF	local disaster risk reduction fund
LGD	Local Government Division
LGED	Local Government Engineering Department
LGI	local government institution
LOI	letter of intent
LS	lump sum
l/s, lps	liters per second
MAR	managed aquifer recharge
MBDT	million Bangldesh taka
MCA	multi-criteria analysis
MDG	Millennium Development Goals
M&E	monitoring and evaluation
MFF	Multitranche Financing Facility (ADB)
MHRW	Ministry of Housing and Public Works
MIDP	municipal infrastructure development plan
MIS	management information system
MLD	million liters per day
MLGRDC	Ministry of Local Government, Rural Development, and Cooperatives
MODMR	Ministry of Disaster Management and Relief
MOE	Ministry of Education
MOF	Ministry of Finance
MOU	memorandum of understanding
MSP	Municipal Services Project
MTBF	Medium Term Budget Framework
NAPA	National Adaptation Program of Action
NCB	national competitive bidding
NGO	non-government organization
NIRAPAD	Network for Information, Response and Preparedness Activities on Disaster
NPDM	National Plan for Disaster Management
NPV	net present value
NRW	non-revenue water
OCR	Ordinary Capital Resources (ADB)
ODA	official development assistance
OHT	overhead tank
OJT	on-the-job training
O&M	operation and maintenance
PAM	project administration manual (ADB)
PD	project director
PDA	project design advance
PDP	pourashava development plan
PIU	project implementation unit
PMO	project management office
PMU	project management unit
PPCR	Pilot Program for Climate Resilience
PPMS	project performance management system
PPP	public-private partnership
PPTA	project preparatory technical assistance
PRA	participatory rural appraisal

PSF	pond sand filter
PSU	pourashava sanitation unit
PWD	Public Works Department (datum)
QC	quality control
QCBS	Quality- and Cost-Based Selection
QM	quality management
RAJUK	Rajdhani Unnayan Katripakkha
RCC	reinforced cement concrete
RF	resettlement framework
ROW	right of way
R&R	resettlement and rehabilitation
RRP	report and recommendation of the president (ADB)
RSC	rural sanitation center
SCF	Strategic Climate Fund (ADB)
SDP	sector development plan
SEWTPS	socioeconomic and willingness-to-pay survey
SFYP	(Bangladesh) Sixth Five-Year Plan
SIDA	Swedish International Development Agency
SLR	sea level rise
SPA	social poverty assessment
SPCR	Strategic Program for Climate Resilience (GOB, 2010)
SPEC	Special Project Evaluation Committee
SPS	Safeguard Policy Statement (ADB)
SST	sea surface temperature
STWSSSP	Secondary Towns Water Supply and Sanitation Sector Project
SWM	solid waste management
SWOT	strength-weakness-opportunities-threat (analysis)
SWTP	surface water treatment plant
TA	technical assistance
TNA	training needs assessment
TOR	terms of reference
TOT	training-of-trainers
TRM	tidal river management
UDD	Urban Development Directorate, Ministry of Housing and Public Works
UFW	unaccounted-for water
UGIAP	urban governance improvement action plan
UGIIP	Urban Governance Infrastructure Improvement Project
ULB	urban local body
UNDP	United Nations Development Programme
UNFRA	United Nations Food Relief Agency
UN-HABITAT	United Nations agency for human settlements
UNICEF	United Nations Children's Fund
UP	union parashad
UPPRP	Urban Partnerships for Poverty Reduction Project
USAID	United States Agency for International Development
UTIDP	Upazila Towns Infrastructure Development Project
V	variation (contract)
VRC	vulnerability reduction credit (climate change adaptation)
WACC	weighted average cost of capital
WAPDA	Water and Power Development Authority
WARPO	Water Resources Planning Organization
WASH	water, sanitation and hygiene
watsan	water and sanitation

WB	World Bank
WFPF	Water Financing Partnership Facility (Netherlands Trust Fund)
WHO	World Health Organization
WQ	water quality
WRM	water resources management
WS	water supply
WSP	water service provider
WSP-EAP	Water and Sanitation Program – East Asia Pacific
WSS	water supply and sanitation
WSUP	Water and Sanitation for Urban Poor
WTP	willingness-to-pay
WWTP	wastewater treatment plant

LOCATION MAP



★ **Study town**

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1 INTRODUCTION

1. This Draft Final Report presents the investment scope and financing plans for the proposed Coastal Towns Improvement Project (CTIIP). The project is located in the coastal area of Bangladesh, and is designed to improve and expand municipal infrastructure and related services in selected pourashavas (municipalities) incorporating climate chance resilience measures. Complementing the physical infrastructure components will be project management support services, and institutional development and capacity building activities.

2. A sector lending modality will be used as the financing framework for CTIIP. As is the case with other projects financed under a sector lending modality (such as Urban Governance and Infrastructure Improvement Project and the Secondary Towns Water Supply and Sanitation Project), the release of project funds to the pourashavas will be administered under a 2-stage process known as the Performance Criteria Mechanism, whereby the project pourashavas have to meet certain institutional capacity and governance criteria to receive funding

3. The project design has been prepared under a Preparatory Project Technical Assistance (PPTA) financed by the Government of Japan though a Japan Fund for Poverty Reduction (JFPR) grant, and administered by the Asian Development Bank (ADB). The PPTA covers a period of 8 months. The Consultant (lead firm GHK Consulting Limited [ICF GHK] and associated companies ADSL and eGen) mobilized on 9 January 2013.

4. The Executing Agency (EA) for the PPTA is the Local Government Engineering Department (LGED) in the Local Government Division (LGD) of the Ministry of Local Government, Rural Development, and Cooperatives. LGED is mainly responsible for developing municipal infrastructure (such as roads, bridges, drainage) in local government areas. Close liaison has been kept with the Department of Public Health Engineering (DPHE) for technical advice and guidance on water supply and sanitation.

5. During the PPTA feasibility studies were conducted in four towns in Barisal Division: the three towns studied under CDTA-7890[1] (Amtali, Galashipa and Pirojpur) and Mathbaria.

6. Additional funding for the PPTA, from the Netherlands Trust Fund under the Water Financing Partnership Facility, is being used for two capacity building mobile support teams (MST) consisting of national consultants to assist the study pourashavas to prepare for the compliance of performance criteria which will trigger the release of project funding tranches. The MSTs mobilized in June 2013.

7. There have been three ADB missions during the PPTA: Inception (5-14 February 2013), Interim (5-13 May), Final Review (30 June - 7 July, intermittent).

2 PROJECT RATIONALE

8. The low-lying deltaic coastal area of Bangladesh (consisting of 19 districts in 4 divisions, with a total population of about 38.1 million, of which the urban population is about 8.6 million)[2] is very vulnerable to severe weather events such as tropical cyclones in the Bay of Bengal and storm/tidal surges, resulting in extensive flooding, backup of sewage, wind damage and, tragically, loss of human lives. Existing urban infrastructure in pourashavas such as water supply systems, sanitation facilities, roads, bridges and boat docking stations

[1] CDTA-7890 *Strengthening the Resilience of the Urban Water Supply, Drainage, and Sanitation to Climate Change in Coastal Towns*, the Final Report of which was completed in June 2013.

[2] BBS Community Reports, 2012.

is generally inadequate, and suffers a great deal of damage during such events.

9. Modeling studies conducted during the PPTA indicate that cyclones will intensify in the future owing to increased sea surface temperatures in the Bay of Bengal. In fact, it is estimated that the number of severe storms will increase in the future, with those having wind speeds of over 250 km/hour tripling in frequency. Sea level rise is exacerbating the vulnerabilities of coastal towns, as storm surge heights will increase. Climate change impact is expected to result in an average sea level rise of between 17.5-39 cm by 2050—this could make 10-15% of the country extremely vulnerable to floods, and dislocate around 35 million people from coastal towns and rural areas.[3]

10. As well the increased risk of flooding, sea level rise will also increase saline intrusion of water supply sources (both surface water, and shallow groundwater), which will deteriorate water quality and the availability of potable water, with disproportionate impacts to women and the poor, including impacts on maternal health.[4] Backup of sewage and water logging due to inadequate drainage will result in a deterioration of public health though the increased prevalence of waterborne diseases.

11. The impacts of climate change on coastal towns will be significant. Damages to buildings, roads, and economic activity will be steep. During Cyclone Sidr in 2007, an estimated $45 million in loss and damage was assessed. For 2045 the model indicates cyclone damage may increase to about $20 million in the four PPTA towns **(Table ES.1)**.

12. New infrastructure will need to take into account changes in climate, including increased requirements for drainage systems, and higher flood inundation levels impacting the integrity of roads, bridges, and other infrastructure. New cyclone shelters will be required.

13. Governance and institutional capacity local governments in coastal towns is weak, and poverty incidence is high (52%).[5] A recurring theme, in interviews with local and central government officials, and with coastal town residents and non-government organizations (NGO), is the limited role of the pourashavas in disaster risk reduction (DRR) and disaster risk management (DRM). The limited power of pourashavas to raise revenues limits their ability to maintain existing infrastructure.[6] Extensive capacity building in local governments is needed to facilitate the development and operation of basic needs infrastructure.

Table ES.1: Future Projection of Damage Caused by Tropical Cyclones

(Million US$)

Town	2010	2020	2030	2040	2050
Galachipa	2.51	2.85	3.07	3.62	4.43
Amtoli	3.48	3.87	4.12	4.40	5.53
Mothbaria	2.65	3.07	3.34	3.65	4.95
Pirojpur	2.58	3.00	3.31	4.20	5.81
Total	12.79	13.83	15.87	20.71	21.84

Source: PPTA Consultant.

[3] The Daily Star: Business, 22 April 2013, citing ADB study on cutting greenhouse gases.

[4] Aneire Ehmer Khan et al. September 2011. *Dinking Water Salinity and Maternal Health in Coastal Bangladesh: Implications of Climate Change.* Vol. 119, No. 9, Environmental Health Perspectives.

[5] Ministry of Local Government, Rural Development & Cooperatives, Local Government Division, Local Government Engineering Department. Oct 2012. *Technical Assistance Project Proposal (TPP) (Recast) for Project Preparatory Technical Assistance (PPTA) Project for Coastal Towns Infrastructure Improvement Project (CTIIP) (Financed by Asian Development Bank) (SPEC meeting held at 30 September 2012*.

[6] Smith, Barry, *Financing Urban Adaptation to Climate Change: Assessment of International Funding Mechanisms,* Background paper for Financing Urban Adaptation to Climate Change - An International Meeting Hosted by IIED, 13-14 June 2013, p. 29. Less than 2% of total government revenue is collated at sub-national levels.

14. Coastal towns face similar constraints in urban development and planning as encountered throughout urban Bangladesh, but exacerbated by the anticipated impacts arising from climate change. These constraints include: (i) steadily accelerating, hitherto unplanned and uncontrolled urbanization, some of which is attributable to the migration push factors of increased vulnerability to climate change, (ii) severe deficits in appropriate and adapted urban infrastructure provision and basic service delivery resulting from alarming financial constraints, (iii) planning instruments that either have not existed or are inadequately adapted to climate change and disaster risk management, lack an implementation-orientation and/or are un-enforced, (iv) the growth in urban poverty and lack of inclusiveness in municipal planning, with the burden of vulnerability falling disproportionately on the urban poor, (v) severe constraints in local government capacity, governance structures, and municipal finances all of which impact on the ability of pourashavas to respond to climate change.

15. Local urban planning is in its infancy throughout Bangladesh, including the coastal towns, with master plans and development control systems only now emerging. There is agreement that efficient planning systems are critical for efficient urban development and management, the need for which is magnified by climate change and the need to manage and reduce disaster risks. CTIIP will systematically build capacity in urban planning in general, and urban planning and climate change in particular, by strengthening the climate resilience of master plans, enhancing development control systems, introducing straightforward infrastructure investment programming and building the understanding of, and skills, in urban planning within the participating pourashavas.

3 OVERALL PROJECT PLANNING AND COMPONENTS

16. **Impact.** The expected impact of CTIIP is improved access to and delivery of climate resilient municipal services in selected pourashavas, including urban roads and bridges, solid waste management, drainage, and water supply and sanitation; and reduction of the occurrence of water-related diseases, with reduced exposure to climate extremes.

17. **Outcome.** The projected outcome is the provision of more accessible, reliable and climate-resilient municipal services to the population of the pourashavas. The project design will incorporate the role of women in improving municipal services, particularly for water supply and sanitation, and target the poor.

18. **Outputs/ components.** The construction of improved infrastructure is by far the largest cost component of the project. However, ensuring that this infrastructure is transformed into sustainable services resilient to climate change will also require other factors such as improving community awareness and pourashava accountability and ensuring that pourashavas have sufficient human and financial resources to continue to deliver these services effectively.

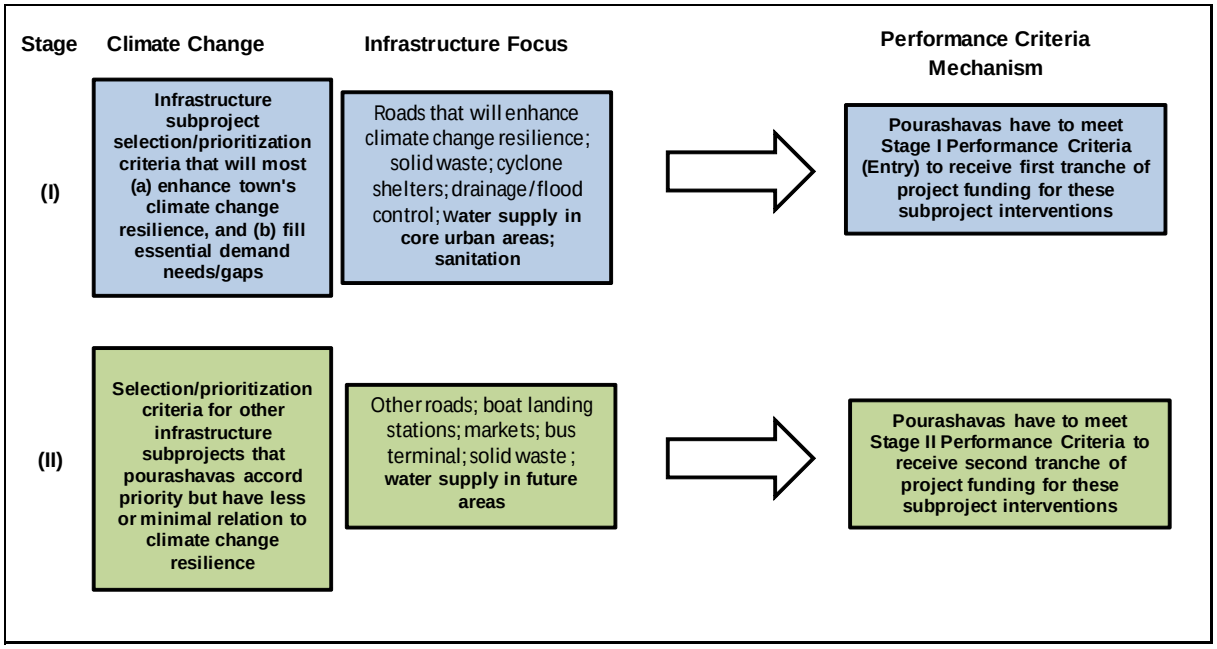
19. Taking this into account, the project outputs will be: (i) improved municipal infrastructure with climate-resilient designs; (ii) strengthened local governance and institutional capacity for sustainable service delivery, urban planning and climate change adaptation; (iii) awareness raising and behavioral change in community-based climate change adaptation, disaster preparedness, and hygiene activities; and (iv) project management and administrative support.

20. **Infrastructure planning.** The scope of infrastructure subprojects/interventions was determined through an iterative, consultative process with LGED, ADB, and the four study pourashava local governments and other relevant stakeholders. In line with the 2-stage Performance Criteria Mechanism and associated funding triggers, infrastructure selection was divided between Stage I funding and Stage II funding, as illustrated on **Figure ES.1**.

21. Selection criteria were developed within this framework and priority was given to the potential subprojects' contribution to climate change resilience. Stage I includes those infrastructure components in urban core areas and considered critical for building climate change resilience such as: (i) cyclone shelters, (ii) roads, bridges and culverts which will enhance climate change resilience through improved connectivity and access to emergency services in the event of disasters caused by natural hazards, (iii) solid waste management, (iv) drainage and flood control, and (v) water supply in urban core areas, and (vi) sanitation.

22. Investments considered under Stage II could include: (i) other priority roads, bridges, and culverts, (ii) boat landing stations, (iii) markets, (iv) bus terminals, and (v) solid waste management, and (vi) water supply for future planned development areas.

Figure ES.1: Infrastructure Intervention Selection with Relation to Performance Criteria Mechanism



23. **Project towns/pourashavas.** It is intended that as many coastal towns as possible will participate in the project, depending on scope, readiness to meet the performance criteria, and availability of funding resources.

24. The four PPTA study towns constitute Batch 1. It was estimated during the ADB final review mission (30 June – 7 July 2013) that four more towns (Batch 2) could be covered by the project from the funding resources which were planned in the Technical Assistance Project Proposal (TPP).[7] If additional funding resources can be secured, from bi-lateral donors, further towns could be covered.

[7] Ministry of Local Government, Rural Development & Cooperatives, Local Government Division, Local Government Engineering Department. Oct 2012. *Technical Assistance Project Proposal (TPP) (Recast) for Project Preparatory Technical Assistance (PPTA) Project for Coastal Towns Infrastructure Improvement Project (CTIIP) (Financed by Asian Development Bank) (SPEC meeting held on 30 September 2012)*.

25. Batch 2 towns will be selected from a long-list of 36 pourashavas in 11 districts in the coastal region, based on criteria developed during the PPTA. The selection of infrastructure interventions for these towns will be conducted by the EA using the criteria developed during the PPTA.

26. **Project Design Advance.** To avoid the risk of start-up delays as a result of recruiting project implementation consultants, a project design advance (PDA) TA will initiate these tasks prior to loan approval. It is anticipated that the PDA detailed design consultants will start in November/December 2013.

4 CLIMATE CHANGE PROJECTIONS AND IMPACTS

27. Climate change projections are summarized in **Table ES.2**. Current and future climate will impact the infrastructure, environment, ecology, agriculture, water supply, sanitation and livelihood of the people of the areas covering the selected coastal towns. The increase in temperature has the potential to cause material expansion resulting in damages to concrete structures such as buildings, bridges, and culverts and bitumen seals to roads, which are susceptible to softening unless higher temperature resistant construction materials are used. The expansion and contraction due to high fluctuation of temperature may affect life of the structures. Floods resulting from increased rainfall, cyclones and storm surges have the potential to damage roads, embankments, water supply, sanitation, markets, housing and drainage structures. Sea level rise (SLR) will increase the potential risks.

28. Based on field surveys and flood modeling, it is that anticipated flooded areas will increase in each pourashava. Also, what is most noticeable is the increase in the area flooded more than 25 cm deep (by 6.5-7.6%). The cause of this increase in the flooded area is attributed to the increase of monsoon rainfall. Of course the increase of flood area is a function of the topography, but as 25 cm is the depth at which the flooding causes significant physical and economic impacts, any action that can minimize these impacts will be helpful.

Table ES.2: Climate Change Projections to 2050

Climate Element	Status of change
Temperature	➢ Current change: 0.4^0 C during last 50 years ➢ Future: 1.4^0C by 2030 and 2.5^0 C by 2050
Rainfall	➢ Current trend: 25 cm in last 50 years ➢ Wetter monsoon rainfall with future scenarios: Increase of 13.5-19% in 2030 ➢ Increase of 22-25% in 2050 ➢ Increase of 27% in 2060
Sea Level Rise (SLR)	➢ Current SLR: 4-6 mm/year ➢ Projection in 2030: 21 cm reference to land inside polders. ➢ Projection in 2050: 39 cm reference to land inside polders.
Increase of Tidal Level	➢ Tidal Level will also increase due to SLR.
Tropical Cyclones and surges	➢ Tropical cyclone intensity will rise and the destruction will be severe due to wind and surges. ➢ Tropical cyclones may have wind up to 275km/hr in the future.
Salinity impacts	➢ The 5ppt line of salinity will move further inland affecting the pourashavas of Amtali and Galachipa in 2050, and all these pourashavas and Mathbaria will come under this 5 ppt line in 2100.

Sources: Various, compiled by PPTA Consultant.

29. 'Drainage congestion'[8] is one of the main constraints to efficient and effective drainage and flood control services. Already it is shortening the time available to discharge runoff to the primary drainage systems by up 10 hours per tidal cycle during the peak of the monsoon season in some locations, as well as reducing the capacity of the existing outfalls, channels and drains. By 2050 it is possible that some low lying areas will be 100% restricted during both spring and neap tides at the peak of the monsoon. Another constraint is the increase in rainfall intensity, which is increasing the amount of runoff. By 2050 individual storm events may increase by as much as 27%. Both constraints will increase the risk of more frequent and severe flooding.

5 EXISTING INFRASTRUCTURE SITUATION IN STUDY POURASHAVAS

30. **Roads.** Pourashava roads generally fall into two categories: *kutcha* (earthen) construction and *pukka* (formed) roads. Formed roads are mainly black-topped (BT) asphalt roads with some concrete (CC) roads in a few places for main roads, while minor roads may also be brick-on-edge soling, known locally as herring bone bond (HBB). Nearly all roads are built above the existing ground level, not only to avoid inundation during storms, but as the silty loam and alluvial soils typical of the area compact easily, roads need a supporting base layer that is often built up to around one meter above ground level.

31. Typically, most new roads start as earthen roads and are upgraded (raised, widened and surfaced) as funds become available. However, the decisions as to which roads should be upgraded do not seem to be based upon proposed traffic levels as there is little traffic data. In the district center of Pirojpur, road widths are generally adequate for current traffic flows. However, many of the roads in the smaller towns, particularly roads on the periphery of the town, are narrow and only single lane and, in some areas, many households only have footpath access, often over substantial distances.

32. **Cyclone shelters.** In the PPTA study towns, there are two cyclone shelters in Amtali Pourashava constructed over 35 years ago which are in a poor condition, and two in Galachipa Pourashava constructed about 15 years ago.

33. **Solid waste management.** Compared to many urban areas of South Asia, and Bangladesh, solid waste is not such a noticeable issue in the study towns. This is notable, despite the fact that there is no formal solid waste management in the towns. Thus not much waste is formally disposed to the existing dumpsites. A community-based solid waste collection system is not adopted at present in the study pourashavas. None of the towns have sanitary landfills and waste is just dumped in low lying areas.

34. **Drainage.** The majority of the drainage in each of the pourashavas (63%-91%) is primary-type[9]. In Amtali, Galachipa and Mathbaria the remainder is tertiary (9%, 37% and 30% respectively), while Pirojpur has 19 % secondary drainage and only 1% tertiary. This contrasts with most 'normal' or established towns, where the vast majority of the storm drainage will be tertiary level, usually followed by secondary and then primary level, and reflects the pourashavas' rural origins[10] and the limited investment in storm drainage to date.

35. Flooding and waterlogging are common but records of the severity and frequency of flooding are poor, as are records of the events contributing to them. Studies by the PPTA indicate that while flooding due to high tides and storm surges can be severe in most cases

[8] This is due mainly to sea level rise and falling ground levels, due to land settlement and little sedimentation.

[9] For the supply and drainage of irrigation water, and drainage of irrigation and flood water from the polders. They comprise the natural *khals* and channels, and are almost entirely unlined earth, while the secondary drains are both natural earth and *pucca* brick and concrete channels. The tertiary drains are all *pucca* drains.

[10] Galachipa and Mathbaria are largely urban/peri-urban but only about 10% of Amtali and Pirojpur are urban.

the effects are limited to near to embankments, outfalls and open channels. Also, unless there is a breach of a main defense, or there is no primary-level flood defense, both of which are the responsibility of Bangladesh Water Development Board (BWDB) of the Ministry of Water Resources, the typical duration is less than a day. In contrast monsoon/rain-based flooding can be more frequent – up to 35 days in Mathbaria; extensive – 45-60% in Galachipa, Mathbaria and Pirojpur; and longer duration too – 2–7 days in Mathbaria. This is because of the greater rainfall, the lack of infrastructure and organizational arrangements to manage rural and urban flooding differently, i.e. according to impacts and need, and the increasing 'drainage congestion'.

36. Other challenges to efficient and effective services include losses of drains and capacity due to encroachments of various kinds, including new roads, blockages due to poor maintenance and solid waste management, insufficient numbers and sizes of culverts, the different irrigation water requirements of rural and urban dwellers (typically high and low respectively), the flat topography and long, shallow gradients, human and financial resources constraints, and inadequate or absent primary-level flood defenses—which is under BWDB.

37. **Water supply.** The preferred raw water source for a municipal supply is deep groundwater if the water quality is good. Amtali and Galachipa pourashavas have good municipal piped supplies, from deep production tubewells (almost continuous supply), but coverage is only around a third of households at present.

38. In Pirojpur and Mathbaria available data indicate that deep groundwater is saline and unsuitable for municipal supply. Surface water is the only feasible raw water option. Pirojpur's future mid-term demand will be met by a new surface water treatment plant and distribution system presently being constructed under the Secondary Water Supply and Sanitation Project (STWSSP).

39. However, Mathbaria does not have a piped water supply system at present, and the population there is suffering from the lack of a good supply, and has to obtain its water from ponds (through pond sand filters), saline shallow groundwater (for non-drinking purposes), rainwater, and rivers and *khals*. Residents are paying a high price (two to four times that for piped supplies in the other towns) for drinking water of much inferior quality. Preliminary results from the socioeconomic and willingness-to-pay survey (SEWTPS) indicate a very high willingness to pay (94%) for an improved water supply system, and connection to a project piped system (79%). With the proposed system, based on a surface water treatment plant, the household water bill is estimated to be only about BDT300/month (compared to the almost BDT700 residents are paying at present), for a continuous supply of good quality water for all household purposes, not just for drinking. A piped water supply system for Mathbaria is thus high priority.

40. **Sanitation.** There is high coverage of household toilets/latrines (94-98% in Amtali, Pirojpur and Mathbaria; 62% in Galachipa). Most toilets are pit latrines, which are generally located in relatively low areas in the household. There are no septage treatment plants or sewerage/ off-site facilities at present.

6 INFRASTRUCTURE SELECTION AND DESIGN CONSIDERATIONS

41. **Selection of infrastructure Interventions.** The scope of infrastructure subprojects/interventions for implementation under CTIIP was determined through an iterative, consultative process with LGED, ADB, and the four study pourashava local governments and other relevant stakeholders. All of the components identified for potential interventions under CTIIP are included under the pourashavas' mandate.

42. The following steps were carried out:

a) Review of the guidelines from the ongoing Second Urban Governance and Infrastructure Improvement Project (UGIIP-2), available master plan documents, and the findings and recommendations in the Draft Final Report (March 2013) of CDTA-7890 BAN.

b) Development of initial selection criteria, and consultations and workshops with the pourashavas to determine potential interventions and to categorize them into three priority groupings—Priority I, Priority II and Priority III.

c) During the ADB Interim Mission (5-13 May 2013) it was recognized that the costs for Priority I subprojects for the four towns were too high for the project budget, and there was a need to further prioritize to concentrate on infrastructure that will make the towns more climate resilient.[11] Infrastructure types were divided into the two performance criteria stages—Stage I and Stage II, as illustrated on Figure ES.1.

d) Following the Interim Mission, the selection technical criteria were revised to reflect the climate change resilience focus, and the division of infrastructure interventions between performance criteria stages I and II. Further consultations were then carried out with the pourashavas to finalize the selection of infrastructure interventions for the project in view of the revised criteria and approach.

e) Costing of the proposed infrastructure interventions, which indicated base costs including climate change resilience (CCR) of between $9.4 to 21.3 million per town. However, the ADB review mission of 30 June – 7 July 2013 and LGED considered these costs to be too high in view of the absorptive capacity of the pourashavas and the limited scope for additional towns to be included in the project (in Batch 2). Reductions were therefore made to the scope of the subprojects to more acceptable levels ($5.7 to 11.5 million base cost per town including CCR). It was also decided that the lower priority subprojects under Stage II of the performance criteria mechanism to be in the form of a lump sum of $1.0 million per town.

43. **Climate resilience measures in preliminary engineering design.** As a general principle infrastructure interventions have been designed for a period of 25 years or until 2040, and incorporate features to address climate change resilience (CCR) measures, as outlined in **Table ES.3**.

44. Drainage and flood control/protection are key to climate change resilience. In addition to improving the secondary and tertiary level infrastructure, the project will seek to improve the current institutional arrangements and capacity, especially at the local level. There will also be special attention to understanding the effects of drainage congestion, and implementing measures to mitigate its effects. These will include pro-active and 'real-time' flood management and improved maintenance, as working with BWDB to improve and complete the infrastructure for which it is responsible in the Batch 1 pourashavas. The latter will include improving and providing flood embankments and related infrastructure in each of these pourashavas.

[11] Resilience in this context is defined as the capacity of a town to reduce damages and quickly recover from future climate related or disaster events. This is achieved by reducing a town's exposure and sensitivity through investments in climate resilient infrastructure and building human capacity to adequately plan and respond.

Table ES.3: Measures for Climate Change Resilience in Municipal Infrastructure

Infrastructure Component	Climate Change Resilience Measures
Roads	• Crest level raised 200mm above A1B[12] scenario sea levels in 2034. • Improvement of HBB/BFS as concrete pavement brick-wall at end edges and temperature reinforcement. • Modification of design standards for BC pavement with increase of thickness, providing hard shoulder and turf, grass/shrub along road sides. • Embankments additionally strengthened on roads in flood areas with either concrete or brick work. • Provision of additional road-cross drains and culverts. • Strengthened abutments and approaches to bridges and culverts.
Cyclone shelters	• Base level of first floor raised by 200mm to avoid higher storm surges. • Considered wind speed 260 km/hour in structural design.
Solid waste management	• Drainage improved to accommodate more frequent and intense rainfalls. • Need to pump more water over landfill to avoid any heat stress. • Identifying suitable landfill sites is the major issue with solid waste management in the towns. Applying typical environmental norms for the location of a landfill site such as distance to habitation, surface and groundwater and free from flooding, etc, indicates that there are no suitable areas for landfill sites in the towns' vicinities.
Drainage	• Existing drains rehabilitated and capacities enhanced to 2050 projections – dredging, re-profiling, lining, etc., as appropriate. • New drains constructed to same capacity, including reinstating and enhancing natural drainage channels, etc., wherever feasible. • Runoff detention capacity introduced wherever feasible. • Materials selected and construction quality monitored for increased durability, because of longer inundation periods, wastewater risks, etc.
Water supply	• Increased water demand due to temperature rise predicted 1.2-2.4^0 C by 2050 has been taken into account in the water demand projection. 15% of average daily demand (ADD) has been assumed as increased water demand due to temperature rise. • Cyclonic strong wind is taken into account for designing superstructures such as overhead tanks in order to make them strong enough to withstand. • The upper well casing of production tube wells will be vertically extended for protection from flooding and storm surges. • Provision for power backup (generator) to keep the water supply operational if the normal power supply gets interrupted/stopped from National Grid due to cyclones/storms. • Protection measures (embankment with block pitching) around the surface water treatment plant (for Mathbaria) to protect from cyclones, storms and sea level rise.
Sanitation	• Septic tanks and superstructures of public toilets, school toilets and community latrines will be constructed above flood level to keep protected from inundation during monsoon flooding. • Latrine pits will be placed above flood level. • Elevated pit of about 1 m high with an impermeable lining extended down at least 0.6 m below ground level is expected. • Cover slab with the provision of gas outlet will be placed at the top of the pit. • Latrine platform and the pit will be separetly located. • Latrine platform with squatting pan and water seal U-pipe will be directly connected to the pit by a junction pipe.

Source: PPTA Consultant.

[12] A1B represents a mid-range emission scenario for the future global emission of greenhouse gases. A1B makes assumptions about future growth and development of human activities during the next century. It was used for the IPCC climate change assessments in 2007.

45. As the National Water Policy and the associated institutional arrangements place the responsibility for large primary infrastructure on BWDB the project's infrastructure improvements will concentrate on the secondary and tertiary levels. The objective is to improve their scope and capacity both during and after storm events, especially at the secondary-level, and thus improve climate resilience to the maximum extent possible. Where flooding may be prolonged at certain times of year and under certain circumstances pumping will also have to be considered, though the aim will be to restrict this to short-term/temporary arrangements for as long as possible.

7 PROJECT SCOPE

46. As a result of the procedures and considerations outlined in the preceding sections, the elements of the proposed Stage I infrastructure interventions are summarized in **Table ES.4**.

47. Complementing the physical infrastructure will be project management consultancy support, institutional development and capacity building consultancy support and NGO support for community mobilization, communication and awareness raising on climate change adaptation and resilience building, hygiene and behavior change.

48. The SEWTPS and focus group discussions (FGD) conducted as part of the PPTA with people from different income groups in the four *pourashavas* revealed the need for awareness creation. A large proportion of community members, both male and female, lack awareness on hygiene practices and solid waste management at household and community levels, impacting health and environment. FGD findings suggest that the poor are the worst sufferers due to inadequate service access and poor sanitation and hygiene practices. The poor also bear the brunt of disasters and are often least equipped to deal with them.

49. It is proposed that awareness raising of communities on behavioral change in water, sanitation and hygiene (WASH) activities, community-based climate adaptation and livelihood development, as well as on the resettlement framework, entitlements of affected persons (AP) and perform activities to support implementation of the resettlement plan, will be carried out by a non-government organization (NGO). The NGO will also help form water and sanitation user groups to ensure sustainability of community facilities provided under the project.

Table ES.4: Summary of Proposed Stage I Infrastructure Interventions

No.	Infrastructure Category	Proposed Infrastructure Interventions				
		Batch 1 Pourashavas				Batch 2 Pourashavas
		Amtali	Galachipa	Pirojpur	Mathbaria	
1	Roads, bridges (included side drain as required)	Roads: 8 no., 8.38 km	Roads: 7 no., 7.00 km	Roads: 17 no. 34.20 km Bridges: 4 no., length 38m	Roads: 5 no., 8.00 km Bridges: 1 no., length 42m	As per Batch 1 pourashavas, depending on infrastructure deficits, priority needs and contribution to climate change resilience (scope of interventions to be determined)
2	Cyclone shelters	3 no.	3 no.	4 no.	1 no.	
3	Solid waste management	5 no. rickshaw vans 10 no. push carts	5 no. rickshaw vans 10 no. push carts	6 no. rickshaw vans, 15 no. push carts	5 no. rickshaw vans 10 no. push carts	
4	Drainage and flood control	2.66 km drains - earthen channels - cement concrete block lined channels - reinforced cement concrete box culverts - reinforced cement concrete open drains - box culvert cleaning and gate repair	10.39 km drains: - earthen channels - cement concrete block lined channels - reinforced cement concrete box culverts - reinforced cement concrete covered drains - reinforced cement concrete open drains	25.3 km drains: - earthen channels - cement concrete block lined channels - reinforced cement concrete covered drains - reinforced cement concrete open drains	10.8 km drains: - earthen channels - cement concrete block lined channels - reinforced cement concrete covered drains	
8	Water supply	- 2. no. production tubewells - 1 no. overhead tanks - 37 km new transmission and distribution pipelines - replacement of 50mm pipelines with 100mm pipes (5.00 km) - 1,560 service connections - reconnection of 400 existing service connections with 100mm pipelines - service connection water meters - 3 no. bulk water meters - 30 no. hand deep tubewells - Mini water testing equipment - Vehicles, 2 no. back-up generators	- 2. no. production tubewells - 1 no. overhead tank - 25 km new transmission and distribution pipelines - replacement of 50mm pipelines with 100mm pipes (4.00 km) - 2,325 service connections - reconnection of 600 existing service connections with 100mm pipelines - service connection water meters - 4 no. bulk water meters - Mini water testing equipment - Vehicles, 2 no. back-up	None	- 1 no. surface water treatment plant 5.5 MLD capacity - river intake - 1 no. OHT, 1 no. ground reservoir, - embankment, - 10 no. exploratory wells, - 3.5 km transmission pipeline - 3,200 SCs - mini water testing equipment, - 1 no. genset	

No.	Infrastructure Category	Proposed Infrastructure Interventions				
		Batch 1 Pourashavas				Batch 2 Pourashavas
		Amtali	Galachipa	Pirojpur	Mathbaria	
			generators			
9	Sanitation	- 6 no. public toilets - 2 no. community latrines - 1 no. desludging truck	- 6 no. public toilets - 6 no. school latrines - 2 no. community latrines - 1 no. desludging truck-	None	- 6 no. public toilets - 6 no. school latrines - no. community toilets - 1 no. desludging truck	

CC=climate change; DTW=deep tubewell; GR=ground reservoir; OHT=overhead tank; PTW=production tubewell; RCC=reinforced cement concrete; SC=service connection; SWTP=surface water treatment plant

Source: PPTA Consultant.

8 INVESTMENT AND FINANCING PLAN

50. **Investment with CCR measures.** The total cost of the investment in the project is estimated at $115.6 million, inclusive taxes, duties, and interest and other charges on the loan during construction. Indicative cost estimates for the project are shown in **Table ES.5**.

Table ES.5: Project Cost Estimates ($ Million)

Details	Total US $ Million	ADB and SCF	GoB	% to Total
A. Base Costs				
1. Climate Resilient Infrastructure Improvements				
Drainage	9.41	9.40	0.01	8.1%
Roads	8.71	8.71	0.00	7.5%
Bridges	0.57	0.57	0.00	0.5%
Cyclone Shelters	3.53	3.53	0.00	3.0%
Solid Waste	0.01	0.01	0.00	0.0%
Sanitation	0.54	0.54	0.00	0.5%
Water Supply	7.90	7.90	0.00	6.8%
Stage II	3.40	3.40	0.00	2.9%
Batch 2 towns infrastructure	34.75	34.75	0.00	30.1%
Resettlement and Land Acquisition	0.19	0.00	0.19	0.2%
Subtotal (1)	**69.00**	**68.8**	**0.2**	59.7%
2. Consultant Packages				
Project Design Advance Consultants	3.44	3.44	0.00	3.0%
Project Management and Supervision Consultants	3.74	3.74	0.00	3.2%
Institutional Strengthening and Awareness Building Consultants	1.99	1.99	0.00	1.7%
NGO for Community Awareness and Outreach	0.62	0.62	0.00	0.5%
Subtotal (2)	**9.78**	**9.78**	**0.00**	8.5%
3. Project Management Support				
Incremental Administration	2.81	2.81	0.00	2.4%
Subtotal (3)	**2.81**	**2.81**	**0.00**	2.4%
Total Base Cost (A)	**81.59**	**81.39**	**0.20**	70.6%
B. Contingencies	11.10	11.10	0.00	9.6%
C. Duties and Taxes	20.26	0.00	20.26	17.5%
D. Financing Charges	2.65	0.00	2.65	2.3%
Total Project Cost	**115.60**	**92.49**	**23.11**	100.0%

Notes:
1. Costs are at 2013 prices.
2. Physical contingencies: Civil Works and Equipments – 5%
3. Price contingencies - as per SARD circular for BANGLADESH
4. Taxes: 5.5%, International Consultants – 25% and balance of GoB contribution
5. Exchange Rate used 1 US$ = BDT 78
Source: PPTA Consultant estimates.

51. **Financing plan, with CCR.** The proposed financing plan is an ADB loan of US$52 million (inclusive of US$3.5 million PDA), Pilot Program for Climate Resilience (PPCR) 20% to 30% of capital costs, and GOB counterpart funds amounting to 20% **(Table ES.6)**.

Table ES.6: Financing Plan, with CCR

Sources	Amount ($ million)	Percentage of Total (%)
Asian Development Bank	52.0	45.0
SCF	40.5	35.0
GoBangladesh and Pourashavass	23.1	20.0
Total	**115.6**	**100.0**

Source: PPTA Consultant estimates.

52. CTIIP is intended to be financed with assistance from ADB from its Asian Development Fund (ADF) resources. The loan will have an equal amortization period of 25 years, including a grace period of 5 years, and an interest rate of 2% per year throughout the loan.

53. The Borrower will be the Government of Bangladesh. The GOB counterpart contribution is expected to be in the range of 20% of the project cost. During the project preparation stage, the modality for sub-lending to the project towns would be discussed with GOB, i.e. loan:grant ratio, interest rate, and repayment period.

9 PROJECT IMPLEMENTATION ARRANGEMENTS

54. **Project management organization structure.** The scope of CTIIP infrastructure for Stage I consists of seven categories: (i) roads, (ii) bridges, (iii) solid waste management, (iv) cyclone shelters, and (v) drainage and flood control—which are the responsibility of LGED; and (vii) water supply and (viii) sanitation—which are the responsibility of the Department of Public Health Engineering (DPHE), in the Rules of Business. LGED will also be responsible for providing support and guidance to pourashavas concerning performance criteria and pourashava development planning.

55. In this context, LGED will be the Executing Agency (EA) for the project, and DPHE will be a co-executing agency. Overall coordination of the project, and the primary point of contact with ADB, will be provided by a Project Director (PD) from LGED who will head a Project Management Unit (PMU) in LGED. There will be three Deputy Project Directors (DPD) in the PMU: two from LGED (one for municipal infrastructure, and one for governance and institutional capacity building), and one from DPHE.

56. In addition, because flood protection and disposal of flood waters are key for climate change resilience there will be a need for good coordination with BWDB, to ensure that embankments and outfall structures are completed to required standards and are adequately maintained. This coordination will be based on the existing memorandum of understanding (MOU) between LGED and BWDB.

57. The PMU will be responsible for engaging technical assistance (TA) services under the Project—three TA packages are envisaged: (i) Project Management and Supervision Consultants, (ii) Institutional Strengthening and Awareness Building Consultants, and (iii) a non-government organization (NGO) team for Community Mobilization, Communications and Behavioral Change (CMCBC) activities.

58. The participating pourashavas will be the Implementing Agencies (IA), and will establish a project implementation unit (PIU) within the pourashava structure. Local LGED and DPHE offices will be involved in the functioning of the PIUs to provide technical support. BWDB, if necessary, will provide technical support as per the MOU.

An inter-ministerial project steering committee at national level, chaired by the Secretary LGD, will provide overall policy guidance to the project. The committee will include key government stakeholders, including local government representatives from the participating pourashavas.

59. **Implementation schedule.** A 6-year implementation period is envisaged for CTIIP, from 2014 to 2020.

60. **Performance criteria mechanism.** The performance criteria 2-stage mechanism was developed during the PPTA and extensively discussed with LGED, ADB and the PPTA study pourashavas. A performance evaluation committee will be formulated in LGED to assess compliance with the criteria. A signed Partnership Agreement submitted to the PMU is a pre-condition for entry to Stage I.

61. The criteria matrix will be used by the capacity building mobile support teams, which mobilized in June 2013, to assist and guide the PPTA study pourashavas to carry out measures to comply with the Stage I criteria.

62. **Project implementation technical assistance teams.** Besides the PDA consultants for detailed engineering design, contract documents preparation and safeguards facilitation, it is envisaged that there will be three technical assistance (TA) teams to assist and support the PMU and PIUs with addressing the four project outputs:

(i) A Project Management and Supervision Consultant (PMSC) team for project management and administration support (Output 4), and assistance in supervising the construction of improved municipal infrastructure interventions, and with improving water supply O&M (Output 1). Estimated inputs are 67 international person-months and 427 national person-months.

(ii) An Institutional Strengthening and Awareness Building Consultant (ISABC) team for the strengthening of local governance for sustainable service delivery and urban planning; to conduct studies, surveys and research on flood inundation, climate change impacts; facilitate disaster risk management capacity building, and community level adaptation though locally managed climate resilience funds; and to promote improved groundwater management (Output 2). Estimated inputs are 44 international person-months and 168 national person-months.

(iii) An NGO for community-based climate adaptation and disaster preparedness, awareness raising on behavioral change in WASH activities, and facilitating resettlement procedures (Output 3). Estimated inputs are 343 national person-months.

63. **Procurement plan.** Indicative lists of goods and works contracts for which the procurement process will commence within the first 18 months of the project are summarized in **Table ES.7**.

64. In general, LGED will procure and administer all consultancy/ technical assistance contracts, unless this will be managed by the implementing agencies due to the particular nature of an assignment. **Table ES.8** summarizes the required contract packages for which recruitment activity is expected to commence within the next 18 months.

Table ES.7: Summary of Goods and Works Contracts within First 18 Months of CTIIP

Category	Total No. of Packages	Maximum No. of Contracts (Lots*[1])	Total Estimated Value of Contracts (USD million)	Comments
Goods	**7**	**7**	**1.27**	Note*2: * Exact value of each contract package yet to be decided subject to availability of adequate funds.
Works				
Works Part-1 (Amtali Pourashava)	7	10	4.65	All NCB contracts.
Works Part-2 (Galachipa Pourashava)	8	12	7.33	All NCB contracts.
Works Part-3 (Mathbaria Pourashava)	8	11	8.84	Includes 1 ICB contract of value USD 3.97 m.
Works Part-4 (Pirojpur Pourashava)	9	14	10.49	All NCB contracts.
Works - Subtotal	**32**	**47**	**31.31**	
Grand Total	**39**	**54**	**32.59**	

Note[1]: The procurement plan for civil works includes 12 packages having 2 or 3 lots. Each lot in a package may be separately awarded to different bidders. However, if a bidder wins all lots in a package, only one contract will be signed for the package.*
Source: PPTA Consutlant.

Table ES.8: Consultancy Contracts for CTIIP

General Description	Contract Value* (USD million)	Recruitment Method[1]	Advertisement Date (quarter/year)	International or National Assignment	Comments
CTIIP/S-01: Project Management and Supervision Consultant (PMSC)	3.7	QCBS (90:10) International	Q3/2013	FTP	Outline TORs have been prepared.
CTIIP/:S-02 Institutional Strengthening and Awareness Building Consultant (ISABC)	2.0	QCBS (90:10) International	Q3/2013	FTP	
CTIIP/S-03: NGO for Community Mobilization, Communications and Behavioral Change (CMCBC) Activities	0.6	QCBS (90:10) International	Q4/2013	FTP	
Total	**6.3**				

Note: Contract value refers to estimated "Base Cost" excluding price contingencies.*
Source: PPTA Consultant.

10 ECONOMIC AND FINANCIAL ASSESSMENTS /ANALYSES

65. **Summary of financial data of study pourashavas.** The key features of current pourashava finances are:

- Own revenue: comprising of tax and non tax revenue was 98.6% in Galachipa, 98.7% in Amtali, 99.2% in Pirojpur and 99.0% in Mathbaria pourashava of total revenue income.
- Own revenue growth was 27.2% in Amtali, 19.7% in Galachipa, 28.1% in Mathbaria and 11.3% in Pirojpur.
- Collection efficiency for property tax: was 17.5% in Galachipa, 43.3% in Pirojpur, 63.2% in Mathbaria and 75.5% in Amtali.
- Revenue expenditure growth, was 0.9% in Pirojpur, 13.3% in Mathbaria, 25.7% in Amtali and 26.3% in Galachipa pourashava.

66. **Operation and maintenance** of water supply is with the pourashava. At present operation and maintenance cost recovery is to the extent of 143 percent in Galachipa; 155 percent in case of Amtali, and 98 percent in Pirojpur Pourashava.

67. **Collection efficiency** of the study towns in the financial year 2011-12 ranged from (i) 17.5% (Galachipa), 43.4% (Pirojpur), 59.9% (Mathbaria) and 75.6% (Amtali) in case of property tax and (ii) 86% (Pirojpur), 95% (Amtali) and 96% (Galachipa) in respect of water charges.

68. **Financial analysis for project.** The financial analysis has appraised the sustainability and viability of the subprojects proposed under the CTIIP investment program, according to ADB's Financial Management and Analysis of Projects, 2005. For revenue-generating sectors—water supply (WS), sanitation, solid waste management, boat landing stations, market and bus terminals—incremental revenue and cost due to the subprojects were estimated on with - and without- project basis. Tariff revisions for these sub-projects are proposed to meet the project's institutional and financial reform action plan. The financial internal rate of return (FIRR) for these subprojects is given in the **Table ES.9**.

69. The FIRR for these subprojects compare favorably to the weighted average cost of capital (WACC) of 3.09%. For these subprojects, average tariffs in the four pourashavas are higher than the average incremental financial cost (AIFC) for O&M. Sensitivity analysis shows FIRRs are generally robust and relatively sensitive to changes in revenues. For these earning subprojects in the four towns, the pourashavas' total projections demonstrate that they are sustainable, as the revenue account will be in surplus.

70. For non-revenue-generating sectors—urban drainage, roads, bridges, and cyclone shelters—the analysis focused on the capacity of the project pourashavas to sustain the assets created under the program by providing financial resources for maintenance and debt service, if any. Financial projections of cash flow were made over a 20-year period, incorporating the impact of the subprojects. For the four study pourashavas, the financial projections show that the pourashavas can absorb the investment in appraised subprojects, as they are expected to have a revenue account surplus and a positive close balance for the revenue account.

Table ES.9: Financial Internal Rate of Return of Subprojects, with CCR - %

Town	Water	Sanitation	Solid Waste
Amtali	4.8	19.9	66.5
Galachipa	6.2	18.8	78.5
Pirojpur	Not Applicable	Not Applicable	81.6
Mathbaria	3.3	18.8	72.5

Source: Consultants' analysis.

71. **Economic analysis.** Since the project is formulated as sector lending, the economic analysis focuses on the rationale for government involvement, government plan and approach, economic policies and government capacity. The project has a clear rationale for government involvement. The infrastructure to be developed under the project is to meet the basic needs of citizens and often public goods in nature. The government's goals and approach are sound. Recognizing urban development as a driving force of economic growth, the government has adopted measures to advance priority projects and governance reforms. The government has been successfully implementing many ADB assisted infrastructure projects like UGIIP-2, demonstrating sufficient capacity to implement CTIIP.

72. The economic analysis of subprojects has been conducted for all the subprojects under the infrastructure component, namely drainage, roads, bridges, sanitation, solid waste, water, cyclone shelters, boat landing stations, markets and bus terminals in four project towns. The estimated economic internal rates of return (EIRR) of these subprojects are given in Table **ES.10**, indicating sufficiently high economic returns compared with the opportunity cost of capital. The results are robust against most downside risks such as increase of capital cost, increase of O&M cost, decrease of benefits, and delay in completion. These results are most likely underestimated, since the subprojects have benefits which are not easily quantifiable and not accounted in the analysis.

Table ES.10: Economic Internal Rate of Return of Subprojects, with CCR - %

Town	Drain	Road	Bridge	Cyclone Shelter	Water	Sanitation	Solid Waste
Amtali	28.1	20.6	NA	16.5	17.7	16.0	60.7
Galachipa	23.9	20.9	NA	17.1	14.0	22.4	70.1
Mathbaria	45.9	20.3	22.2	35.0	15.3	26.9	64.7
Pirojpur	38.8	21.4	22.6	19.3	NA	NA	82.6

Source: Consultants' analysis.

73. **Climate damages and loss, resilience costs and benefits.** The PPTA has identified the losses and damages from climate change, and formulated a series of structural and non-structural measures to reduce these losses specifically related to climate change. The incremental costs of these measures were calculated, and then it was possible to assess both the economic, social and environmental costs and benefits of undertaking these measures.

74. The PPTA evaluated the economic costs and benefits looking at both direct (stock) damage and loss, and indirect (flow) loss owing to lost productivity, health care costs, and reduced economic activity. Economic analyses were possible and performed for the water supply, sanitation, drainage and flood control, solid waste, cyclone shelter, bus terminals, markets, boat landings and road subprojects for each pourashava.

75. Social and environmental impacts of climate resilience were another priority addressed by the PPTA. While data were unavailable to quantify impacts, the consultant social safeguards and environmental specialists examined all climate resilient measures for the subprojects and articulated the potential impacts, positive and negative, from these measures.

76. The analysis includes an alternative metric, based on the cost: benefit analysis but that also normalizes loss and damage for income levels. This measure, the vulnerability reduction credit (VRC), may be useful in comparing the relative scale of alternative climate resilience measures.

77. The conclusion to the environmental assessment was that climate resilience measures will benefit the general public by contributing to the long-term improvement of infrastructure and community livability in the project towns. The potential adverse environmental impacts are mainly related to the construction period, which can be minimized by mitigating measures and environmentally sound engineering and construction practices.

78. Economic costs:benefits were overall very favorable for climate resilience measures. Proposed CTIIP infrastructure investments have uniformly attractive EIRRs.

11 ENVIRONMENTAL AND SOCIAL SAFEGUARDS

79. Surveys and FGDs were conducted to assess environmental and social safeguards.

80. **Environment.** It is concluded that the project will have only small-scale, localized impacts on the environment which are readily mitigated. The potential adverse environmental impacts are mainly related to the construction period, which can be minimized by the mitigating measures and environmentally sound engineering and construction practices. Therefore, the project has been classified into environmental category B. It is likely that future subprojects will seek to replicate the sample subprojects in other town areas, and thus are expected to be category B due to the low-impact nature of such works. No category A type of works (with significant impacts) will be considered.

81. **Involuntary resettlement.** Assessment of involuntary resettlement (IR) impacts conducted for the proposed municipal infrastructure—roads, bridges, cyclone shelters and solid waste management—reveal that the subprojects/components will have largely temporary impacts, except for permanent impacts on eight affected persons (AP) for a proposed bridge at Mathbaria. The solid waste component will not involve any IR impacts.

82. In the case of water supply, private land acquisition (10 acres) is envisaged at Mathbaria for a proposed surface water treatment plant; surveys of affected persons are under way. Government land is identified for production tubewells (PTW) and overhead tanks (OHT) in Galachipa. In Amtali, one production tubewell is proposed on private land, belonging to a councillor of the ULB, who is willing to donate the land, while government land is identified for another PTW and two OHTs. Water supply pipe laying work in the four towns and sanitation interventions are not likely to entail any permanent resettlement impacts, although temporary impacts such as disruptions to traffic, supply disruptions for those with existing connections and temporary income losses to hawkers and vendors are identified.

83. Project design for drainage and canal improvement works attempts to minimize IR impacts by proposing improvements to existing drains and avoiding widening of proposed stretches. Surveys were conducted to identify potential IR impacts along channels; data collection is under process.

12 KEY ISSUES

84. **Flood protection and coordination with BWDB.** A major issue is the vulnerability of the project pourashavas to extensive and prolonged flooding from rivers if flood protection embankments and facilities such as outfalls and sluice gates, for which BWDB is responsible, are not complete—particularly in view of the projected impacts of climate change in the area.

85. Drainage and flood protection are key for climate change resilience. However, in the study pourashavas, and probably in the Batch 2 towns, BWDB's infrastructure along the

rivers is not always to the necessary standards because of gaps, low levels, insufficient outfalls, poor condition/operation, etc.[13]

86. Infrastructure developed by CTIIP will be compromised if these flood defenses are not complete. The Master Plan for Pirojpur in particular, and the vulnerability survey of Mathbaria both indicate possible impacts in their urban cores if the flood defenses are not upgraded to meet the expectations of 2050. This includes the capacity to mitigate the effects of storm surges, which is currently inadequate for both.

87. Also, because of the expected increase in rainfall, and therefore run-off, and the reduction in the time sluices and outfalls will be able to operate at their maximum capacity,[14] there is a need for:

1) greater capacity to detain and temporarily store surface runoff when it is not possible to dispose of it directly to the rivers because their levels are too high, and
2) increased discharge capacity, to cope with the increased volumes of runoff to be disposed of, and the shorter times in which it will be possible to do this.

88. The first item, 1), is the responsibility of the pourashavas, but is difficult because most of them lack suitable locations.[15] However, installing sluices on the open *khals* in Pirojpur and Mathbaria pourashavas could help achieve some of the storage suggested under (1), especially when the need can be forecast, e.g. cyclones and severe depressions, and pre-emptive actions are possible. Even so this storage will be limited. There should therefore be complementary steps to manage inundation of urban and rural areas separately, for example, by implementing differentiated flood management arrangements and infrastructure for urban and rural areas, e.g. peripheral embankments and structures for urban areas,[16] and implantation of measures to improve integrated action on flood management by the various stakeholders.

89. Along the rivers and main channels, where the need for increased capacity is greatest, (2) is the responsibility of BWDB. BWDB is also considered to be the primary stakeholder in implementing suitable infrastructure and organisational arrangements for differentiated urban and rural flood management. Arrangements for operating and maintaining these systems will have to be negotiated and agreed with the stakeholders, including the funding required.

90. In conclusion, achieving more climate resilient services and infrastructure through CTIIP will be severely reduced unless there is coordinated action by the project and BWDB, to ensure BWDB's existing infrastructure is upgraded to the necessary levels, and necessary new infrastructure is implemented too.

91. BWDB should therefore be an active partner in CTIIP's implementation, and a meeting was eventually held with BWDB on 4 July 2013 during the ADB final review mission to initiate contact for the project. This has been followed up with a letter from the LGED Chief Engineer to request BWDB to nominate a focal person to actively coordinate and cooperate

[13] Reasons for this are still to be determined, and may include such practical matters as land acquisition problems, inadequate funds, and/or higher priority needs elsewhere.

[14] Estimates indicate that the present operating times could reduce by about 30% by 2065, possibly reducing capacity by as much 50%, because of reduced differences in head, while rainfall could increase by 25%.

[15] Amtali has two large water bodies that can help in this respect. The potential for this in the other pourashavas is virtually non-existent unless it becomes possible to use their *khals*. In all of them it is necessary to have a flood management plan, to regulate flows in ways that minimise impacts in the most vulnerable and valuable areas to the maximum extent possible. Ideally this should be a participatory plan, so that it can be implemented with the partnership and the consent of the public, rather than their ignorance or opposition.

[16] National Water Management Plan 2001, Vol 2.

with LGED for the further preparation of CTIIP and during implementation of the project.

92. It is hoped that part of a BWDB program should be to implement/upgrade primary flood defense infrastructure to the required levels and capacity for 2050, including the effects of climate change, for the CTIIP towns.[17]

93. **Performance criteria mechanism.** A performance evaluation committee will be formulated in LGED to assess compliance with the criteria. A signed Partnership Agreement submitted to the PMU is a pre-condition for entry to Stage I.

94. There will need to be substantial support from the project to assist the pourashavas with the effective implementation of the performance criteria mechanism in line with the proposed compliance schedule, and for the establishment and development of a strong monitoring and evaluation (M&E) system with the pourashavas to achieve this. For the PPTA study pourashavas (Batch 1 towns), this support will be provided by the capacity building mobile support teams,[18] which mobilized in June 2013, to assist and guide the towns to carry out measures to comply with the Stage I criteria.

95. **Project scope.** During the ADB review mission of 30 June – 7 July 2013, scope and costs for the Stage I interventions for the PPTA study towns (Batch 1) were revised to $5.7-11.5 million base cost per town including climate change resilience (average $9.9 million per pourashava, incorporating and with contingencies). These proposed investments have a higher cost compared to other projects such as UGIIP ($2.6 to 3.2 million per pourashava, depending on class). This is because the main aim of CTIIP is to make the participating pourashavas climate change resilient, and the infrastructure scope has to be more holistic to achieve this aim, which is reflected in the higher cost.

96. **Absorptive capacity of pourashavas to manage and maintain proposed infrastructure interventions**. The higher investment amounts for CTIIP raises the issue of the technical, institutional and financial capacity of the pourashavas to manage project implementation activities and the long-term and sustainable operation and maintenance of the infrastructure facilities, particularly for water supply installations, after they have been constructed.

97. Generally the existing capacity in the pourashavas is limited in all aspects, and constrained by the provisions of the Local Government (Pourashava) Act, 2009. There will need to be a lot of strengthening of resources during project implementation and the preparation of a more flexible enabling environment to ensure that the pourashavas are sufficiently prepared to take on the responsibilities for the sustainable O&M of the physical facilities and assets. Although this aspect has been built into the project design, through the provision of technical assistance and guidance from the project management unit and the Management Support Unit of LGED, a lot will depend on the leadership and motivation of the pourashava authorities and elected officials, and pressure from customers and communities for services to be provided and maintained to acceptable levels.

98. On a positive note, financial analyses conducted for the four Batch 1 towns for revenue earning sectors—water supply, sanitation, solid waste management, boat landing stations, market and bus terminals—indicate financial sustainability, as the revenue account will be in surplus. Also, for non-revenue-generating sectors—urban drainage, roads, bridges, and cyclone shelters—the financial projections show that the pourashavas can absorb the investment in appraised subprojects, as they are expected to have a revenue account surplus and a positive close balance for the revenue account.

[17] An important criterion for the selection of Batch 2 towns was the presence or otherwise of BWDB primary flood defense infrastructure.

[18] The capacity building mobile support teams are being financed from additional PPTA funds.

99. **Procurement for civil works contracts.** Contracts for civil works will be awarded, managed and supervised by the concerned pourashavas' project implementation units (PIU). Although ADB would prefer to have large contract packages to minimize the time and effort needed for contract tender documentation preparation and related administrative procedures; the pourashavas favor smaller packages which are more within their capacity, and would cause less disruption due to massive construction activities within a small pourashava area, and encourage more bidders to participate. Also, smaller packages would be within the proposed threshold of $1.5 million for national competitive bidding (NCB) contracts. While discussing about the recommended value of single contracts with LGED engineers and pourashava officials of the Batch 1 towns of CTIIP, none of them suggested a single contract value beyond BDT 50 million (approximate USD 400,000) considering the past experiences from other urban sector projects.

100. For international competitive bidding (ICB), regional contractors are unlikely to be interested in contracts valued at less than $20 million as found from discussion with some potential contractors in the neighboring country India because of many factors/ reasons, including lengthy procedures to obtain the necessary permits and fulfill requirements to work in Bangladesh. From the tentative procurement plan prepared by the PPTA team, the estimated value of all works packages for a town varies from $4.7 to 10.5 million, with a grand total for all towns about USD 32.6 million. As such, the choice of ICB method may not add value in attracting international bidders. Based on prevailing conditions, the NCB method has been recommended for implementation of civil works packages, balancing the risks of procedural delay and possibility of getting the work done within the designated time. Nevertheless, the advertisement of works packages valued over USD 1.0 million would be mandatorily published in the ADB website, and also in the national web portal dedicated for posting procurement notices.

101. A challenging part of pourashava procurement capacity is the "random" transfer of staff. For example, the Assistant Engineer (AE) of Amtali Pourashava has been transferred to a new working place just some days after he received orientations on the project and hands-on training on how to prepare the contract packaging from the tentative scheme list. Since then, the position of AE Amtali Pourashava has been charged to the Sub-Assistant Engineer, who has been posted in Amtali Pourashava for less than two years. In order to ensure adequate capacity of each pourashava throughout the project period, the local government division may consider as follows: (i) suitable staff are posted against all procurement and technical positions of the selected pourashavas; (ii) these staff are not transferred during the project implementation period; and (iii) if any of these staff are transferred for any unavoidable circumstances, the vacancies are immediately filled in with appropriate replacements.

102. **Quality control of construction works.** A common problem in Bangladesh, and in many other developing countries, is ensuring adequate quality control on construction works, particularly where local governments have limited capacity in terms of qualified and experienced staff, which is the case in the project pourashavas. One measure proposed is to include international and national quality control specialists in the Project Management and Supervision Consultant team, to support the PMU and PIUs with assessing construction progress and completed works, and advising on remedial measures before payments are made to contractors.

103. **Hartals.** Since the ADB Interim Mission on 5-13 May 2013, there have been 12 days of *hartals*, over half a month's worth of work days—when international consultants could not get to the office and face-to-face contacts with national colleagues and LGED counterparts were severely compromised. During the final stages of completing this Draft Final Report there were four straight days of *hartals*, which caused difficulties and delays in finalizing certain parts of the report.

104. Further *hartals* are expected over the next months (leading up the General Election that must be held by 24 January 2014).

MAIN REPORT

1 INTRODUCTION

1.1 PROJECT CONCEPT

1. **Preparation.** An ADB fact-finding mission was fielded on 20-22 March 2012 to consult with the Government of Bangladesh (GOB) for a project to address the municipal infrastructure improvement requirements in the coastal area in the light of climate change adaptation, and to prepare for a project participatory technical assistance (PPTA) to carry out feasibility studies and project design, and a TA for a new ADB financing instrument known as Project Design Advance (PDA) to facilitate the start of project implementation.

2. The proposed ADB-assisted project is known as the Coastal Towns Infrastructure Improvement Project (CTIIP). The key themes of the project are (i) climate change resilience and (ii) natural disaster preparedness, in poor and vulnerable coastal towns of Bangladesh.

3. Following a Special Project Evaluation Committee (SPEC) meeting on 30 September 2012, the Technical Assistance Project Proposal (TPP) was completed by the government in October 2012.

4. The proposed CTIIP is consistent with the Government of Bangladesh's 6th 5-Year Plan (FY 2011-2015) and 2010 Strategic Program for Climate Resilience (SPCR), prepared under the Pilot Program for Climate Resilience (PPCR); and ADB's Bangladesh Country Partnership Strategy (2011-2015).

5. **Implementation arrangements.** The executing agency (EA) will be the Local Government Engineering Department (LGED) in the Local Government Division (LGD) of the Ministry of Local Government, Rural Development, and Cooperatives. Local governments of the participating pourashavas will be the implementing agencies.

6. A project steering committee, chaired by the Secretary LGD, will include key government stakeholders, including local government representatives from the participating pourashavas.

7. **Project scope.** The project will implement the construction of improved municipal infrastructure in priority towns which will be designed to mitigate the effects of disasters caused by natural hazards and climate change.

8. Local governance and institutional capacity in the pourashavas is weak, and the project also will strengthen these aspects to improve urban planning capabilities, strengthen municipal financial management, and governance, the sustainable delivery of water supply, sanitation and solid waste management service delivery, and disaster preparedness.

9. The project will build on the experience and good practices of other relevant projects, including the Urban Governance and Infrastructure Improvement Project (UGIIP) I and II[19] and the Secondary Towns Water Supply and Sanitation Project (STWSSP);[20] lessons learned from the ADB-funded TA-7197 BAN *Strengthening Resilience of the Water Sector in Khulna to Climate Change* and TA-7848 *Climate Change Capacity Building and Knowledge*

[19] Particularly in the performance-based grant approach—towns must fulfill performance criteria to qualify for project funding.

[20] UGIIP and STWSSSP are both sector lending projects, similar to the lending modality proposed for CTIIP.

Management; and recommendations from the recently completed CDTA-7890 *Strengthening the Resilience of the Urban Water Supply, Drainage, and Sanitation to Climate Change in Coastal Towns*.

10. The project will also draw on the best practices to be developed during the implementation of the ADB Coastal Climate-Resilient Infrastructure Project (CCRIP). This project shares many similar features with CTIIP, including LGED as the EA. The project was approved in 2012 under GOB's Strategic Program for Climate Resilience (SPCR), prepared under the Pilot Program for Climate Resilience (PPCR). The project focuses on improving coastal embankments, rural connectivity (roads), capacity building for mainstreaming climate resilience, and knowledge management. As one of the projects approved for enhanced climate resilience under the SPCR, the CCRIP will improve livelihoods in the rural coastal districts vulnerable to climate variability and change.

11. **Project lending modality and framework.** A sector lending modality will be used as the financing framework for CTIIP.[21] During the PPTA, an investment package will be prepared for the selected high priority pourashavas for implementation during the project.

12. The total project cost is estimated at $120.4 million.[22] The proposed financing plan (to be finalized during the PPTA) is an ADB loan of US$52 million (inclusive of US$3.5 million for the PDA), PPCR 20% to 30% of capital costs (for the mainstreaming of climate adaptation investment), and GOB counterpart funds amounting to 20%.

13. **Project safeguard category.** CTIIP is considered to be a low risk category project, and ADB safeguard categorization for environment, involuntary resettlement, and indigenous peoples (if any), is expected to be B or lower.

1.2 OBJECTIVES OF THE PROJECT PREPARATORY TECHNICAL ASSISTANCE

14. Detailed investment and financing plans have been prepared under the PPTA, which is financed by the Government of Japan though a Japan Fund for Poverty Reduction (JFPR) grant, administered by ADB. The PPTA covers a period of 8 months. The terms of reference (TOR) are shown in **Appendix A.1 (Volume 2)**.

15. The primary objectives of the PPTA are:

- Conduct feasibility/ due diligence studies of priority subprojects and prepare a project investment/financing package in selected pourashavas, with preliminary outline engineering designs and implementation arrangements for the initial phase of the project. The studies will encompass technical/engineering, economic and financial, governance, poverty and social, and safeguards aspects—including an assessment of the procurement capacity of the EA and

[21] From ADB's operational manual D3: "The purpose of a sector loan is to assist in the development of a specific sector or subsector by financing a part of the investment in the sector planned by the DMC [developing member country]. Such lending is particularly appropriate when a large number of subprojects in the sector or subsector are to be financed. A sector loan is expected to improve sector policies and strengthen institutional capacity.
Certain criteria need to be satisfied in order to meet ADB's policy on sector lending: (i) the borrowing DMC has a sector development plan to meet the priority development needs of the sector; (ii) the borrowing DMC has the institutional capacity to implement the sector development plan; and (iii) the policies applicable to the sector are appropriate and will be improved, if warranted.
If these criteria are not met adequately, technical assistance (TA) may be given for project preparation, sector analysis, and capacity building before or together with the provision of a sector loan."

[22] ADB. March 2012. *Concept Paper: Project Number 44212: People's Republic of Bangladesh: Coastal Towns Infrastructure Improvement.*

IAs, and preparation of a procurement plan and contract packaging.

- Incorporate the recommendations from the recently completed CDTA-7890 *Strengthening the Resilience of the Urban Water Supply, Drainage, and Sanitation to Climate Change in Coastal Towns*, as well as lessons learned from other relevant urban work, including the ADB-supported Urban Governance Infrastructure Improvement Project (UGIIP) and Secondary Towns Water Supply and Sanitation Project.[23]
- Enhance project readiness and contribute to the smooth start-up of the ensuing loan by working closely with the detailed design consultants to be funded under a PDA, which will overlap with the PPTA, in undertaking advanced preparatory actions such as detailed design work, safeguards finalization, and bidding document preparation.
- Prepare a project administration manual (PAM).
- Assist in capacity building for the project.

1.3 PPTA ORGANIZATION AND MANAGEMENT

16. **PPTA Consultant.** The consultant consortium selected to conduct the PPTA based on the Quality and Cost-Based Selection (QCBS) selection process is GHK Consulting Limited (ICF GHK), United Kingdom, in association with Associates for Development Services Limited (ADSL), Bangladesh, and E.Gen Consultants Ltd. (e.Gen), Bangladesh (hereinafter known as the Consultant). The Consultant mobilized on 9 January 2013.

17. **PPTA organization and management.** The EA for the PPTA is LGED. Close liaison is kept with DPHE which is providing technical advice and guidance during the PPTA for water supply and sanitation through a focal person appointed by the Chief Engineer of DPHE. **Figure 1.1** shows the organization and management structure for the PPTA.

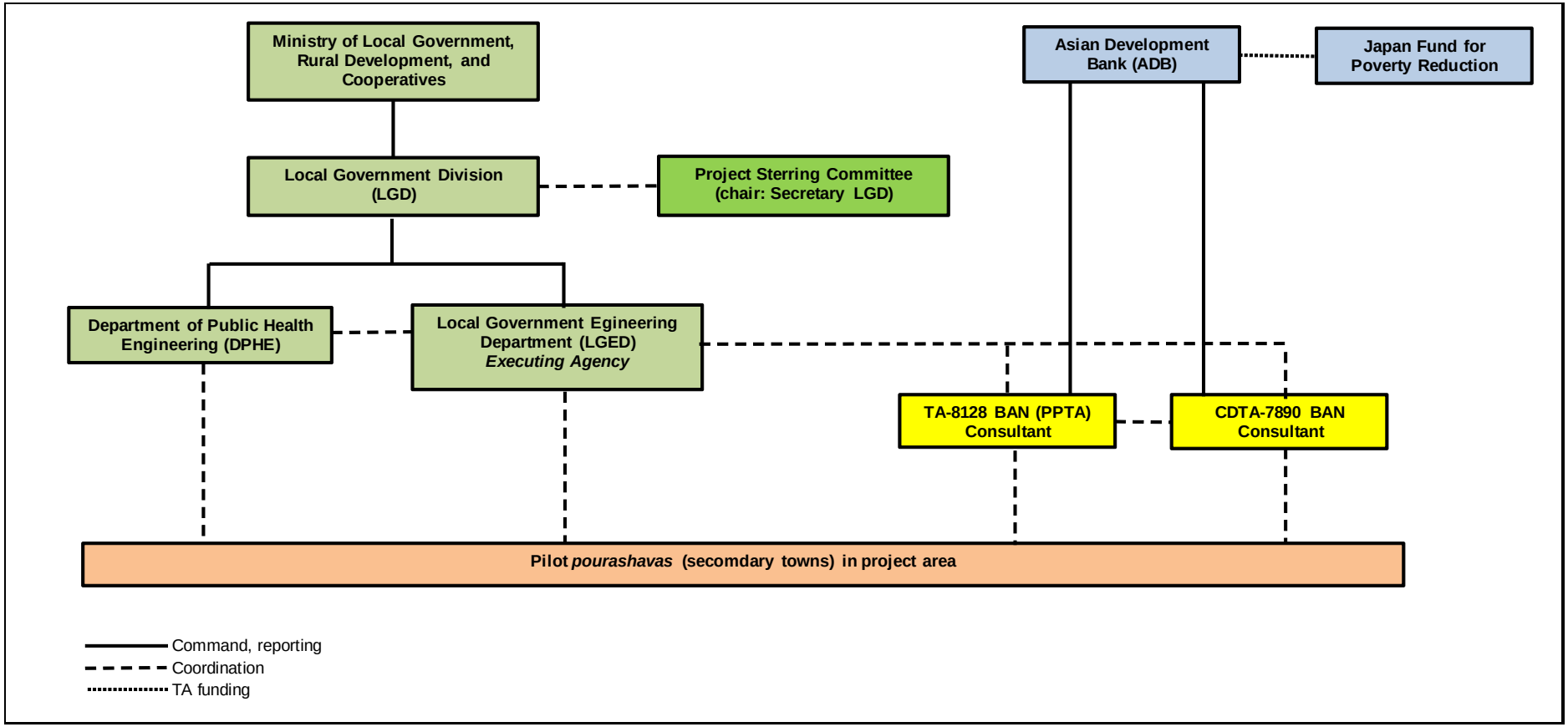
18. A steering committee, chaired by the Secretary LGD, provides overall policy guidance to the PPTA. Steering committee membership includes:

- LGED;
- DPHE;
- Ministry of Environment and Forests (Climate Change Unit);
- Representatives of pilot pourashavas (mayor, engineer, secretary/ chief executive officer, LGD engineer, DPHE engineer);
- Urban Development Directorate;
- Disaster Management Bureau;
- Bangladesh Water Development Board (BWDB);
- Economic Relations Division, Ministry of Finance (MOF);
- Finance Division, MOF;
- General Economic Division, Planning Commission; and
- Physical Planning, Water Supply and Housing (PPWS&H) Sector, Planning Commission.

19. It is expected that the Steering Committee would meet at least twice during the PPTA.

[23] A list of documents collected during the PPTA is shown in **Additional Appendix A.2 (Volume 2)**.

Figure 1.1: Organization Chart for PPTA Implementation



Source: PPTA Consultant

1.4 PPTA DELIVERABLES AND WORK PLAN

1.4.1 Deliverables and Workshops

20. **Inception Report, and Workshop.** The Inception Report was submitted on 3 February 2013. The Inception Workshop was held on 11 February, as part of the ADB Inception Mission.

21. Comments on the Inception Report were received from ADB, and ADB requested for a revised version of the report to be prepared. The Inception Report (Revised) was submitted on 23 February.

22. **Interim Report, and Workshop.** The Interim Report was submitted on 28 April, and contained the sector development plans (urban sector, and water supply and sanitation sector) analysis, the preliminary results of institutional, financial and urban planning assessments, and the scope of subproject components. The Interim Workshop was held on 7 May, as part of the the ADB Interim Review Mission.[24]

23. Comments on the Interim Report were received from ADB and LGED; these are listed, together with responses from the PPTA team, in **Additional Appendix A.4, Volume 2**.

24. **Draft Final Report, and Workshop.** This DFR presents the proposed design of the project to a standard consistent with ADB requirements. The DFR Workshop is scheduled to be held during the ADB Fact-Finding Mission scheduled for 25 August – 8 September, after the Eid al Fitr marking the end of the holy month of Ramadhan.

25. **Final Report.** The Final Report will be submitted at the conclusion of the PPTA, incorporating comments on the DFR and outcomes of the DFR Workshop.

1.4.2 Work Plan

26. The main tasks are listed in **Table 1.1**. A flowchart showing the main activities and outcomes is shown on **Figure 1.2**. The detailed work program is shown on **Figure 1.3**.

Table 1.1: Main PPTA Tasks

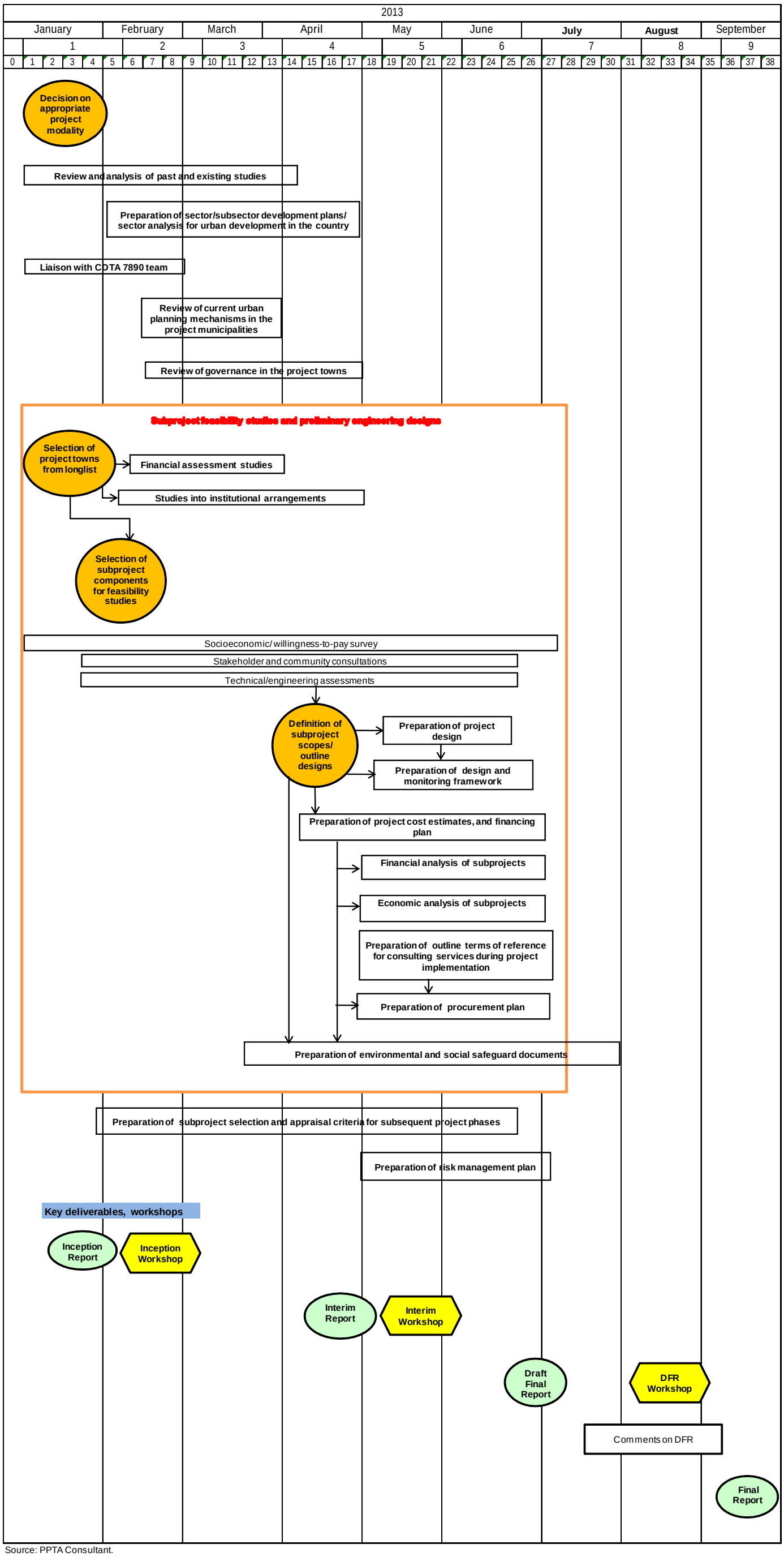
Task	Deliverable
1. Inception activities, including of selection of project towns for PPTA feasibility studies	Inception Report
2. Sector analysis and sector development plan	Interim Report
3. Conduct of technical engineering assessments for study towns, and determination of subproject infrastructure components	Interim Report Draft Final Report
4. Socioeconomic and willingness-to-pay survey in study towns	Interim Report Draft Final Report
5. Studies into institutional arrangements	Interim Report Draft Final Report
6. Financial assessment studies	Interim Report

[24] Notes on the Interim Workshop, and key meetings during the period leading to the DFR, are shown in **Additional Appendix A.3 (Volume 2)**.

Task	Deliverable
	Draft Final Report
7. Review of current urban planning mechanisms in the project municipalities	Interim Report Draft Final Report
8. Review of governance in project towns	Interim Report Draft Final Report
9. Feasibility studies of proposed subproject components (technical, cost estimates, financial plan, financial and economic analyses, capacity building plan, environmental and social safeguard documents)	Draft Final Report
10. Preparation of project design and implementing arrangements	Interim Report Draft Final Report
11. Risk assessment	Interim Report Draft Final Report

Source: PPTA Consultant.

Figure 1.2: Flowchart of Key Activities



Source: PPTA Consultant.

Figure 1.3: Detailed PPTA Work Program

2013

No.	Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Month No.	1	2	3	4	5	6	7	8	9
	Week No.	1–38								
			Inception Report	Inception Workshop	Interim Report	Interim Workshop		Draft Final Report	DFR Workshop	Final
1	GENERAL									
1.1	Mobilization of technical assistance team									
1.2	Conduct initial consultantions and meetings with key stakeholders									
1.3	Liaison with CDTA 7890 team									
1.4	Liaison with Project Design Advance team									
1.5	Propose appropriate modality for investment and O&M of the facilities to be constructed.									
2	SECTOR REVIEW AND PREPARATION FOR DETAILED PROJECT DESIGN									
2.1	Conduct review of sector and urban planning mechanisms, and field visits									
2.2	Review and analysis of past and existing studies, and of external assistance and lessons learned from other projects									
2.3	Prepare sector and subsector analysis									
2.4	Preparation of sector development plan									
3	SELECTION OF PROJECT TOWNS FOR FEASIBILITY STUDIES									
3.1	Selection of project towns from longlist for feasibility studies and surveys during PPTA									
3.2	Preparation of subproject component selection criteria for feasibility studies, reconfirm list of candidate towns, pilot subprojects									
4	SOCIOECONOMIC AND WILLINGNESS-TO-PAY SURVEY, AND STAKEHOLDER CONSULTATIONS									
4.1	Preparation of survey									
4.2	Conduct of survey in field									
4.3	Data encoding, analysis, reporting									
4.4	Stakeholder consultations, focus group discussions									
5	STUDIES INTO INSTITUTIONAL ARRANGEMENTS									
5.1	Technical, procurement and management capacity assessment of the executing agency, project towns, and other key organizations involved in the project.									
5.2	Propose measures to develop and strengthen institutional capacity in these areas, if required, of the organizations assessed to ensure smooth project implementation and sustainability, with special attention to long-term management arrangements of the facilities proposed to be developed under the project.									
5.3	Propose an effective and workable institutional arrangement for the project, including mechanisms to enhance coordination and coherence among different organizations at the central and municipal levels and possible involvement of NGOs and community participation.									
6	FINANCIAL ASSESSMENT STUDIES									
6.1	Review and assess current fiscal transfer level and mechanism from the central government to project towns.									
6.2	Undertake a financial management assessment of the executing agency and project towns and based on such assessment provide the design of the fund flow mechanism of the ensuing project									
6.3	Assess debt repayment capacity and potential for revenue enhancement in the project towns , including examination of revenues and expenditures in the recent 5 years and estimated 20 years projection.									
6.4	Prepare a financial improvement plan for each municipality.									
6.5	Propose appropriate financial arrangements with special attention to tariffs and financial sustainability for the project towns.									
6.6	Provide project-specific information such as the level of investment and O&M requirements for each municipality for their analyses of financial sustainability.									
7	REVIEW CURRENT URBAN PLANNING MECHANISMS IN THE PROJECT MUNICIPALITIES									
7.1	Identify ways to strengthen urban planning in project towns, including recommendations to introduce climate-resilience into master planning and/or implementation/enforcement of the approved master plans.									
7.2	Ensure that the location of proposed infrastructure under the project is consistent with any existing urban and land-use planning of the municipalities, and propose measures to improve planned and organized development.									
7.3	Propose measures to fill gaps in urban planning and develop specific interventions to strengthen urban planning with climate resilience under the project.									
8	REVIEW GOVERNANCE IN PROJECT TOWNS									
8.1	Propose measures to fill gaps and strengthen local management capacity within the project design, considering lessons learned and good practices in performance criteria for governance reforms based on ongoing ADB and World Bank projects in municipal governance improvement.									
9	FEASIBILITY STUDIES FOR EACH CANDIDATE SUBPROJECT									
9.1	Technical Surveys, Definition of Subproject Scopes, and Preliminary Engineering Designs									
9.1.1	Water supply									
9.1.2	Sanitation									
9.1.3	Drainage and flood control									
9.1.4	Municiapl infrastructure									
9.2	Cost Estimates and Financing Plan									
9.2.1	Estimation of capital and O&M costs for each subproject									
9.2.2	Preparation of financing plan									
9.3	Financial and Economic Analyses									
9.3.1	Financial analysis of subprojects									
9.3.2	Least-cost analysis for non-revenue earning subprojects									
9.3.3	Economic analysis									
9.4	Preparation of Safeguard Documents									
9.4.1	Assess environmental and social soundness									
9.4.2	Preparation of environmental safeguard documents									
9.4.3	Undertake poverty and social analysis, and gender assessment									
9.4.4	Preparation of social safeguard documents									
10	PREPARATION OF PROJECT DESIGN									
10.1	Identify climate change adaptation (CCA) and disaster risk reduction (DRR) requirements with reference to CDTA 7890 recommendations.									
10.2	Study how greenhouse gas emissions will be reduced through such measures as adopting energy-efficient options for water supply.									
10.3	Propose innovative approaches for sanitation, both hard and soft solutions, where appropriate and its feasibility within the local context.									
10.4	Propose local adaptation and community participation measures.									
10.5	Develop a DMF outlining impact, outcome, outputs, assumptions, risks and key activities with clear links to performance targets and indicators, and identifying risks and assumptions.									
10.6	Preparation of outline terms of reference for consulting services during project implementation									
10.7	Preparation of procurement plan, including innovative contract packaging to minimize delays and maximize efficiency									
10.8	Preparation of Project Administration Manual (PAM)									
10.9	Preparation of subproject selection criteria for susequent project phases									
11	RISK ASSESSMENT									
11.1	Undertake risk assessment covering the areas of public financial management, procurement, and corruption pertaining to the project and propose a risk management plan.									
12	DELIVERABLES AND WORKSHOPS									
12.1	Inception Report (preparation, submission)									
12.2	Inception workshop (preparation, conduct)									
12.3	Interim Report (preparation, submission)									
12.4	Interim workshop (preparation, conduct)									
12.5	Draft Final Report (preparation, submission)									
12.6	Draft Final Report workshop (preparation, conduct)									
12.7	Final Report (preparation, submission)									

Source: PPTA Consultant.

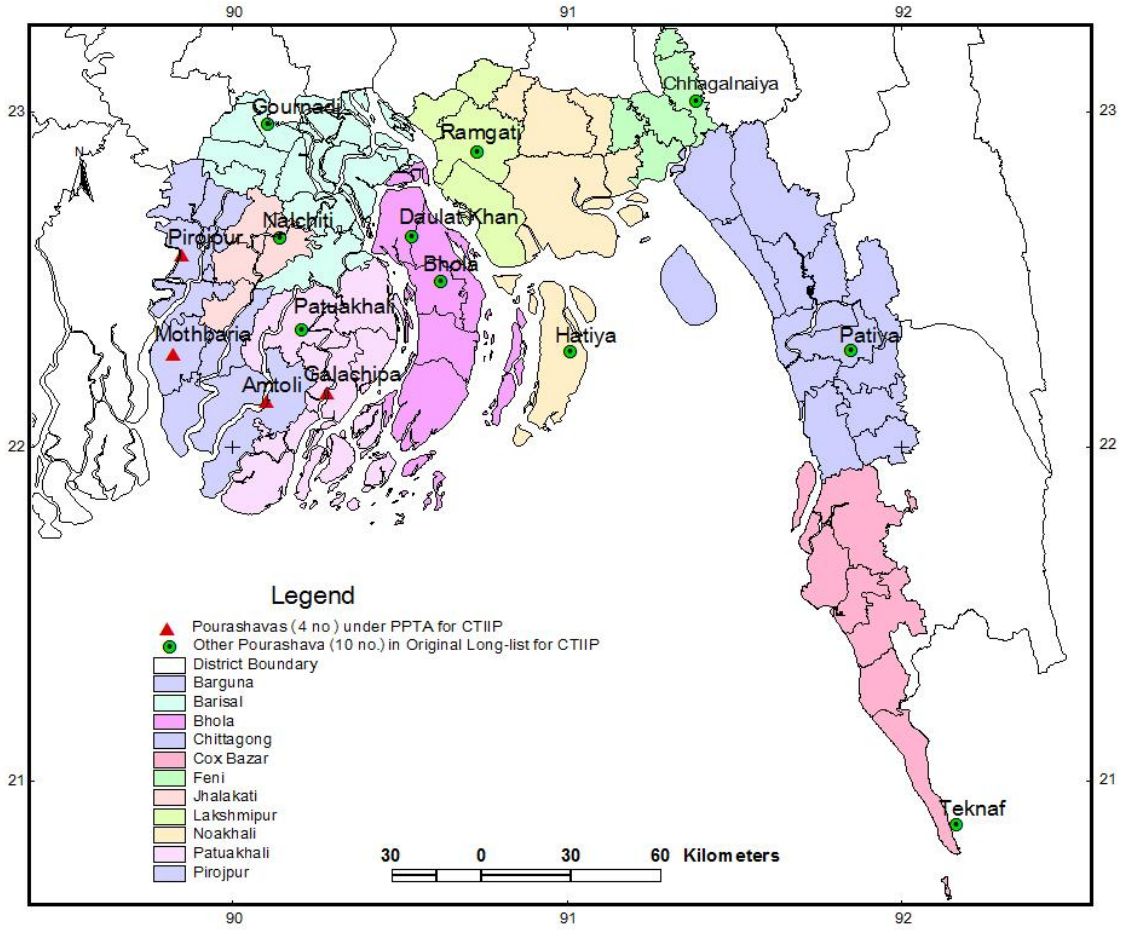
Id al-Fitr

1.5 SELECTION OF POURASHAVAS FOR STUDY UNDER PPTA

27. For the determination of the scope of CTIIP, a tentative long-list of 13 potential pourashavas was prepared by LGED before the PPTA started **(Figure 1.4)**. The three towns studied under CDTA-7890 (Amtali, Galashipa and Pirojpur) were included for study under the PPTA and that, considering the limitations of the resources and timeframe of the PPTA, there should only be one additional town, which should be in the same general area of the three towns to facilitate the implementation of the PPTA and initial project phase. During the wrap-up meeting of the ADB Inception Mission with the Steering Committee on 14 February 2013, it was decided that Mathbaria would be the fourth town.

28. However, the list of 13 pourashavas is no longer valid, and the selection of future project pourashavas will be drawn from the full list of pourashavas in the coastal districts by means of a screening process involving key criteria and considerations (see Chapter 10).

Figure 1.4: Location of Pourashavas in Original Long-list for CTIIP



Source: PPTA Consultant.

1.6 CAPACITY BUILDING MOBILE SUPPORT TEAMS

29. Additional funding for the PPTA, from the Netherlands Trust Fund under the Water Financing Partnership Facility, is being used for two capacity building mobile support teams (MST) consisting of national consultants (65 person-months)[25] to assist the study pourashavas to prepare for the compliance of performance criteria which will trigger the release of project funding tranches.[26] The MSTs mobilized in June 2013.

1.7 SUMMARY OF MAIN PROJECT ACTIVITIES DURING DRAFT FINAL REPORT PERIOD

30. After the submission of the Interim Report on 28 April 2013, the following main activities were carried out during the period leading up to the submission of this Draft Final Report (May-July 2013):

- Participation in the ADB Interim Mission.
- Responses to ADB and LGED comments on the Interim Report.
- Revisions to town selection criteria, and infrastructure subproject selection criteria.
- Completion of socioeconomic and willingness-to-pay survey.
- Conclusion of institutional, governance, financial and urban planning studies and evaluations; and the development of capacity building programs.
- Flood inundation survey, and illustration of results on GIS maps
- Research on cyclones and degree of damage for economic assessments.
- Feasibility studies of subproject components (with climate change adaptation/ resilience focus).
- Costing of subproject infrastructure components (including climate change adaptation/ resilience elements), outline designs, and contract packaging.
- Overall project design, completion of draft design and monitoring framework, implementing arrangements, and procurement plan.
- Preparation of financing plan.
- Financial and economic analyses.
- Environmental assessments, and the start of preparation of relevant safeguard documents.
- Social, poverty, gender assessments, and preparation of required documents.
- Resettlement assessments, social safeguards (resettlement) survey, and the start of the preparation of relevant documents.
- Market survey, to assess land and property valuations.
- Risk assessments, preparation of risk management plan.
- Groundwater resource assessment for coastal areas of Bangladesh.[27]

[25] Each team will consist of urban and development planning, financial management, social/gender/community development, and water utility management specialists.
[26] The performance criteria are shown in Appendix 7, Volume 2.
[27] See Annex F, Volume 5, for the relevant report.

- Preparation of this Draft Final Report.

1.8 ADB INTERIM MISSION AND FINAL REVIEW MISSION

31. **ADB Interim Mission.** The ADB Interim Mission was fielded on 5-13 May 2013. There was some disruption due to *hartals* (nationwide strikes/demonstrations) and political unrest, and some coordination meetings were held in alternative venues. The actual program carried out during the Mission is summarized below:

- 5 May: Meetings with possible bilateral co-donors.
- 6 May: Kickoff meeting with LGED and Consultant representatives, to discuss PDA processing, project implementation arrangements, infrastructure subproject component costs, and town selection criteria.
- 7 May: Interim Workshop.
- 8 May: Brainstorming discussion with the Consultant concerning infrastructure costs and scope, and performance criteria; and briefing by the the ADB-recruited international environmental and safeguards specialists on findings from their field visit (2-7 May).
- 9 May: Meeting with LGED, DPHE and Consultant representatives concerning infrastructure scope and costs, and town selection criteria.
- 11 May: Meeting at LGED to review the draft aide memoire.
- 13 May: Pre wrap-up meeting with the LGED Chief Engineer and senior LGED staff in the morning to review the draft aide memoire and discuss key issues, and wrap-up meeting at the Bangladesh Secretariat in the afternoon to present the draft aide memoire and discuss key issues.

32. **ADB Final Review Mission.** The ADB Interim Mission was fielded on 30 June – 7 July 2013. There was some disruption due to *hartals*, and some coordination meetings were held in alternative venues. The actual program carried out during the Mission is summarized below:

- 30 June: Kickoff meeting with LGED and consultant team, during which the PPTA implementation schedule, town selection criteria, data for groundwater study, scope and cost estimates for the project, and procurement were discussed.
- 3 July: Meeting with possible co-financiers (AfD, KfW).
- 4 July: Meeting with LGED and consultant team to revise/reduce project scope and cost estimates to increase the geographical coverage of the project. Meetings with DPHE and BWDB.
- 6 July: Meeting at LGED to review the draft aide memoire.
- 7 July: Pre wrap-up meeting with the LGED Chief Engineer and senior LGED staff in the morning to review the draft aide memoire and discuss key issues, and wrap-up meeting at the Bangladesh Secretariat in the afternoon to present the draft aide memoire and discuss key issues.

1.9 CONSULTANT PERSONNEL

1.9.1 Consultant Firms' Core Team

33. Consultant inputs to date are summarized in **Table 1.2**.

Table 1.2: Inputs of Consultant Core Team to Date

No.	Name	Post	Input (2013)
International			
1.	Roger Jackson	Team Leader/ Water Supply and Sanitation Specialist	First field input 14 Jan – 20 Mar Second field input 9 Apr –
2.	Ian Munt	Urban Planning Specialist	Resident in Dhaka until 28 Jun. Input started 16 Jan, intermittent
3.	Bruce Pollock	Municipal Infrastructure Specialist	First field input 17 Feb – 8 Mar Second field input 7-19 Apr Third field input 28 May – 13 Jun
4.	Dr. Barney Popkin Paul Dean (replacement)	Drainage and Flood Control Engineer	Popkin: field input 17 Feb – 17 Mar Dean: field input 12 May – 28 Jun
5.	P. Krisnan	Project Economist/ Financial Specialist	First field input 24 Feb – 14 Mar Second field input 14-21 May Third field input 13 Jun – 8 Jul
6.	Karl Shultz	Climate Change Adaptation Specialist	First field input 10 Mar – 12 Apr Second field input 28 Apr – 24 May
7.	Suresh Gupta (replacement of Vijay Tandon)	Procurement Specialist	Home office input only (July 2013)
National			
8.	Engr. Md. Zahangir Alam	Water Supply and Sanitation Specialist/ Deputy Team Leader	From 9 Jan (fulltime)
9.	Dr. Dewan Abdul Quadir	Climate Change Adaptation Expert	From 16 Jan (intermittent)
10.	Engr. Syed Nesar Ahammed	Municipal Infrastructure Expert	From 16 Jan (intermittent)
11.	Md. Abdul Matin	Geologist	From 16 Jan (intermittent)
12.	Dr. AKM Abdul Kalam	Urban Planning Expert	From 16 Jan (intermittent)
13.	Dr. Md. Ghulam Murtaza	Institutional and Governance Expert	From 16 Jan (intermittent)
14.	Md. Hamidur Rashid	Project Economist/ Financial Expert	From 16 Jan (intermittent)
15.	Md. Nurul Hoque	Social Safeguard Expert	From 16 Jan (intermittent)
16.	Ms. Shireen Akhter	Social, Gender, and Community Participation Expert	From 16 Jan (intermittent)
17.	Engr. Shah Md. Muhibbullah	Drainage and Flood Control Engineer	From 23 Jan (intermittent)
18.	Md. Yasin Mozumber	Environmental Safeguard Expert	From 11 Feb (intermittent)

Source: PPTA Consultant.

34. **Replacements, extensions of staff.** During the course of the PPTA there were contract variations to cover staff replacements, input adjustments/extensions, budget line adjustments, deliverable schedule adjustments, and contract period extensions (**Table 1.3)**.

Table 1.3: Contract Variations – PCTIIP-PPTA

Variation No.	Topic	Date Request Submitted	Date Variation Issued	Notes
1	• Replacement of National Environmental Safeguards Expert, Mr. Abu Nahid Munir Uddin, by Mr. Md. Yasin Mozumber.	8 Feb 2013	13 Mar 2013	Mr. Abu Nahid Munir Uddin was no longer available due to the delay in the start-up of the PPTA.
2	• Replacement of the International Drainage and Flood Protection Specialist, Dr. Barney Popkin, by Mr. Paul Dean. • Replacement of the International Procurement Specialist, Mr. Vijay Tandon, by Mr. Suresh Gupta. • Staffing of the capacity building mobile support teams (8 no. national consultants, 65.0 person-months) • Adjustments to out-of-pockets expenses and contingency.	10 Apr 2013	7 Jun 2013	Dr. Popkin resigned after the first field input of the post. Mr. Tandon was unable to be fielded for the PPTA due to family medical issues and pressing ongoing commitments. The mobile support teams will utilize $500,000 funding from Netherlands Trust Fund under the Water Financing Partnership

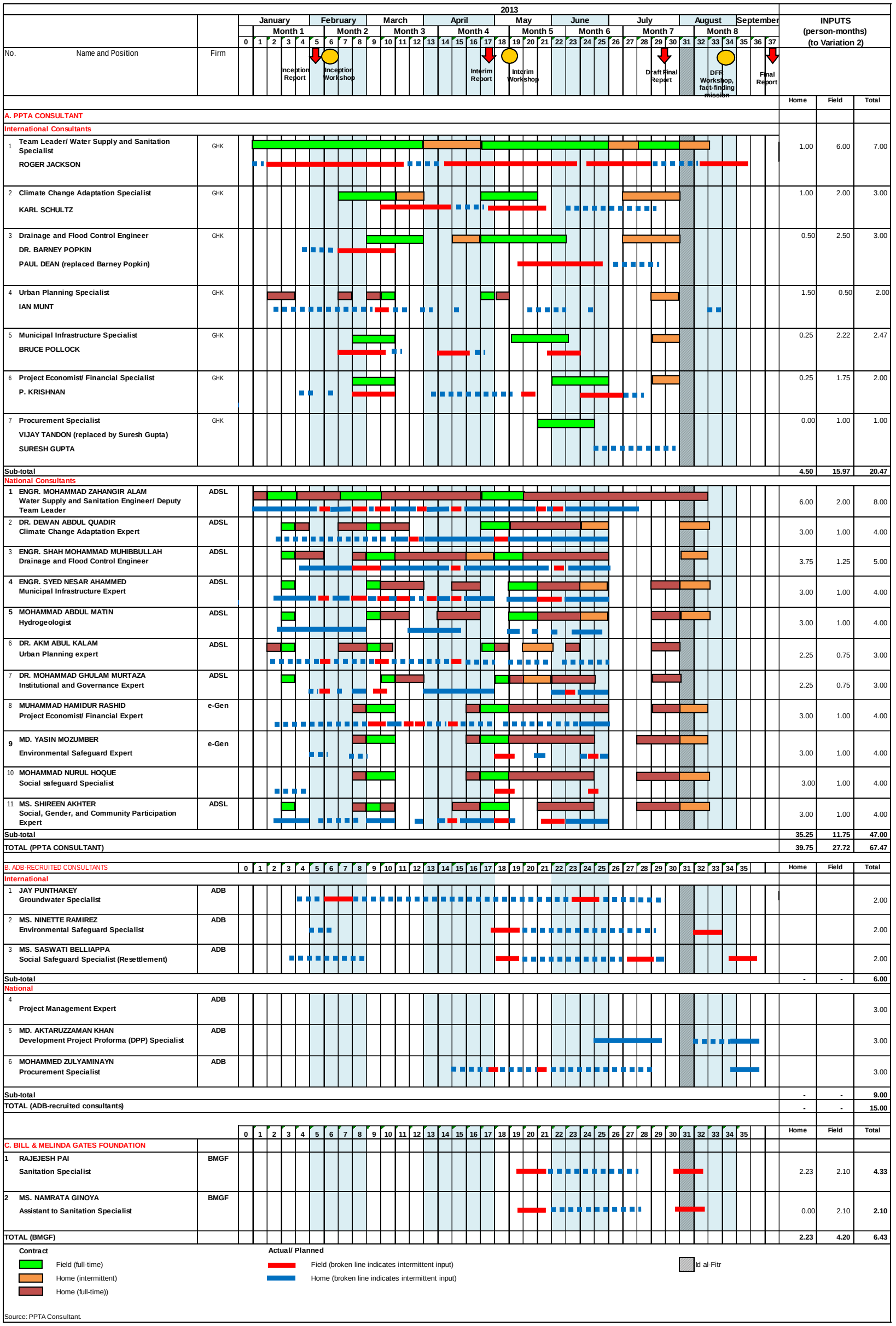
Variation No.	Topic	Date Request Submitted	Date Variation Issued	Notes
	• Extension of PPTA period to 28 Feb 2014.			Facility.
3	• Extension of National Municipal Expert, Mr. Syed Nesar Ahammed, by 0.67 months field and 1.00 month home. • Change to progress payment schedule and use of contingency.	25 Apr 2013	xx Jul 2013	
4	• Increase field input of Team Leader, Mr. Roger Jackson, by 0.25 months. • Increase field input of International Project Economist/ Financial Specialist, Mr. Krishnan, by 0.50 month, and home input by 0.50 month. • Cancel field input of 1.00 month for International Procurement Specialist, Mr. Suresh Gupta, and replace with 0.50 month home input. • Increase home input of National Climate Change adaptation Expert, Dr. Dewan Quadir, by 1.45 months, and decrease field input by 0.63 months. • Replacement of Dr. Khondaker Azharul Haq by Mr. Abul Basher Khan for post of National Water Utility Expert. • Change to progress payment schedule and use of contingency.	19 Jul 2013		• Due to delays to DFR caused by 5 days of hartal 15-19 Ju 2013. • For DFR revised project scope and costs, and for fact-finding mission • To support National Procurement Specialist concening international contractors. • To reflect shift in emphasis in project planning to climate change issues, and for additional surveys and studies. • For Mobile Support Teams.

Source: PPTA Consultant.

35. **Staffing schedule.** The staffing schedule is shown on **Figure 1.5,** which shows inputs as specified in the Contract for Consultant's Services (green and brown bars, for field and home inputs respectively) and actual/planned inputs (red and blue bars, for field and home inputs respectively).

Figure 1.5: Consultant Personnel Schedule

No.	Name and Position	Firm	Home	Field	Total
	A. PPTA CONSULTANT				
	International Consultants				
1	**Team Leader/ Water Supply and Sanitation Specialist** **ROGER JACKSON**	GHK	1.00	6.00	7.00
2	**Climate Change Adaptation Specialist** **KARL SCHULTZ**	GHK	1.00	2.00	3.00
3	**Drainage and Flood Control Engineer** **DR. BARNEY POPKIN** **PAUL DEAN (replaced Barney Popkin)**	GHK	0.50	2.50	3.00
4	**Urban Planning Specialist** **IAN MUNT**	GHK	1.50	0.50	2.00
5	**Municipal Infrastructure Specialist** **BRUCE POLLOCK**	GHK	0.25	2.22	2.47
6	**Project Economist/ Financial Specialist** **P. KRISHNAN**	GHK	0.25	1.75	2.00
7	**Procurement Specialist** **VIJAY TANDON (replaced by Suresh Gupta)** **SURESH GUPTA**	GHK	0.00	1.00	1.00
	Sub-total		**4.50**	**15.97**	**20.47**
	National Consultants				
1	**ENGR. MOHAMMAD ZAHANGIR ALAM** **Water Supply and Sanitation Engineer/ Deputy Team Leader**	ADSL	6.00	2.00	8.00
2	**DR. DEWAN ABDUL QUADIR** **Climate Change Adaptation Expert**	ADSL	3.00	1.00	4.00
3	**ENGR. SHAH MOHAMMAD MUHIBBULLAH** **Drainage and Flood Control Engineer**	ADSL	3.75	1.25	5.00
4	**ENGR. SYED NESAR AHAMMED** **Municipal Infrastructure Expert**	ADSL	3.00	1.00	4.00
5	**MOHAMMAD ABDUL MATIN** **Hydrogeologist**	ADSL	3.00	1.00	4.00
6	**DR. AKM ABUL KALAM** **Urban Planning expert**	ADSL	2.25	0.75	3.00
7	**DR. MOHAMMAD GHULAM MURTAZA** **Institutional and Governance Expert**	ADSL	2.25	0.75	3.00
8	**MUHAMMAD HAMIDUR RASHID** **Project Economist/ Financial Expert**	e-Gen	3.00	1.00	4.00
9	**MD. YASIN MOZUMBER** **Environmental Safeguard Expert**	e-Gen	3.00	1.00	4.00
10	**MOHAMMAD NURUL HOQUE** **Social safeguard Specialist**		3.00	1.00	4.00
11	**MS. SHIREEN AKHTER** **Social, Gender, and Community Participation Expert**	ADSL	3.00	1.00	4.00
	Sub-total		**35.25**	**11.75**	**47.00**
	TOTAL (PPTA CONSULTANT)		**39.75**	**27.72**	**67.47**
	B. ADB-RECRUITED CONSULTANTS		**Home**	**Field**	**Total**
	International				
1	**JAY PUNTHAKEY** **Groundwater Specialist**	ADB			2.00
2	**MS. NINETTE RAMIREZ** **Environmental Safeguard Specialist**	ADB			2.00
3	**MS. SASWATI BELLIAPPA** **Social Safeguard Specialist (Resettlement)**	ADB			2.00
	Sub-total		**-**	**-**	**6.00**
	National				
4	**Project Management Expert**	ADB			3.00
5	**MD. AKTARUZZAMAN KHAN** **Development Project Proforma (DPP) Specialist**	ADB			3.00
6	**MOHAMMED ZULYAMINAYN** **Procurement Specialist**	ADB			3.00
	Sub-total		**-**	**-**	**9.00**
	TOTAL (ADB-recruited consultants)		**-**	**-**	**15.00**
			Home	**Field**	**Total**
	C. BILL & MELINDA GATES FOUNDATION				
1	**RAJEJESH PAI** **Sanitation Specialist**	BMGF	2.23	2.10	**4.33**
2	**MS. NAMRATA GINOYA** **Assistant to Sanitation Specialist**	BMGF	0.00	2.10	**2.10**
	TOTAL (BMGF)		**2.23**	**4.20**	**6.43**



Source: PPTA Consultant.

1.9.2 ADB-Recruited Consultants

36. It was planned that the Consultant's team would be joined at various times by three international and three national specialists recruited by ADB (Figure 1.5). All the specialists were recruited except the National Project Management Specialist, and it is unlikely that this post will now be required.

37. The International Groundwater Specialist accompanied the ADB inception mission in February 2013, and had a second field input in June. The Environmental Safeguard Specialist and Social Safeguard Specialist arrived in Bangladesh for their first field visit on 28 April and 1 May respectively, and for their second field input on 7 July respectively.

38. The National Procurement Specialist was recruited on 12 April, and began his services on 15 April. The National Development Project Proforma (DPP) was recruited in late June.

1.9.3 Gates Foundation Consultants

39. Following an agreement with ADB, the Bill and Melinda Gates Foundation (BMGF) is funding a Sanitation Specialist to assist the PPTA team with assessing the existing sanitation situation and advising on the scope for affordable on-site and decentralized sanitation facilities. The first of the Sanitation Specialist's two scheduled field inputs was carried out from 11 to 25 May 2013, during which time he and his support staff (Figure 1.5) visited the four study pourashavas. A Field Visit Report and Interim Report were prepared; the latter is included in **Annex E, Volume 5**.

1.10 PURPOSE AND STRUCTURE OF THE DRAFT FINAL REPORT

40. The purpose of the Draft Final Report is to present the overall design of the proposed Coastal Towns Infrastructure Improvement Project, for review by ADB, LGED, DPHE and other stakeholders.

41. The structure of this Main Report after this introductory chapter is as follows:

- Chapter 2 – Project rationale, overall planning for the project, scheduling of main components/outputs, and lessons learned from previous and ongoing projects.
- Chapter 3 – Socioeconomic and willingness-to-pay survey: main findings and results.
- Chapter 4 – Climate change adaptation and natural disaster resilience, describing strategies and climate change projections for the next 50 years, to provide guidelines for the incorporation of climate change resilience features in preliminary infrastructure designs.
- Chapter 5 – Existing infrastructure situation.
- Chapter 6 – Selection criteria, prioritization in terms of performance criteria mechanism stages for infrastructure interventions, design considerations, and the basis for cost estimates.
- Chapter 7 - The scope of proposed infrastructure interventions in the study pourashavas for municipal infrastructure (roads, cyclone shelters, boat landings, solid waste facilities, etc), drainage and flood control, and water supply and sanitation, based on field evaluations, selection criteria/considerations, and

stakeholder consultations and workshops, and incorporating climate change resilience measures.

- Chapter 8 – Project component/output concerning local governance strengthening for sustained service delivery and urban planning, and capacity building programs.
- Chapter 9 - Project component/output concerning community awareness raising and behavioral change programs for climate change adaptation, disaster preparedness, and hygiene.
- Chapter 10 – Selection selection process and criteria for Batch 2 towns.
- Chapter 11 – Investment and financing plans.
- Chapter 12 – Project implementation arrangements, including organograms and roles and responsibilities for the Project Managment Unit and Project Implementation Units, and performance criteria.
- Chapter 13 – Due diligence: economic and financial management assessment; governance assessments, including procurement capacity of pourashavas; poverty, social, gender assessments; willingness-to-pay, environmental and social safeguards; and project risk assessments.
- Chapter 14 – Key issues.

2 OVERALL PROJECT PLANNING AND COMPONENTS

2.1 RATIONALE FOR PROJECT

42. The low-lying deltaic coastal area of Bangladesh (consisting of 19 districts in 4 divisions, with a total population of about 38.1 million, of which the urban population is about 8.6 million)[28] is very vulnerable to severe weather events such as tropical cyclones in the Bay of Bengal and storm/tidal surges, resulting in extensive flooding, backup of sewage, wind damage and, tragically, loss of human lives. Existing urban infrastructure in pourashavas (municipalities) such as water supply systems, sanitation facilities, roads, bridges and boat docking stations is generally inadequate, and suffers a great deal of damage during such events.

43. Modeling studies conducted during the PPTA indicate that cyclones will intensify in the future owing to increased sea surface temperatures in the Bay of Bengal. In fact, it is estimated that the more severe storms (windspeeds greater than 178 km/hour) will increase by approximately 60%, with the most severe storms with windspeeds over 250 km/hour trebling in frequency. Sea level rise is exacerbating the vulnerabilities of coastal towns, as storm surge heights will increase. Climate change impact is expected to result in an average sea level rise of between 17.5-39 cm by 2050—this could make 10-15% of the country extremely vulnerable to floods, and dislocate around 35 million people from coastal towns and rural areas.[29]

44. As well the increased risk of flooding, sea level rise will also increase saline intrusion of water supply sources (both surface water, and shallow groundwater), which will deteriorate water quality and the availability of potable water, with disproportionate impacts to women and the poor, including impacts on maternal health.[30] Backup of sewage and water logging due to inadequate drainage will result in a deterioration of public health though the increased prevalence of waterborne diseases.

45. The impacts of climate change on coastal towns will be significant. Damages to buildings, roads, and economic activity will be steep. During Cyclone Sidr in 2007, an estimated $45 million in loss and damage was assessed; for 2045 the model indicates cyclone damage may increase to $20 million in the four towns studied under the PPTA. Loss of life, health and livelihoods is also expected to increase. Damage owing to monsoon season flooding is also expected to increase with sea level rise and increases in seasonal rainfall. The need for new infrastructure based on the existing development deficits and population growth, will be exacerbated by these climate impacts. New infrastructure will need to take into account changes in climate, including increased requirements for drainage systems, and higher flood inundation levels impacting the integrity of roads, bridges, and other infrastructure. New cyclone shelters will be required.

46. Governance and institutional capacity local governments in coastal towns is weak, and poverty incidence is high (52%).[31] A recurring theme, in interviews with local and central government officials, and with coastal town residents and NGOs, is the limited role of the

[28] BBS Community Reports, 2012.

[29] The Daily Star: Business, 22 April 2013, citing ADB study on cutting greenhouse gases.

[30] Aneire Ehmer Khan et al. September 2011. *Dinking Water Salinity and Maternal Health in Coastal Bangladesh: Implications of Climate Change.* Vol. 119, No. 9, Environmental Health Perspectives.

[31] Ministry of Local Government, Rural Development & Cooperatives, Local Government Division, Local Government Engineering Department. Oct 2012. *Technical Assistance Project Proposal (TPP) (Recast) for Project Preparatory Technical Assistance (PPTA) Project for Coastal Towns Infrastructure Improvement Project (CTIIP) (Financed by Asian Development Bank) (SPEC meeting held at 30 September 2012*.

pourashavas in disaster risk reduction (DRR) and disaster risk management (DRM). The limited power of pourashavas to raise revenues limits their ability to maintain existing infrastructure.[32] Extensive capacity building in local governments is needed to facilitate the development and operation of basic needs infrastructure.

47. **Urban Planning.** Coastal towns face similar constraints in urban development and planning as encountered throughout urban Bangladesh, but exacerbated by the anticipated impacts arising from climate change. These constraints include: (i) steadily accelerating, hitherto unplanned and uncontrolled urbanization, some of which is attributable to the migration push factors of increased vulnerability to climate change, (ii) severe deficits in appropriate and adapted urban infrastructure provision and basic service delivery resulting from alarming financial constraints, (iii) planning instruments that either have not existed or are inadequately adapted to climate change and disaster risk management, lack an implementation-orientation and/or are un-enforced, (iv) the growth in urban poverty and lack of inclusiveness in municipal planning, with the burden of vulnerability falling disproportionately on the urban poor, (v) severe constraints in local government capacity, governance structures, and municipal finances all of which impact on the ability of pourashavas to respond to climate change.

48. Local urban planning is in its infancy throughout Bangladesh, including the coastal towns, with master plans and development control systems only now emerging. There is agreement that efficient planning systems are critical for efficient urban development and management, the need for which is magnified by climate change and the need to manage and reduce disaster risks. CTIIP will systematically build capacity in urban planning in general, and urban planning and climate change in particular, by strengthening the climate resilience of master plans, enhancing development control systems, introducing straightforward infrastructure investment programming and building the understanding of, and skills, in urban planning within the participating pourashavas.

49. **Bangladesh sector planning and policy context.** The development plans for both the urban and water supply sectors set the policy framework and rationale for project implementation. The overall Government development framework, the Bangladesh 'Sixth Five Year Plan (FY 2011-15)', emphasises the significance of the urban sector to overall national development, and commits to strengthening urban development, infrastructure and services, and urban local government. All government policy (existing and planned) is aligned with the Sixth Five Year Plan.

50. The Sector Development Plan (FY 2011-25) – Water Supply and Sanitation Sector In Bangladesh', and the 'Bangladesh Climate Change Strategy and Action Plan', are the core strategic policy instruments addressing the need to improve urban water supply, and adapt and extend climate resilient urban infrastructure and services. The project will support the emerging consolidated urban sector framework—the draft National Urban Sector Policy—by addressing the main thrust of the policy through development of the local planning system, addressing infrastructure deficiencies and building the capacity of coastal town pourashavas for urban development, management and planning. CTIIP will demonstrate how urban development and planning can better respond and adapt to climate change risks. The National Plan for Disaster Management 2008-2015 provides a holistic DRM approach of which priorities include preparedness through vulnerability and risks assessments and mapping, hazard land zoning, and land use planning and incorporating all hazard risk reduction perspectives into sectoral policies and development plans such as urban housing,

[32] Smith, Barry, *Financing Urban Adaptation to Climate Change: Assessment of International Funding Mechanisms,* Background paper for Financing Urban Adaptation to Climate Change - An International Meeting Hosted by IIED, 13-14 June 2013, p. 29. Less than 2% of total government revenue is collated at sub-national levels.

urban infrastructure, and water and sanitation. These priorities are specifically targetted by this project.

51. The coastal zone specifically is covered by a Coastal Zone Policy (approved 2005) and subsequent Coastal Development Strategy (2006) that provides an integrated coastal zone management development strategy and for tackling the vulnerabilities and poverty of the zone. Strategic priorities that this project addresses include ensuring fresh and safe water availability and providing safety from man-made and natural hazards.

2.2 PROJECT IMPACT, OUTCOME AND OUTPUTS/COMPONENTS

52. **Impact.** The expected impact of the Coastal Towns Infrastructure Improvement Project (CTIIP) is improved access to and delivery of climate resilient municipal services in selected pourashavas, including urban roads and bridges, solid waste management, slum improvements and boat landing stations, drainage, and water supply and sanitation; and reduction of the occurrence of water-related diseases, with reduced exposure to climate extremes.

53. **Outcome.** The projected outcome is the provision of more accessible, reliable and climate-resilient municipal services to the population of the pourashavas. The project design will incorporate the role of women in improving municipal services, particularly for water supply and sanitation, and target the poor.

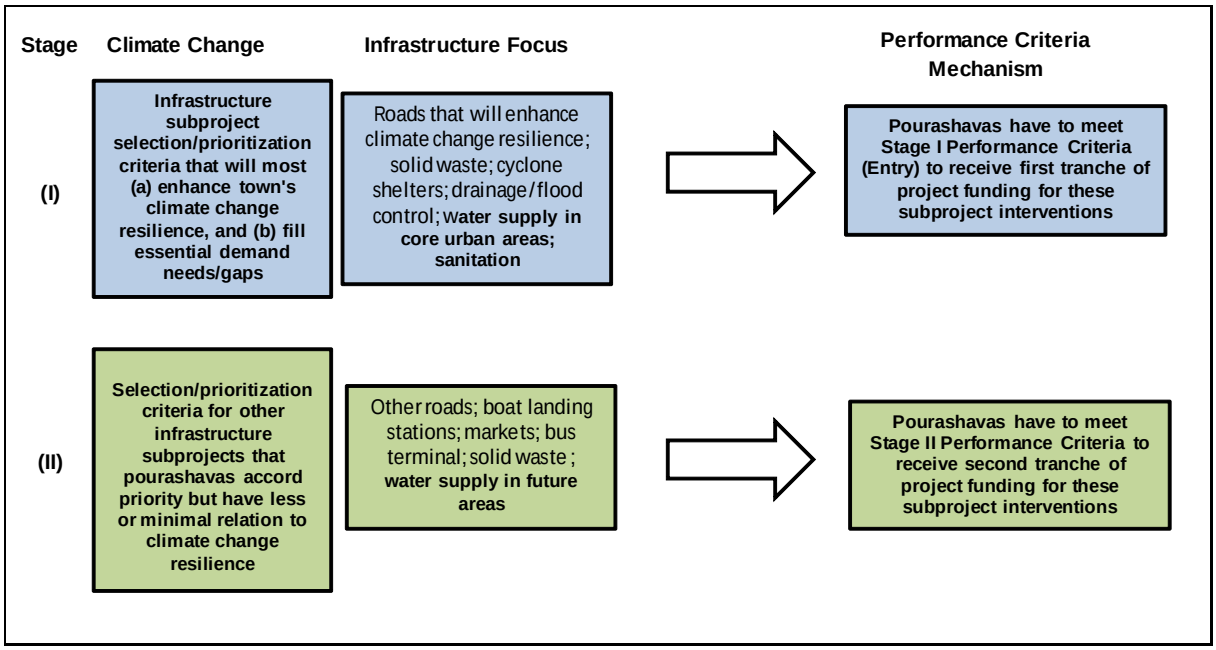
54. **Outputs/ components.** The construction of improved infrastructure is by far the largest cost component of the project. However, ensuring that this infrastructure is transformed into sustainable services resilient to climate change will also require other factors such as improving community awareness and pourashava accountability and ensuring that pourashavas have sufficient human and financial resources to continue to deliver these services effectively.

55. Taking this into account, the project outputs will be: (i) improved municipal infrastructure with climate-resilient designs; (ii) strengthened local governance and institutional capacity for sustainable service delivery, urban planning and climate change adaptation; (iii) awareness raising and behavioral change in community-based climate change adaptation, disaster preparedness, and hygiene activities; and (iv) project management and administrative support.

2.3 PROJECT PLANNING

56. **Project funding system.** A sector lending modality will be used as the financing framework for CTIIP). As is the case with other projects financed under a sector lending modality (such as Urban Governance and Infrastructure Improvement Project and the Secondary Towns Water Supply and Sanitation Project), the release of project funds to the pourashavas will be administered under a 2-stage process known as the Performance Criteria Mechanism, whereby the project pourashavas have to meet certain institutional capacity and governance criteria to receive funding (see **Appendix 7, Volume 2,** for details on the criteria). Infrastructure subprojects were therefore divided between Stage I funding and Stage II funding, as illustrated in **Figure 2.1**.

Figure 2.1: Infrastructure Intervention Selection with Relation to Performance Criteria Mechanism



57. In accordance with the ADB Interim Mission (5-13 May 2013) Aide Memoire, investments under Performance Criteria Stage I include those infrastructure components in urban core areas and considered critical for building climate change resilience such as: (i) cyclone shelters, (ii) roads, bridges and culverts which will enhance climate change resilience through improved connectivity and access to emergency services in the event of disasters caused by natural hazards, (iii) solid waste management, (iv) drainage and flood control, and (v) water supply in urban core areas, and (vi) sanitation.

58. Investments considered under Performance Criteria Stage II could include: (i) other priority roads, bridges, and culverts, (ii) boat landing stations, (iii) markets, (iv) bus terminals, and (v) solid waste management, and (vi) water supply for future planned development areas.

59. **Project towns/pourashavas.** It is intended that as many coastal towns as possible will participate in the project, depending on scope, readiness to meet the performance criteria, and availability of funding resources.

60. The first batch of towns (Batch 1) are the four towns studied under the PPTA (Amtali, Galashipa, Pirojpur and Mathbaria). It was estimated during the ADB final review mission (30 June – 7 July 2013) that four more towns (Batch 2) could be covered by the project from the funding resources which were planned in the Technical Assistance Project Proposal (TPP).[33] If additional funding resources can be secured, from bi-lateral donors, further towns could be covered.

61. Batch 2 towns will be selected from a long-list of 36 pourashavas in 11 districts in the coastal region, based on criteria developed during the PPTA (see Chapter 10 for details). The selection of infrastructure interventions for these towns will be conducted by the executing agency (EA) using the criteria developed during the PPTA (see Chapter 6 for

[33] Ministry of Local Government, Rural Development & Cooperatives, Local Government Division, Local Government Engineering Department. Oct 2012. *Technical Assistance Project Proposal (TPP) (Recast) for Project Preparatory Technical Assistance (PPTA) Project for Coastal Towns Infrastructure Improvement Project (CTIIP) (Financed by Asian Development Bank) (SPEC meeting held on 30 September 2012)*.

details).

62. It is recommended that the Batch 2 towns are in the same geographical area as the Batch 1 towns area, since there is a risk that if the geographic coverage for CTIIP is too wide the implementation capacity for project preparation in both government and ADB would be stretched too far—leading to start-up delays, inefficient operations and development targets not being met.

63. **Project readiness.** Project readiness of participating pourashavas will be scrutinized based on the following criteria:

- Detailed engineering design completed.
- Advanced procurement bids have been evaluated, and contracts to be awarded.
- Safeguard measures are in place for at least the first 24 months of the project.
- Local counterpart funding has been secured.
- The project director and team have been selected and are in place.
- Local permits and clearances have been obtained.

64. **Project schedule.** In line with the proposed processing schedule outlined in ADB Final Review Mission Aide Memoire, loan effectiveness is expected to be concluded by June 2014. The project implementation period is planned to be 2014-2020.

2.4 PROJECT DESIGN ADVANCE

65. Implementation experience in Bangladesh has shown that projects typically face severe start-up delays as a result of recruiting project implementation consultants (for detailed engineering design, preparation of civil works contract tender documents, and project management support) after ADB loan approval. To mitigate this risk, these tasks will be intiated prior to loan approval by means of a new ADB financing instrument known as a Project Design Advance (PDA) financed under the loan and included in the TPP.

66. The recruitment of the PDA consultants for Detailed Design Services (DDS) is underway, and it is anticipated that they will mobilize in November/December 2013. The main tasks of the DDS consultants are as follows:[34]

a. Undertaking feasibility studies, including preliminary engineering design; cost estimates of subprojects;
b. Conducting physical surveys;
c. Identifying and prioritizing subprojects;
d. Conducting technical assessments of subprojects;
e. Undertaking detailed engineering designs, including specifications, drawings, and detailed cost estimates;
f. Preparation of bidding documents;
g. Undertaking social and environmental safeguards analysis based on detailed designs and preparation of necessary safeguard documentation; and
h. Undertaking Development Project Proposal (DPP) preparation for investment project and assisting in approval process.

67. The DDS Consultant will be engaged under the Project Management Unit (PMU) for a total period of five years. However, the consultants will only initially be recruited for the period until 30 Jun 2014, and will be extended to the full term once the project has been approved.

[34] From TOR in the Request for Proposals for Detailed Design Service (DDS) Consultancy Services under "Project Design Advance (PDA) Project" for Coastal Towns Infrastructure Improvement Project (CTIIP), issued by LGED on 15 May 2013.

68. The consulting team will consist of four international consultants (50 person-months) and 17 national consultants (371 person-months). The team will be headed by an International Team Leader/ Municipal Infrastructure Specialist supported by a National Deputy Team Leader/ Senior Municipal Infrastructure Design Engineer and other experts.

69. The expected deliverables/ outputs of DSS consultant team include the following:

a. Report on feasibility study including preliminary engineering design, cost estimate of each non sample subproject.
b. List of prioritized subprojects.
c. Physical survey of each subproject.
d. Technical assessment of each subproject.
e. Detailed engineering design including specification, drawing and detailed cost estimate of each subproject.
f. Modified detailed design including specification, drawing and detailed cost estimate of required subproject if the situation demands.
g. Bidding document of all sub-project.
h. Financial, social and environmental safeguard reports.
i. Approved Development Project Proposal (DPP) for investment project.

2.5 LESSONS LEARNED FROM OTHER PROJECTS

70. Lessons learned from ADB, World Bank and other development partners, and project experience in the urban development sector, particularly UGIIP and STWSSP, have been reviewed. How these lessons will be considered in CTIIP design is shown in **Table 2.1**.

Table 2.1: Lessons Learned for Consideration in CTIIP Design

Topic	Lesson, Observation	CTIIP Design
Overall project design/ guiding principles	Performance-based allocation of investment funds can generate a strong incentive for pourashavas to carry out governance reforms. Participatory planning is not always strong for the allocation of funds. Linkage between infrastructure development and governance improvement is often weak. Climate change adaptation/resilience and disaster preparedness/management is generally not built into project/infrastructure designs. It is crucial to establish clear client and beneficiary ownership of a project if it is to be successfully implemented and sustainability operated.	- A 2-stage performance criteria mechanism modeled on the successful UGIIP experience will be adopted for pourshavas to trigger access to investment funds. - Governance improvement and infrastructure development will be planned and implemented in a more integrated manner through the development of pourashava development plans (DPD). - For CTIIP, climate change (CC) adaptation/resilience and disaster preparedness/management will be key features of infrastructure designs. - Beneficiaries will be encouraged to make some in-kind (provision of labor) contribution to the community-based physical works in order to inculcate a sense of buy-in and ownership.
Urban planning, master plans	Master plans are deficient in providing a methodical climate change vulnerability and adaptation assessment, and implementation orientation of the plans is weak. There are two issues related to the capacity of pourashavas to plan in CC/DRM: (1) The master plans developed under GOB support. These are traditional land use instruments that can be revised (as necessary) on the basis of a vulnerability	- It is not proposed that there is a separate CC plan or strategy (given the size of the towns this is best integrated in the master plan), but rather an investment instrument that can be used to prioritize investments (including CC/DRM).

Topic	Lesson, Observation	CTIIP Design
	assessment. A list of projects is identified for implementation in the first five years of the Master Plan period. But on balance these plans will remain deficient as a method for identifying and bringing forward investments on an on-going basis due to a lack of prioritization, and the absence of a link to available funds and on-going O&M. This is a critical gap and it needs to be bridged (a matter that the UGIIP MIDP/PDP tried to address). (2) Experience suggests that shorter-range investment plans are the best way of trying to plug this gap – these should be far more operational, quicker to develop, more responsive to changing needs, based on financial capacity. • Building permit system needs improvement.	- Improve building permit system through improved decision making systems. Implementation of uniform building application and approval format/system in all categories of pourashavas.
	• Capacity for urban planning (human, organization and institutional) in the pourashavas is insufficient human resources and understanding of urban planning, sub-optimal use of decision-making and influencing structures (the Standing Committees on Urban Planning, Urban Services and Development and TLCCs) and insufficient participation in planning.	- Urban Planners are appointed in participating pourashavas. - Training, briefing and sensitization activities designed and implemented with pourashava representatives and staff. - Development of control systems enhanced with elaboration of new systems (approval processes and storage) and testing of most effective mechanisms for enforcement and compliance. - Awareness raising campaigns designed and implemented. - Municipal (Climate Resilient) Investment Plans developed in participating pourashavas, supporting capacity development activities undertaken, method tested and revised, training modules and activities established and implemented. - GIS systems installed in pilot pourashavas, staff assigned and trained, and applications established.
Project implementation arrangements	• It is important to make clear and simple implementation arrangements to facilitate smooth and timely project implementation, and avoidance of excessive delays. • A strong project office and active implementing agencies (IA) are keys to a project's success.	- There will be a project management unit (PMU) in the EA (LGED), and project implementation units (PIU) in the pourashavas. - The active participation of the pourashava mayors and key officials will be crucial for successful project implementation. - Pourashavas will actively participate in the planning and design of works.
Project Implementation staffing	• Recruiting key staff in pourashavas, in particular urban planners (for A class pourashavas) is critical for effectively implementing the project. • Trained staff under projects tend to move out of the pourashavas, undermining continuity and momentum.	- The recruitment of staff will be included in the assurances of the ADB loan agreement. - There will be explicit assurances in the loan agreement about keeping trained staff in the project pourashavas.
Project management	• Inadequate staff resources to implement the project.	- Permanent staff appointments to be incorporated in the project plan and given high priority; budgetary support to be provided for incremental staff for project duration. - Consultant teams will provide

Topic	Lesson, Observation	CTIIP Design
		implementation support to the EA and IAs, and organize capacity building activities.
	Weak project management, and delayed recruitment of consultants has contributed to poor outcomes.	- Recruitment should start at the earliest appropriate time.
	Ensuring full transparency and public accountability of project administration and procurement is crucial to stimulating community participation and commitment to project policies and procedures.	- Accountability procedures such as public disclosure of budgets, tenders, contracts, and terms of reference will ensure good governance and help prevent fraud and corruption.
Capacity of pourashava local governments	Pourashava authorities will need considerable support for infrastructure development for some period of time.	- One of the components of the project is capacity building and project implementation support.
	In cases where substantial devolution of additional responsibilities has taken place, more capacity development is required than usual.	
	Appointing an adequate number of qualified staff to operate and maintain water supply and sanitation facilities to acceptable standards	- Technical units in the pourashavas to operate and maintain water supply systems will follow standard O&M practices according to DPHE guidelines.
Urban governance improvement action program (UGIAP)	Pourashavas are not familiar with urban governance action plans.	- The project will develop detailed task lists and guidelines for the implementation of action plans.
	Pourashavas tend to focus on physical activities rather than on governance improvement.	- The project will introduce citizens' report cards to examine citizens' perception of governance improvement.
	Some mayors influence the selection of representatives in TLCCs and WLCCs, particularly for low-income groups.	- Low-income groups will be encouraged to select their own representatives, and include leaders of slum improvement committees and community-based organizations.
	The role of pourashava mayors is critical for the smooth implementation of governance action plans.	- Mayors will be involved from an early stage in the project, and, together with other key staff, receive capacity training on governance improvement.
	There is no mechanism to keep pourashavas from borrowing excessively.	- UGIAPs will include debt indicators and a requirement of full repayment of debts due before receiving further funding.
	Lengthy budgetary process slows the implementation of poverty reduction and gender action plans (PRAP/GAP).	- Clear budget requirements for PRAP/GAPs will be included in PDPs.
Affordability	Water supply projects often only connect a much-reduced number of consumers because of low willing-to-pay and/or low incentives on the part of the authority concerned to actually make the connection.	- Connection charges should be affordable, and set so as to attract the greatest number of consumers, and for costs to be gradually recouped from user fees over the long term.
Financial management, tariff setting	Successful financial management is often associated with financial autonomy. Effective cost recovery requires accurate tariff setting, good budgeting and close monitoring of billing and collection, all of which are difficult when financial autonomy is limited.	- The project will include capacity development in tariff structures, billing and cost recovery procedures. - For water supply, cost recovery should be based on metered water consumption, and not a fixed rate tariff.
	Tariff setting and collection of user charges is vital to system sustainability.	
	Non-revenue water reduction and financial targets for revenue generation should be realistic and translated into specific activities with monitoring milestones.	
	Project financing inadequate to prevent cash flow problems in final year.	- Final year of project will cover O&M, and hence will have minimal cash flow.

Topic	Lesson, Observation	CTIIP Design
Comprehensive cost estimates	Cost estimates should be realistic.	- Application of LGED schedule of rates which is now updated every year. - For water supply and sanitation, rates from DPHE will be used.
Procurement	Too many contracts entail onerous document preparation, and lengthy approval process for award of contracts Approval processes in design and tender management delayed by lack of designation of authority	- Contract package numbers will be minimized, and as large as possible, within the capacity of pourashava management. - Significant authority will be given to PIUs/pourashavas in project design; the project will incorporate delegation of authority of authority provisions in the loan covenants.
Land acquisition	One of key issues for infrastructure such as water supply treatment plants, septage treatment plants, solid waste landfills is availability of land. Land acquisition problems have affected urban development projects. Land acquisition issues must be resolved as early as possible.	- The need for land acquisition will be minimized as much as possible.
Physical works	Interventions in slum areas are generally limited. O&M budgets as a fixed share of total budget does not always match actual requirements. Design and documentation inadequately understood by local contractors. Contractor failure to adequately staff and resource project. Construction delays caused by poor procurement practices.	- All pourashavas will be required to spend at least 5% of allocated funds on basic services in slum areas. - UGIAPs will require the formulation of O&M plans and budgets as part of PDPs. - Documentation will be in both English and Bangla. - Tender documents are to place specific emphasis on tender appraisal of contractor staffing and resources. - Civil works contracts will include supply of materials.
Community participation	Inadequate community participation resulting in poor revenue collection. Community awareness of the benefits of sanitation and good hygiene are inadequately understood and promoted. Low community awareness on climate change adaptation.	- An NGO will be engaged for awareness raising campaigns. - Formation of TLCCs and WLCCs will formalize participation of stakeholders. - The project proposes pourashava level community adaptation funds, getting the pourashava disaster committees to actually operate and manage these; sustained revenues through agreements with funds for outcome based "credit" (maybe with VRCs), etc.
Monitoring and evaluation	Government monitoring and evaluation of projects has generally been weak.	- Monitoring and evaluation will be included in the capacity development and implementation support work.
Private sector participation (PSP)	Given the constraints on public sector resources and capacity, the private sector needs to play an important and growing role in infrastructure development. PSP, where it has been promoted, by and large has showed promise in terms of coverage and quality of service, but it is not the panacea to the sector's structural problems.	- PSP feasibility will be assessed as the project progresses.

Source: PPTA Consultant.

3 SOCIOECONOMIC AND WILLINGNESS-TO-PAY SURVEY

3.1 INTRODUCTION

71. Implied in the TOR of the PPTA was a requirement to conduct a Socioeconomic and Willingness-to-Pay Survey (SEWTPS). The main aim of the SEWTPS was to collect primary baseline data for socioeconomic analysis and development of appropriate interventions for poverty reduction, gender action plan, water and sanitation, solid waste management and related strategies. The basic output is a socioeconomic profile of households in the study locations, with gender disaggregation for gender sensitive data.

72. The TOR and questionnaire for the survey were included in the Interim Report (Appendices 4.1 and 4.2 respectively, Volume 2). The willingness-to-pay part of the questionnaire was based on the Contingent Value Method.

73. Following a selection process in accordance with ADB guidelines, DATASEARCH was engaged as the service provider (SP) to conduct the survey. The survey activities began at the beginning of April 2013 and field activities were completed in early June.

74. The survey was conducted in the four study pourashavas (Amtali, Galachipa, Pirojpur and Mathbaria) in the coastal area. The number of samples was drawn from the urban households determined from the population and housing census 2011. Urban population and urban households means the population and households within the pourashava and other urban areas outside of the pourashava. Using the above methodology, and applying a contingency, the target size was a total of 1,458 households, distributed among the selected pourashavas as shown in **Table 3.1**.

Table 3.1: Sample Size for SEWTPS

Name of the Pourashava	Urban Population	Urban Households	Determined Sample Size	Determined Sample Size including Contingency
Amtoli	21,808	5,084	358	372
Galachipa	25,917	6,128	362	376
Pirojpur	60,056	13,646	374	389
Mathbaria	28,851*	6,801	364	379
TOTAL	**136,632**	**31,659**	**1,458**	**1,516**

Note: *At the time of survey preparation this was believed to be the population of Mathbaria Pourashava. However, it was later learnt that the correct population is 18,375.
Source: BBS 2011 census.

3.2 SUMMARY OF KEY SURVEY RESULTS

75. The service provider has prepared complete sets of output tables of survey results for each pourashava. However, when reviewed by the Consultant, many inconsistencies were noticed, and the table outputs need to be thoroughly checked and revised for consistency and accuracy. Bearing this caveat in mind, a summary of preliminary key results from the SEWTPS is shown in **Table 3.2**.

Table 3.2: Summary of Preliminary Key Results from SEWTPS*

No.	Indicator	Value			
		Amtali	**Galachipa**	**Pirojpur**	**Mathbaria**
1	Sex of the respondents:				
	Male	54.0%	40.2%	55.8%	49.2%
	Female	46.0%	59.8%	44.2%	50.8%
2	Average Household Size	4.6	4.8	5.3	4.6
3	Average household monthly income	Tk.13,841	Tk.13,167	Tk.14,620	Tk.21,744
4	Percentage distribution of households by expenditure group/poverty status:				
	Extreme Poor Group (Lowest-Tk.4999)	13.5	10.8	6.7	2.1
	Poor Group (Tk.5000-6999)	25.5	15.7	13.3	4.2
	Low income group (Tk.7000-12499)	41.6	42.3	45.9	27.9
	Middle income group (Tk.12500-24999)	17.8	25.2	25.9	50.0
	Upper income group (Tk.25000 - Highest)	1.6	6.0	8.2	15.8
5	Average HH monthly expenditure	Tk.9606	Tk.11,834	Tk.12,874	Tk.17,574
6	% of HHs in slum areas	3.7%	29.8%	12.2%	7.1%
7	% of female headed households (main earners are female)	4.2%	7.1%	4.4%	4.5%
8	Occupation of the household members:				
	Business	11.6%	12.2%	8.5%	12.7%
	Skilled labourer (driver, mason, carpenter, nurse, paramedic etc.)	5.7%	5.8%	5.4%	2.9%
	Service	6.9%	4.7%	8.7%	10.6%
	Agriculture	9.2%	7.9%	7.1%	6.8%
	Fisherman	1.5%	0.7%	2.9%	0.5%
	Jobless/unemployed	1.7%	3.3%	3.3%	2.0%
	Old aged/retired people	3.0%	1.7%	4.1%	4.1%
	Students	29.7%	27.2%	29.8%	28.5%
	Housewife	26.3%	25.6%	25.6%	26.5%
	Domestic workers	1.0%	5.1%	1.0%	0.5%
	Others	2.90%	5.4%	3.2%	4.90%
9	Sources of drinking water (multiple response):				
	Shallow Tube well	5.0%	16.8%	50.8%	7.6%
	Deep Tube well	92.3%	70.9%	7.7%	.8%
	Pond/ River/ Canal	0.8%	29.4%	32.8%	32.1%
	Pond sand filter				71.8%
	Bottled water			18.5%	1.3%
	Pipe water	1.9%	5.8%	2.6%	
	Piped water of others' house			1.5%	
	Road side tap/pipe water			1.0%	
	Rainwater			1.3%	1.9%
	Others	3.2%	0.2%	0.8%	0.0%
	N		381	390	
10	% of households get pipe water supply from the municipality	39.0%	26.3%	39.0%	0.0%
11	% of households reported to drink directly the supply water from Pourashava (who get pipe water from municipality)	5.0%	33.0%	27.9%	Not Applicable
12	Reasons for not to drink directly the water supplied from municipality (multiple response)				Not Applicable
	Unsafe to drink	76.2%	82.8%	63.4%	
	Because of diseases	20.8%	37.9%	56.1%	
	Because of dirtiness	55.4%	65.5%	73.2%	
	Because of bad smell	12.3%	6.9%	31.7%	
	Because of bad taste	23.8%	29.3%	6.1%	
	Because of Iron	0.8%	13.8%	2.4%	
	N	130	58	82	
13	Average monthly amount of bill paid for water to municipality	Tk.233.55	Tk. 182	Tk.255.87	Tk. 664 (non-piped)
	N	141	78	117	42
14	Use of latrine:				
	Individual	94.1%	61.5%	94.1%	98.2%
	Shared (with few houses)	5.3%	31.9%	4.9%	1.8%
	Public		3.4%	.5%	

No.	Indicator	Value			
		Amtali	**Galachipa**	**Pirojpur**	**Mathbaria**
	None	0.6%	3.2%	.5%	
	N	377	381	390	377
15	Type of latrine the household member use				
	Flush to septic tank	25.3%	14.1%	32.6%	46.9%
	Pit latrine with slab and water seal	2.8%	2.7%	9.7%	16.4%
	Pit latrine with no water seal	7.7%	9.2%	.3%	2.7%
	Ring slab latrine with water seal	59.8%	20.1%	34.5%	25.3%
	Ring slab latrine with no water seal	4.4%	48.4%	21.6%	8.1%
	Hanging toilet/hanging latrine		3.3%	.8%	
	No facilities or bush or field	0.6%	1.4%	.3%	
	Other/ Toilet releasing waste directly into drain		.8%	.3%	0.5%
	N		381	390	
16	Modes and places of household waste disposal				
	Throws the wastes to the nearby open space	41.4%	45.7%	24.1%	44.2%
	Throws the wastes into the nearby water bodies (river/canal/ditches/open water bodies)	24.1%	47.0%	41.8%	28.9%
	Dispose waste at HH dustbin and those wastes are collected from HH	2.9%	0.5%	1.8%	7.9%
	Goes to the nearby municipal dustbin and disposes wastes			6.2%	3.4%
	Waste collection van collects the HH wastes	3.7%	0.3%	0.5%	0.3%
	Others	27.9%	6.5%	25.6%	15.3%
	N	377	381	390	377
17	Whether any HH members suffered from water or vector borne diseases	13.5%	22.3%	28.7%	25.3%
18	Types of diseases the household members suffered:	%			%
	Diarrhea	62.0%	61.6%	43.3%	66.7%
	Amoebiasis	12.0%	11.0%	13.5%	18.4%
	Cholera		2.7%	1.9%	1.1%
	Gastroenteritis	2.0%	5.5%	8.7%	2.3%
	Hepatitis A	10.0%	6.8%	12.5%	2.3%
	Dysentery	6.0%	4.1%	5.8%	10.3%
	Paratyphoid & Typhoid	10.0%	6.8%	13.5%	5.7%
	Dengue	10.0%	1.4%	2.9%	
	TB	4.0%	1.4%	1.9%	
	Skin diseases	6.0%	6.8%	6.7%	10.3%
	Sore eyes	6.0%	4.1%	1.0%	
	Malaria			1.9%	
	Others			3.9%	1.1%
	N	50	73	122	87
19	Whether the household got affected by any natural disaster during the last 5 years	1.9%	23.1%	76.2%	13.7%
	N	377	381	381	380
20	Type of natural disasters affected by the HHs				
	Water logging	0.8	15.0	3.3	6.3
	Cyclone		5.5	14.9	11.1
	Flood	0.8	13.6	4.6	1.6
	Drought		1.6	0.5	0.5
	Storm	0.3	15.0	67.4	2.1
	N		88	297	
21	Type of damages caused by the natural disasters during the last 5 years	%	%	%	%
	Death of family member(s)		6.8		
	Injury/disability		4.5		
	Damage to house or property, without displacement	28.6	34. 1	24.3	24.3
	Loss of house, resulting in displacement	14.3	9.1	5.4	5.4
	Loss of vehicles, boats or other household assets	14.3	11.4	1.3	1.3
	Loss of animals	42.9	29.5	5.1	5.1
	Loss of trees	14.3	17.0	82.8	82.8
	N	7	88	297	52
22	% of households willing to pay for the quality	37.7%	63.8%	79.0%	94.1%

No.	Indicator	Value			
		Amtali	**Galachipa**	**Pirojpur**	**Mathbaria**
	water on consumption basis				
23	% of households willing to pay additional fee (Surcharge) for safe disposal of waste water	50.7%	36.6%	31.8%	37.1%
24	% of households willing to spend money for maintenance of the sewerage and improved water drainage system	35.2%	18.7%	44.5%	33.8%
25	% of households willing to pay more for better service for waste management	32.6%	46.2%	19.0%	50.7%

Note: * Subject to thorough checking and revision for consistency and accuracy.
Source: SEWTPS, PPTA.

4 CLIMATE CHANGE ADAPTATION AND RESILIENCE

4.1 CLIMATE CHANGE ASSESSMENT AND ADAPTATION STRATEGY

4.1.1 What is Mainstreaming Climate Change?

76. The Coastal Towns Infrastructure Improvement Project (CTIIP) is a mainstream urban sector investment project. Effectively mainstreaming climate change into this project is the challenge of the climate change assessment and adaptation strategy. Ayers et al (2013) provide this definition:

> Mainstreaming of climate change into development and/or development cooperation is the process by which development policies, programmes and projects are (re)designed and (re)organized, and evaluated from the perspective of climate change mitigation and adaptation. It means assessing how they impact on the vulnerability of people (especially the poorest) and the sustainability of development pathways—and taking responsibility to readdress them if necessary. Mainstreaming implies involving all social actors—governments, civil society, industry, and local communities—into the process. Mainstreaming calls for changes in policy as far upstream as possible.[35]

77. "Mainstreaming" climate "is seen as making more sustainable, effective and efficient use of resources than designing and managing policies separately from ongoing activities. In theory, mainstreaming should create 'no regrets' opportunities for achieving development that is resilient to current and future climate impacts for the most vulnerable groups, and avoid potential tradeoffs between adaptation and development strategies that could result in mal-adaptation in the future."[36] There are two approaches to mainstreaming:

- A technological approach ("climate proofing, or "mainstreaming minimum", ensuring that projections of climate change impacts are considered in decisions about climate investments); and,
- A vulnerability-based view, where, in addition to climate-proofing, development is deliberately aimed at reducing vulnerability, including "creating an enabling environment by removing existing financial, legal, institutional, and knowledge barriers to adaptation and strengthening the capacity of people and organizations to adapt."[37]

78. Ayers, et al argue for the second approach as superior because it addresses the "adaptation deficit" that needs to be overcome before people can adapt to future climate changes.

4.1.2 Adaptation Strategy for CTIIP

79. The strategy for CTIIP is a hybrid of the technological and the vulnerability-based approach to mainstreaming climate change into development activities. While CTIIP acknowledges that vulnerability-based mainstreaming is more robust, it also accepts that this

[35] Ayers, J.M, et al, 2013. "Mainstreaming climate change adaptation into development: A Case study of Bangladesh," Wiley Interdisciplinary Reviews - Climate Change.
[36] Ibid.
[37] Klein, R.T.J., 2010. Mainstreaming Climate Adaptation into Development: A Policy Dilemma. In Ansohn, A., and Pleskovic, B. *Climate Governance and Development.* The World Bank.

is an aspiration that, owing to institutional constraints, limitations on potential to eliminate all existing financial, legal, and institutional barriers, will only be partially met.

80. However, the strategy for CTIIP is ambitious considering these constraints, and will, in addition to "climate proofing" the infrastructure investments, address these systemic barriers whenever possible, and take as the primary metric "human climate vulnerability", rather than simply assessing investments against climate impact avoidance.

4.1.3 Climate Adaptation Results Framework: The Pilot Program for Climate Resilience Approach

81. For CTIIP, funding is sought from the Pilot Program for Climate Resilience (PPCR), a targeted program under the Climate Investment Funds. According to the PPCR website:

> "The PPCR funds technical assistance and investments to support countries' efforts to integrate climate risk and resilience into core development planning and implementation. It provides incentives for scaled-up action and initiates transformational change by catalyzing a shift from "business as usual" to broad-based strategies for achieving climate resilience at the country level."[38]

82. PPCR provides grants and concessional financing for investments in agricultural, water supply and sanitation infrastructure, analysis of weather data, and climate resilient housing, for instance. The aim is to address the "additional costs and risks associated with integrating climate risk and resilience in core development activities, which adversely affect the viability of investments."[39]

83. The CTIIP climate assessment will enable PPCR funding by justifying these incremental costs, and also integrate PPCR's results framework and indicators into the CTIIP Investment and Monitoring and Evaluation plan. The CTIIP adaptation strategy embraces PPCR's results framework which includes:

- A1. Increased resilience of households, communities, businesses, sectors and society to climate change,
- A2. Strengthened climate responsive development planning,
- B1. Strengthened adaptive capacities,
- B2. Improved institutional framework in place,
- B3. Use of climate information in decision making routinely applied, and,
- B4. Climate responsive investment approaches identified and implemented.[40]

84. With each of these results is at least one indicator. For CTIIP it is believed that interventions that will be undertaken impact all of these key results areas, and will assess the vulnerabilities and vulnerability reduction against these areas. These will be complemented by an incremental cost-benefit analysis that will serve as a tool in identifying the optimal set of structural and non-structural interventions, and determine and justify the incremental costs of climate change.

[38] See "Pilot Program for Climate Resilience" downloaded at https://www.climateinvestmentfunds.org/cif/ppcr on 19 April 2013.
[39] Climate Investment Funds, 2010, "Pilot Program on Climate Resilience (PPCR): Financing Modalities," June 15, 2010.
[40] Climate Investment Funds, 2012, "Revised PPCR Results Framework," December 3, 2012. Note that there appears to be an error in the results listing as B4 is repeated as B5.

4.1.4 Climate Vulnerability Reduction: Strategy for Proposed Measures

85. CTIIP, as an infrastructure project, will budget a majority of incremental costs of climate change investment to infrastructure, but activities will also include considerable efforts in softer areas, such as knowledge generation and capacity building. Investments will include:

- Assessing how infrastructure investments will be "climate proofed" (= mainstreaming minimum),
- Assessing how the "adaptation deficit" can be overcome in both reducing hard infrastructure deficits (e.g., inadequate sanitation that makes some communities more vulnerable) and policy, legal, financial and institutional deficits (e.g., lack of local capacity and finance to plan and manage for disaster risks, etc.).

86. Some projects face criticism for overstating the "climate adaptation" elements. Germanwatch and others have studied how donors have "overcoded" in the OECD "climate adaptation marker": 58% of the largest 50 projects coded as "climate adaptation" "seem to have no relevance for climate change adaptation at all."[41] All too often, projects that might be viewed as agricultural, or forestry, or urban sector infrastructure, are renamed "climate adaptation" without justification. For CTIIP attempts to dispel any chance of this criticism is through an in-depth analysis of how sectors and institutions are directly impacted by future climate change, through robust analysis of anticipated future climate changes, and linking these to a climate vulnerability assessment and vulnerability reduction assessment.

87. Establishing a robust climate vulnerability monitoring and evaluation framework is the key starting point. As will be discussed in Section 4.3, the sector experts will use the PPCR indicators, and also identify how future relevant climate changes as provided in an annual schedule will impact their sectors. To go beyond "climate proofing", climate vulnerability is the key metric, and this is assessed not only through engineering impacts, but also through a combination of tools including community participatory hazard mapping, and community surveys of disaster and climate risk perceptions.[42] This is key in understanding how climate change and disasters impact the communities, and is thus a helpful tool in identifying vulnerabilities and prioritizing projects.

88. The climate vulnerability and vulnerability reduction assessment also measures the level of climate vulnerability reduction that projects might gain through an economic cost-benefit analysis, through normalizing this for income, and by discussing the non-economic and non-quantifiable costs and benefits, including social and environmental costs and benefits.

4.1.5 Assessment Methodology

89. The assessment, already underway, entails the following:

- Climate model outputs identified, assessed, and appropriate outputs organized for sector experts' use.
- A framework and guidelines for assessments is provided for sector experts.

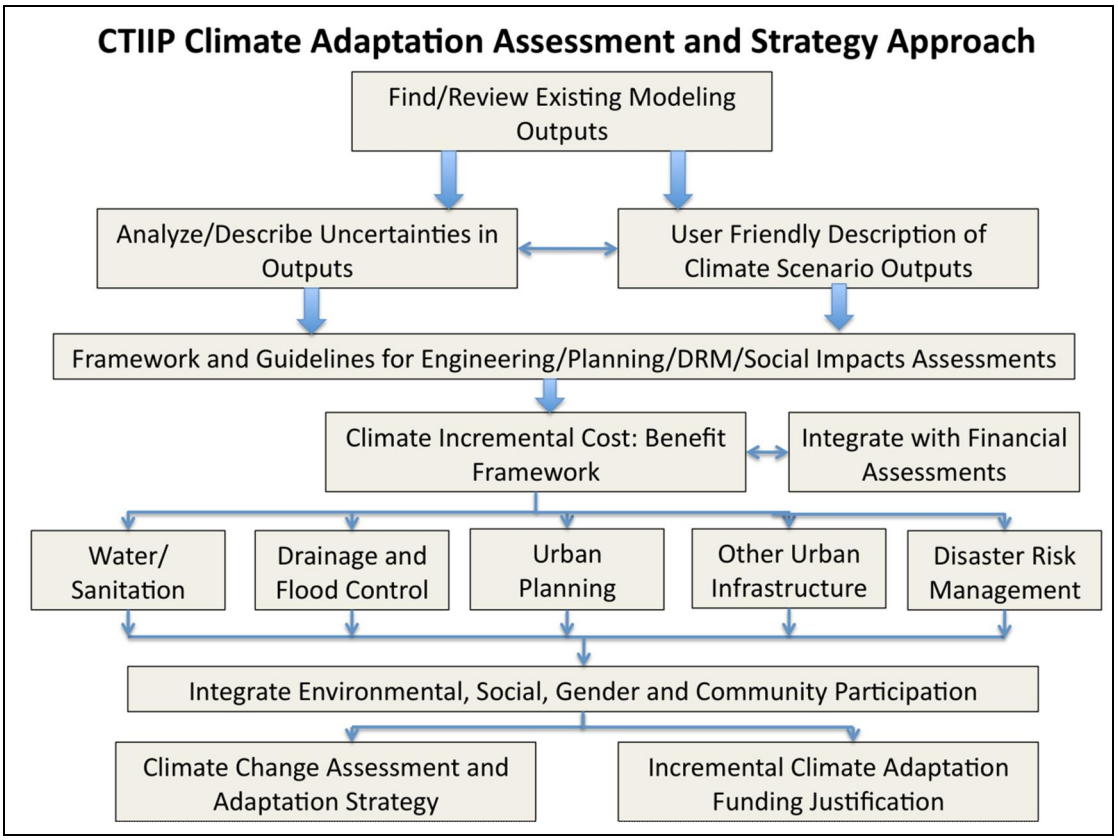
[41] Junghans, L., and Harmeling, S., 2012, "Different tales from different countries, A first assessment of the OECD "adaptation marker," Germanwatch Briefing Paper, September 2012. Downloaded at: http://www.germanwatch.org/5375

[42] See **Volume 4**: Community Perceptions of Climate Change and Disaster Risk in CTIIP Coastal Towns.

- Climate change related vulnerabilities, vulnerability reductions, and incremental costs: benefits developed and integrated with financial assessments.
- Sector experts worked with the climate experts to assess vulnerabilities and vulnerability reductions, including PPCR indicators, damage and loss/damage and loss reduction, and vulnerability reduction credit (VRC) generation potential.
- Environmental, social, gender and community participation aspects are integrated into the costs and benefits assessments with PCTIIP relevant experts.
- The two primary outputs of this assessment are a climate assessment and adaptation strategy (see Main Appendix 4, Climate Change Assessment and Adaptation Strategy), and incremental funding justification for PPCR (to be completed after DFR results are available).

90. **Figure 4.1** shows this process.

Figure 4.1: Climate Change Adaptation Assessment and Strategy Approach



Source: PPTA Consultant.

4.2 CLIMATE CHANGE PROJECTED TRENDS

91. The following section summarizes the work of the PPTA climate change specialists characterizing current and future climate change to inform project designs. Further details of the research and analyses performed can be found in **Volume 4**.

4.2.1 General Climate of Bangladesh

92. Bangladesh is situated in the heart of the South Asian monsoon region. With the Bay of Bengal and vast Indian Ocean to the south of Bangladesh and huge mountain ranges—

Himalayan Mountains and Arakan ranges to the north and east respectively—the country receives very high annual rainfall, about 70-75% of which is concentrated during the monsoon season (June-September). There are four climatic seasons in Bangladesh:

Winter	December-January
Pre-monsoon	March-May
Monsoon	June-September
Post-monsoon	October-November

93. The climatology of annual distribution of country-average monthly minimum and maximum temperature is shown on **Figure 4.2**. The figure shows high values of maximum temperature from March-October with peak in April (33.5 ^{0}C) and a secondary peak in September (31.6 ^{0}C). The lowest minimum temperature is obtained in January (12.5 ^{0}C). **Figure 4.3** shows the annual pattern of monthly rainfall. This shows that very high rainfall occurs in the monsoon season, 46 times greater than in the winter season.

Figure 4.2: The Climatology of Annual Distribution of Country Average Minimum and Maximum Temperature

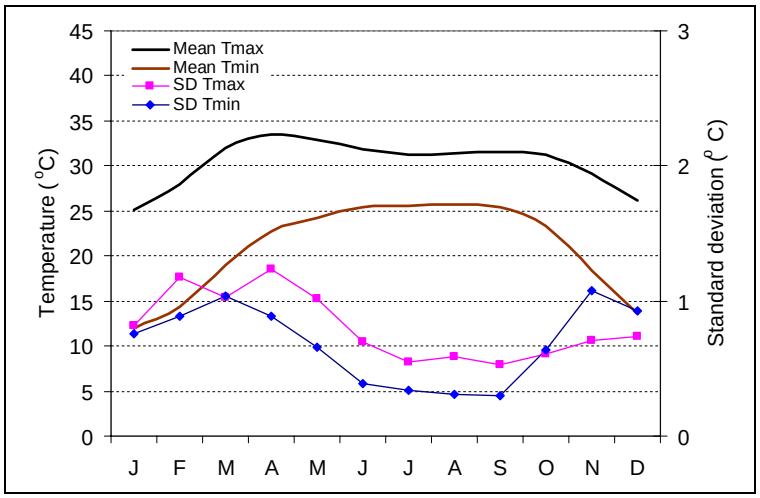
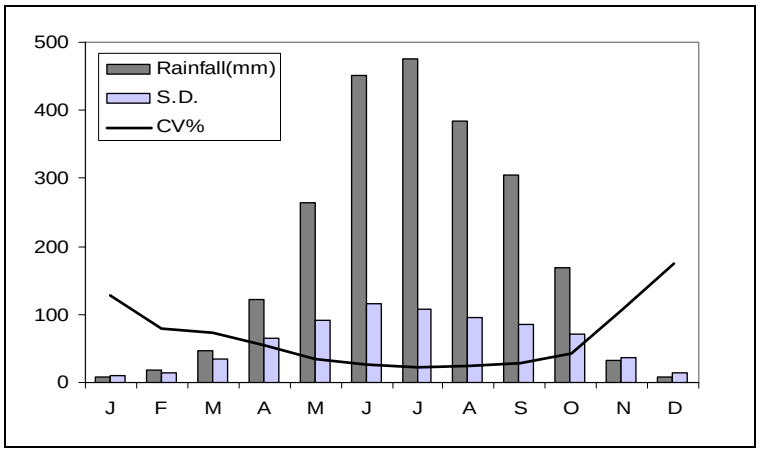


Figure 4.3: Annual Distribution of the Climatology of Country Mean Rainfall Based on 1948-2004 Data

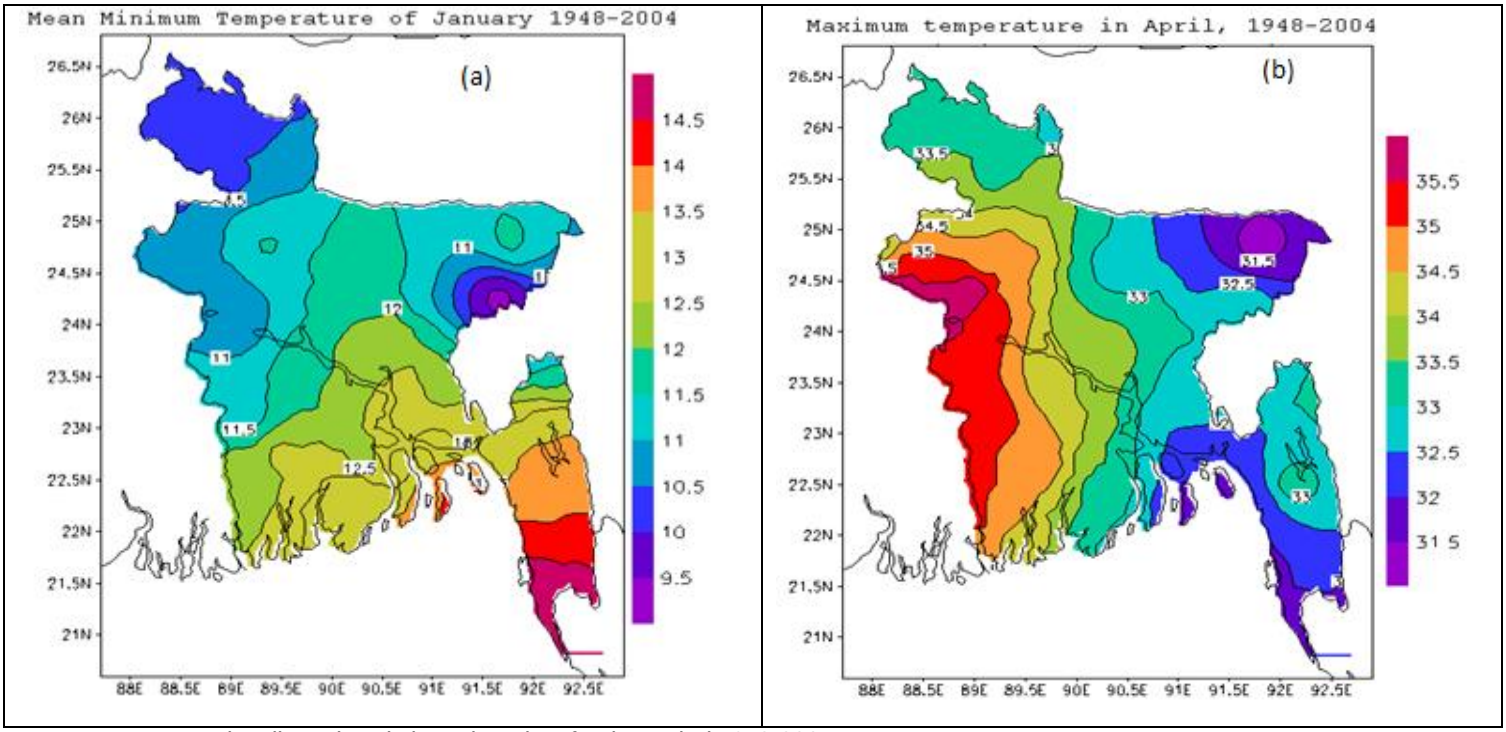


94. Bangladesh annually receives on an average 2286 mm of rainfall, with standard deviation of 286 mm. The seasonal distribution shows that most of the rainfall occurs in the monsoon season amounting to 1616 mm /year which is 70.7% of the annual rainfall. The pre-monsoon season get about 19% of the annual rainfall. The post-monsoon season occupies 9% of the annual rainfall. The winter is relatively dry and receives about 1.5% of the annual rainfall.

95. The geographical distribution of minimum temperature of January and maximum temperature of April has been shown in **Figure-4.4(a,b)** respectively. The figure of January minimum temperature [Figure-4.4 (a)] shows that winter has relatively low minimum temperature in the northern part of the country and warm temperature in the south-southeastern part. The summer maximum temperature shows that the western and southwestern Bangladesh is warm while the northeastern part is relatively cooler [Figure-4.4(b)].

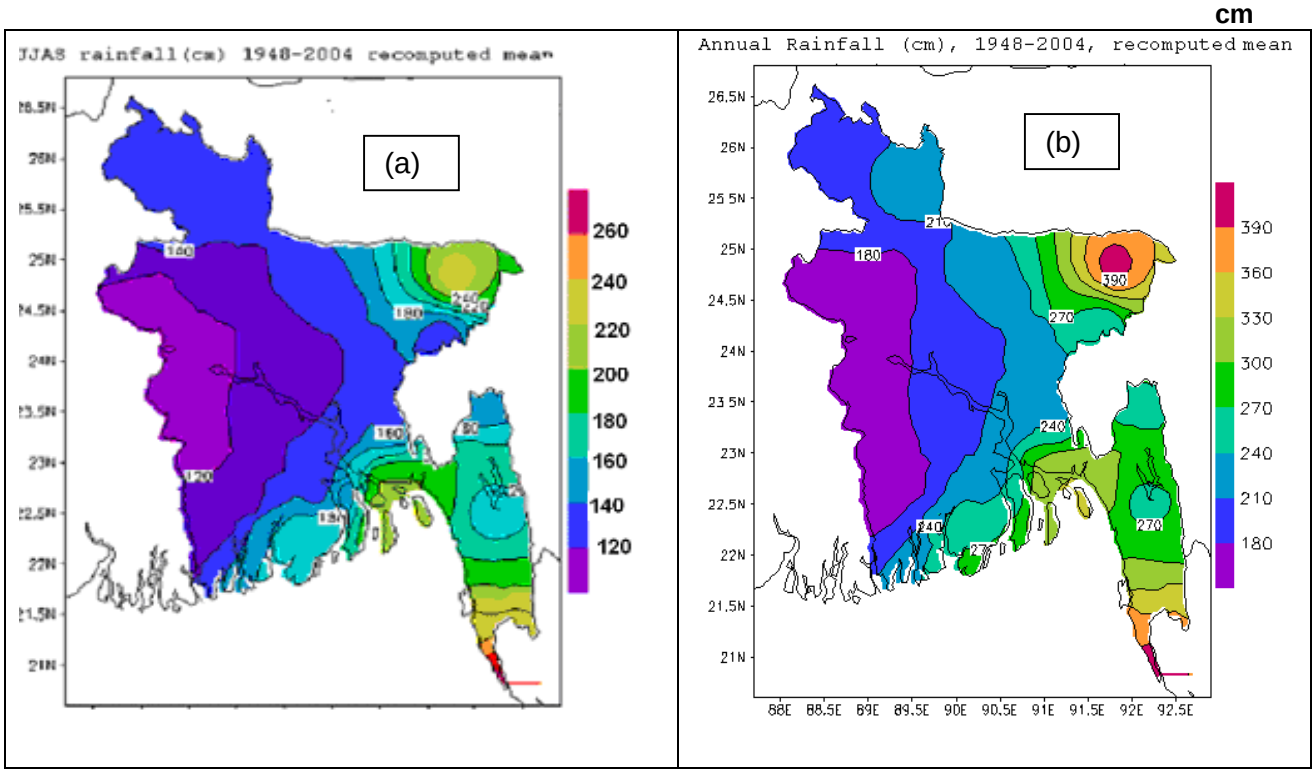
96. The geographical variation of annual rainfall is shown on **Figure 4.5 (a,b)** for the monsoon season and annual respectively. It reveals from the figures that the highest amount of rainfall is obtained in the north-eastern and south-eastern part of Bangladesh amounting to around 2000-2800 in the monsoon season and 3000-4000 mm for the annual. Relatively low rainfall is obtained in central-western Bangladesh which is oriented in the north–south direction. The low rainfall area bulges towards central Bangladesh. The distribution pattern is more or less similar for both annual and monsoon. The geographic distribution of annual rainfall shows that the coastal zone experiences around 2000-3500 mm of rainfall, but it is relatively higher over the southeastern coastal zone and gradually decreases towards the west. Over the areas containing the study towns the annual rainfall is around 2400-3000 mm. The deficit and excess rainfall from normal becomes critical causing droughts and floods.

Figure 4.4(a): The Geographical Distribution of Minimum Temperature of January (a) and of Maximum Temperature of April



Note: The climatology is based on data for the period 1948-2004.

Figure 4.5 (a,b): Distribution of Monsoon Rainfall (a), and Annual Rainfall (b)



97. The monsoon depressions, tropical cyclones, and meso-scale heavy rainfall associated with thunderstorms and tornadoes are common disaster events in Bangladesh. The local high intensity rainfall causes flash floods, water-logging, and landslides impacting health, livelihood, resources and environment. The depressions and tropical cyclones form over the Bay of Bengal, move to inland and produce high rainfall. Tropical cyclones are the cause of death for hundreds of thousands of people and animals, and damage to infrastructure, the environment, resources, and livelihoods. The months April-May and October-December are considered the tropical cyclone seasons.

98. The low-lying coastal zone of Bangladesh is highly vulnerable both to the floods at extreme tides during strong monsoon activities, and from tropical cyclones. A total of 58 tropical cyclones have impacted Bangladesh during the period 1961-2010 based on analysis in Quadir and Iqbal (2008) and updated data obtained from the JTWC site. The tropical cyclones have a horizontal dimension of about 1,000-1,500 km. As a result the selected study area experiences impacts from the tropical cyclones that hit the west Bengal coast adjacent to Bangladesh border up to Chittagong and its nearby areas depending on the intensity of the cyclones. From the above data analysis, around 49% of the tropical cyclones.

99. All together 20 tropical cyclones hit Bangladesh during the period of 1991-2010. Among them the cyclone of April 29 1991 that hit the coast of Noakhali-Chittagon was category-4 in intensity. About 134,000 people lost their lives due to the strong winds (250 km/hr) causing high storm surges (8 meters). The cyclone Sidr which hit the Patuakhali-Borguna coast reached category-5 intensity with maximum wind speeds of 254 km / hr and is the strongest tropical cyclone of the century.

100. The PPTA team has shown that the frequency of cyclone categories 1 and 2 has decreased from 1991 to 2010, while the frequency of categories 4 and 5 has increased. Before 1991 there was no category-5 cyclone in Bangladesh. Thus the tropical cyclone and storm surge hazard has grown in Bangladesh. The study indicates that Bangladesh on average gets 1.14 tropical cyclones per year. The study also shows that the low intensity tropical cyclone is decreasing, with simultaneous increase of the category 3-4 cyclones. **Table 4.1** shows the probability of tropical cyclone occurrence in Bangladesh.

Table 4.1: Probability of Different Categories of Cyclones affecting Bangladesh (1961-2010)

Intensity Level	Probability/decade	Probability/year
Category-0 (62-117 km/hr)	5.2	0.52
Category-1 (118-153 km/hr)	2.5	0.26
Category-2 (154-177 km/hr)	1.4	0.14
Category-3 (178-251 km/hr)	1.2	0.12
Category-4(209-51km/hr)	0.8	0.08
Category-5 (v>251 km/hr)	0.2	0.02
Total	11.4	1.14

Source: PPTA Consultant.

4.2.2 Current Climate Change and Future Projections

101. This climate change study of the coastal zone shows that the temperature trends for most of the stations are within 0.15-0.2 ^{0}C/decade. The monsoon rainfall trends concentrate around the range 4.0-8.6% /decade over the areas covering the study towns.

102. The projection of the climate scenarios for the time horizon from 2010-2065 with interval of 10 years has been made based on the IPCC AR4 models. The projections were reconstructed and adjusted after Tanner et al., 2007.[43] The scenarios are shown in **Table 4.2 (a,b)**.

Table 4.2 (a): New Scenarios of Temperature (^{0}C) of Bangladesh for Future at 10-year Intervals, with 2000 as the Base Year

GHG Scenario	YEAR	2010	2020	2030	2040	2050	2060	2065
A2	Annual	0.49	0.95	1.42	1.89	2.35	2.82	3.05
	DJF	0.73	1.40	2.07	2.74	3.41	4.08	4.42
	JJA	0.58	1.08	1.50	1.84	2.10	2.28	2.34
B1	Annual	0.51	0.98	1.38	1.71	1.98	2.18	2.26
	DJF	0.92	1.66	2.23	2.64	2.89	2.98	3.00
	JJA	0.59	1.05	1.41	1.67	1.81	1.85	1.83

(reconstructed after Tanner, et al. 2007 using expert judgment).

[43] Tanner T.M., Hassan A, Islam KMN, Conway, D, Mechler R, Ahmed AU, and Alam, M, 2007. ORCHID: Piloting Climate Risk Screening in DFID Bangladesh. Detail Research Report. Institute of Development Studies, University of Sussex, UK.

Table 4.2(b): Scenarios of Future Rainfall (%) over the Study Area at 10-year Intervals, with 2000 as the Base Year

GHG Scenario		2010	2020	2030	2040	2050	2060	2065
A2	Annual	3.54	6.87	9.87	12.53	14.86	16.86	17.74
	Winter	19.34	34.91	47.16	56.09	61.70	63.99	63.89
	JJA	4.63	9.05	13.47	17.89	22.32	26.74	28.95
B1	Annual	1.5	4.2	8.0	12.9	19.0	26.2	30.2
	Winter	29.2	47.2	52.0	43.6	22.0	-12.8	-35.2
	JJA	7.4	13.7	18.7	22.4	24.7	25.7	25.7

(reconstructed after Tanner et al. 2007 using expert judgment following the current climate change).

103. The projections in Table 4.2 (a) suggest that the annual temperature will increase by 1.3 ^{0}C by 2030 and by between 2 and 2.35 by 2050. This temperature increase will increase the evaporation rate. Further, in this warmer environment, the per capita water demand for household use, animal consumption and irrigation for agriculture will increase. The levels human discomfort due to heat will worsen in the warm season and the attacks of some diseases like heat stroke, lung diseases/ asthma, heart attacks and stomach and kidney disorder, rashes, etc. will be higher in numbers causing more suffering and higher casualties.

104. The monsoon rainfall is projected to increase by 9-13.7% by 2030 and 22-25.7% in 2050 [Table 4.2(b)]. This table depicts that more intense monsoon floods are expected to occur in the future increasing damage and loss.

105. Sea level rise projections were derived from International Panel on Climate Change (IPCC) projections with a local adjustment of subsidence at the rate of 3 mm/year for the land surface (Khan et al. 2008) and very low rate of deposition of sediment (assumed rate of 1mm/year within polder). The towns not protected by polders (Pirojpur, for example) have low sedimentation rates, because the concreted surfaces within the towns are not able to hold sediment. Thus, considering IPCC projections and local effect, the SLR projection for 2030 is 21 cm and for 2050 39.4 cm.

106. The above projections are consistent with earlier findings, and findings of CDTA and CEIP projections, except for the sea level rise (SLR) projections. The study of NAPA and CDTA has adopted 32 cm by 2050. However, CEIP has considered SLR of 50 cm by 2050, but no detail commentary is available on this high figure. The CCRIP study has taken 7 mm/year of sea level rise (a conservative assumption) but also considered 3 mm/year land subsidence.

4.3 CLIMATE RISKS TO PROJECT TOWNS

107. The study towns—Amtoli, Galachipa, Mothbaria and Pirojpur—are situated in the most vulnerable zone of the coast, being exposed to tropical cyclones, storm surges, sea level rise and strong astronomical tides. The towns experienced severe damages in past cyclones that hit the south central coast and its neighbourhood coastal zone. Besides, these towns are subjected to severe risks of flooding due to heavy monsoon rainfall from tropical storms, monsoon depressions and convective activities associated with monsoon troughs. The anticipated high sea levels will pose problems for drainage of the flood water in the future, as the tidal level may go so high due to sea level rise that there is a chance that the lowest tide in the monsoon season may remain at higher level compared to the bed of the drainage system—resulting in long term inundation of large area of the towns.

108. Current and future climate will impact the infrastructure, environment, ecology, agriculture, water supply, sanitation and livelihood of the people of the areas covering the selected coastal towns. The increase in temperature has the potential to cause material expansion resulting in damages to concrete structures such as buildings, bridges, and culverts and bitumen seals to roads, which are susceptible to softening unless higher temperature resistant construction materials are used. The expansion and contraction due to high fluctuation of temperature may affect life of the structures. Floods resulting from increased rainfall, cyclones and storm surges have the potential to damage roads, embankments, water supply, sanitation, markets, housing and drainage structures. SLR will increase the potential risks.

109. The enhanced salinity is also hazardous to metal and concrete structures, in addition to its impacts on fresh water supply, agriculture, environment and ecology. The salinity causes lowering of lives of the metalic structures. The heath impact of human intake of saline water with salinity contents above tolerance levels causes health hazards to the people, especially for pregnant women. Thus, the increase of salinity in the coastal zone is a serious problem in broader perspectives.

110. The increase of future severity of storms will increase the potential storm surge related damage as well as causing additional erosion damage from the over-topping of roads and embankments. High winds associated with storm events have the potential to damage lives, plants, buildings, agriculture, and fisheries as well as cause secondary damage from trees and other debris. Wind-driven wave action can have a significant erosive effect on exposed road embankments, bridges and sanitation systems.

111. PPTA findings show that the intensity of tropical cyclones will increase with the rise of sea surface temperature (SST). As a result, the probability of higher category cyclones would increase in 2040-2050 (Table 4.1).

112. The probability/year of different categories of tropical cyclones was extrapolated using the future scenarios of tropical cyclone intensity of different categories relative to the statistics of the decade 1991-2000, which was a relatively normal year in terms of the distribution of tropical cyclone intensity. The results of the future cyclone probability estimate are given in **Table 4.3.** The results show that the transition occurs from low intensity cyclones to high intensity once the probability of category-5 cyclones are seen to be high in 2040-2050 when the probability of category-0 cyclone are seen to come down to 0.1.

Table 4.3: Projection of Probability of Tropical Cyclone Probability for the Future for Different Intensity Levels

Projection of probability of tropical cyclone incidence for future				
Categories	**2011-2020**	**2021-2030**	**2030-2040**	**2040-2050**
Tropical Cyclonic storms Cat-0 (62-117 km/hr)	0.4	0.4	0.2	0.1
Cat-1 (118-153 km/hr)	0.2	0.1	0.2	0.2
cat-2 (154-177 km/hr)	0.2	0.1	0.1	0.2
Cat-3 (178-207 km/hr)	0.2	0.1	0.2	0.2
Cat-4 (208-251 km/hr)	0.2	0.4	0.4	0.3
Cat-5 km/hr (speed>250 km/hr)	0.1	0.2	0.2	0.3

Source: PPTA Consultant.

113. Considering the above, the climate consultants have identified some specific impacts on the project infrastructures of the study towns with some highlights on possible adaptation. The guidance provided in the report of ADB TA7902-BAN (2012) and the data collected from the field trips were used for developing **Table 4.4**.

114. The vulnerability of infrastructure due to monsoon and tidal flooding and cyclone impacts over the project area increase significantly. Table 4.4 highlights the impacts and adaptation approaches to provide preliminary guidance in developing climate resilient infrastructure designs for the study towns.

Table 4.4: Town Specific Climate Change and Adaptation (User Friendly Output for Climate Resilience)

Pirojpur, Mathbaria, Amtali and Galachipa Pourashavas			
Climate element	**Status of change**	**Impacts**	**Recommended adaptation**
Temeprature	Current change: 0.4^0 C during last 50 years Future: 1.4^0C by 2030 and 2.5^0 C by 2050	Infrastructure damaged by long exposure to heat, new concrete structures weakened due to poor curing.	Materials and design to be selected suitable for resilience of high temperature. Placing and curing of concrete requires more water.
		Surface water is rapidly evaporated affecting household water supplies and garden irrigation. Due to heat, overall per capita water needs will increase. Agriculture and fisheries suffer due to rise of temperature and greater salinity.	Water supply projects should include future increased demands in addition to that due to increase of population and future development. Rainwater harvesting needs to be encouraged and suitable design may be prescribed for this purpose including making arrangements for rainwater preservation and use for domestic application. Reserve ponds may be digged to preserve rainwater for community use.
		High temperature affects health due to heat stroke, dehydration and facilitates diseases like diarrhea, asthma and heart and kidney failure.	Building design criteria should consider suitable factors to keep interiors cooler. Green coverage should be developed over suitable areas of the towns, so that there is a shielding against the incoming solar radiations which may to some extent provide comfort the people from heat.
Rainfall	Current trend: 25 cm in last 50 years Wetter monsoon rainfall with future scenarios: Increase of 13.5-19% in 2030 Increase of 22-25% in 2050 Increase of 27% in 2060	Floods impacting infrastructures	Increased and more intensive rainfall will cause more floods inundating roads and yards, market places and other important areas. It is recommended that the infrastructure is built that the floods do not damage them or the water supply plants, reservoirs, pipe lines are not affected.
		Reduced drainage channel size causes flooding	Larger, steeper or lined drains will be required to discharge excess storm water. The CTIIP towns' topography does not lend itself to steeper drainage with complex pumping or water management arrnagnements. Land avilability for larger drains is also an issue. Keep drains free from waste and siltation.
		Sanitation is damaged due to flood	Sanitation systems should be made climate resilient; especially should be installed above the flood level.
		Sludge and solid waste management is affected	Sludge drying areas and solid waste landfills must be above flood inundation level or protected with embankments or linings to avoid .
		Roads damaged due to more flooding and overtopping.	Ensure road is cambered as designed. Use concrete surfaced roads. Better compaction and use of stronger materials for road bases. Build more culverts and drainage for road base. .
Sea Level Rise (SLR) Increase of Tidal	Current SLR: 4-6 mm/year	Infrastructure is heavily damaged	The infrastructure might be needed to be raised if they are not well protected by the embankment.
	Projection in 2030: 21 cm reference	Embankments also damaged by increased	Raise and strengthen embankments. The embankments need to be protected from sea side

Pirojpur, Mathbaria, Amtali and Galachipa Pourashavas			
Climate element	**Status of change**	**Impacts**	**Recommended adaptation**
Level	to land inside polders. Projection in 2050: 39 cm reference to land inside polders. Tidal Level will also increase due to SLR	erosion induced by leaching and overtopping of water.	through plantation of trees and by other means of ecological and engineering measures. The areas which are not protected by polders may require sidewalls for tide and surge protection.
		Housing is severely damaged Inundate more areas by extreme high tides.	Housing should be of clustering types and be so designed that they are above the flood / surge level on higher plinth above extreme monsoon flood level on compacted soil with concreted perimeter case. The ground floor may be kept open for freely passing of the storm surge flow; the building materials are to be so chosen that the structure is able to sustain strong cyclone winds and thrust of storm surges. The extra protection due to sea level rise is to be undertaken. Climate and flood resilient Building Codes should be developed.
		Water resources / supply sector is severely affected by storm	Ponds, installation site of deep tube wells, reservoirs and distribution lines should be made climate resilient considering the projected of sea level rise;
		Sanitation	The sanitation system is to be made climate resilient considering sea level rise.
		Sludge management Solid waste dumping	Sludge disposal should be made in designated site with appropriate structure so that the tidal water and storm surges do not affect the system due to climate change enhanced sea level. The climate resilience is to be considered for solid waste dumping stations considering extra floods and storm surges in future climate.
Tropical Cyclones and surges	Tropical cyclone intensity will rise and the destruction will be severe due to wind and surges. The tropical cyclones may have wind up to 275km/hr in the future.	All structural items as mentioned above are affected.	Extra precaution is to be taken because of higher surge levels and higher winds of the future cyclones. The mangrove forests (green belt) may be developed outside the embankment and in the new islands as a protection measure against the impacts of tropical cyclones Strengthen the tropical cyclone and storm surge forecasting and warning system. Strengthen the relief and rehabilitation measures and take care for the injured people Water supply and sanitation system are to be made climate resilient considering higher sea level and higher storm surges. Infrastructure are to be made climate resilient
		Large areas innundate with deep flooding and surges creating hazards to people, livestock and infrastructure.	Build more cyclone shelters with appropriate designs including emergency water and power supplies, toilets, better approach roads and shelter for animals. The refuge or Killas should be constructed near the shelters for sheltering the livestocks
Salinity impacts	The 5ppt line will move further inland affecting the pourashavas of Amtali and Galachipa in 2050 and all these pourashavas and Mothbaria will come under this 5 ppt line in 2100.	Badly impacts on the steel / metallic structures through rusting and reduces lives of such structures where metals are used. Salinity induced by floods affects the material bonding of the contrete structures causing damages to such structures. . Adverse Impacts on Agriculture	Designs should consider this impact for undertaking the adaptation measures. This aspect is important because salinity can affect all sorts of concrete structures. It recommended raising the areas where the buildings will be constructed, so that the monsoon flood does not affect the structures of the house. Agricultural land should be protected from the intrusion of saline water at high tides and storm surges by

Pirojpur, Mathbaria, Amtali and Galachipa Pourashavas			
Climate element	**Status of change**	**Impacts**	**Recommended adaptation**
		Adverse impacts on human health like hyper tension, heart diseases, asthma, strokes skin diseases. It is especially of concern for pregnant women as a cause of pre-eclamsia, early delivery and swelling legs.	polders. Should take appropriate engineering actions to reduce the salinity level of surface and ground water. The ground water monitoring system should be developed and ground water recharging plants needs to be developed in the appropriate areas.

Source: PPTA Consultant.

4.4 SUMMARY RECOMMENDATIONS FOR CLIMATE CHANGE ADAPTATION – STRUCTURAL MEASURES

4.4.1 Municipal Infrastructure

115. **Roads.** The key proposed climate resilience measures associated with roads interventions are:

- road level rise as required;
- increase of bitumen carpeting (BC) thickness;
- ensure proper compaction;
- prefer cement concrete (CC) pavement where there are threats of inundation;
- provision of temperature reinforcement in CC pavement to minimize expansion and contraction;
- provision of hard shoulder along the pavement where there are threats of inundation;
- construction of cross-drains as required;
- guide wall to protect erosion and sliding in case of CC road;
- turf and tree plantation along the roads.

116. CC roads will be damaged due to expansion and contraction with temperature fluctuation. Providing temperature reinforcement in the concrete pavement may protect against this threat.

117. In the case of a bituminous carpeting road, the road material will lose bonding and be damaged due to heat. This can be avoided by selecting CC pavement in place of bituminous pavement in case of new road construction.

118. Roads will be damaged by more flooding and overtopping due to extreme rainfall. This can be avoided by raising the road level. It is suggested to raise the road level by 600 mm above normal flood level. Sea level rise is another threat to the road as it may cause damage to the road by inundation. Therefore, road level will be further raised by 200mm. (Note: for some inside roads it may not be possible to raise them in practice; instead it is advised to raise gradually by overlaying base course during the time of maintenance after every few years).

119. Tropical cyclones and storm surges may cause of damage to roads and road structures like culverts, cross-drains, etc. The bitumen road cannot withstand if it is under water for a certain period of time. These kinds of threats can be avoided by constructing CC pavement instead of bituminous pavement.

120. Provision of hard shoulders for BC roads, brick masonry guide wall for BC road will be constructed along the road alignment, turfing on embankment slope and tree plantation if possible along the road embankment will be done in order to protect the road from tropical cyclones and storm surges.

121. **Bridges.** The key proposed climate resilience measures associated with bridges interventions are:

- maintain rise of deck slab of bridge and pile length needed to be increased;
- ensure proper compaction and hard shoulder in approaches;
- guide wall at tow of approaches to protect erosion of approaches.

122. Approach roads of bridges will be damaged due to extreme rainfall and storm surge inundation. This can be protected by providing proper compaction, hard shoulder and guide-wall at tow of approaches.

123. Inundation of bridges can be avoided by considering future sea levels appropriately.

124. Bridge piles need to be increased at the top and be designed as required.

125. **Cyclone shelters.** The key proposed climate resilience measures associated with cyclone shelters interventions are:

- ensure ground floor open, .i.e. free from any partition walls;
- arrangement of shelter on 1st and 2nd during cyclonic disaster;
- considered wind speed 260 km/hour for designing of the cyclone shelter building;
- ensure best quality items like doors, windows and utilities for defense against wind and storms.

126. The floor should be free from any partition wall for hindrance of water flow in ground floor. This will eliminate the thrust from flooding water on structures.

4.4.2 Drainage and Flood Control

127. Possible actions to mitigate against the main projected effects of climate change on drainage and flood control infrastructure and services are described in **Table 4.5**.

128. Two incremental stages have been adopted for costing purposes:

(i) Design to the current best practice standard and in line with the current LGED guidelines[44] for a 25-year design period.
(ii) Design as (i) but taking account of the projected climate change impacts up to 2050.[45]

129. Possible actions to mitigate against other factors that will affect drainage and flood control infrastructure and climate resilience are described in **Table 4.6**.

[44] Urban Drainage Manual, May 1998

[45] The projected rainfall intensity for a 1:10 year design storm by 2050 is only about 1% greater than the intensity for the same storm in 2030. It is therefore considered more cost-effective to plan and develop infrastructure for 2050 immediately than develop it in two stages.

Table 4.5: Possible Actions to Mitigate against Projected Effects of Climate Change on Drainage and Flood Control Infrastructure and Improve Climate Resilience

No.	Climate Change Effect	Possible Mitigating Actions
1	Increased rainfall quantity & runoff:	- increase infrastructure capacity, e.g. channels, bridges, culverts, regulating structures, outfall vents, etc. (levels to take account of sea level rise) - create capacity to detain runoff as necessary, e.g. ponds, open spaces, channels, *khals*, etc. - isolate/protect vulnerable catchments and sub-catchments, to reduce flooding from adjacent catchments, especially if large in area and volume and impacts are less serious, e.g. agricultural land - actively managing runoff and discharges, according to needs, adverse impacts, etc. - improve O&M, organisational capacity, resource allocation, etc. - work with relevant stakeholders to manage water use and flood discharges more effectively - improve collection and disposal of solid waste - control encroachments - improve public behaviour through active and prolonged information, education and communication campaigns to reduce uncontrolled solid waste disposal, encroachments, damage to infrastructure, unregulated development in key areas, etc., supported by enforcement.
2	Sea level rise (SLR)	- raise existing flood defences to requisite levels and building new flood defences on unprotected tidal channels and *khals* - improve drainage infrastructure and detention capacity as required (see (1)) - improve O&M, organisational capacity, resource allocation, etc. - work with relevant stakeholders, e.g. BWDB, landowners, water user groups, farmers associations, etc., to ensure their actions contribute as required.
3	Increased frequency of severe cyclones	- enhance flood defence levels and strengthen to the requisite levels according to location, etc., e.g. urban areas should have higher and stronger levels of protection than rural areas - improve infrastructure and detention capacity and protecting/isolating catchments as appropriate (see (1)) - improve O&M of defences and drainage, organisational capacity, resource allocation, etc., - work with relevant stakeholders, e.g. BWDB, etc., to ensure their actions contribute as best possible.

Source: PPTA Consultant.

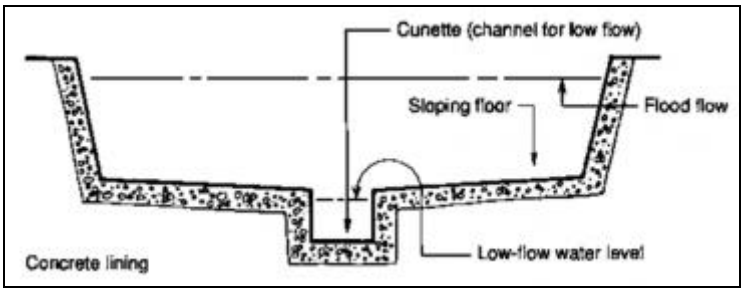
Table 4.6: Actions to Mitigate against Other Factors that may affect Drainage/Flood Control Infrastructure and Climate Resilience

No.	Impact Factor	Mitigating action
1	Construction materials' quality	- Choose most durable materials possible, even if higher cost, e.g. concrete, high quality bricks. - Monitor and control construction quality
2	Flat topography	- Shorten drainage routes - Avoid downstream constrictions, etc. - Retain and upgrade existing natural drainage routes and channels.

		- Maximise runoff and water-level regulation, and detention capacity; regulate land development as required. - Consider short to medium-term pumping, using mobile/emergency pumps wherever appropriate.
3	Rising temperatures	- Execute works during most favourable times of year and day. - Monitor and control preparing, placing and curing concrete and mortar, to ensure placement, etc., during most favourable times. - Use plain high-quality un-rendered brickwork and high quality cement mortar in preference to rendered low-grade bricks - Use sulphate resisting cement in vulnerable locations (higher heat gain during curing) or cement containing fly-ash (less heat gain, so preferred).
4	Runoff	- Require separate arrangements for disposal of faecally-contaminated wastewater. - Use trapezoidal section drains with small low-flow section (cunette) for low flows **(Figure 4.6)** - Line drains to achieve higher discharge velocities without increasing risk of scour, etc.
5	Flooding	- Choose durable materials, preferably concrete or high quality bricks - Ensure high quality construction - Consider short to medium-term pumping (mobile/emergency pumps) - Check and design against possible floating in various operating scenarios (hydrostatic pressure).

Source: PPTA Consultant.

Figure 4.6: Trapezoidal Drainage Channel with Low-level Section for Low Volume Flows



Source: WHO

4.4.3 Water and Sanitation

130. The key proposed climate resilience measures associated with water supply and sanitation interventions are:

- increased water demand due to temperature rise;
- measures will be taken to protect water supply infrastructure such as production tube well, pump house etc. from flooding due to intensive rainfall;
- sanitation structures will be implemented above flood level;
- superstructures will be strong to cope with cyclone;
- proposed surface water treatment plant (SWTP) plant will be protected from cyclone /storm surge;
- water storage provision for emergency use;
- emergency power back up.

131. Water supply projects should include future increased demands for temperature rise, in addition to that due to increase of population and future development. For water demand projections, a 15% increased water demand due to temperature rise prediction (1.2-2.4^0 C by 2050) will be taken into account.

132. Measures will be taken to protect water supply infrastructure such as production tube wells, pump houses, etc. from flooding due to intensive rainfall. It is recommended to keep the upper well casing of tube well 1.5 m extended from the ground so that floodwater cannot move inside the well. The pump house will be constructed above flood level.

133. Sanitation systems should be installed above the flood level, for climate resilience.

134. The cyclonic strong wind will be taken into account during detailed design of the structures such as overhead tanks, pump houses, etc. to make them strong enough to withstand cyclones and to be climate resilient.

135. The proposed SWTP (at Mathbaria) will be protected from cyclones, storm surges, etc. An earthen embankment of height 4.0m above mean sea level with CC block pitching, will be constructed along the boundary of the compound. The width of the embankment crest will be 3 m, and the outside slope and inside slope will be 1:2 and 1:1 respectively.

136. River and pond water gets saline during cyclones and storm surges. A ground reservoir of capacity 2,000 m^3 is proposed for the provision of water storage for emergency use after big cyclone /storm surges.

137. Provision for power backup (generator) to keep the water supply operational if the normal power supply gets interrupted/stopped from the National Grid during cyclones/storms.

4.5 SUMMARY RECOMMENDATIONS FOR CLIMATE CHANGE ADAPTATION - NON-STRUCTURAL MEASURES

138. Investments in infrastructure are not sustainable if they are not supported by a combination of methodical and continuous management and maintenance. Broader physical and institutional contexts also support or threaten a project's capacity to provide sustained service delivery. Hence CTIIP subprojects need to be supported by capacity building, ancillary investment in "soft" and non-structural measures and capital, and policies and management commitment to sustain operations and maintenance under good practices, and sometimes new and sustained financial resources. Climate changes pose additional risks to infrastructure investments and may demand additional non-structural measures, either from the onset or as climatic changes emerge over time.

139. For the purposes of this project, non-structural measures mean all activities besides capital investment for physical assets. As noted in the following section on disaster risk management, there is a strong overlap between climate adaptation and disaster risk management. As such, this section will focus broadly on all climate adaptation non-structural measures, with special attention paid to non-structural disaster risk management measures. Measures will be divided between those that provide community/town-wide benefits in reducing climate vulnerabilities, and those that are associated with particular infrastructure investments (see **Volume 4 Annex, Terms of Reference for Climate Change Planning, Forecasting, Disaster Risk Preparedness and Adaptation** for a description of the general non-structural measures).

4.5.1 Leveraging Existing and Emerging Non-Structural Resources

140. It is important to consider non-structural climate vulnerability reduction measures in coastal towns as fitting within a broader framework of national and international mechanisms. These mechanisms, defined broadly, include financial resources, policy frameworks such as legislation and regulation, research and know-how, incentives for change, and systems of accountability will be important for the resilience and sustainability of the project. New and emerging resources and approaches need to be embraced, promoted and supported if they can address uncertainties or barriers to the investment's sustainability and climate resilience. The following are some key resources the project shall, where appropriate, integrate and leverage into project design and implementation.

141. **Financial resources, mechanisms, and incentives:** CTIIP's sustainability and long-term climate resilience depends on resources throughout the operational life of each subproject. This includes supporting the additional capital and operational expenses of infrastructure-based municipal investment and systems, and resources to minimize and cover the public costs of climate-related loss and damage.

142. There are a number of international financing mechanisms available to support projects that enhance climate resilience. The project financing plan includes funding from the Pilot Project for Climate Resilience (PPCR). PPCR covers the incremental costs of projects to be "climate proofed." As such, the aim is to "mainstream" climate adaptation into the broader development framework. The climate adaptation strategy section in this report discusses PPCR in further detail and how incremental costs will be calculated for project designs. [46]

143. New domestic and international financing mechanisms may be tapped in the future. The Bangladesh Climate Change Trust Fund (BCCTF) is funded by the government and could possibly be an option for sustained resourcing for CTIIP projects and capacity building; as could the multi-donor funded Bangladesh Climate Change Resilience Fund (BCCRF) that may provide grant support to civil society and private sector to, among other things, create "grassroots mechanisms" for community resilience. The proposed Local Disaster Risk Reduction Fund (LDRRF) managed by the Comprehensive Disaster Management Programme (CDMP) is another potential source of funds.LDRRF proposes to encourage sustainable investments by incorporating a trust fund to manage on-going upkeep. The poor upkeep of existing infrastructure (including, for instance, encroachments on canals by footpaths, houses, dams to create fishponds, and garbage disposal) is often a greater cause of climate vulnerability than the absence of infrastructure. As such, mechanisms like that proposed for the LDRRF that offer revenue for operations and maintenance can play a crucial role.

144. Beyond having the resources to maintain infrastructure, creating a financial incentive to sustain climate vulnerability reduction is the ultimate aim. There are also initiatives underway promoting instruments that credit outcome based climate vulnerability reduction. With public or private demand for these instruments, they could provide CTIIP investments with a future revenue stream to incentivize and support robust operations and maintenance of infrastructure projects.

145. For some CTIIP interventions, local level self-funding may be the most sustainable strategy. Efficiency and sustainability in water supply infrastructure can be brought about with robust financial management and monitoring of water supply which is presently a weakness in the pilot pourashavas.

[46] See CDTA, 2013, Final Report, page 18.

146. An important component of climate resilience and disaster risk management is supporting community-based adaptation projects. As noted by Heltberg et. al, "support for adaptation should play to the strengths of community-based approaches, in particular local grounding. Small community-based projects are a viable means of supporting adaptation … although some regions may need to build the capacity of potential providers.[47] They note that grounding in local socioeconomic and climatic realities; use of local knowledge; and synergies between adaptation and development. Adaptation funding regimes should seek to exploit and promote these strengths, and communities should be involved in identifying local causes of vulnerability and in devising responses.[48]

147. Locally managed funds have been successful in serving as a route to pro-poor urban development, having channelled tens of millions of dollars to low-income neighborhood groups, providing accountability and decision-making power to often marginalized people. Development funds at the town-level can be jointly managed by communities and the pourashava in order to facilitate collaboration and capacity building.[49]

148. Funding community level climate adaptation measures using locally managed funds is a relevant approach. The IIED is currently working to provide local finance though such a fund in north Kenya.[50] Community level adaptation is an important tool requiring local level resources to be efficient, effective, and sustainable.

149. CTIIP shall design and work with local communities to set up and provide seed funding for "pro-poor community managed adaptation funds."

150. **Policies:** The Government of Bangladesh has been actively promoting climate adaptation and disaster risk management through a number of policy instruments that the CTIIP should leverage and promote.

151. The recently passed Disaster Management Act, discussed further in the next section, is encouraging a variety of policy changes that may improve the sustainability of CTIIP subprojects. The Act encourages greater attention to comprehensive disaster management over disaster response. A draft National Disaster Management Policy has been formulated, and, in addition to proposals for a disaster management fund, the Act specifically gives local disaster management committees additional authority.

152. Interviews with Pourashava officials and community organizations (see **Section VI, Volume 4**) demonstrated that local level disaster risk management is largely inactive and local level cyclone preparedness is limited primarily to disaster warning, without resources going to awareness raising and disaster risk reduction. Pourashava officials and officials at the Comprehensive Disaster Management Programme (CDMP) acknowledge this.

153. The central government in recent consultations has identified improved local level disaster management as a priority. The CDMP is undertaking work enhance local capacity, through training on use of the Local Government Self Assessment tool to identify gaps in local urban risk reduction. Further details are noted in the following section.

154. **Urban Planning:** Urban planning is another important tool—between policy and management—that can guide climate adaptation. There are four relevant planning functions:

[47] Heltberg, R., et al, (2010) Community-based Adaptation: Lessons from the Development Marketplace 2009 on Adaptation to Climate Change, Social Dimensions of Climate Change Program, Paper No. 122/June 2010.

[48] See Asian Coalition for Housing Rights (ACHR), Housing by People in Asia, No. 17, November 2007, and andUN HABITAT, Housing the Poor in Asian Cities (2008), Quick Guides for Policymakers, 5, for further information and strategies for housing finance for the poor, that may apply to community based climate adaptation finance.

[49] Mitlin, D., 2013, Locally managed funds: a route to pro-poor urban development, IIED Briefing, May 2013.

[50] Ibid.

1. Controlling land use by preventing development in areas of high risk and in areas that exacerbate levels of risk,
2. Promoting, directing and facilitating development in areas of least risk and that are compatible with a climate resilient urban development strategy,
3. Allocating and reserving sufficient land for critical climate resilient infrastructure (such as water supply, drainage and roads) including sufficient rights-of-way and land availability, and
4. Identifying, on a continual basis, priority capital investments (for both new infrastructure and rehabilitation of existing infrastructure, and including 'natural' eco-systems infrastructure).

155. **Appendix B, Volume 2** analyzes the status of planning in the pilot cities, and details further how the above four functions could result in more climate resilient Pourashavas.One specific recommendation to note is to develop 'Climate Change Adaptation Building Standards'. While these would not have legal force, developed on the basis of local knowledge of the five coastal towns, these could provide a short, user-friendly and straightforward guide to ensuring adaptation measures on individual sites and buildings. The PPTA performed a cost:benefit analysis of this option and found favourable returns on the costs imposed by such standards (see **Volume 6: Economic and Financial Analyses**).

156. **Technical Tools for Climate Preparedness:** As noted in the field survey report (**Volume 4, Chapter V**), before Cyclone Sidr many residents either did not receive warning or if they did ignored it, as they thought is might be a false alarm. A priority should be strengthening the monitoring and warning system to improve the prediction systems for weather, rainfall and cyclones and floods improve the warning and preparedness to effective and trust worthy level.

157. For the development of improved vulnerability assessments and local level adaptation plans and projects, research is needed to downscale the future prediction from the GCMs using high resolution dynamical models, such as PRECIS to local level scenarios at required time horizon. Climate investigators should have free access to the high-resolution model data generated in the national institutes. A climate database of the results containing future scenarios of the downscaled climate parameters needs to be generated and archived and be made easily available to the development projects engaged in developing climate resilience. In fact, this task is of utmost interest for the nation for implementing large number of projects dealing climate resilience.

158. An important recommendation from the CDTA report is the importance of setting up a system of monitoring flood inundation patterns during extreme rainfall events to make more reliable estimates of flood prone areas.

159. The project provides emphasis of mapping of the monsoon flood inundation, inundation level due storm surges by Cyclone Sidr and extreme tidal inundations are required to be performed as baseline scenarios of these disasters, which needs to be followed by inundation mapping at 2050 for the selected towns. The GIS technology and availability of up to date DEM would ensure the quality of the results of the baseline study and future scenarios.

160. The damage and losses assessment for the changed climate scenarios in 2050 and further for the study pourashavas is an important task to be performed.

4.5.2 Disaster Preparedness Non-Structural Measures

161. None of the four Batch 1 towns have active pourashava disaster management committees PDMC). The central government in recent consultations has identified improved local level disaster management as a priority.

162. The Bangladesh Department of Disaster Management Director General noted that organization of these committees was the responsibility of pourashava civil servants (Secretaries) who had many mandates and were rotated between towns on a regular basis.

163. Creating an active, resourced and effective PDMC is a key element in making local level disaster management a reality.

164. CTIIP shall support the PDMCs through a program of capacity building, including providing the often rotated civil servants and local officials with orientation tools, and providing technical support to the committees to give them know-how and advice on options to guide local level disaster management.

4.5.3 Integrating Non-Structural Measures in Subproject Designs

165. While many of the above set of non-structural measures will service all subprojects that CTIIP supports in a "centralized" way, the integration of the knowledge, services, resources, monitoring and policy/planning with specific projects is critical if the measures are to be grounded in reality and provide value added for the subprojects.

166. As such, for each subproject identified, the design considers the above issues to come up with appropriate, project specific non-structural needs, and determine if these are subproject specific or if they can be serviced by more central activities. For instance, a water supply project may need to integrate operations with early warning systems or flood inundation monitoring, or it may be something undertaken and managed directly by staff involved in water supply operations. Conversely, some centralized non-structural activities may need to tap subproject staff to secure data or require monitoring reports at regular intervals.

167. **Table 4.7** identifies and specifies the non-structural interventions that go along with the infrastructure investments. Further details of these interventions are found in Chapter 7: Proposed Infrastructure Interventions.

Table 4.7: Nonstructural Measures by Sector and Subproject

Nonstructural Measures by Sector and Subproject		
Infrastructure Project	**What is/are the Non-Structural Intervention(s)?**	**What Resources are Required? (Financial/Human/Policy/ Regulation/Capacity)**
Water: - Groundwater extraction	Maintain pumps.	Operating costs, operator and inspector, monitoring reporting, training on monitoring, etc.
- Surface water extraction	Maintain pumps and treatment facilities, ensure supply of chemicals.	Operating costs, operator and inspector, monitoring reporting, training on monitoring, etc.
Sanitation	Maintenance of facilities, de-sludging of septic tanks services.	Operating costs, operator and inspector, monitoring reporting, training on monitoring, etc.

Nonstructural Measures by Sector and Subproject		
Infrastructure Project	**What is/are the Non-Structural Intervention(s)?**	**What Resources are Required? (Financial/Human/Policy/ Regulation/Capacity)**
Storm water drainage: - Drains	Keeping drains clear. Do not throw garbage into drains. Raise awareness. Land use development planning. Prevent encroachments, IEC programmes on solid waste management and land use development.	Training/capacity/finance, human resources, regulation.
- Flood control	Agree and implement arrangements to minimize impacts of demand for irrigation water on urban flooding. Strengthen sluice management committees, make accountable to statutory bodies. Develop and implement differentiated flood management plans, according to needs and priorities. IEC programmes on flood management. Consider in zoning/ land use plans, polder development plans.	Human resources, trainging/capacity, finance, regulation (byelaws), policies.
Roads	Driving to enhance fuel efficiency.	
Cyclone Shelters	Raise awareness on use and upkeep. Practice drills (school children, other institutions or groups).	Include upkeep in DRM TOR. Incremental maintenance funding from DRM funds. Use CSOs for drills with DRM oversight.
Boat Landings	Raise awareness on climate change issues. Training of boat staff in cyclone safety. Planning for new boat landings.	
Slum Improvement	Community participation in planning, design, construction and operation. Raise cyclone safety and health, and hygiene and awareness.	
Overall	Green construction techniques, e.g. - use “green” materials; - minimize concrete use; - use human labor rather than machines where possible (also has poverty alleviation/ social benefits).	

Source: PPTA Consultant.

4.5.4 Implementing and Funding Non-Structural Measures

168. Understanding how CTIIP can meaningfully address the above challenges to make the results sustainable demands that CTIIP consider realistic means of developing these capacities. The next step is formulating a program and budget for each initiative.

169. As CTIIP is a mainstream urban sector investment project, it is important that capacity building focuses on working with the institutions and individuals directly responsible for managing infrastructure and services. As staff turnover can be an issue, the capacity building needs to be sustainable, meaning a plan needs to be taken seriously by the institutions involved for how new staff learn and act on past knowledge and practices. Much capacity building can deteriorate without management support and resources. As these are identified as deficient at the pourashava level, this is one of the greatest risks.

170. As described above, non-structural measures related to climate adaptation are found in the subproject designs, in the urban planning program of activities (see Chapter 8), and specific climate and disaster management measures are integrated into a package of activities as outlined in **Table 4.8**.

Figure 4.8: Overview of the Climate Change and Disaster Preparedness Technical Assistance Component

Objective: Strengthen Pourashava and community level preparedness for climate change, in all CTIIP towns			
Component A	**Component B**	**Component C**	**Component D**
Climate and disaster technical tools to inform adaptation and DRM decision making	**Community-level awareness raising and warning systems for climate hazards and resilience options,** especially for the poor and marginalized	**Disaster preparedness** through support for Pourashava level Disaster Risk Management Committees	Resource pro-poor, community level adaptation through **locally managed climate resilience funds**
Outputs Downscaled climate model outputs Improved tropical cyclone projections Flood inundation monitoring and mapping Cyclone and flood loss and damage assessments/tools	**Outputs** Community awareness raising events Fishing community early warning system Community DRM hazard mapping and planning	**Outputs** Orientation system for new civil servants/officials Technical support for DRM Committees	**Outputs** Funds Design/Management Plans Locally managed funds for each subject pourashava

Source: PPTA Consultant.

171. While the training of experts, officials, and the community is important, it is far from sufficient. Considerable technical expertise and sustainable resourcing of Bangladesh/pourashava or central ministry expertise will be required, along with financial resources to fund the creation of modeling, monitoring, and evaluation infrastructure. Commitment by government offices to provide staff and implement policies to enable the above non-structural measures is also important, and a key component of the capacity building work will be working through how the above big issues can be “mainstreamed” into government policy. This may only be done if both the policy and the internal/external incentive regime are put in place.

5 EXISTING INFRASTRUCTURE SITUATION IN STUDY POURASHAVAS

5.1 RESPONSIBILITIES FOR INFRASTRUCTURE

172. Pourashavas are tasked with providing a comprehensive range of services aimed at ensuring their citizens are provided with basic services, and that the towns are maintained in a hygienic manner. However, not all urban services are provided by the pourashavas: telephones and power supply are provided by a combination of central government and private entities, while other central government agencies manage national infrastructure, such as national highways.

173. **Table 5.1** provides a summary of the main agencies responsible for service delivery in the pourashavas for the components to be covered by the project. The table should be taken as a general guide for institutional responsibilities, since there are frequently exceptions. However, the pourashavas are generally responsible for providing the majority of the infrastructure facilities in their jurisdictions.

Table 5.1: Institutional Responsibilities for Services in Pourashava Areas

Sector	Planning	Design & Construction	Operation & Maintenance	Revenue Collection
Water Resources				
Surface Water	MOWR, MOEF, BWDB	BWDB (river monitoring stations)	BWDB	n/a
Groundwater	MOWR, MOEF, IWM	BWDB (monitoring wells)	BWDB	n/a
Piped Water Supply				
Extraction and treatment	DPHE, LGED, pourashavas	DPHE, pourashavas	DPHE, pourashavas	Pourashavas
Tube Wells	DPHE, LGED, pourashavas	DPHE, pourashavas	Pourashavas	Pourashavas
Transmission	DPHE, LGED, pourashavas	DPHE, pourashavas	Pourashavas	Pourashavas
Storage	DPHE, LGED, pourashavas	DPHE, pourashavas	Pourashavas	Pourashavas
Distribution & user supply	DPHE, LGED, pourashavas	DPHE, pourashavas	Pourashavas	Pourashavas
Hand pumps	DPHE, LGED, pourashavas, households	DPHE, pourashavas, households	Pourashavas, households	Pourashavas
Flood Control and Stormwater Drainage				
Embankment protection	BWDB	BWDB	BWDB	n/a
Sluice gates	BWDB	BWDB	BWDB	n/a
Pumps	BWDB	BWDB	BWDB	n/a
Dredging	BWDB	BWDB	BWDB	n/a
Main drains	BWDB, LGED, pourashavas	BWDB, LGED, pourashavas	BWDB, pourashavas	n/a
Side drains	BWDB, pourashavas	BWDB, pourashavas	BWDB, pourashavas	n/a
Culverts	BWDB, pourashavas	BWDB, pourashavas	BWDB, pourashavas	n/a
Transportation – Roads and Bridges; Ferry & Launch Ghats; Bus Parks				
National Highways	Roads & Highways Dept.			n/a (some tolls on key bridges)
District Highways	Zila Parishad			n/a
Other roads in Pourashava	Pourashava (Some roads adjacent to flood protection works are owned by relevant central government department (ie. Bangladesh Water Development Board or the Inland Water Transport Authority). This can lead to uncertain maintenance responsibilities.)			

Sector	Planning	Design & Construction	Operation & Maintenance	Revenue Collection
Main Ferry Ghats	Bangladesh Inland Water Transport Authority (BIWTA)			
Launch Ghats (boat landings)	Pourashava & private operators			
Bus Parks	Pourashava and some private companies			
Rickshaw Stands	Pourashavas			
Solid Waste Management				
Collection	Pourashava – sometimes contracted out to private companies or NGOs			
Disposal	Pourashava			n/a
Sorting	Not mandated for Pourashava, but done informally			
Other proposed Components				
Cyclone Shelters	Pourashava (many cyclone shelters attached to schools, so Education Dept. also involved)			n/a
Slum Upgrading	Pourashava			As for Pourashava services
BWDB = Bangladesh Water Development Board ; DPHE = Department of Public and Environmental Health; IWM = Institute of Water Modeling; LGED = Local Government Engineering Department ; MOEF = Ministry of Environment and Forests ; MOWR = Ministry of Water Resources;				

Source: PPTA Consultant.

5.2 EXISTING ROADS, BRIDGES AND CULVERTS SITUATION

174. Pourashava roads generally fall into two categories: *kutcha* (earthen) construction and *pukka* (formed) roads **(Table 5.2)**. Formed roads are mainly black-topped (BT) asphalt roads with some concrete (CC) roads in a few places for main roads, while minor roads may also be brick-on-edge soling, known locally as herring bone bond (HBB). Nearly all roads are built above the existing ground level, not only to avoid inundation during storms, but as the silty loam and alluvial soils typical of the area compact easily, roads need a supporting base layer that is often built up to around one meter above ground level.

175. Typically, most new roads start as earthen roads and are upgraded (raised, widened and surfaced) as funds become available. However, the decisions as to which roads should be upgraded do not seem to be based upon proposed traffic levels as there is little traffic data. In the district center of Pirojpur, road widths are generally adequate for current traffic flows. However, many of the roads in the smaller towns, particularly roads on the periphery of the town, are narrow and only single lane and, in some areas, many households only have footpath access, often over substantial distances.

176. Examples of an existing road and bridge are shown on **Photographs 5.1 and 5.2**.

Table 5.2: Existing Road Situation in Towns

Town	Length of Road (km)			
	Earthen	BT & CC	HBB	Total
Amtali	30.80	35.95	15.00	81.75
Galachipa	14.50	16.00	10.50	41.00
Mathbaria	31.50	41.50	13.00	86.00
Pirojpur	11.50	72.75	79.25	163.50

Source: PPTA Consultant.

Photograph 5.1: Existing Road Proposed for Improvement, Pirojpur Pourashava

Source: PPTA Consultant.

Photograph 5.2: Existing Iron Sleeper Bridge – Damaged and Risky, Galachipa

Source: PPTA Consultant.

5.3 EXISTING CYCLONE SHELTER SITUATION

177. There are existing cyclone shelters in all of the study (Batch 1) towns, but most of them were constructed over 30 years ago and are in a poor condition **(Table 5.3, Photograph 5.3)**. Research commissioned by the various development partners in Bangladesh,[51] shows that 13 types of cyclone shelters have been constructed in Bangladesh. Generally they all follow similar designs, using a framed structure that can withstand storm flows and high winds. A slightly raised unenclosed ground floor, either concrete or earth with external steps leading up to a roofed and walled first floor. This area provides the main protection from cyclones. Key issues[52] with existing cyclone shelters are summarized below:

- Shelters are not located close to human settlements, particularly where the poor and vulnerable reside. This is a particular issue with those living outside embankments.
- Approach roads do not have all-weather surfacing and thus access during cyclones, particularly at night, can be difficult. In addition, the crest level of the roads is often below flood levels, making access dangerous.
- Structures have not been maintained, which is exacerbated by inadequate specifications and construction supervision. Wooden doors and windows rot, while steel hinges and frames rust, and concrete seems to have spalled revealing reinforcing bars which are also rusting.
- Structures lack basic services such as water supply and sanitation facilities. If these are provided they are in poor condition and located at ground level, rendering them useless during cyclones. Power supply and backup is also lacking.
- There are no separate sections for women or secure storage areas for personnel effects.
- As many shelters are not used apart from during cyclones, they are not maintained and even maintenance responsibilities sometimes seem unclear.
- Many shelters are located below road level and the ground floor is often in a shallow hollow that could be one of the first areas to flood.

178. Inspection of existing shelters in the towns confirmed these findings.

Table 5.3: Existing Cyclone Shelters

Town	Number	Age	Capacity	Remarks
Amtali	2	40	2 x 200	Damaged and dangerous structures.
Galachipa	2	20	2 X 200	Used by Bank (1) and School (1).
Mathbaria	Nil	--	--	--
Pirojpur	Nil	--	--	--

Source: PPTA Consultant.

[51] Coastal Climate Resilient Infrastructure Project, TA 7902 – BAN, Annex N, Cyclone Shelters, kfW, ADB, IFAD, Sept 2012.

[52] Based upon findings from Coastal Climate Resilient Infrastructure Project, TA 7902 – BAN, Annex N, Cyclone Shelters, kfW, ADB, IFAD, Sept 2012.plus PPTA consultant's observations.

Photograph 5.3: Poorly Maintained Cyclone Shelter in Ward No. 7, Amtali Pourashava

Source: PPTA Consultant.

5.4 EXISTING BOAT LANDING STATION SITUATION

179. Within the coastal and riverine areas of the CTIIP towns, boat landings play a major communications role. All of the pourashavas have multiple boat landings of various sizes and scales used for both cargo and passenger transfers **(Table 5.4)**. Typically boat landings are built of steel and float as pontoons attached by a jetty to the shore **(Photographs 5.4 and 5.5)**. This allows them to accommodate water level changes. There are also some landings that are rigidly fixed to the shore. The condition of these boat landings varies, but nearly all require maintenance or upgrading. Generally their design does not seem to accommodate storms or cyclones.

180. Apart from dealing with cyclone damage, the main issue with boat landings seems to be that their location often adds to congestion, as access routes and links to main roads do not seem to be considered along with their planning.

Table 5.4: Existing Boat Landings

Town	Number	Age (approx)	Use	Remarks
Amtali	5	15 years.	People, Construction Materials, Food and agricultural items.	Damaged 2 and no structure in 3 sites.
Galachipa	3	15 years.		No structure is available.
Mathbaria	4	15 years.		No structure is available. Used temporary wooden sleepers
Pirojpur	5	15 years.		Damaged infrastructure in 2 and o structure in 3.

Source: PPTA Consultant.

Photograph 5.4: Poorly Maintained Boat Landing Station in Ward No. 4, Amtali Pourashava

Source: PPTA Consultant.

Photograph 5.5: Boat Landing Station without Infrastucture in Ward No. 2, Mathbaria Pourashava

Note: Material is unloaded by temporary and risky wooden planks.
Source: PPTA Consultant.

5.5 EXISTING SOLID WASTE MANAGEMENT SITUATION

181. Compared to many urban areas of South Asia, and Bangladesh, solid waste is not such a noticeable issue in the study (Batch 1) towns. This is notable, despite the fact that there is no formal solid waste management in the towns. None of the towns have information on either solid waste generation or collection rates. The low waste generation can be mainly being attributed to:

- The lower-incomes that create much higher levels of recycling plus, of course, the ban on plastic bags.
- Waste produced is largely vegetable matter.
- The semi-rural nature of the project towns' peripheral areas means that much of this waste is left in courtyards and gardens, and semi-composted into fertiliser with little waste actually reaching the waste stream.
- Waste that enters the waste stream and is collected, particularly construction waste and non-recyclable items, is mainly used as filling for low lying areas, which is an ongoing process.

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182. Thus not much waste is formally disposed to the existing dumpsites. None of the towns have sanitary landfills.

183. Previously, some NGOs were involved in solid waste management in the pourashavas, but are not currently active. Existing solid waste equipment in the pourashavas is outlined in **Table 5.5**.

184. Significant recycling is already happening within households and commercial establishments, and this must be considered in assessing the overall aims for percentages recycled/reused. The current practice is that private collectors visit individual households or commercial establishments to purchase recyclables and they, together with waste pickers at the landfill site, sell recyclables to junk shops and traders. It is already very efficient and significant recycling gains can only be made through recycling new components, such as green waste and demolition waste, or organic waste.

185. As there has been no detailed analysis of solid waste generation rates in the PPTA study towns, information from Khulna[53] has been used to estimate solid waste generation rates. A study by Alamgir and Ahsan in 2007[54] in Khulna estimated that waste generation form different household income levels varied from 0.368 kg/capita/day (high income) to 0.203 kg/capita/day (low income) with an average of 0.297 kg/capita/day. This aligns closely with generation rates of medium sized urban cities in South Asia.

Table 5.5: Existing Solid Waste Generation Estimates

Town	Total Population	Waste Generated (tonnes per day)	50% Waste Reaching Waste Stream (tonnes per day)	Volume (m^3/day)
Amtali	21,800	4.4	2.2	4.7
Galachipa	25,900	5.3	2.6	5.6
Mathbaria	18,900	3.8	1.9	4.0
Pirojpur	60,100	12.2	6.1	12.9

Source: PPTA Consultants' Estimate based upon data from Khulna. Populations rounded to nearest 100.

[53] Cities Development Initiative for Asia (CDIA), Support to Khulna City Corporation (KCC), Sector Report 4. Solid Waste Management, June 2009

[54] SAP 2008 contains substantial detailed information on waste generation in Khulna based Alamgir and Ahsan's work. Appendix C contains comparable data on waste generation from other cities in Bangladesh and Asia.

186. Recognizing the smaller size of the CTIIP towns, plus the reuse and landfilling activities, **Table 5.6** assumes that the lower figure for overall generation is applicable, with 50% reaching the dumpsite. As can be seen from the table, assuming similar waste densities as in Khulna, the waste generation is still very low. In Khulna,[53] around 80% of the waste composition is biodegradable material, with paper and plastic comprising another 12%, so the table assumes an average density of 475 kg/m^3 for solid waste generation. While this calculation is only for domestic waste, the non-domestic waste is mainly commercial waste from shops and offices of which most is recycled. Hence, the table shows that the existing waste generated is very low and currently justifies the small sized solid waste trucks.

187. Apart from medical waste, there is not much waste that is hazardous, such as used fluorescent tubes and batteries. All the towns have clinics and while some medical waste from the hospitals is disposed of in pits, much of the waste, particularly from small private clinics, enters the domestic solid waste stream.

188. None of the towns has a sanitary landfill and waste is just dumped in low lying areas. Identifying suitable landfill sites is the major issue with solid waste management in the Batch 1 towns. Applying typical environmental norms for the location of a landfill site such as distance to habitation, surface and groundwater and free from flooding, etc, indicates that there are no suitable areas for landfill sites in the towns' vicinities.

189. Standard landfill site selection criteria will need to be modified if landfill sites are to be developed in the Batch 1 towns. This should not involve an environmental compromise as greater protection such as thicker lining to protect groundwater and embankments to prevent flooding will have to be constructed. The main issue is proximity to habitation and the increased costs of developing a landfill site that is both environmentally protected and resilient to climate change. The modified site selection criteria are contained in Chapter 6.

Table 5.6: Existing Solid Waste Management

Town	Estimated Waste Generated	Disposal Equipment	Existing Disposal Site	Equipment
Amtali	No record	2 x 3-ton truck	01	Truck -1 Rickshaw -Van -2
Galachipa	No record	2 x 3-ton truck.	01	Truck -1 Rickshaw -Van -2
Mathbaria	No record	2 x 3-ton truck.	01	Truck -1 Rickshaw -Van -2
Pirojpur	No record	3 x 3-ton truck.	01	Truck -2 Rickshaw -Van -3

Source: PPTA Consultant.

5.6 EXISTING SLUM SITUATION

190. All of the towns contain slums **(Table 5.7)**. Slums are defined as areas where the inhabitants lack secure tenure, and are usually located on government land or private land where a rent may be paid. In the Batch 1 CTIIP towns, many slums are located on recently formed land that has emerged on the edge of existing polders, often outside the existing embankment **(Photograph 5.6)**. As such these slums are much more exposed to sea or river level fluctuations.

191. Due to land tenure issues, it is difficult to provide fully comprehensive upgrading to slums. However, in participation with the inhabitants, slums will be assessed for major deficiencies and priority services will be provided. This will include the range of interventions to be provided under the CTIIP such as water supply, sanitation, flood protection, drainage, access, typhoon shelters and sold waste management.

Table 5.7: Summary of Slum Populations in Towns

Town	Total Population*	Number of Slums	Slum Population	% in slums
Amtali*	21,800	6	1,850	8
Galachipa	25,900	11	5,530	21
Mathbaria	18,900	10	3,040	16
Pirojpur	60,100	14	12,020	20

Note: *Not provided in TA Report, estimated from poverty data.
Source: PPTA Consultant.

Photograph 5.6: Slum in Amtali outside the Embankment

Source: PPTA Consultant.

5.7 EXISTING DRAINAGE AND FLOOD CONTROL SITUATION

5.7.1 Existing Situation in PPTA Study Pourashavas

192. **Amtali Pourashava** is protected by a polder embankment on its west along the Payra River (see **Annex B, Volume 5** for location maps). Two major drainage outfalls to Payra River are through two vent sluice gate on the WAPDA road Ward 8, and the other one on the WAPDA road Ward 1. The sluice gates are in a damaged condition and need repair and rehabilitation.

193. The natural drainage flow near the existing launch terminals has been blocked by the construction of the polder by BWDB, which causes long time water congestion in the large area of pthe pourashava.The drainage channel is to be re-opened with a sluice gate structure to facilitate the drainage of the area. The Amtali canal draining to the Payra River through the sluice gate in Ward 1 has been blocked by sand filling for Eid-gah. This has blocked the flowing canal and turned it into a large lake which inundates the surrounding

area for a long time during rainfall in the monsoon. The drainage canal is to be re-opened through the Eid-gah into the Payra River.

194. **Galachipa Pourashava** is protected from floods by an embankment stretching from the north to the western side. But the pourashava building, including a large part of the pourashava, remains outside the embankment. However, the embankment functioned quite well during the past SIDR and AILA events.

195. The pourashava has two major drainage outfalls: (i) a two-vent regulator at Shantibag on WAPDA road, and (ii) a one-vent regulator at Piadabari on Sagardi road. The normal flow of the Galachipa Khal is blocked by the flood embankment. Encroachment and siltation have turned the large main drainage canal into an almost non-flowing small drain. The canal is to be re-excavated to drain out water through the Shantibag regulator.

196. **Pirojpur Pourashava** Pourashava Pirojpur is protected by a polder in its west along the Baleswar River. But some drainage outfalls are into the river without any control structure. During Sidr, the tidal surge overtopped the polder for a few minutes. The crest level of the polder is at +4.50 m PWD and the max. storm surge rose up to 4.7 m PWD. BWDB is taking up measures to increase the height of the whole polder considering the climate change condition.

197. Damudar Khal (canal) is the main natural drainage of the Pirojpur Pourashava and runs through the city connecting the Baleswar and Kocha rivers. Siltation and encroachment of banks are the main challenge for the canal's deterioration. All other drainage networks, including small and big canals, join the Damuder Khal from both sides of the city. Prominent of them are Chila Khal, Vaarani Khal, Sasan Ghat Khal, Madhyama Mashimpur Khal, Dhup Pasha Khal, etc., and all of them join the Damudar Khal. These drainage canals are to be modified for smooth functioning of the drainage system.

198. **Mathbaria Pourashava** drains out its storm water to Baleswar River on the west and Bishkhali River on the east through a network of *khals* (open channels).These canals have polders on both banks to protect the pourashava from floods. These are named as 39/1B polder, 39/1C polder, 39/2D polder etc., constructed by BWDB. Besides, flood walls are also constructed along the canal banks in densely populated areas in the town due to the scarcity of land to construct polders. A large portion of the flood walls are damaged and sluice gates in the polder are also in very poor condition. All these flood walls and sluice gates need repair and rehabilitation/ reconstruction.

199. The drainage canal network in the pouroshava mainly consist of Mirukhali Khal, Bashimara Khal, Tushkhali Khal, Masua Khal, Hachir Khal, Tikikata Khal, Argugi khal, WAPDA Khal etc. Almost all these canals are silted up, filled with garbage and encroached by settlements. Prolonged water logging occurs during monsoon high tides and rainfall in the low lying area, overflowing the canal banks. These canals need re excavation up to the designed depth and top width up to the original RoW (right-of-way). CC block lining is also required where the canals are endangered by erosion.

200. There are inadequate numbers and lengths of street drains in the pourashava .For proper drainage flow into the secondary drains, many new street drains are required.

201. **Table 5.8** shows the total primary, secondary and tertiary drains in each pourshava. The primary drains comprise the natural *khals* and channels, and are almost entirely unlined earth, while the tertiary drains are *pucca* brick and concrete drains. The secondary drains comprise both natural earth and *pucca* channels.

Table 5.8: Primary, Secondary and Tertiary Drains in Each Pourshava

Pourashava	Primary	Secondary	Tertiary	Total	Area (km^2)
Amtali	19.3	-	1.8	21.1	8.92
Galachipa	8.6	-	5.0	13.6	3.39
Mathbaria	8.1	-	3.5	11.6	6.56
Pirojpur	111.7	25.8	1.5	139.0	29.46
Total	**147.7**	**25.8**	**11.8**	**185.3**	**-**

Source: CDTA Final Report and DPHE Master Plan.

202. As can been seen, while Amtali and Pirojpur pourashavas both include large rural areas,[55] each pourashava has very little secondary and tertiary drainage, showing that their systems are incomplete and have not been developed in a well planned and integrated manner. Also, while many of the drainage and master plan studies and investment plans mention 'drainage congestion' as a major issue there has been no detailed consideration of its impacts on developing and operating efficient and effective drainage networks.

203. Other constraints on efficiency and effectiveness include the very flat gradients, the extended drainage lines resulting from many roads being elevated above local ground levels, often cutting natural drains, and insufficient cross-drains; and where culverts exist they are often small. Poor management, especially weak O&M, has not helped either, allowing silting, blockages by solid waste, and vegetation—especially in the primary drains. Poor regulation has allowed encroachments, often in key places. Also, there are no arrangements for pumping when conditions prevent gravity drainage, and no facilities to regulate flows within the polders. Amtali is the only pourashava with potential capacity to detain storm runoff.

204. The results are prolonged, low-level water logging in many locations, especially during the monsoon season, and flooding too, sometimes even during moderate rainfall.

5.7.2 Conclusions from Surveys and Analyses

205. **Rain-based flooding.** Most rain-based flooding occurs during the monsoon period, when rainfall is highest and most frequent. However, genuine and reliable data about flooding are limited, including sufficient details of when it took place, its extent and duration, and the associated rainfall and tidal events. As a result it is difficult to determine the typical and exceptional flooding events and risks in the study pourashavas.

206. Surveys conducted during the PPTA indicate that apart from Amatali Pourshava flooding can be extensive, i.e. >40% **(Table 5.9)** and is often more than 25 cm, though other surveys, e.g. LGED Master Plan Surveys, say that most flooding is below property plinth levels.[56] The frequency ranges from 4.5 days per year in Pirpopur to about 11 days in Amtali and Galachipa, with most of it lasting less than 24 hours. The situation in Mathbaria is more severe in all respects, with a total of about 35 days flooding every year, most of it more than 25 cm and lasting from 1 to 2 days. This is attributed to the very low lying and flat topography, and the pourashava's exposure to flooding from the surrounding agrcultual areas, whereas the urban cores of the other pourashavas are mainly on land that is higher than the the surrounding agricultural areas. Consequently they tend to be at less risk of inundation from elsewhere within their polder even though it is not yet possible to manage the runoff differently.

[55] About 6.5 km^2 and 21 km^2 respectively.

[56] According to the Master Plan socio-economic survey of Pirojpur in 2011 most of the households (76%) reported that the flood level was below the property plinth level (assumed as 25 cm min) while in 1998 flooding was 1- 1.5 m deep.

Table 5.9: Preliminary Socio-economic Survey Results of Households Inundated by Flooding*

Incidence and type of inundation or water logging	Amtali	Galachipa	Mathbaria	Pirojpur
% of HHs reporting inundation or water logging of roads, footpaths or house **during rainy season** [only]	11.7%	60.4%	48.2%	44.4%
Average number of days of inundation or water logging of roads, footpaths or house **during rainy season** [only]	11.4 days	16.3 days	35.6 days	4.6 days
% of HHs reporting inundation or water logging of roads, footpaths or house **during the year including rainy season**	2.4%	14.4%	3.7%	11.3%
Average number of days of inundation or water logging of roads, footpaths or house **during the year including rainy season**	7.0 days	59.6 days	48.8 days	11.1 days
Number of respondents	377	381	380	390

Note: * Subject to thorough checking and revision of output tables.
Source: SEWTPS during PPTA, 2013.

Table 5.10: 2012 Flooding Depths and Durations in Urban Cores, Study Pourashavas

Survey locations & records	Amtali		Galachipa		Mathbaria		Pirojpur	
no. of locations	24		23		31		18	
no. of records	27		23		32		18	
Worst monsoon flood 2012	**Amtali**		**Galachipa**		**Mathbaria**		**Pirojpur**	
Depth	**records**	**%**	**records**	**%**	**records**	**%**	**records**	**%**
No flooding	17	63%	19	83%	6	19%	6	33%
depth <0.25m	0	0%	0	0%	11	34%	3	17%
depth = 0.25-0.75m	6	22%	1	4%	15	47%	8	44%
depth = 0.75-1.5m	4	15%	3	13%	0	0%	1	6%
depth >1.5m	0	0%	0	0%	0	0%	0	0%
total no. >0.25m	10	37%	4	17%	15	47%	9	50%
Duration of flooding >25 cm								
duration <6hrs	10	100%	2	50%	0	0%	5	56%
duration = 6-24 hrs	0	0%	0	0%	4	27%	1	11%
duration = 24-48 hrs (1-2 days)	0	0%	0	0%	8	53%	0	0%
duration = 48hrs-198 hrs (2-7 days)	0	0%	1	25%	3	20%	3	33%
duration = 1 week - 1 month	0	0%	1	25%	0	0%	0	0%
total no. of records	10	100%	4	100%	15	100%	9	100%

Source: PPTA flood inundation survey.

207. During the 1998 flood Pirojpur was inundated by 1–1.5 m of water.

208. It has also been noted that even in moderate rainfall flooding is more severe when there is an extreme tide and water flows up the drains, and where flow is constrained by a weak network and/or insufficient outlets (sluice vents). It is also more severe where open land, natural water bodies and drainage *khals* have been occupied by settlements, i.e. the residential areas. Consequently many residential areas suffer from extended water logging.

209. **Tidal flooding and storm surges.** Amtali and Galachipa pourashavas are both within polders, so are potentially protected from tidal flooding and storm surges by embankments and sluices along their respective rivers. Consequently tidal flooding and storm surges tend to be limited the areas close to the embankments, although the areas affected by the latter also depend heavily on the state of the tide. However, the embankment and sluice levels in both pourashavas are not adequate for projected sea level rise. Also, as water is often drawn into the polders for farming use, via the sluices, water levels within the urban core are often the same as the high tide level. This restricts drainage of any flood event occurring at or near high tide.

Table 5.11: Preliminary Socio-economic Survey Results of Households Inundated by Flooding*

Incidence and type of inundation or water logging	Amtali	Galachipa	Mathbaria	Pirojpur
% of Hs reporting inundation or water logging of roads, footpaths or house only **during massive flooding or cyclone**	5.6%	7.6%	0.8%[a/]	14.1%
Average number of days of inundation or water logging of roads, footpaths or house only **during massive flooding or cyclone**	9.8 days	4.1 days	44.0 days[b/]	5.6 days
Number of respondents	377	381	380	390

Note: * Subject to thorough checking and evision of output tables.
[a/] does not correspond to PPTA flood inundation survey.
[b/] does not correspond to PPTA flood inundation survey, which reports 100% less than 6 hours (31 survey points).
Source: SEWTPS during PPTA.

Table 5.12: Storm Surge and 2012 Tidal Flooding of Urban Cores, Study Pourashavas

Survey locations & records	Amtali		Galachipa		Mathbaria		Pirojpur	
no. of locations	24		23		31		18	
no. of records	27		23		32		18	
Cyclone Sidr	**Amtali**		**Galachipa**		**Mathbaria**		**Pirojpur**	
Depth of flooding	**records**	**%**	**records**	**%**	**records**	**%**	**records**	**%**
No flooding	15	56%	13	57%	0	0%	3	17%
depth <0.25m	0	0%	0	0%	0	0%	4	22%
depth = 0.25-0.75m	0	0%	0	0%	10	31%	4	22%
depth = 0.75-1.5m	11	41%	8	35%	22	69%	6	33%
depth >1.5m	1	4%	2	9%	0	0%	1	6%
total no. >0.25m	12	44%	10	43%	32	100%	11	61%
Duration								
duration <6hrs	12	100%	7	70%	32	100%	10	91%
duration = 6-24 hrs	0	0%	1	10%	0	0%	0	0%
duration = 24-48 hrs (1-2 days)	0	0%	1	10%	0	0%	0	0%
duration = 48hrs-198 hrs (2-7 days)	0	0%	1	10%	0	0%	0	0%
duration = 1 week - 1 month	0	0%	0	0%	0	0%	0	0%
total no. of records	12	100%	10	100%	32	100%	11	100%
Worst tidal flood 2012	**Amtali**		**Galachipa**		**Mathbaria**		**Pirojpur**	
Depth of flooding	**records**	**%**	**records**	**%**	**records**	**%**	**records**	**%**
No flooding	17	63%	20	87%	28	88%	9	50%
depth <0.25m	0	0%	0	0%	2	6%	2	11%
depth = 0.25-0.75m	6	22%	1	4%	2	6%	7	39%
depth = 0.75-1.5m	4	15%	2	9%	0	0%	0	0%
depth >1.5m	0	0%	0	0%	0	0%	0	0%
total no >0.25m	10	37%	3	13%	2	6%	7	39%
Duration								
duration <6hrs	10	100%	3	100%	0	0%	7	100%
duration = 6-24 hrs	0	0%	0	0%	2	100%	0	0%
duration = 24-48 hrs (1-2 days)	0	0%	0	0%	0	0%	0	0%
duration = 48hrs-198 hrs (2-7 days)	0	0%	0	0%	0	0%	0	0%
duration = 1 week - 1 month	0	0%	0	0%	0	0%	0	0%
total no. of records	10	100%	3	100%	2	100%	7	100%

Source: PPTA flood inundation survey.

210. Tidal data also indicate that current average low water levels do not fall below the lowest ground levels in Galachipa Pourashava during August for neap tides (lowest difference in levels) and July–September for spring tides (highest difference in levels). In

Amtali they fall below the ground level by about 80 cm during neap tides and 1.1 m during spring tides, which is at or very close to the drain invert (base) levels. Hydraulic gradients and operating periods are therefore limited.

211. Pirojpur and Mathbaria both have open *khals* passing through their urban cores, and while there are tidal defences along the *khal* in Mathbaria, with sluice gates on the main internal drains,[57] there are low points. Projpur has gaps and low points in the riverside embankments and no defences along its main *khal* as well as branch *khals* open to it. Consequently both towns are open to tidal flooding and storm surges; Pirojpur is especially exposed because each high tide reaches right into the heart of its urban core. A survey of flooding in Mathbaria during cyclone Sidr conducted by the PPTA consultant found that the embankment failed and the whole Pourshava was flooded to a depth of about 60–120 cm. However, in most places it lasted only about 15 minutes, and 30 minutes maximum.

212. **Drainage congestion.** Drainage congestion features regularly in many of the studies and plans, but does not appear to have been examined in any detail.

213. A study of the tidal data that could be obtained during the PPTA shows that at various times of the year and under various tidal regimes, i.e. spring, neap and median tides, the tidal level will prevent runoff being discharged until it drops to the required level, e.g. below the lowest ground level. **Table 5.13** summarises the various conditions in Pirojpur and when they are most likely to occur. It can be seen that even for average tides there is congestion all year during spring tides, rising to a maximum of about 8 hrs, and that during July–August the low water level never falls below the expected drain invert level during both spring and neap tides.

214. **CDTA Urban Drainage Model Study.** The UDM study conducted as part of the CDTA[58] showed that even for the present day design storm conditions several of the *khals* in Amtali, Galachipa and Pirojpur will overflow, resulting in inundation of surrounding area. It concluded that with increasing rainfall and rising tidal levels, induced by sea-level rise, the drainage congestion situation will worsen, and recomended a programme of channel dredging, reprofiling, etc., to restore and increase capacity.

215. At the same time it acknowledged that there were only sufficient data to calibrate the model with one or two single storm events, although it reported a reasonable correlation between the model and the hydrographs constructed from the observed water level data in the respective rivers and *khals*.

216. Other observations include the reliability of the digital elevation data and the catchment layouts adopted, compared to the actual drainage patterns on the ground, because of road and other developments, and a signiifcnat difference between the predicted sea level rise of 0.1–0.2 m compared to the CTIIP's (0.29 m), and no allowance for land settlement. Also, where a channel discharges via a sluice vent, the model does not appear to consider the capacity with respect to the tidal level, the models are only run for the peak tide levels, and some of the channel depths (heights) and invert levels proposed for 2050 result in embankment levels that exceed the local ground levels by 1 m or more. Consequently while the channel may be able to carry the design flow, it is not clear how the water outside the channel, e.g. storm runoff, will enter it without pumping, or allowing flooding until the tidal level drops below the flood and ground level.

[57] One sluice gate is new, and the gates are still to be fitted (June 2013)
[58] Annex IV, CDTA Final Report, June 2013.

Table 5.13: Drainage Congestion for Average Tidal Levels, Pirojpur Pourashava

	Spring tides												Neap tides											
	maximum inundation level				lowest ground level				lowest drain invert level				maximum inundation level				lowest ground level				lowest drain invert level			
level (m PWD)	1.75				1.40				0.50				1.75				1.40				0.50			
Average high water level is below above level:																								
months	3				0				0				12				12				4.5			
	early-Dec -early-Mar				never				never				all year				all year				mid-Jun - Oct			
Average low water level is below above level:																								
months	12				12				8				12				12				8.5			
	all year				all year				Nov - mid-Jun				all year				all year				early-Oct - late-Jun			
Congestion (hrs)/ tide cycle (12.4 hrs) wrt min grd lvl	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
	0.9	1.1	2.5	3.4	4.7	5.7	6.4	7.8	7.3	6.4	4.2	2.1	0	0	0	0	0	0.7	2.5	3.2	2.3	0	0	0
drain invert inundation (m)						0	0.11	0.35	0.29	0.15									0.15	0.33	0.25			

Note: Light and dark shaded cells indicate average minimum low water level is above drain invert level for part or all of month respectively.
Source: PPTA Consultant, based on BWDB data

5.8 EXISTING WATER SUPPLY AND SANITATION SITUATION

217. **Water supply.** The existing water supply situation in the study pourashavas based on field data collection, consultations and surveys is summarized in **Table 5.14**. Preliminary data on water supply, water quality and water use from the socioeconomic and willingness-to-pay survey (SEWTPS) are summarized in **Table 5.15**.

218. Out of the four Batch 1 pourashavas, only Mathbaria does not have a piped water supply system at present. The population there is suffering from the lack of a good water supply, and has to obtain its water from ponds (through pond sand filters), saline shallow groundwater (for non-drinking purposes), rainwater, and rivers and *khals*.

219. Amtali and Galachipa pourashavas have good municipal piped supplies (almost continuous supply), but coverage is only around a third of households. The municipal piped supply in Pirojpur Pourashava is more intermittent.

220. **Sanitation.** The existing sanitation situation in the study pourashavas based on field data collection, consultations and surveys, including the field survey conducted by the Gates Foundation Sanitation Specialist in May 2013, is summarized in **Table 5.16**. Preliminary data on sanitation from the SEWTPS are summarized in **Table 5.16**.

221. There is high coverage of household toilets/latrines (94-98% in Amtali, Pirojpur and Mathbaria; 62% in Galachipa). Most toilets are pit latrines, which are generally located in relatively low areas in the household. The latrines consist of 4/5 nos. rings placed to the depth of around 3-4ft (0.9-1.2m) in the ground; a platform is simply positioned on the uppermost ring of the pit which is almost at the ground level. Consequently the latrines are easily inundated due to rain water accumulation in the monsoon season, resulting in a loss of accessibility to the latrine and pollution caused by discharge of the contents. It was observed in some places during the field visit that holes have been made on the surface of ring of the latrine pit to allow the flow of sludge over the ground to a nearby ditch, *khal* or canal, which is really environmentally and health hazardous.

222. SEWTP findings indicate that there is hardly any usage of public toilets. Public toilets are viewed as being poorly maintained and equipped (e.g. no water line or electricity).

Table 5.14: Existing Water Supply Situation in Study Pourashavas

Town	Raw Water Source	Water Quality	Existing Facilities	Service Connections	Coverage
Amtali	Deep groundwater aquifer, from 270 mbgl to the total drilling depth of 380 mbgl.	Analyses of Cl, As and Mg for DPHE-DANIDA, CDTA and PPTA were within Bangladesh standards for all samples. Analyses of pH and Fe showed vaues higher than Bangladesh standards for 2 samples.	Under the DPHE-DANIDA Water Supply and Sanitation Project, the first piped water supply system was commissioned in 2005. **Production tubewells:** 2 no. production tubewells, installed in 1998 by DANIDA, located the Amtola Degree College Compound. The distance between the tubewells is 100m. The tubewells were subsequently handed over to the Pourashava Authority for operation and maintenance. The two production wells run for 15 hours in summer and 12 hours in winter at 118 m^3 per hour. The average water production is estimated at1,652 m^3/day (1.65 MLD). **Overhead tank:** 500 m^3. **Water distribution pipelines:** Under the DPHE-DANIDA Water Supply and Sanitation Project, 1.5 km transmission pipeline and 17 km distribution line were installed. Latter on the Pourashava installed another 5 km of pipelines of diameter 40 mm, to a total of 24 km at present.	1,174 domestic and 25 commercial (Jun 2012)	38% of population
Galachipa	Deep groundwater aquifer, from 310m below GL, 50m thick and confined by clay layer of 12m thick above and 18m thick below. Static water levels are approximately 1m below GL and vary depending on tidal and barometric effects.	Analyses of pH, Fe, Cl, As and Mg for DPHE-DANIDA, CDTA and PPTA were within Bangladesh standards for all samples.	Under the DPHE-DANIDA Water Supply and Sanitation Project, the first piped water supply system was commissioned in 2005. **Production tubewells:** 2 no. production tubewells, installed in 1998 by DANIDA, located the BWDB compund. The tubewells were subsequently handed over to the Pourashava Authority for operation and maintenance. The two production wells run for 15 hours in summer and 12 hours in winter at 120 m^3 per hour. The average water production is estimated at 1,560 m^3/day (1.56 MLD). **Overhead tank:** 500 m^3. **Water distribution pipelines:** Under the DPHE-DANIDA Water Supply and Sanitation Project, 1.5 km transmission pipeline and 17 km distribution line were installed. Latter on the Pourashava installed another 6 km of pipelines of diameter 40 mm, to a total of 24 km at present.	1,946 domestic and 34 commercial (Jun 2012)	40% of population
Pirojur	Surface water (Baleshwar River), due to high salinity of deep groundwater. However, problems	Analyses of pH,TDS, Cl, Cr and SO_4 for CDTA were within Bangladesh standards for all	**First system (STWSSP Phase 1):** - Developed in 1983 by DFPHE under the Secondary Town Water Supply and Sanitation Project (STWSSP). - Capacity 100m^3/hour (2.4 MLD). - The treated water is stored in a clear water reservoir of capacity 680 m^3	4,076 (3,861 domestic, 215 commercial)	30% of households

Town	Raw Water Source	Water Quality	Existing Facilities	Service Connections	Coverage
	have been reported in that flows in the Baleshwar River have been declining, with the river silting up; upstream flows have been reducing due to upstream changes in the river morphology.	samples from Baleshwar and Kocha rivers.	from where water is pumped directly into the water supply system using two centrifugal pumps. - The system has no overhead tank (OHT). - A river intake was constructed on the bank of the Baleshwar River within the treatment plant compound, with the objective of pumping water from the river during low tide. However, it is reported that the intake has not been used for pumping water, as a sufficient quantity of raw water for a treatment plant of capacity 100m^3/hour is stored in the settling pond during high tide. - The system is operated for around 20 hours a day. - Chlorination is undertaken in the clear water chamber using bleaching powder containing around 30-33% available chlorine. - In 2006, the system consisted of 32 km distribution pipelines (250-75 mm), 2,210 house connections and 65 street taps. - Renovation of the existing water supply system: Under Phase 1 of this project, 13.8 km new pipeline has been laid, along with rehabilitation of 9.1 km of pipes, bringing the total to 45.5 km of supply and distribution pipelines (75~250 mm diameter), 2,600 water meters, and material for 2,308 new service connections. **New system (STWSSP Phase 2):** - In progress under Phase 2 of STWSSP. - Additional river intake on the Baleshwar River. - Surface water treatment plant (SWTP) of capacity 300m^3 per hour (7.2 MLD) - Two overhead tanks (OHT) of capacity 680 m^3 each are. - After completion of the construction, 6,000m^3/day (6.0 MLD) water will be available to distribute in the supply system. - Construction of 45.28 km new water pipeline is in progress under Phase 2 of STWSSP.		
Mathbaria	Surface water sources include four canals (Tushkhali, Boyratala, Mirukhali and Machua/Ramna khals) flowing inside the pourashava area; tidal water is available round the	Shallow and deep groundwater is saline. Shallow groundwater is also Fe and As contaminated in places. The Baleswar River	Presently, there is no piped water supply. Main sources are water are: **Shallow hand tubewells.** Shallow hand tube well water is the main source of water supply for majority of the Pourashava population for domestic use only and not for drinking as the water has extreme salinity. There are 225 hand tube wells which have been installed by the Pourashava and DPHE; most of which (about 115) are reportedly dysfunctional at the moment due the presence of extreme salinity in the groundwater.	-	-

Town	Raw Water Source	Water Quality	Existing Facilities	Service Connections	Coverage
	year in these *khals*.	is above the permissible limit of drinking water standards, whereas the Bishakhali River is within the permissible limit around the year. So it seems that the Bishkhali River is a better source of water supply for Mathbaria rather than the Baleswar River.	About 150 hand tube wells are installed by the individual owners sunk at their homestead. There are deep tubewells inside the pourashava. **Pond sand filters.** There are 65 pond sand filters (PSF) in the pourashava area; out of which about 40 are in a functional condition. The PSF consists of (i) raw water pump (ii) raw water chamber (iii) filter bed of sand and charcoal (iv) clear water chamber with clear water outlets. The raw water from ponds is pumped to the filter bed and the filtered water flows through the outlet of the PSF. The capacity of the each PSF is 1,500 to 2,000 liters per day. PROSHIKA, an NGO, is operating a mini water treatment plant in Mathbaria. The plant was established in 2003 in the Upazilla Office Compound. The pond water in the compound is being used as a water source. Water from the pond is pumped to the chamber where alum and chlorine is added and the water is allowed to a filter of stone chips, carbon and sand layers. The treatment capacity of the plant is 5,000 liter/day. The cost of 20 liters water is 2 taka only. **Surface water.** The people of the area use river and *khal* water for domestic use, and drinking after filtration and sometimes after boiling. **Rain water harvesting.** Rain water harvesting (RWH) facilities are hardly found in practice in the pourashava.		

Source: PPTA Consultant.

Table 5.15: Summary of Selected Water Supply, Water Quality and Water Use Data in Study Pourashavas from SEWTPS*

Question No.	Topic	Unit	Response			
			Amtali	**Galachipa**	**Pirojpur**	**Mathbaria**
F.1	Households that have piped water supply from municipality	%	39.0	26.5	39.0	0.0 (there is no municipal piped water supply)
F.2	Main water source for drinking and cooking		deep tubewell	deep tubewell	shallow tunewell	other
F.2B	Main water source for bathing and washing		pond/river/canal	pond/river/canal	pond/river/canal	pond/river/canal
F.4A	Main alternative water source for drinking and cooking		deep tubewell	deep tubewell	pond/river/canal	rainwater
F.4B	Main alternative water source for bathing and washing		pond/river/canal	rainwater	rainwater	rainwater
F.5	Average volume of water collected from secondary source for drinking	liter	38.6	52.2	90.7	24.4
F.6	Average volume of water collected from secondary source for bathing and washing	liter	109.5	174.1	84.4	51.1
F.7C	Average time spent to collect water	min	18.0	17.0	11.4	21.4
F.13	Availability of piped water supply from municipality during summer	hr/day days/wk	19.7 7.0	20.8 6.9	2.8 6.5	n/a n/a
F.14	Availability of piped water supply from municipality during other seasons	hr/day days/wk	21.6 6.9	22.2 7.0	2.8 6.7	n/a n/a
F.15	Main problem regarding piped water supply		none	quality issues	low pressure	n/a
F.22	Average volume of water from municipal piped supply	liter/day	99.6	158.0	109.2	n/a
F.26	Quality of groundwater		safe	safe	safe	safe
G.11	Average amount of water bill	BDT/mth	234	182	256	664 (non-piped)

Note: * Subject to thorough checking and revision of output tables. n/a = not applicable.
Source: SEWTPS, 2013.

Table 5.16: Existing Sanitation Inrastructure in Study Pourashavas

<table>
<tr><th>Town</th><th>Household Sanitation</th><th>Public Toilets</th><th>School Latrines</th><th>Community Latrines</th><th>Desludging Equipment</th></tr>
<tr><td>Amtali</td><td></td><td>Near cinema hall:
- Seats: women 2, men 3, urinals 2
- Charges: toilet use BDT5, urinal use BDT2
- No. users per day: about 200
- Caretaker lease: BDT10,500/year
- Disposal system: septic tank and soak pit, overflow pipe discharges to open drain
- Facility designed by DPHE
- Septic tank is desludged 3 times a year, 1 time paid by pourashava, 2 times by caretaker
- Monthly maintenance cost: BDT300-400.
(Source: Gates Foundation Field Visit Report, May 2013).</td><td>AK High School:
- 2 toilets, 1 for boys and 1 for girls – inadequate
- Disposal: septic tank
(Source: Gates Foundation Field Visit Report, May 2013).</td><td>None.</td><td></td></tr>
<tr><td>Galachipa</td><td>BBS data show that about 81% of households have a sanitary toilet, whereas 3% households have no toilet facilities. Furthermore, 12% of households have other types of toilet facilities such as kutcha toilet, hanging toilet, etc.

The socio-economic survey results indicate that about 48% of the toilets are pucca, 1% kutcha and the rest, 51%, have no toilet facility. However, in Ward No. 4 and 5 there is about 60% coverage of sanitary facilities. No disposal and treatment facilities are available inside the Pourashava. No sewerage system is available (source: LGED Master Plan).</td><td>There are two public toilets:
<table>
<tr><th>Sl No.</th><th>Location</th><th>Existing Facilities</th><th>Leased out</th><th>Observations</th></tr>
<tr><td>1</td><td>Thana Mosque Attached, Ward No-04</td><td>Chamber 4 nos.
Urinal 2 nos.</td><td>Yes</td><td>Electricity and water supply exist</td></tr>
<tr><td>2</td><td>Poura Monch Attached Ward No-07</td><td>Chamber 3 nos.
Urinal 2 nos.</td><td>Yes</td><td>Electricity and water supply exist</td></tr>
</table></td><td>Most of the schools (Primary schools, High Schools and Madrashas) have inadequate sanitation facilities. Existing latrines are in a bad condition as the pits/septic tanks and superstructures are mostly damaged, there is no arrangement for electricity and water supply, and there is a lack of separate provision for girls.</td><td>None.</td><td>The Pourashava does not have de-sludging equipment for cleaning latrines pits and septic tanks. As a result the poura dwellers themselves take initiative of cleaning these facilities, mainly through sweepers. At present sweepers manually clean the latrines, and sludge is buried underground at the cost of Tk 500 to Tk. 1000 depending on the size of pit and septic tank.</td></tr>
<tr><td>Pirojpur</td><td colspan="4">A considerable number of community latrines, public toilets, school latrines and household latrines are being constructed at different locations of Pirojpur Pourashava under STWSSP:</td><td></td></tr>
</table>

<table>
<tr><th>Town</th><th>Household Sanitation</th><th>Public Toilets</th><th>School Latrines</th><th>Community Latrines</th><th>Desludging Equipment</th></tr>
<tr><td></td><td>
<table>
<tr><td>SL NO.</td><td>TYPE OF LATRINES/TOILETS</td><td>NO. OF UNITS</td></tr>
<tr><td>1</td><td>COMMUNITY LATRINES</td><td>25</td></tr>
<tr><td>2</td><td>PUBLIC TOILETS</td><td>5</td></tr>
<tr><td>3</td><td>SCHOOL LATRINES</td><td>8</td></tr>
<tr><td>4</td><td>HOUSEHOLD LATRINES</td><td>45</td></tr>
<tr><td colspan="2">TOTAL =</td><td>83</td></tr>
</table>
</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Mathbaria</td><td>The sanitary condition is relatively poor. The types of toilets in use are:
Toilets with Septic Tank: 4.4% (of households)
Water Sealed Latrines : 50%
Pit Latrines: 45.6%
(Source: Baseline Survey Final Report, Groundwater Management and Feasibility Study for 148 Pourashava of DPHE).</td><td>There are five public toilets:
<table>
<tr><td>Sl No.</td><td>Location</td><td>Existing Facilities</td><td>Leased out</td><td>Problem observed</td></tr>
<tr><td>1</td><td>Merukhali Tempo stand, Ward No- 07</td><td>Chamber 4nos. Urinal 4 nos.</td><td>Yes</td><td>No electric Connection and no water supply</td></tr>
<tr><td>2</td><td>Pirojpur Bustand' Ward No- 05</td><td>Chamber 2 nos. Urinal 4 nos.</td><td>Yes</td><td>-</td></tr>
<tr><td>3</td><td>Sadar Road Boro Bridge Attached, Ward No- 04</td><td>Chamber 2 nos. Urinal 4 nos.</td><td>Yes</td><td>-</td></tr>
<tr><td>4</td><td>Dakhin Bandar Eidgah Attaced, Ward No- 02</td><td>Chamber 2 nos. Urinal 4 nos.</td><td>Yes</td><td>-</td></tr>
<tr><td>5</td><td>Central Jama Mosque, Ward No- 06</td><td>Chamber 2 nos. Urinal 4 nos.</td><td>Handed over to Masjid Committee</td><td>Structure damaged, reconstruction needed</td></tr>
</table>
</td><td>Most of the schools (Primary schools, High Schools and Madrashas) have inadequate sanitation facilities. The condition of existing latrines is bad as the pits/septic tanks and superstructures are mostly damaged, there are no arrangements for electricity and water supply, and there is a lack of separate provision for girls.</td><td>None.</td><td>The Pourashava does not have de- sludging equipment for cleaning latrines pits and septic tanks. As a result the poura dwellers themselves take the initiative of cleaning latrine pits and septic tanks mainly through sweepers. At present sweepers manually clean the latrines, and sludge is buried underground at the cost of Tk 500 to Tk. 1000 depending on the size of pit and septic tank.</td></tr>
</table>

Source: PPTA Consultant.

Table 5.17: Summary of Selected Sanitation Data in Study Pourashavas from SEWTPS*

Qustion No.	Topic	Unit	Response			
			Amtali	**Galachipa**	**Pirojpur**	**Mathbaria**
J.1	Access to toilet in household	%	94.1	61.5	94.1	98.2
J.2	Main type of latrine in household		ring slab with water seal	ring slab with no water seal	ring slab with water seal	flush to septic tank
J.5	Main outlet from latrine		ring slab hole	ring slab hole	ring slab hole	to septic tank
J.7	Average construction cost of septic tank	BDT	32,214	45,793	41,141	34,632
J.8	Average maintenance cost of septic tank	BDT	1,484	1,805	922	975
J.9	Frequency of desludging septic tank	year	4.3	1.1	2.5	1.1
J.10	Use of public toilets		no	no	no	no
J.12	Main inconvenience of public toilets		no proper maintenance	no electricity	no water line, no electricity, no doors for latrines	no water line, no electricity, no doors for latrines, unhygienic, strong bad smell
J.31	Main current practice of kitchen wastewater disposal		to ditch, nearby small water body	to open space	to nearby earthen hole	to open space

Note: * Subject to thorough checking and revision of output tables.
Source: SEWTPS, 2013.

6 INFRASTRUCTURE SELECTION AND DESIGN

6.1 INFRASTRUCTURE SELECTION

6.1.1 Approach for Selection of Infrastructure Interventions

223. The scope of infrastructure subprojects/interventions for implementation under the Coastal Towns Infrastructure Improvement Project (CTIIP) was determined through an iterative, consultative process with LGED, ADB, and the four study pourashava local governments and other relevant stakeholders. All of the components identified for potential interventions under CTIIP are included under the pourashavas' mandate.

224. The following steps were carried out:

a) Review of the guidelines from the ongoing Second Urban Governance and Infrastructure Improvement Project (UGIIP-2), available master plan documents, and the findings and recommendations in the Draft Final Report (March 2013) of CDTA-7890 BAN *Strengthening the Resilience of the Urban Water Supply, Drainage, and Sanitation to Climate Change in Coastal Towns*.

b) Development of initial selection criteria, and consultations and workshops with the pourashavas to determine potential interventions and to categorize them into three priority groupings—Priority I, Priority II and Priority III—as presented in the Interim Report, Chapter 7.

c) During the ADB Interim Mission (5-13 May 2013) it was recognized that the costs for Priority I subprojects for the four towns were too high for the project budget, and discussions were held concerning investment ceilings per town, and the need to prioritize further with the pourashavas to concentrate on infrastructure that will make the towns more climate resilient.[59] Infrastructure types were divided into two priority categories, based on performance criteria stages.

   As outlined in Chapter 3, infrastructure subproject interventions were divided between Stage I funding and Stage II funding, in accordance with the Performance Criteria Mechanism whereby project pourashavas have to meet certain institutional capacity and governance criteria to trigger the release of investment funding.

   Investments under Performance Criteria Stage I include those infrastructure components considered critical for building resilience (i.e., reducing exposure and sensitivity) to future climate change and natural disasters, and filling essential infrastructure deficit needs/gaps. These infrastructure interventions include: (i) roads, bridges and culverts which will enhance climate change resilience through improved connectivity and access to emergency services in the event of disasters caused by natural hazards (ii) solid waste management, (iii) cyclone shelters, (iv) drainage and flood control, (v) water supply for existing core urban areas, and (vi) sanitation.

   Investments under Performance Criteria Stage II include infrastructure interventions that are priority but have less or minimal relation to climate change resilience, such as: (i) other priority roads, bridges, and culverts, (ii) boat landing stations, (iii) markets, (iv) bus terminals, (v) solid waste management, and (vi)

[59] Resilience in this context is defined as the capacity of a town to reduce damages and quickly recover from future climate related or disaster events. This is achieved by reducing a town's exposure and sensitivity through investments in climate resilient infrastructure and building human capacity to adequately plan and respond.

water supply for future planned development areas.

d) Following the Interim Mission, the selection technical criteria were revised to reflect the climate change resilience focus, and the division of infrastructure interventions between performance criteria stages I and II. These criteria are fully described in **Appendix 5, Volume 2**, together with supportive scoring matrices, and are summarized in Section 6.1.2.

e) Further consultations were then carried out with the pourashavas to finalize the selection of infrastructure interventions for the project in view of the revised criteria and approach.

f) Costing of the proposed infrastructure interventions, which indicated base costs including climate change resilience (CCR) of between $9.4 to 21.3 million per town. However, the ADB review mission of 30 June – 7 July 2013 and LGED considered these costs to be too high in view of the absorptive capacity of the pourashavas and the limited scope for additional towns to be included in the project (in Batch 2). Reductions were therefore made to the scope of the subprojects to more acceptable levels ($5.7 to 11.5 million base cost per town including CCR). It was also decided that the lower priority subprojects under Stage II of the performance criteria mechanism to be in the form of a lump sum of $1.0 million per town.

   Reducing the cost for the Batch 1 towns provides the opportunity for more towns to be included in Batch 2 within the project funding allocation, and it was estimated that four towns could be included in Batch 2.

6.1.2 Infrastructure Selection Technical Criteria

225. A basic consideration for the final infrastructure selection technical criteria was whether the proposed interventions would enhance climate change resilience.

226. The criteria that follow are descriptive. However, scoring matrices were also developed to facilitate prioritization from long-lists of options (except for water supply and sanitation where options are more limited and clear cut), and these are shown in Appendix 5, Volume 2.

A. Roads

227. For Stage I investments, the selection of roads will consider the following factors:

- Roads leading to existing and planned cyclone shelters, or any other establishment used as a shelter during disasters.
- Roads used for key public safety and health care facilities for post-disaster response.
- Roads which are critical for emergency evacuation during disasters.
- Access roads for emergency services, and provision of post-disaster recovery and reconstruction goods (relief workers, food, medical supplies, etc.).
- Roads contributing to flood defences and vulnerable areas.
- Roads that are frequently inundated due to floods.
- Roads serving slum areas.

228. For Stage II investments, the selection of roads will consider the following factors:

- Roads that pass through densely populated, commercial areas.
- Roads leading to boat landing stations, bus terminals, public transport facilities.
- Roads that connect to other main urban centers.

- Roads that have existing drainage and culverts.

B. Bridges

229. Subprojects for bridges will usually include the repair, reconstruction, upgrading or relocation of existing bridges. If justified, new bridges can also be included. Considerations are:

- Bridges that are part of the roads which are selected for Stage 1 investment, and are critical for emergency evacuation during disasters.
- Physical condition and type of existing bridge.
- Number of population that will be served by the proposed bridge.
- Type and quantity of vehicles that will be served by the proposed bridge.
- Economic growth will be enhanced by the bridge.

C. Cyclone Shelters

230. Selection criteria:

- The site for the cyclone shelter should serve populations in an area most vulnerable to cyclone damage.
- The site should be located within or very close to the locality of the users.
- The site must be prioritized in educational, institutional or commercially let compound where the concerned authority has no objection.
- The site should be selected in the area where significant numbers of population live..
- The site has no or minimal land acquisition requirements.

D. Boat Landing Stations (BLS)

231. Selection criteria:

- The boat landing will be owned by the pourashava.
- Existing landings are deficient.
- The embankment is generally suitable for a BLS and does not require substantial protection.
- The BLS will not encroach into existing shipping or boat lanes.
- The site has access to a main road that will not seriously disrupt traffic.
- Passenger BLSs - Access by minibus is possible with disrupting traffic.
- Cargo BLSs – Access by truck is possible without disrupting traffic.

E. Markets

232. Selection criteria:

- The market will be owned by the pourashava.
- The market has economical potential which earns significant revenue.
- The connectivity (road, river etc) is easy and sufficient.
- The site possesses sufficient land for providing sanitation facilities.
- Revenue will be increased after improvement.

- Land for the market should have no dispute and no or minimal land acquisition requirement.

F. Bus /Truck Terminal

233. Selection criteria:

- The bus /truck terminal will be owned by the pourashava.
- The existing bus park causes traffic congestion.
- The bus/truck terminal has is economical potential which earns significant revenue.
- The site should have sufficient land for future development.
- The site must be far from core town area.
- Revenue will be increased after improvement/new construction.
- Land for the terminal should have no dispute and no or minimal land acquisition requirement.

G. Solid Waste Landfill Sites

234. As described in Chapter 5, standard site selection criteria for landfill sites is not feasible in the Batch 1 towns. Thus the criteria have been modified, while the prioritization measures have also been reviewed **(Table 6.1)**.

Table 6.1: Modified Selection Criteria for Solid Waste Landfill Sites

Typical Criteria	Modified Criteria	Mitigation Measures to mitigate impacts of modified criteria
Design Life 30 years	Design Life 15 years	If 30 years size not available
Located at least 500 meters from any dwellings	Located at least 400 meters from any dwellings	Provide higher fences
At least 2 km distance from any urban area	At least 1 km distance from any urban area	Provide higher fences
No urban expansion is expected in the next 20 years	No urban expansion is expected in the next 10 years	Landfill sites to be designed for shorter life. Given the current low waste generation levels this should create efficiencies.
Not cause any pollution to surface or ground water	Not cause any pollution to surface or ground water	
Locate at least 500 meters from any water course	Locate at least 200 meters from any water course	Build 2m embankment for each 100 meters short of the norm.
No risk of flooding or other hazards	No risk of flooding or other hazards	
Groundwater table at least 3 meters deep	Groundwater table at least 1 meter deep	Use thicker or double PVC lining.
Not impact upon environmentally sensitive areas	Not impact upon environmentally sensitive areas	
Have suitable impervious soil such as clay;		Use thicker or double PVC lining.
Be on non-agricultural land	Be on non-agricultural land	
Have good quality road access to minimize vehicle wear and tear	Have good quality road access to minimize vehicle wear and tear	
Have sufficient cover material	Have sufficient cover material	
No land ownership or acquisition problems	No land ownership or acquisition problems	Land is owned by the pourashava
Minimize haulage distance	Minimize haulage distance	

Typical Criteria	Modified Criteria	Mitigation Measures to mitigate impacts of modified criteria
Have a potential for re-use	Have a potential for re-use and can create flood free land	

Source: PPTA Consultant.

H. Drainage and Flood Control

235. All drainage and flood control works will be under Stage I, and there will not be any Stage II subprojects, i.e. that do not contribute directly to climate-resilience. This is because all the drainage and flood control subprojects implemented under the project will mitigate the effects of climate change for the beneficiaries and their communities, and thus contribute to their climate resilience.

236. Eligible subprojects will comprise repair and upgrading or construction of the following drainage infrastructure which will help reduce damages from flooding and storm surge, provided it is or will be the responsibility of the pourashava only:[60]

- Main drains.
- Side drains
- Outfalls and associated structures, etc.
- Minor embankments[61]
- Pumping stations and pumps.

237. As required, works to existing Main Drains and Side Drains will include one or more of:

- cleaning, dredging, re-excavation, realignment, removing encroachments, channel widening,
- bed and/or embankment lining, raising wall or embankment levels, repairing or providing drain covers,
- reconstructing or constructing retaining structures, culverts, bridges,[62]
- improving outfalls and control structures,
- repair or construction of maintenance access.

238. As appropriate, structures may be 'hard', i.e. concrete, steel, etc., or 'soft', i.e. flexible. The latter will mainly comprise earth-based structures, protected or reinforced by vegetation, geotextile, timber, etc.

239. No river training works will be included under the project.

240. Where appropriate subprojects are to be implemented outside of polders, e.g. to serve slum communities settled on newly deposited land, etc. However, this infrastructure will not be protected against the effects of storms, and should not be prohibitively expensive to replace if and when they are lost because of a storm, erosion, etc.

241. If the cost of the proposed subprojects exceeds the total budget available it is expected that the scope will be prioritized based on the criteria to prioritize those that will result in the

[60] BWDB is responsible for other key flood defence infrastructure that is important for achieving the climate-resilient communities envisaged by the Project. These mainly comprise river embankments and associated structures, e.g. outfalls, flood etc.

[61] To subdivide existing catchments/polders - where feasible, the main objective being to reduce impacts in important areas by retention of floodwater and controlled discharge from areas where the impacts are less serious. ,

[62] Any culverts, bridges, etc., required as part of a road improvement subproject will be designed to meet the requirements of the drainage and flood control system but will be financed through road subproject.

greatest benefits, especially with respect to their contribution to climate change resilience, etc., even if they are not the least-cost. However, all subprojects will be reviewed to ensure this is achieved, and they will all contribute effectively to mitigation of the effects of climate change, such as such as sea level rise and increased rainfall.

242. Any resettlement required, whether permanent or temporary, will be kept to the minimum possible, and will be implemented according to the project's safeguards policy.

I. Water Supply

a) Demand for new or improved piped water supply:

Priority areas for Stage I would be:
- Unserved (or underserved) core urban areas.
- Slum areas.

Priority areas for Stage II would be:
- Economically important future urban development areas.

b) Design considerations:

- Water quality meets government drinking water quality standards.
- 24-hour supply.
- 100% metered household connections.
- Shared connections in slum areas as appropriate.

c) Water source:

- Groundwater is the preferred source if water quality meets Bangladesh drinking water standards, and there is sufficient abstraction potential.
- Surface water source where the groundwater source is saline.
- Surface water should be treatable to meet Bangladesh drinking water standards.

e) Climate change considerations:

- Location of abstraction points. Consider climate change impacts on groundwater (low water tables, more pollution) or surface water (increase salinity).
- Structural protection of facilities from future floods.
- Locate water treatment plant (WTP) at sites where there is no risk of flooding or other hazards that might impair functioning of the plant or present a risk of damage to the plant or its environs, or the site can be protected from floods.
- Additional storage for supplying during any disaster/ crisis.
- Standalone power back up for treatment plants and pumping stations.
- Promote more efficient use of water by reduce losses and wastage to counter increased demands due to higher temperature.

d) Environmental/resettlement considerations

- Avoid using water sources that may be polluted by upstream users.
- Avoid water-use conflicts by not abstracting water that is used for other purposes (e.g. irrigation).
- Locate pipelines within the right of way (ROW) of other linear structures (roads, irrigation canals) as far as possible, to reduce the acquisition of new land.
- Locate pipelines are at least 10 meters for from latrines, septic tanks and any main drains. Do not put water pipes in or across drains.

- Ensure that pipeline routes do not require the acquisition of land from individuals in amounts that are a significant proportion of their total land holding (>10%).

J. Sanitation

a) Demand for sanitation facilities:

- Public toilets in strategic locations such as bus terminals, recreation areas, commercial centers.
- School toilets where nonexistent or existing facilities are inadequate/inappropriate.
- Community latrines for slum/ low-income areas.

b) Collection and treatment of septage:

- Desludging equipment.
- Septage treatment plant (land required, less than for solid waste landfill).
- Biogas.

c) Climate change considerations

- To avoid risk of flooding or other hazards, the plinth of the toilets should be kept more than 0.8 m from the ground level (GL).
- To avoid contamination during flood the sludge tank should be placed, preferable above the GL
- Onsite treatment of sludge will be provided with the toilets

c) Environmental considerations

- Ensure that the site selection for the septic tank or any other treatment method proposed is not close to water intake or water usage points, or areas prone to flooding or water logging.
- Where latrine pits or septic tanks are below the level of the highest ground water table they should be made waterproof.
- Ensure no immediate downstream drinking water intakes.
- For shared or communal latrines, the entrances for men and women should be separated, preferably at each end of the structure.
- All toilets should be provided with water supply.

6.1.3 Consultations with Pourashavas

243. The schedule of consultations carried out is shown in **Table 6.2**. Two 'rounds' of consultations were conducted.

Table 6.2: Schedule of Consultations at Pourashava Level

No.	Topic/Activity	Amtali	Galachipa	Pirojpur	Mathbaria
First Round					
1	Water supply and sanitation	22-27 Feb	27 Feb – 1 Mar	29 Mar – 1 Apr	8-10 Mar
2	Drainage and flood control	26-28 Feb	1-2 Mar	3-4 Mar*	5-7 Mar*
3	Other municipal infrastructure (roads, cyclone shelters, etc.)	22-28 Feb, 9 Mar	6-8 Mar	17-19 Mar*	14-16 Mar
4	Financial assessment	28-30 Mar	6-7 Mar	20-22 Mar	8-9 Mar

No.	Topic/Activity	Amtali	Galachipa	Pirojpur	Mathbaria
5	Urban planning, master plans	8 Mar	8 Mar	7 Mar	8 Mar
6	Institutional, governance assessment	8 Mar	8 Mar	7 Mar	8 Mar
7	Climate change adaptation	22-24 Mar	5 May	3 May	21-22 Mar
8	Workshops to finalize scope of infrastructure interventions	15 Apr	16 Apr	12 Apr	13 Apr
Second Round					
1	Water supply and sanitation	3-4 Jun	22-24 May		5-6 Jun
2	Drainage and flood control	3 Jun	4 Jun	6 Jun	5 Jun
3	Other municipal infrastructure (roads, cyclone shelters, etc.)	2-3 Jun	22-23 May	24-29 May	30-31 May
4	Institutional, governance, performance criteria	10 Jun	11 Jun	8 Jun	9 Jun

Note: * Work disrupted by *hartals*.
Source: PPTA Consultant.

244. **First round of consultations.** During 22 February – 6 April 2013 field visits and consultations were conducted by individual consultants or small groups of consultants in related fields, with pourashava officials and stakeholders to collect information on the existing situation, the scope and locations of possible infrastructure requirements for the implementation under the CTIIP, and key problems. This work was carried out in the four feasibility study pourashavas (Amtali, Galachipa, Pirojpur and Mathbaria).

245. Infrastructure options were discussed with the pourashavas for water supply, sanitation, drainage and flood control, and other municipal infrastructure such as roads and cyclone shelters. However, particularly for drainage and roads, very large numbers of potential schemes (long-lists) were proposed by the pourashavas. Since it would not be possible to implement all the proposed schemes in the long-lists due to funding and capacity constraints, initial selection criteria and considerations were applied to prepare short-lists of the highest priority schemes for implementation under the project.

246. Structured workshops were then carried out with a range of stakeholders in the four study pourashavas, during 12-16 April, to agree on the prioritization of the proposed infrastructure interventions in three priority groupings: Priority I, Priority II and Priority III, as shown in the Interim Report (Chapter 7).

247. **Second round of consultations.** Following the ADB Interim Mission of 5-13 May, a second round consultations was carried out separately by the engineering consultants during 22 May – 6 June with the pourashavas to finalize the infrastructure interventions for investment under the project, based on the revised infrastructure selection criteria which focused on climate change resilience and adherence to the two-stage performance criteria mechanism.

6.2 PRELIMINARY ENGINEERING DESIGN CONSIDERATIONS

248. **Infrastructure design horizon.** As a general principle infrastructure interventions were designed for a period of 25 years or until 2040, and incorporated features to address climate change resilience measures.

249. **Climate change setting.** Bangladesh being situated in the heart of the southwest monsoon region is experiencing climate changes and their impacts. The coastal zone of Bangladesh is particularly vulnerable to extreme climatic events like tropical cyclones, sea level rise and salinity increase. It is evident that in the past few decades an increasing number of severe cyclones has hit the coast of Bangladesh. The cyclones of 1991, 1997, 2007 (Sidr)

and 2009 (Aila) are the best examples. Sea level rise due to global warming and local level subsidence of land add to the climate change impacts over the coastal zone, causing higher inundation levels and increased saline intrusion further and further northwards.

250. The PPTA climate study provides the scenarios of the future climate change (increase of temperature, rainfall and sea level rise) for the years 2030, 2050 and 2060 and for some parameters up to 2065 based on the IPCC AR-4 modelling results. The tropical cyclones hitting Bangladesh have been found to be sensitive to the sea surface temperature (SST) of the Bay of Bengal. Thus the probability of future tropical cyclones of different intensities has been estimated based on this relationship, providing an avenue to derive the damage function related to the aggregated wind speed of the future tropical cyclones for coming up the tropical cyclone damage scenarios from 2020 to 2050.

251. Since the coastal towns are highly vulnerable to floods due to monsoon rains, tropical cyclone surges and extreme astronomical tides, the climate impacts on flooding are given adequate attention and increases in inundation by 2050 was derived using flood modelling techniques.

252. The climate change setting of the coastal zone has applications to assess the impacts on the coastal pourashavas of Galachipa, Amtoli, Mothbaria and Pirojpur based on the future climate scenarios. Climate resilient designs have been prepared to improve municipal infrastructure, water supply, sanitation and drainage and flood control. The PPTA recommends both structural and non-structural measures to enhance these towns' climate resilience.

6.2.1 Roads and Bridges

253. Urban roads are usually designed for a period of around 20 years. Both herring bone bond (HBB) and bitumen topped (BT) roads require resurfacing at least every five years. Cement concrete (CC) roads are more expensive to construct, but tend to last longer, up to 20 years. However, if BT roads are flooded, then they can be severely degraded, while CC roads are less damaged by water. Thus, in the coastal areas, it is recommended that all vehicular roads be constructed of CC. This will have a higher capital cost, but over time be compensated by lower maintenance and repair costs. Importantly, CC roads will be more resilient to flooding. As temperatures rise BT roads will also face issues of bitumen melting that causes the aggregate to sink if the mix is not placed properly. Higher temperature-resistant bitumen will need to be used as expansion joints for CC roads, while placing of concrete in temperatures above 40^{o}C is not recommended.[63]

254. A major consideration for roads is determining the finished surface levels to accommodate climate change related inundation and storm surges. In the towns, this could actually be determined by the proposed work on embankments to avoid overtopping, but road crest levels may well have to accommodate increased flooding due to more intense and lengthier rainfall. This issue has already been fully discussed in other reports that state this really has to be considered for each individual project.[64] This holds particularly true for roads, as the existing crest level may already be at an adequate height. As proposed by the Coastal Climate-Resilient Infrastructure Project (CRRIP), each road to be funded will be assessed against whether:

- the existing crest level is 600 mm above existing normal flood level;
- embankments are protected against surges; and
- drainage is adequate to accommodate storm flows.

[63] Centre for Public Health and Environmental Engineering Organisation, India, Construction Guidelines.
[64] For example, Coastal Climate-Resilient Infrastructure Project (RRP BAN 45084), Section III, ADB, August 2012.

255. In addition, to counter climatic change impacts over the 20-year design life, road crest levels will be raised by 200 mm and additional embankment protection will also be applied along with improved drainage. It might be questioned why raising the crest level by 200 mm for roads which are being climate proofed by changing to CC surfacing is required. However, the climate change information provided is neither exact nor fixed and has multiple scenarios. Raised roads could still be overtopped from time to time. Providing this double enhancement increases the factor of safety.

256. The levels of service for roads and bridges are outlined in **Table 6.3**.

Table 6.3: Levels of Service for Proposed Interventions – Roads and Bridges

Road Part	Existing Standard	Proposed Standard	Additional Climate Change for CTIIP
Design Life	20 years		20 years with consideration for 50 years sea level rise for rights of way (RoW)
Minimum width	Minor roads 1.0-3.0 m Town Roads 3.0-5.0 m	3.0 m for minor access roads with 1.0 shoulder only if RoW permits. 5.0 m with 2 x 1.15 meter shoulders where RoW exists	
Crest level	600 mm above normal flood level	600 mm above normal flood level	200 mm above A1B[65] scenario sea levels in 2034
Surface material	BT, CC or HBB depending on width		All CC with minimum thickness of 150 mm with adequate reinforcement and 150 mm plastic pipes to be placed at 50 meter intervals under roads for services
Pavements	Thickened sand cushion or sometimes sand aggregate. (7 to 11 meters wide)		All thickened sand aggregate. Sub-base to be 0.25 meters wider than overlying layer.
Earthworks	Compacted where necessary either by hand or machine.	Machine compacted in layers and tested.	
Embank-ments	Slope 1:1.5	Embankments strengthened with edge protection. Where possible, trees or bushes should be planted on earth embankments	Additional strengthening on roads in flood areas, either concrete brick work.
Run-off / drainage	Culverts provided as necessary	Ensure side drains are integrated into town's drainage system	Increase cross drainage structures as necessary. Full width drainage layer in sub-base Assess need for larger culverts
Bridges			Strengthen abutments and approaches

Source: PPTA Consultant.

[65] A1B represents a mid-range emission scenario for the future global emission of Greenhouse gases. A1B makes assumptions about future growth and development of human activities during the next century. It was used for the IPCC climate change assessments in 2007.

257. The major considerations adopted for preliminary design and costing were as follows:

- LGED's road design manual and standards followed. The road design type 6 for Bituminous Carpeting (BC) pavement was considered, with some modifications.
- Guidelines on climate change resilience (CCR) and adaptation measures were followed adopted for the preliminary design and costing. Outlines of CRIIP (Costal Resilient Infrastructure Improvement Project) of LGED were studied and accommodated as necessary.
- Existing BFS (bitumen finished surface)/HBB roads were considered for improvement with reinforced cement concrete (RCC) pavement in most cases as suitable, with modified design standard. The thickness of BC was taken as 40 mm instead of 25 mm as generally practiced. Other CCR measures were considered as required/applicable for roads (BC/RCC) like (a) turf, grass/shrub, tree plantation, side protection works, rise of road level, shoulder/footpath, cross-drain, etc., and (b) brick masonry guide wall on the edge of RCC pavement.

6.2.2 Cyclone Shelters

258. Design Criteria:

- A design life of 50 years should be taken for the structure, but for size, cost efficiencies suggest taking this as 20 years—clearly if the vulnerable population around the shelter increases beyond the capacity of the shelter, another shelter will need to be constructed.
- Designs should provide 1m^2 per person[66] and sizing will depend upon the estimated number of people who will use the shelter, but the minimum size should be for 500 people (500m^2) to lower unit costs.
- Base level of first floor raised by 200mm to avoid higher storm surges and sea levels.
- Design needs to consider:
  - whether the shelter is within or without the polder, with priority being given to the latter;
  - location should be close to an all-weather road or one should be provided;
  - location should preferably be on raised ground, if this is not possible, then the plinth level of the ground floor should be raised by importing earth;
  - location should be at least 300 meters from high voltage overhead power lines and not be close to other potential hazards such as fuel depots, etc;
  - the need to deflect storms flows and protect users from winds during cyclones, such as planting trees on the upstream and windward sides of the shelter;
  - specifications should consider materials that will neither rot nor rust, or can be replaced easily by using locally sourced materials, possibly the use of plastics or aluminum for doors and windows could be piloted;
  - there should be a separate section for women with some secure storage for personnel belongings if possible;
  - water supply (minimum 5 liters per person) and sanitation should be available on the first floor with water either provided through a hand pump or in a storage tank if groundwater is not available, latrines should be segregated by sex with one latrine per 50 women and one per 50 men:[66]
  - solar panels should be installed to provide limited lighting when there is no mains power;
  - there should be a raised area nearby for livestock to gather.

[66] Design Guidelines for Public Cyclone Shelters, The State of Queensland, Department of Public Works, Sept 2006. No of latrines slightly modified to reflect local conditions.

259. The key to maintaining cyclone shelters in a condition that they can be effectively used at very short notice is finding a day-to-day use for them. This has already been partially done in the study (Batch 1) towns. The integration of the shelter with the use of the institution that is responsible for its maintenance needs to be fully planned with possibly some funds being supplied for the additional cost of maintaining the shelter. The upkeep of cyclone shelters should also be included in the TOR of the DRM plan, as should regular use drills and inspection visits.

6.2.3 Boat Landing Stations

260. There is a demand for more boat landings as there are many simple informal landings constructed that are in use. In all the towns, locations for new boat landings have been identified. Only pourashava-owned boat landings will be funded. Floating pontoon-type boat landings will be constructed. These will be climate proofed by strengthening the overall construction and accommodating greater tolerance in water level fluctuations.

6.2.4 Solid Waste Management

261. While overall waste generation rates can be reasonably accurately assessed, accurate projections of waste actually reaching landfills is more difficult as climate change could actually cause less waste to reach landfills as the demand for land infilling increases. This assumes both greater generation rates as incomes increase as well as a greater amount of waste being collected. The increase in generation has been assumed as 15% per decade. Waste density has been assumed to remain constant over time at 475 kg/m^2 **(Table 6.4)**. This could increase along with incomes, but much of the waste will still be used for infilling of low-lying areas.

262. Even with these somewhat ambitious assumptions, the solid waste generated in the towns is still relatively low. Thus the project will provide small rickshaws to cart the waste where required. If necessary, small transfer stations will be built if the distance to the landfill is over three kilometers.

Table 6.4: Projected Solid Waste Generation and Collection

Year	2030			2040			2050		
	Population '000	Tones per day	m3 per day	Population '000	Tones per day	m3 per day	Population '000	Tones per day	m3 per day
Per capita generation	0.23 kg/day			0.26 kg/day			0.30 kg/day		
% Collected	60%			70%			80%		
Amtali	28	3.9	8.1	36	6.6	13.8	47	11.3	23.8
Galachipa	25	3.5	7.3	31	5.6	11.9	37	8.9	18.7
Mathbaria	22	3.0	6.4	26	4.7	10.0	31	7.4	15.7
Pirojpur	69	9.5	20.1	80	14.6	30.7	92	22.1	46.5

Source: PPTA Consultant.

263. Studies have shown that once-a-week systems collect 25% more waste per collection hour than twice weekly collections. Personnel and equipment requirements for daily collection are generally 50% higher than for once-a-week collection. However, in Bangladesh's hot and humid climates it is best to maintain a twice-a-week collection service because of health and odour concerns.

264. Thus some key solid waste design parameters are:

- Collection – house to house twice a week.
- Collection Equipment – rickshaw vans with a capacity of 0.5 tonnes.
- Design life of landfills – 20 years. This is greatly reduced from the standard but land for large landfills is not available, while landfills can be used to ultimately create inert, safe flood free land.
- Cell size – excavation to 1.0 or 1.5 meter depth (depending on groundwater depth) to provide soil for cover. Landfill to reach 2.0 meters above ground level

265. Locally the main effect of climate change on solid waste management will be hotter drier summers, more intense rainfall events in the wet season and possibly more frequent/more intense extreme weather events.

266. The hotter and drier summers means that grass and other vegetation planted on previously worked areas of the controlled landfill mound may die due to lack of water and heat stress. This will be overcome by a conscious plan to collect and pump leachate or groundwater over the vegetation to act as an irrigant. This has been done successfully at many other controlled landfills and controlled dumps.

267. The more extreme wet weather events will be managed at the controlled landfill by ensuring that the external batters are protected against erosion resulting from the higher rainfall intensities. The master drainage infrastructure will be sized to account for the higher rainfall intensities to prevent stormwater runoff entering the operating cells and associated recycling areas and stockpiles.

268. A further effect from the more intense storms will be a greater amount of debris damage but this will find its way for re-use of for raising low-lying areas rather than to landfill.

6.2.5 Drainage and Flood Control

269. The design of drains, channels, culverts, etc., shall be for the most severe of the following conditions:[67]

a) Rainfall runoff during periods of unrestricted discharge, i.e. no drainage congestion.
b) Rapid drainage of areas inundated by flooding, including designated detention areas, following:
   i) rainfall during drainage congestion, e.g. tidal level prevents immediate discharge;
   ii) tidal inundation;
   iii) storm surge inundation.

270. The design criteria adopted for the preliminary designs of drains, channels, culvert capacity and cross-sections, etc., and increased climate resilience, are based on LGED's

[67] The probability of inundation due to a high tide or a storm surge at high tide occurring at the same time as intense rainfall is very low, even during a cyclone. Also, unless the defences fail, tidal or storm overtopping is generally short-term and local. Therefore, in view of the return periods considered for the various individual events (see 2(a) and 2(g)) it is not considered cost-effective r necessary to design for combined events.

Urban Drainage Manual. May 1998, as follows.

a) Rainfall: 2 hour design storm[68] for 2050[69] based on model storms for:
   i) Khepupara, for towns in coastal areas, i.e. Amtali, Galachipa
   ii) Barisal, for inland towns, i.e. Mathbaria, Pirojpur
   (see Annex in Volume 6).

   Storm return period:
   Flood inundation during drainage congestion and primary infrastructure:1:10 year return period
   Secondary infrastructure: 1:5 year return period
   Tertiary infrastructure: 1:2 year return period

b) Rainfall runoff: Catchment area less than 60 ha, time of concentration (t_c) less than 50 min and limited runoff storage capacity in the catchment:

   Q $m^3/s = C_R C_S iA/360$ (Modified Rational formula)

   C_R = run-off coefficient, based on permeability (refer to LGED Urban Drainage Manual)
   C_S = storage coefficient, based on catchment type and slope (refer to LGED Urban Drainage Manual)
   i = average rainfall intensity (mm/hr) for t_c, as determined for the relevant design storm
   A = contributing catchment area (hectares)
   t_c = time needed for water to flow from the most remote point in the contributing catchment to the drain outlet, including overland flow
   weighted coefficients shall be used to calculate runoff for catchments with multiple types of permeability, soil storage characteristics, slope, etc. (refer to LGED Urban Drainage Manual)

   Other catchments/situations:
   hydrograph routing method, as described in LGED Urban Drainage Manual

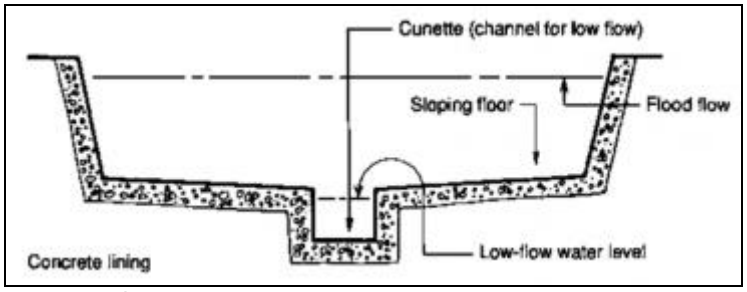
c) Drain/channel section: $A = Qn/(R^{0.6667}S^{0.5})$ (Manning formula)

   A = flow area (cross section) (m^2)
   Q = flow rate (m^3/s)
   n = Manning's roughness coefficient
   (see Annex in Volume 6)
   R = hydraulic radius (m) = flow area (m^2)/wetted perimeter (m)
   S = gradient of water surface (m/m), based on 1:10 year average peak 10 day tidal maximum for 2030 and 2050, including allowance for sea level rise and in-polder settlement and sedimentation[70]

   Channels and drains shall preferably be trapezoidal in cross section. Channels and drains carrying large flows shall preferably have a cunette, for low flows, with the invert sloping to it. **(Figure 6.1)**

[68] CDTA and CEIP-1 have used this storm return interval, however CEIP-1 has used the 5-day rainfall because the permitted maximum inundation period is 3 days.
[69] The projected rainfall for the 2050 climate-adjusted 1:10 year design storm is only about 1.3% greater than the 2030 1:10 year design storm (IWFM, BUET). It is therefore more cost-effective to design for 2050 events immediately.
[70] Net 0.39 m by 2050 (0.29 m sea level rise + 0.15 m settlement – 0.05 m sedimentation).

Figure 6.1: Trapezoidal Drainage Channel with Low-level Section for Low Volume Flows



Source: WHO.

d) Runoff detention: Detention areas shall be developed to the maximum extent possible and shall include maximum management of khal and large channel water levels before and during forecast rainfall and storm events.

e) Inundation: Inundation of high risk/high value areas will be a maximum of 2 tidal cycles, i.e. low tide – low tide – low tide (approx 25 hrs maximum[71]).
Drains and channels at risk of inundation from downstream will be fitted with a flap valve or similar to prevent inundation due to backflow. The valve and any associated structure should not restrict the channel/drain's discharge capacity
:

f) Other drain/channel design criteria, e.g. maximum and minimum gradients, velocities, drain/channel freeboard etc:
refer to LGED Urban Drainage Manual, May 1998

g) Tidal and storm surge flooding (works to be planned and implemented by BWDB): embankment and structure crest levels, etc., to be according to CEIP design criteria, with appropriate freeboard, etc., e.g.
1:100 year return period high tide level, for 2030 and 2050
1:25 year cyclone storm surge with permitted overtopping[72]
as amended by any decisions based on the National Water Policy and/or National Water Management Plan during the project, e.g. designation of flood risk zones and/or implementation of specific district and upazila towns flood defense schemes (as opposed to general flood defense projects) (see risk table in Chapter 13).

271. **Climate change resilience:** The design criteria have considered the main findings and recommendations of the CDTA study for both 2030 and 2050, modified according to the PPTA's Climate Change Specialists' recommendations (see Chapter 4). Projected sea level rise has been incorporated according the information available and review of other studies, e.g. IPCC, CDTA. These have resulted in an approximate increase in capital costs (capex) of about 25%.

6.2.6 Water Supply

272. **Planning horizon.** The planning horizon considered is 25 years or until 2040.

273. **Population projection.** The main assumption/factors required for population projection for any geographical area and for a specific planning period depend on the:

- existing population;
- natural increase rate (the balance of births and deaths); and

[71] Low tide – low tide = approx 12.4 hrs.
[72] 5 l/s/m.

- net migration rate (balance of people moving into and out of an area).

274. There are several population prediction methods, out of which the geometric progression method is the most widely used which is also known as the empirical (geometrical progression) method suggested by J. Von. Hardenberg. From the known population/dwellings of at least two last censuses, growth rate can be estimated by method using equation:

$$P_f = P_p (1+ r/100)^n$$

where, Pf = Future population or dwellings
P_p = Present population or dwellings
r = Growth rate of population or dwellings; and
n = Design period.

275. **Water demand projection.** The estimation of water demand depends on various factors such as climate, environmental condition, population, customs, extent of industrialization and others. The use of water, i.e. daily water demand, varies between cities/areas and within a city, and demand may still vary from season to season, day to day and even hour to hour.

276. The daily demand has been considered as 100 lpcd for the purpose of forecasting aggregate daily demand for the year 2040 (considering 25 years of design horizon) as the design year for the investment. The assessment of Average Daily Demand for the pourashavas has been made based on the projected population, area served, peak daily demand, non-revenue water (NRW), etc.

277. The climate change adaptation has also been taken into account for water demand projection. “Temperature Rise”, a key element of climate change, due to which surface water is rapidly evaporated will affect household water supplies, and irrigation. Due to heat, overall per capita water needs will increase. It is predicted that 1.2-2.4^0 C temperature will increase by 2050.

278. Key considerations for water demand projection are:

- 25 years of design horizon;
- Area coverage: only the core area as per selection criteria;
- 100% of population coverage in the service area;
- 100 l/c/d water demand;
- NRW 15% of total production;
- Non-domestic demand is 15% of total production;
- 15% of increased water demand due to temperature rise;
- Peak supply factor is 1.2.

279. **Operation and maintenance of water supply system.** Operation and maintenance (O&M) is the decisions and actions regarding the control and upkeep of infrastructure and equipment. Due to lack of proper operation O&M, pourashava water utilities may experience the following consequences:

- Breakdown of production tubewells, treatment plants;
- Technical water loss from the distribution network;
- Declining yield of production tubewells;
- Higher percentage of NRW, and water quality deterioration in the distribution network; and
- Artificial water crisis.

6.2.7 Sanitation

280. Sanitation aims at the creation of living conditions which will not result in the outbreak of epidemic diseases. Sanitary measures are preventive for the preservation of health of the community in general and individuals in particular. Soundness of human body depends mainly on health indicators which helps physical and mental set up.

281. Sanitation is now high priority to maintain a good living standard in the community. Sanitation may be on an individual or institutional basis. The purpose of sanitation is clean, well acceptable environmental conditions and favorable situations for human beings.

A. Key Design Considerations for Sanitation

282. **Individual pit latrines.** Proposed remedial measures to overcome exiting problems are:

- Pit will be circular, ring can be purchased from market;
- Minimum water requirement for flush is 1.5 to 2 liters;
- Depth of pit should not exceed 1.5 m;
- Pit may be lined with bamboo, burnt clay ring, concrete or brick masonry;
- 0.5 m free space to be kept at top of pit;
- In low-lying or flood prone areas, pits should be constructed on elevated earthen mounds with at least 1 m earth covering all around the pits;
- Elevated pit of about 1 m high with an impermeable lining extended down at least 0.6 m below ground level is expected;
- Bottom of pit should remain undisturbed and un-sealed;
- Safe distance between pit and the tube wells should be at least 10 m horizontally;
- Permeability of surrounding soil is important function of the pit latrines. In case of compacted clay soil of low permeability, a sand envelop of 0.3 m should be provided around the pit;
- Distance between two pits for a twin pit latrine should be at least equal to the effective depth of pit.
- The pit latrines will located at high area of the household;
- The pit of the latrine will be placed above the flood level;
- Cover slab with the provision of gas outlet will be placed at the top of the pit;
- Latrine platform and the pit will be separetly located;
- Latrine platform with squatting pan and water seal U-pipe will be directly connected to the pit by a junction pipe.

283. The single pit latrine with the above remedies can be suggested for use at individual household level. However where feasible or affordable, twin pit latrines are more suitable than a single pit latrine.

284. **Public toilet/school toilet:**

- Capacity : 60 persons/seat/day;
- Average running hour : 8 hrs/day;
- Users : to be calculated considering seats in the toilet;
- Toilet pan : Squatting type, slope $25\text{-}30^0$;
- Flushing & water flow : Flushing needed 50L/day for cleaning and 2.50 L/user day
- Legend depth : minimum 300 mm at tank full condition;
- Sludge removal : when sludge & scum occupy 67% of net volume considered for desludging once a year;
- Free board : 300 mm above water level;
- Shape : Rectangular, length width – 2:1, depth – 1.5 m;
- Pit pattern : Brick work, RCC ring, etc, depth 1.5 m;

- No. of compartments : Minimum 2, 1-67% of total volume, 2-33% of total volume;
- Sewer : 150mm PVC pipes to be used in inlet & outlet;
- Soak pit : to be constructed with brick honey comb masonry.

285. Septic tanks may also be used in public toilets, school latrines and community latrines based on availability of land size, flooding condition, location and use.

286. **Community latrine:**

- More than one chamber;
- Two to three pits, each consist of 5 to 7 rings;
- Septic tank may also be constructed;
- Design capacity - 50 persons / seat day;
- Average running hour – 16 hours /day;
- Toilet pan – squatting type slope 25 to 30^0
- Flushing requirements – 2 liter/user;
- Design water flow – to be calculated considering no. of users & general cleaning of toilet;
- Sludge accumulation rate – 25 liter/person/year;
- Liquid depth – min.300 mm at tank full condition;
- Sludge removal – when sludge & scum occupy 67% of net tank volume;
- Desludging interval.

287. Standard designs for public toilets, school toilets and community latrines are shown in **Volume 5**.

B. Operation and Maintenance for Sanitation

288. Public toilets may be operated by pourashava people or may be leased out to private operators. This will collect a toll (to be fixed by the pourashava) from the users to maintain the toilet hygienically. This will also ensure uninterrupted water supply and liquating arrangement.

289. Community latrines will be managed and maintained by the users (10 families for one latrine). The user will select one person who will look after proper use of the latrine, keep it clean. Users will pay a monthly toll for O&M.

290. Desludging equipment will be used for taking out sludge from the pit/septic tank and dispose in a dumping ground fixed by the pourashava outside the town. The user shall pay to the pourashava for hiring the truck used for desludging.

C. Gates Foundation Sanitation Team

291. The sanitation specialist and his support team engaged by the Bill and Melinda Gates Foundation (BMGF) conducted their first input in Bangladesh from 11 to 25 May 2013, and made a reconnaissance visit to the four study pourashavas from 16 to 23 May. A report recording their field visit was received on 12 June, and their Interim Report was received on 13 July, which was well after the infrastructure scope and costs had been finalized for this Draft Final Report, so their findings and proposals have not been considered for the sanitation component at present.

292. The Interim Report is included in **Annex E, Volume 5**. It describes various treatment technologies in detail in terms of design, areas of application, O&M requirements, climate adaptation measures for efficient functioning of treatment systems, capital costs and pros and cons. Various combinations of treatment modules are proposed that are applicable for diverse

land uses in the PPTA towns.

293. The Gates team propose to prepare comprehensive sanitation plans for each PPTA town to address sanitation issues in stress areas. An overall approach and methodology to prepare the same was presented along with the financials.

294. The broad cost estimates for the provision of sanitary infrastructure in the public domain (public/community toilets, public buildings, institutions like schools, hospitals etc.) and for preparing a detailed sanitation plan for all the PPTA towns combined is estimated to be $2.92 million.

6.3 BASIS FOR COST ESTIMATIONS

295. **Municipal infrastructure.** LGED's current (July 2013) Schedule of Rates was followed to determine unit costs. Costs were estimated based on the inventory from the preliminary surveys.

296. The cost of a bridge depends mainly on its sub-structure for sub-soil condition of the site. The unit cost for RCC bridges was determined from collected data on engineering costs and construction costs performed by various projects of LGED.

297. For cyclone shelters, the ECRRP (Emergency Cyclone Recovery and Restoration Project) of LGED implements cyclone shelter-cum-school with providing essential facilities like (i) toilets for male and female separately, (ii) pregnant-women care room, (iii) water supply lines with deep tube-well, (iv) furniture for school, (v) rainwater harvesting system, (vi) solar panel etc. More facilities can be included as necessary during detailed design. There are five options of cyclone shelters under ECRRP, three of which (1, 2 and 5) are suitable for the pourashava. The cost of option-5 is considered for the proposed cyclone shelter-cum-school in the study pourashavas under this project.

298. The costing for solid waste management collection equipment was estimated following MSU/MSP of LGED.

299. **Drainage and flood control.** Quantities for each drainage and flood control structure type were worked out from the preliminary designs. Cost estimates have been prepared from the LGED Schedule of Rates, 2012. Some of the unit costs of each item of work as adopted from the schedule of rates are as follows:

1. Earth work in excavation : tk. 105 per m^3
2. Sand filling F.M=0.8 : tk. 719 per m^3
3. Brick work (1:6) : tk. 5415 per m^3
4. C.C. work (1:3:6) : tk. 6615 perm^3
5. RCC with stone chips (1:2:4) : tk. 10135 per m^3
6. M.S Reinforcement 60 grade : tk. 94.5 per Kg
7. C.C block making
    a. 300x300x150 = tk. 97 per piece
    b. 400x400x300 = tk. 338 per piece
    c. 500x500x300 = tk. 534 per piece
8. C.C block laying : tk. 1114 per m^3
9. Sand-khoa (1:1) mix : tk. 2507 per m^3
10. Geo-textile : tk. 2183 per m^3

300. **Water supply and sanitation.** The cost estimates of proposed water supply and sanitation interventions have been prepared in line with:

i. Secondary Towns Water Supply and Sanitation Project (STWSSP), DPHE.
ii. Urban Governance Infrastructure Improvement Project (UGIIP) – II, LGED.
iii. Khulna Water Supply Project, Khulna Water Supply and Sewerage Authority (KWASA).
iv. Groundwater Management and Feasibility Study for 148 Pourashavas having no Piped Water Supply, DPHE.

7 PROPOSED STAGE I INFRASTRUCTURE INTERVENTIONS, AND COST ESTIMATES

7.1 AMTALI POURASHAVA

7.1.1 Amtali Pourashava Profile

301. A pourashava summary profile was prepared on the basis of the master plan of Amtali Pourashava, with CDTA findings on the draft master plan; reference should be made to Appendix 7.2 of the Interim Report.

302. **Background.** The Amtoli Pourashava was established on 23 August 1998 and classified as a Class-C Pourashava. Later it was upgraded to a Class-B Pourashava. The Pourashava is divided into 9 wards.

303. **Location.** Amtoli is located in Barguna District of Barisal Division. Out of five Upazilas of Barguna District, Amtali Upazila ranks first in respect of both population and area. It is located between latitude 21º51' and 22º18' north and between longitude 90º00' and 90º23' east. The Upazila is bounded on the north by Patuakhali Sadar Upazila, on the east by Galachipa and Kalapara Upazilas of Patuakhali District, on the south by the Bay of Bengal on the west by Barguna Sadar Upazila and Mirzaganj Upazila of Patuakhali District.

304. The Pourashava is bordered in the north and the east by Chaora Union, in the west by Payera River and in the south by Amtoli Union. .

305. **Area and population.** Amtali Pourashava is the only urban area of the upazila and occupies an area of 8.75 km^2, with a population of 17,311 as per BBS Census 2011. The information about total number of households with average size and population of Amtali Pourashava is presented in **Table 7.1**.

Table 7.1: Population of Amtali Pourashava

Administrative Unit	Area (km^2)	Households (nos.)	Population			Average HH Size	Density (per km^2)
			Total	Male	Female		
Amtali	**8.75**	**4,067**	**17,311**	**8,701**	**8,610**	**4.3**	**1,941**
Ward No - 01	1.50	226	1011	532	479	4.5	1,774
Ward No - 02	0.96	412	1800	856	944	4.4	1,651
Ward No - 03	0.86	650	2,718	1,366	1,352	4.2	4,118
Ward No - 04	0.36	626	2,662	1,388	1,274	4.3	1,823
Ward No - 05	0.59	572	2,441	1,196	1,245	4.3	10,171
Ward No - 06	0.59	448	1,901	988	913	4.2	5,138
Ward No - 07	1.18	493	2,018	1,018	1,000	4.1	834
Ward No - 08	0.88	380	1,648	823	825	4.3	1,288
Ward No - 09	1.84	260	1,112	534	578	4.3	1,340

Source: BBS Community Report, Zilla: Barguna, 2011.

7.1.2 Municipal Infrastructure - Amtali

A. Roads - Amtali

306. Roads necessary for improvement /rehabilitation were surveyed and an inventory of required works was conducted with the assistance of the pourashava engineers considering all necessary issues and findings such as existing condition, type, formation level (rise), widening, shoulder/footpath, side protection works, side-drain, cross-drain/culvert, tree

plantation, etc. with a view to perform preliminary design and cost estimation.

307. The identified roads were finalized through the workshop organized in the pourashava in the presence of the mayor, councilors, engineers, PPTA consultants and invited officials from relevant organizations. Then the roads were finally selected and prioritized according to the selection criteria and scoring matrix (weight) developed for this project (as outlined in Section 6.1).

308. Basic data on the proposed roads and related works in Amtali Pourashava are shown on **Table 7.2**.

Table 7.2: Basic Data on Proposed Roads - Amtali

No.	Item	Qty	Unit
1.1	Number of road	8	No.
1.2	Length of road	8.38	Km
1.3	BC pavement, length	5.00	Km
1.4	RCC pavement, length	3.38	Km
1.5	Width ranges	3.0 to 8.0	m
1.6	Total Pavement Area	36,316	m^2
1.7	BC pavement area	25,700	m^2
1.8	RCC pavement area	10,616	m^2
2.1	Road side drain	3.05	Km
2.2	Cross-drain /Culvert	27	No.
2.3	Side protection works	1.06	m
2.4	Tree plantation	2,750	No.
2.5	Rise of road (avg.)	0.30	m

Source: PPTA Consultant.

309. The cost estimate of the proposed roads and other related (variable) works in Amtali Pourashava are shown in **Table 7.3**.

Table 7.3: Cost Estimate of Proposed Roads - Amtali

Particulars	Unit	Cost
BC road :		
i) Standard (fixed items) cost for roads without CCR cost	BDT Lakh	517
ii) Cost for CCR stands 22% on standard /capital cost	BDT Lakh	114
iii) Cost for related (variable) works	BDT Lakh	28
Cost in total for BC road =	***BDT Lakh***	***659***
RCC road :		
i) Standard (fixed items) cost for roads without CCR cost	BDT Lakh	236
ii) Cost for CCR - stands 30% on standard /capital cost	BDT Lakh	71
iii) Cost for related (variable) works	BDT Lakh	200
Cost in total for RCC road =	***BDT Lakh***	***507***
Grand Total for all roads =	BDT Lakh	**1166**
Grand Total for all roads =	USD million @ BDT 78/$	**1.50**

Source: PPTA Consultant.

B. Cyclone Shelters - Amtali

310. In Amtali Pourashava there are two existing cyclone shelters, which are severly damaged and risky for usage. During the field visit some important sites for cyclone shelters were identified with the assistance of pourashava engineers. The identified cyclone shelters were finalized through the workshop organized in the pourashava. Then three sites for cyclone shelters, based on educational institutions, were finally selected and prioritized according to the selection criteria and scoring matrix (weight) developed for this project.

311. Basic data on the proposed cyclone shelters in Amtali Pourashava are shown in **Table 7.4**.

312. The cost estimate of the proposed cyclone shelters in Amtali Pourashava is shown in **Table 7.5**.

Table 7.4: Basic Data on Proposed Cyclone Shelters - Amtali

No.	Item	Qty	Unit
1.1	Cyclone shelter –cum-school	3	No.
1.2	Floor area (1st) [2655 sft] /shelter	247.73	m^2
1.3	Capacity /shelter	1,328	No.
1.4	Cost per CS-cum-school	25	BDT Lakh

Source: PPTA Consultant.

Table 7.5: Estimated Cost of Proposed Cyclone Shelters - Amtali

Particulars	Unit	Cost
Cyclone Shelter-cum-school :		
i) Capital cost - without CCR cost for 3 nos.	BDT Lakh	682
ii) Cost for CCR - approx. 10% on capital cost	BDT Lakh	68
Total cost =	BDT Lakh	**750**
Total coat =	USD million @ BDT 78/$	**0.96**

Source: PPTA Consultant.

C. Solid Waste Management (SWM) - Amtali

313. Proposed items for solid waste management in Amtali Pourashava are (i) ricksha-van and (ii) hand trolley. The existing status of solid waste collection and disposal will be accelerated and improved by these items.

314. The cost estimate of the proposed solid waste management items for Amtali Pourashava is shown in **Table 7.6**.

Table 7.6: Cost Estimate of Proposed Solid Waste Management Items - Amtali

Particulars (Items)	Quantity	Unit cost	Total cost
i) Ricksha-van	5	0.25	1.25
ii) Push cart /hand trolley.	10	0.10	1.00
Total cost in BDT Lakh =			**2.25**
Total coat =	USD million @ BDT 78/$		**0.003**

Source: PPTA Consultant.

D. Summary of Municipal Infrastructure Cost Estimates – Amtali

Table 7.7: Summary of Municipal Infrastructure Cost Estimates – Amtali

Component	Unit	Capital cost	CCR cost	Total cost
1. Cost for Roads & related items	BDT Lakh	981.00	185.00	1166.00
2. Cost for Cyclone Shelter	BDT Lakh	682.00	68.00	750.00
3. Cost for SWM facilities	BDT Lakh	2.25	0.00	2.25
Grand Total =	BDT Lakh	**1665.25**	**253.00**	**1918.25**
Grand Total =	USD million @ BDT 78/$	**2.13**	**0.32**	**2.46**

Source: PPTA Consultant.

7.1.3 Drainage and Flood Control – Amtali

315. Field surveys were done for the inventory of canals and drains in Amtali Pourashava considering necessary issues like existing conditions, re-excavation of silted up canals and widening to their right-of-way (RoW), making new street drains etc., with a view to prepare preliminary designs and cost estimates. The detailed inventory of the drains was assessed with the assistance of pourashava engineers.

316. The priority of the canals and drains was determined through participatory approaches during the workshop held on April 15, 2013 in Amtoli Pourashava in the presence of the mayor, councilors, engineers, PPTA consultants and others officials of relevant government agencies. The drains were finally selected to satisfy the selection criteria which are also in conformity with the CDTA report and draft master plan prepared by LGED.

317. Preliminary designs have been made, and cost estimates of re-excavations of earthen and lined canals, RCC drains etc. estimated as per LGED schedule of rates, July 2012.

318. Considering climate change resilience and adaptation issues, items like the raising up of canal banks and re-excavation to protect flooding and to improve flow capacities of the drains etc., have been included in the proposed interventions.

319. The inventory and proposed interventions on the drainage and flood control structures are listed on a priority basis in the annex in **Volume 5**.

320. The summary of quantities, and tentative capital cost (capex) (FY-2012-2013) and O&M cost (opex) for the proposed drainage and flood control structures, are stated in **Table 7.8**

Table 7.8: Quantity and Cost Estimate for Proposed Drainage and Flood Control Structures – Amtali Pourashava

SL No	Proposed Drainage & Flood Control Interventions	Unit	Unit Cost (Million Taka)	Quantity (Km)	Capital Cost (Million Taka)		O&M cost (Million Taka)	
					With CCR	Without CCR	From year 3 to 10 (% of capital cost per year)	From year 11 & Beyond (% of capital cost per year)
1	Earthen channel	Km	4	1.75	16.43	13.144	1	2
2	CC Block lined channel	Km	25	0.26	6.47	5.176	0.25	0.5
3	RCC Box culvert	Km	58	0.24	13.947	11.158	0.2	0.4
4	RCC covered drain	Km						
5	RCC open drain	Km	15	0.411	6.18	4.944	0.2	0.4
6	RCC pipe drain	Km						
7	Brick drain	Km						
8	RCC sluice gate structures	Nos.						
9	Box culvert cleaning & gate repair	Nos.	0.62	1	0.62	0.56	0.2	0.4
10	RCC flood wall	Km						
11	Maintenance Equipment				0.80	0.40		
				2.66 km				
BDT million					**44.45**	**35.38**		
USD million @ BDT78/$					**0.57**	**0.45**		
Additional cost due to CCR (BDT million)					**9.07**			
Additional cost due to CCR (USD million)					**0.12**			

Source: PPTA Consultant.

7.1.4 Water Supply - Amtali

A. Existing Water Supply System

321. **Water sources.** The current source of piped water supply of Amtali Pourashava is based on groundwater resources. Underground water of sufficient quantity is available within the area. The good potential abstraction rate and the acceptable water quality make the aquifer suitable as a source for the town water supply.

322. A hydro-geological investigation in Amtali Pourashava was carried out under the DPHE-DANIDA Water Supply and Sanitation Project in Coastal Belt. The investigation shows that there are three main zones: inter-bedded clay and saline sand to 170 mbgl; a thick silty/sand clay to 270 mbgl; and inter-bedded clay and fresh water sand from 270 mbgl to the total drilling depth of 380 mbgl.

323. **Production Tube Wells (PTW).** Two production tubewells (illustrated in **Photograph 7.1**) supply the pourashava water supply system, and were installed in 1998 by DANIDA. Both the wells were installed in the Amtola Degree College Compound. The distance between the tubewells is 100m. The tubewells were subsequently handed over to the Pourashava Authority for operation and maintenance. The summary of the well details are presented in **Table 7.9**.

324. The PPTA Consultant monitored the PTWs with the assistance of the Pourashava Water Supply Section (PWSS) in April 2013, and the findings are shown in **Table 7.10**.

Photograph 7.1: Existing Production Tube Wells, Constructed by DANIDA

Source: PPTA Consultant.

Table 7.9: Details of Existing Production Tube Wells - Amtali

Sl No.	Production Tubewell Details	PTW - 01	PTW - 02
1	Year of Installation	1998	1998
2	Size of Well	150mmx600mm	150mmx600mm
3	Drilled Depth	380 m	375 m
4	Production Capacity	50 m^3/h	90 m^3/h
5	Specific Capacity	8.33 m^3/h/m	12.5 m^3/h/m

Source: DPHE-DANIDA WSS Project.

Table 7.10: Performance Data of Production Tube wells - Amtali

Sl No.	Production Tubewell Details	PTW - 01	PTW - 02
1	Static Water Level (SWL)	2.28 mbgl	2.28 mbgl
2	Dynamic Water Level (DWL)	6.70 mbgl	8.00 mbgl
3	Water Production Rate	38 m^3/h	80 m^3/h
4	Specific Capacity	8.60 m^3/h/m	14 m^3/h/m

Source: PPTA Consultant field investigation 24 Feb 2013.

325. The two production wells run for 15 hours in summer and 12 hours in winter at 118 m^3 per hour. The average water production is estimated at 1,652 m^3/day (1.65 MLD).

326. **Water Quality.** During the commissioning of the wells, water samples were collected from the two PTWs and analyzed in the BUET Laboratory. The analysed parameters were found to be below the limit of the WHO Guideline Values, except pH for PTW No. 2. The results are shown in the **Table 7.11**.

Table 7.11: Water Quality Data - Amtali

PTW	Date	Laboratory	pH	Fe (mg/l)	Cl (mg/l)	As (mg/l)	Mg (mg/l)
01	Nov. 98	BUET	7.5	0.29	30	0.00	0.036
02	Jan. 99	BUET	8.9	0.102	71	0.00	0.033
Bangladesh Standard			**6.5~8.5**	**0.3~1.0**	**150~600** 1000 (coastal)	**0.05**	**0.10**

(Source: DPHE-DANIDA WSS Project).

PTW	Date	Laboratory	pH	Fe (mg/l)	Cl (mg/l)	As (mg/l)	Mg (mg/l)
01	May'12	DPHE	7.9	0.22	62	<0.001	<0.05
02	May'12	DPHE	8.0	0.22	30	<0.001	<0.05
Bangladesh Standard			**6.5~8.5**	**0.3~1.0**	**150~600**	**0.05**	**0.10**

(Source: CDTA Draft Final Report).

PTW	Date	Laboratory	pH	Fe (mg/l)	Cl (mg/l)	As (mg/l)	Mg (mg/l)
01	Mar. 13	DPHE	8.2	0.60	36	0.00	-
02	Mar. 13	DPHE	8.0	0.22	81	0.00	-
Bangladesh Standard			**6.5~8.5**	**0.3~1.0**	**150~600**	**0.05**	**0.10**

Source: Barisal DPHE Laboratory.

327. The CDTA consultant team collected water samples from the above mentioned PTWs and analyzed in the DPHE Central Laboratory in Dhaka. All the tested parameters were found well below the WHO Guideline Value this time also. The results are shown in Table 7.11.

328. As requested by the PPTA Consultant, water samples of the PTWs were collected and tested in the Barisal DPHE Laboratory by the Pourashava Authority. The test results are shown in Table 7.11. All analysed parameters are within the Bangladesh drinking water standards.

329. The water quality from all of the test results indicates that aquifer is confined and fully protected by an impermeable layer. The potential abstraction rate and acceptable water quality make the aquifer suitable for the town's water supply.

330. **Water distribution pipelines.** Under the DPHE-DANIDA Water Supply and Sanitation Project, the first piped water supply system based on groundwater source was built up and commissioned in 2005. Under the project, 2 nos. production wells, an overhead tank of capacity 500m^3, 1.5 km transmission pipeline and 17 km distribution line were installed **(Table 7.12)**. Latter on the Pourashava installed another 5 km of pipelines of diameter 40 mm, to a total of 24 km at present.

Table 7.12: Details of Existing Distribution Pipelines - Amtali

Sl No.	Pipe Diameter (mm)	Length (km)	Material	Remarks
1	200	1.50	uPVC	Total length 23.00 km of PVC pipelines of diameter ranging from 40 mm to 200 mm.
2	150	5.00	uPVC	
3	100	9.50	uPVC	
4	75	2.00	uPVC	
5	50	6.00	uPVC	

Source: Amtali Pourashav, March 2013, April 2013.

331. **Service connections and population coverage.** As reported by the Pourashava in June 2012, there are 1,174 domestic service connections and 25 commercial connections, mostly hotels and restaurants. Details of connections are given in **Table 7.13**.

Table 7.13: Details of Existing Service Connections - Amtali

Type of Connection	Dia. of Connection (mm)	No. of Connection	Population Served (nr.)	Service Coverage of Total Population*
Domestic	13	935	5,163	30%
	19	239	1,320	8%
Non-domestic	13	23	-	-
	19	2	-	-
Total:		**1,199**	**7,203**	**38%**
				Population served = 6 persons/SC

* Service Coverage is based on Census 2011 population
Source: AmtaliPourashav, March 2013.

B. Population Projection

332. According to the census reports, the average annual population growth rate in Amtali Urban Area during 1981–1991 and 1991–2001 are 3.60% and 3.66% respectively. Amtali Pourashava was established on 23 August 1998 and population growth calculated based on the census of 2001 and 2011 indicated 2.67% growth rate which seems to be acceptable for the baseline growth rate of population.

333. The population projection up to 2050 for Amtali Pourashava is presented in the **Table 7.14**.

Table 7.14: Population Projection Data - Amtali

Amtali Pourashava	Area (km^2)	Population				
		2,011	**2020**	**2030**	**2040**	**2050**
Ward No -01	1.50	2,483	3,231	4,205	5,472	7,121
Ward No - 02	0.96	2,122	2,761	3,593	4,676	6,085
Ward No - 03	0.86	1,430	1,861	2,422	3,152	4,102
Ward No - 04	0.36	2,275	2,960	3,852	5,013	6,524
Ward No - 05	0.59	1,755	2,284	2,972	3,867	5,032
Ward No - 06	0.59	3,352	4,362	5,677	7,388	9,611
Ward No - 07	1.18	3,148	4,097	5,332	6,939	9,030
Ward No - 08	0.88	2,301	2,994	3,896	5,070	6,598
Ward No - 09	1.84	2,334	3,037	3,952	5,143	6,693
Total	**8.75**	**17,300**	**27,587**	**35,901**	**46,720**	**60,796**
Growth Rate		Growth Rate	2.67%	2.67%	2.67%	2.67%

Source: PPTA Consultant.

C. Water Demand Projection

334. The water demand projection for Amtali Pourashava is shown in **Tble 7.15**.

335. The two existing production wells run for average 16 hours in a day at $120m^3$ per hour. The average water production is estimated 1,920 m^3/day. Additional water demand till 2040 is 2,845 m^3/day

Table 7.15: Water Demand Projection - Amtali

Parameter	Unit	2020	2030	2040
Predicted Total Municipal Population	Nr	27,587	35,901	46,720
W S Service Area Population (% of total municipal population)	%	60	60	60
W S Service Area Population	Nr	16,552	21540	29,032
People Using the Service	%	85	90	90
Design Population	Nr	14,069	19,386	26,128
Population Served by Domestic Connection (100%)	Nr	14,069	19,386	26,128
Population Served by Street Hydrants	Nr	Nil	Nil	Nil
Daily Per Capita Consumption				
Domestic Demand (DD)	m^3/day	1,406	1,938	2,612
Non-domestic Demand (NDD) : 15% of DD	m^3/day	211	290	391
Total DD + NDD	m^3/day	1,617	2,228	3,003
Unaccounted for Water (UFW)				
15% of Total Production for 2020 and 2040	m^3/day	242	334	450
Average Daily Demand (ADD)=DD+NDD+UFW	m^3/day	1,859	2,562	3,453
Increased Water Demand Due to Temperature Rise				
15% of ADD	m^3/day	278	384	518
Total Average Daily Demand	m^3/day	2,137	2,946	3,971
Design Demand for Transmission System (1.20 x Peak day demand)	**m^3/day**	**2,564**	**3,535**	**4,765**

Source: PPTA Consultant.

D. Proposed Water Supply Interventions - Amtali

336. The interventions to improve water supply system and increase coverage has been proposed based on the results of field investigations, analysis and review of current water supply system, water demand projection for the year 2040, and climate change impacts for the year 2050.

337. The proposed water supply interventions in Amtali Pourashava with and without climate change adaptation are presented in the **Table 7.16**.

Table 7.16: Proposed Water Supply Interventions, and Cost Estimates - Amtali Pourashava

Sl. No.	Items	Unit	Rate (Lac Tk.)	Qty	Amount (Lac Tk.)		Remarks
					With Climate Change Adaptation	Without Climate Change Adaptation	
1.0	**Installation of Production Tube wells:** • Well Capacity = 100 m^3/hr • Well Size = 150x350 mm • Drilling Depth = 350 m • Upper Well Casing = 35 m • Lower Well Casing = 250 m • Screen Length = 35 m • Column Pipe Dia = 125 mm • Column Pipe Length = 30 m • Pump = Submersible	No.	100.00	2	200.00	200.00	
2.0	**Construction of Overhead Tanks (OHTs):** • Capacity = 500 m^3 • Height = 25 m	No.	220.00	1	220.00	200.00	10% (assumed) of total cost will be increased if the cyclonic strong wind is taken into account for designing the structure.
3.0	**Installation of Water Transmission and Distribution Pipelines**						
3.1	100 mm dia.	km	12.00	18	216.00	216.00	-
3.2	150 mm dia.	km	16.00	9	144.00	144.00	-
3.3	200 mm dia.	km	25.00	3	75.00	75.00	-
3.4	250 mm dia.	km	35.00	1.5	52.50	52.50	-
4.0	**Replacement of Existing 50 mm Distribution Pipelines by 100mm pipes**	km	12.00	5	60.00	60.00	
5.0	**Laying of Service Connections including Water Meter Chambers**						
5.1	13 mm connection	Nos.	0.06	1400	84.00	84.00	-
5.2	20 mm connection	Nos.	0.065	145	9.43	9.43	-
5.3	25 mm connection	Nos.	0.07	10	0.70	0.70	-
5.4	50 mm connection	Nos.	0.075	5	0.38	0.38	-

Sl. No.	Items	Unit	Rate (Lac Tk.)	Qty	Amount (Lac Tk.)		Remarks
					With Climate Change Adaptation	Without Climate Change Adaptation	
6.0	**Reconnection of Existing Service Connections with 50 mm Pipelines**						
6.1	13 mm connection	Nos.	0.06	350	21.00	21.00	-
6.2	20 mm connection	Nos.	0.065	50	3.25	3.25	-
7.0	**Procurement & Installation of Water Meters in Service Connections**						
7.1	13 mm connection	Nos.	0.03	1400	42.00	42.00	-
7.2	20 mm connection	Nos.	0.035	145	5.08	5.08	-
7.3	25 mm connection	Nos.	0.04	10	0.40	0.40	-
7.4	50 mm connection	Nos.	0.05	5	0.25	0.25	-
8.0	**Procurement & Installation of Bulk Water Meter**						
8.1	150 mm dia.	Nos.	0.40	3	1.20	1.20	-
9.0	**Installation of Hand Deep Tube Well (Depth 300 m) for Rural Area**	Nos.	1.00	30	30.00	30.00	
10.0	**Mini Water Testing Laboratory**	LS	0.50	1	0.50	0.50	-
11.0	**Logistics**						
11.1	Pick-up	No.	50.00	1	50.00	50.00	-
11.2	Motor Cycle	Nos.	1.00	2	2.00	2.00	-
11.3	Computer & Software etc.	LS.	2.00	1	2.00	2.00	-
11.4	Generator for Existing System	No.	25.00	1	25.00	-	Power backup for water supply is urgently needed if infrastructures get damaged by cyclone/storm
11.5	Generator for proposed System	No.	25.00	1	25.00	-	
	Total (BDT)				**1269.69**	**1199.69**	
	Total (USD)				**1.62 million**	**1.53 million**	Conversion Rate: 1 USD @ 78 BDT
	Climate Change Adaptation Cost (USD)				**0.09 million or 5.6% of Total Cost**		

Source: PPTA Consultant.

338. **Distribution zones.** The entire service area under Amtali Pourashava is proposed for the division into two service zones:

> Service Zone – 01 consists of the area to be supplied by the existing two production wells and the over head tank through the existing net work with proposed extension towards north boundary and partly in Ward 08 in the south.
>
> Service Zone – 02 includes the area to be served by two production wells and an overhead tank proposed to be constructed in the Poura Graveyard in Ward No. 03. The area is bordered by Patuakhali-Barguna Highway and Amtali Lake in the West.

339. The two service zones with proposed extension in water supply are shown on the **Figure 7.1**.

340. It is also proposed setting up District Metering Areas (DMA) within the service zones to monitor production, supply and consumption of water supplied and monitor UFW and NRW.

341. The primary criterion for the establishment of a DMA is that the distribution network for the demarcated area can be easily isolated by installation of control valves and other such mechanisms. Bulk meters will be installed to monitor the total volume of water supplied to the demarcated area. The DMA Junction points have been identified and shown on the drawing in **Volume 5**. The detailed individual DMA junctions with the location of control valves and bulk meters shall be done during the detailed design phase.

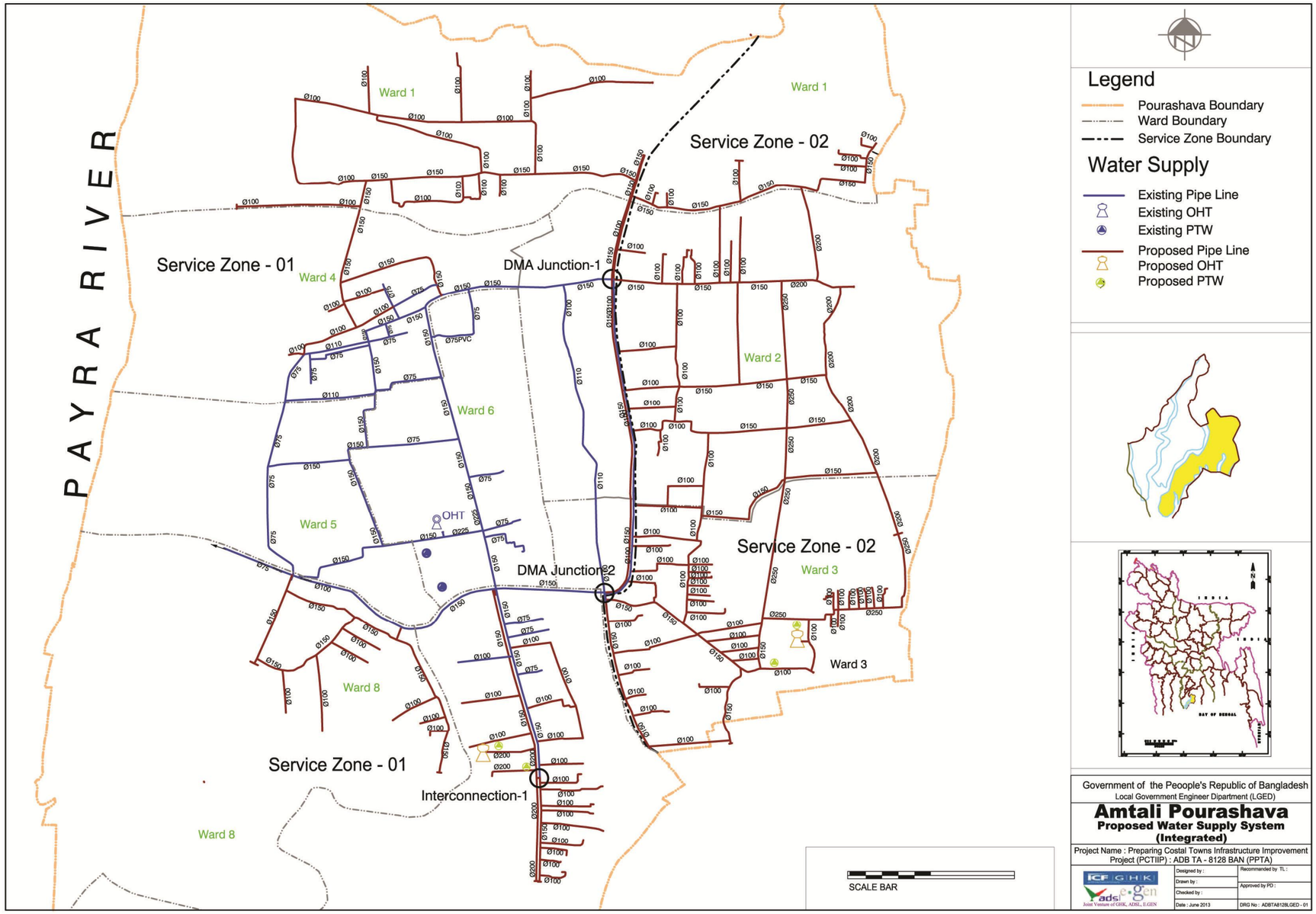
342. All the Service Zones will be supplied for 24 hours with minimum residual pressure of 5 m in the distribution system.

343. **Production tube wells.** The existing piped water supply system in Amtali Pourashava covers only about 35% (ward 4, 5, 6 and part of 2 & 3) of the total urban area. In order to meet the estimated demand of water supply for 2040 for the urban area, two production wells for the service zone–02 have been proposed. The well depth and capacity will be 300 m and 100 m^3/hr respectively.

344. The proposed locations of production wells (Poura Graveyard in Ward No. 03 are in a densely populated area. The area may be inundated due to monsoon flooding. Provision for proper drainage of the area is necessary to make the infrastructure climate resilient. The upper well casing of production wells will be extended vertically to protect the wells from inundation due to monsoon flooding. The location of the proposed PTWs is shown in Figure 7.1.

345. In the water demand projection, 15% of the increased water demand (about 700 m^3/day) is due to temperature rise prediction (1.2-2.4^0 C by 2050) and has been taken into account in the water demand projection.

Figure 7.1: Map of Proposed Water Supply Extension in Amtali Pourashava



Source: PPTA Consultant.

346. **Overhead tank.** Two overhead tanks (OHT) have been proposed for each of the Service Zone 02 and 03. The capacity of the over head tanks will be 500 m^3 which is within 15% of total production capacity. The cyclonic strong wind will be taken into account during detail design of the structure to make it strong enough to withstand the cyclones and can be climate resilient. The location of the proposed OHTs has been shown on Figure 7.1.

347. **Water distribution pipelines.** Preliminary designs of water distribution systems for each of the Service Zones have been prepared and shown on Figure 7.1. A total of about 37 km pipelines of different diameters ranging from 100 mm to 250 mm are required to be laid. The uPVC pipes will be used for the water distribution system.

348. **Replacement of existing smaller diameter pipes.** About 5 km of 50 mm diameter pipes were laid by the Pourashava with DANIDA implemented distribution system in order to extend the coverage of water supply in the town. The pipelines will be replaced by higher diameter pipes.

349. **Service connections.** Amtali Pourashava has already 1,199 service connections. A population of 16,552 (60% of the projected population of 27,587 by 2020) has been considered for calculating the additional number of service connections and to determine the costing for that. The total predicted number of service connections by 2020 will be 2,759 and the additional number of service connections is 1,560, as 1,199 connections already exist.

350. In addition to that, about 400 service connections from the existing 50 mm pipelines will be relayed and reconnected to the new pipelines replacing the existing 50 mm pipelines.

351. **Service connection water meters.** All the new connections will be metered. A total of 1,560 water meters will be procured for the new service connections. Multijet water meter of metrological class B as per ISO 4064 is recommended for procurement under the project. The meter will be semi-dry dial type. All the water meters will be protected by water meter chambers.

352. **Bulk water meters.** There are three DMA junctions connecting the two service zones in the distribution network. The bulk water meters will be installed at each of the DMA junctions. Horizontal Helix Woltmann type bulk water meter of metrological class B as per ISO 4064 is recommended for DMA junctions.

353. **Power backup.** Generally, water production is interrupted due to frequent power failure and load-shedding. The situation becomes worse if a big storm/cyclone strikes and damages infrastructures resulting in uncertainty of power supply recovery. Power backup (generator) is needed to recover the crucial water supply situation after disaster occurred.

354. **Hand deep tube wells.** The shallow aquifer in Amtali area has no potential for water supply as it produces water of saline contamination. The deep tubewells of average depth 300m produce sweet water. The current cost of deep hand tubewell installation in the area is about Tk. 1,00,000/- which is not at all affordable to the poor. A number of deep hand tube wells (depth 300 m) have been proposed for the rural part of the Pourashava which will not be covered by the proposed piped water supply extension.

355. **Water testing laboratory.** A mini water testing laboratory will be established in the Pourashava in order to create facilities to monitor water quality produced and supplied to the consumers. The laboratory should have the testing facilities for the following parameters: pH, Fe (mg/l), Cl (mg/l), As (mg/l), Mg (mg/l),fecal Coli form and E. coli.

356. **Logistics.** Necessary logistics such as transportation facilities, computers etc. will be provided to the Pourashava for smooth operation of the water supply system of Pourashava.

E. Operation and Maintenance of Water Supply System

357. An indicative O&M cost has been calculated for the proposed water supply interventions which are presented in **Table 7.17**, for.

a) Hours of Operation : 15 hours/day
b) Hours of Supply : 24 hours/day
c) Manpower Proposed : 16 persons
d) O&M Cost : Tk. 462,000/month

Table 7.17: Indicative O&M Cost of Water Supply - Amtali Pourashava

Sl. No.	Description of Items	Unit	Rate/Month (Tk.)	Nr.	Amount/month
1.0	Water Superintendent	Person	18,000.00	1	18,000.00
2.0	Bill Clark	Person	12,000.00	2	24,000.00
3.0	Pump Operator Cum Guard	person	10,500.00	6	63,000.00
4.0	Plumber/Mechanic	Person	10,500.00	4	42,000.00
5.0	Electricity	LS	45,000.00	4	180,000.00
6.0	Chemical	LS	20,000.00	1	20,000.00
7.0	Repair (Fittings, Spares)	LS	25,000.00	1	25,000.00
8.0	Generating Operating Cost including Fuel, Repair and Maintenance etc.	LS	45,000.00	2	90,000.00
				Total =	**462,000.00**

Source: PPTA Consultant.

7.1.5 Sanitation – Amtali

A. Existing Sanitation

358. The sanitary condition in Amtali Pourashava is relatively poor. As per BBS 2011, about 41.2% of the latrines are sanitary water sealed, 38.5% latrines are sanitary non-water sealed, 18.3% latrines are non-sanitary and 2% have no toilets. Examples of existing toilets are illustrated on **Photograph 7.2**.

359. No disposal and treatment facility are available inside the Pourashava. No sewerage system is available.

Photograph 7.2: Existing Household Pit Latrines in Amtali Pourashava

Soure: PPTA Consultant.

360. **Household pit latrines.** The majority of the household pit latrines are generally located in relatively low areas in the household. The latrines consists of 4/5 nos. rings placed to the depth of around 3-4' in the ground; a platform is simply positioned on the upper most ring of the pit which is almost at the ground level. Consequently the latrines are easily getting inundated during monsoon flooding resulting in a loss of accessibility to the latrine and pollution caused by discharge of the contents. Moreover the latrines are not well maintained; sledges from pits flow over ground to the nearby ditch, khal or canal causing environmental and health hazards.

361. **Public toilets.** There are few public toilets in Amtali Pourashava but those are in worse condition as the pits/septic tanks and superstructures are mostly damaged, no arrangement for electricity and water supply, lack of separate provision for girls. A few of public toilets are needed to be constructed at some strategic locations which may contribute to improve sanitation status of Amtali city area.

362. **School latrines.** Most of the schools (Primary schools, High Schools and Madrashas) of Amtali Pourashava have inadequate sanitation facilities. Condition of existing latrines are in worse condition as the pits/septic tanks and superstructures are mostly damage, no arrangement for electricity and water supply, lack of separate provision for girls. School latrines with all facilities should be provided in both primary and secondary schools, and in Madrashas in order to promote and propagate hygienic behavior.

363. **Community latrines.** Community sanitation facilities are required to be implemented in the slums in the Pourashava. On-site individual latrines are not feasible in the slums due to housing density and ground condition. The community sanitation system should consist of toilet facilities and shower and laundry facilities. There are no community latrines in Amtali Pourashava.

364. **De-sludging equipment.** The Pourashava does not have de-sludging equipment for cleaning latrines pits and septic tank. As a result the poura dwellers themselves take initiative of cleaning those mainly through sweepers. At present sweepers manually clean the latrines and sludge is buried underground at the cost of Tk 500 to Tk. 1,000 depending on the size of pit and septic tank.

B. Proposed Sanitation Interventions – Amtali Pourashava

365. A number of public toilets, community latrines and school latrines have been proposed by the authority of Amtali Pourashava **(Table 7.18)**.

366. All the toilets should have climate change adaptation measure to make them climate resilient. Septic tanks and superstructures of the toilets will be constructed above flood level to keep them protected from inundation during monsoon flooding.

Table 7.18: Proposed Sanitation Interventions - Amtali

Sl No	Items	Unit	Rate (Lac Tk.)	Qty	Amount (Lac Tk.)
1.0	**Public Toilet**				
1.1	Patuakhali Bus Stand, Ward No - 7	No.	6.0	1	6.0
1.2	Launch Ghat Wood Market, Ward No - 5	No.		1	6.0
1.3	Mango Market, Ward No – 1	No.		1	6.0
1.4	Fish Market, Ward No – 7	No.		1	6.0
2.0	**Community Latrine**				
2.1	Zilla Parishad Dak Banglo- Natun Bandh Basti, Ward No - 04	No	2.0	6	12.0
2.2	Bandh Banglo-New Embankment Ward No - 04	No		4	8.0
3.0	**Truck Mounted Desludging Equipment**	No.	60.0	1	60.0
	Total (BDT)				**104.0**
	Total (USD)		**0.13 million**		
	Climate Change Adaptation Cost, USD (Assumed 15% of Base Cost excluding Desludging Equipment)		**0.02 million**		Conversion Rate: 1 USD @ 78 BDT
	Grand Total, USD		**0.15 million**		

Source: PPTA Consultant.

7.2 GALACHIPA POURASHAVA

7.2.1 Galachipa Pourashava Profile

367. A pourashava summary profile was prepared on the basis of the master plan of Galachipa Pourashava, with CDTA findings on the draft master plan; reference should be made to Appendix 7.3 of the Interim Report.

368. **Background.** Galacipa became a police station in the year 1873 as *thana* and was upgraded to an upazila in 1983. The Galachipa Pourashava was established on 17 March 1997 and classified as Class-C Pourashava. Later it was upgraded as Class-B Pourashava on 28 April 2010. Finally the Pourashave was upgraded as a Class-A Pourashava on 07 April 2013.

369. **Location.** Galachipa is located in Patuakhali District of Barisal Division. It is the largest upazila of Patuakhali District in respect of both area and population. Galachipa is located between $21^0$48' and $22^0$21' north and between $90^0$15' and $90^0$37' east. The upazila is bounded on the north by Bauphal Upazila and Patuakhali Upazila, on the east by Dashmina and Char Fasson Upazilas, on the south by Bay of Bengal and Kalapara Upazila and on the west by Amtoli Upazila of Barguna Zila.

370. The Pourashava is bordered on the north and the west by the Ramnabad River and on the south and east by Ratandi, Matibhaga and Phulkhali Mouza (see Location Map).

371. **Area and population.** The Upazila occupies a total area of 1,268.37 km^2.Galachipa Pourashava is the only urban area of the upazila and occupies an area of 3.4 km^2, with a population of 21,200 as per BBS Census 2011; the Pourashava is divided into 9 wards. The information about total number of households with average size and population of Galacipa Pourashava is presented in **Table 7.19**.

Table 7.19: Population of Galachipa Pourashava

Administrative Unit	Area (km^2)	Households (nos.)	Population			Average HH Size	Density (per km^2)
			Total	Male	Female		
Galacipa Pourashava	**3.40**	**4,967**	**21,200**	**10,888**	**10,312**	**4.26**	
Ward No - 01	0.27	595	2,483	1,279	1,204	4.17	9,196
Ward No - 02	0.28	502	2,122	1,080	1,042	4.22	7,578
Ward No - 03	0.39	326	1,430	695	735	4.38	3,666
Ward No - 04	0.16	560	2,275	1,255	1,020	4.06	14,218
Ward No - 05	0.23	446	1,755	915	840	3.93	7,630
Ward No - 06	0.68	720	3,352	1,717	1,635	4.65	4,929
Ward No - 07	0.35	746	3,148	1,632	1,516	4.22	8,994
Ward No - 08	0.36	524	2,301	1,158	1,143	4.39	6,391
Ward No - 09	0.67	548	2,334	1,157	1,177	4.26	3,483

Source: BBS Community Report, Zilla: Pirojpur, 2011.

372. The area of Galachipa Pourashava is smaller compared to other Class A Pourashavas in Patuakhali District. It is a rapidly expanding town and a famous port for rice and other crops due to adjacent Ramnabad River. The Pourashava Authority will propose to the Ministry of LGRD for increasing the area of the Pourashava. About 2.8 km^2 area of Ratandi-Kalikapur Mouza and Phulkhali Mouza, located in the east, will be proposed soon to include in the Pourashava Area with expectation of its quick approval. The final Pourashava area will be 6.2 km^2.

7.2.2 Municipal Infrastructure - Galachipa

A. Roads - Galachipa

373. Roads necessary for improvement /rehabilitation were surveyed and an inventory of required works was conducted with the assistance of the pourashava engineers considering all necessary issues and findings such as existing condition, type, formation level (rise), widening, shoulder/footpath, side protection works, side-drain, cross-drain/culvert, tree plantation, etc. with a view to perform preliminary design and cost estimation.

374. The identified roads were finalized through the workshop organized in the pourashava in the presence of the mayor, councilors, engineers, PPTA consultants and invited officials from relevant organizations. Then the roads were finally selected and prioritized according to the selection criteria and scoring matrix (weight) developed for this project (as outlined in Section 6.1).

375. Basic data on the proposed roads and related works in Galachipa Pourashava are shown on **Table 7.20**.

376. The cost estimate of the proposed roads and other related (variable) works in Galachipa Pourashava are shown in **Table 7.21**.

Table 7.20: Basic Data on Proposed Roads - Galachipa

No.	Item	Qty	Unit
1.1	Number of road	7	No.
1.2	Length of road	7.00	Km
1.3	BC pavement, length	4.85	Km
1.4	RCC pavement, length	2.15	Km
1.5	Width ranges	4.0 to 5.0	m
1.6	Total Pavement Area	31,370	m^2
1.7	BC pavement area	22,790	m^2
1.8	RCC pavement area	8,580	m^2
2.1	Road side drain	4.70	Km
2.2	Cross-drain /Culvert	29	No.
2.3	Side protection works	1.00	m
2.4	Tree plantation	2,200	No.
2.5	Rise of road (avg.)	0.30	m

Source: PPTA Consultant.

Table 7.21: Cost Estimate of Proposed Roads - Galachipa

Particulars	Unit	Cost
BC road :		
i) Standard (fixed items) cost for roads without CCR cost	BDT Lakh	459
ii) Cost for CCR stands 22% on standard /capital cost	BDT Lakh	101
iii) Cost for related (variable) works	BDT Lakh	170
Cost in total for BC road =	***BDT Lakh***	730
RCC road :		
i) Standard (fixed items) cost for roads without CCR cost	BDT Lakh	191
ii) Cost for CCR - stands 30% on standard /capital cost	BDT Lakh	57
iii) Cost for related (variable) works	BDT Lakh	79
Cost in total for RCC road =	***BDT Lakh***	327
Grand Total for all roads =	BDT Lakh	**1057**
Grand Total for all roads =	USD million @ BDT 78/$	**1.36**

Source: PPTA Consultant.

B. Cyclone Shelters - Galachipa

377. In Galachipa Pourashava there are two existing cyclone shelters, which are in a useable condition. During the field visit some important sites for cyclone shelters were identified with the assistance of pourashava engineers. The identified cyclone shelters were finalized through the workshop organized in the pourashava. Then three sites for cyclone shelters (two in educational institutions and one in on government land) were finally selected and prioritized according to the selection criteria and scoring matrix (weight) developed for this project.

378. Basic data on the proposed cyclone shelters in Galachipa Pourashava are shown in **Table 7.22**.

379. The cost estimate of the proposed cyclone shelters in Galachipa Pourashava is shown in **Table 7.23**.

Table 7.22: Basic Data on Proposed Cyclone Shelters - Galachipa

No.	Item	Qty	Unit
1.1	Cyclone shelter –cum-school	3	No.
1.2	Floor area (1st) [2655 sft] /shelter	247.73	m^2
1.3	Capacity /shelter	1328	No.
1.4	Cost per CS-cum-school	25	BDT Lakh

Source: PPTA Consultant.

Table 7.23: Cost Estimate of Proposed Cyclone Shelters - Galachipa

Particulars	Unit	Cost
Cyclone Shelter-cum-school :		
i) Capital cost - without CCR cost for 3 nos.	BDT Lakh	682
ii) Cost for CCR - approx. **10%** on capital cost	BDT Lakh	68
Total cost =	BDT Lakh	**750**
Total coat =	USD million @ BDT 78/$	**0.96**

Source: PPTA Consultant.

C. Solid Waste Management (SWM) - Galachipa

380. Proposed items for solid waste management in Galachipa Pourashava are (i) ricksha-van and (ii) hand trolley. The existing status of solid waste collection and disposal will be accelerated and improved by these items.

381. The cost estimate of the proposed solid waste management items for Galachipa Pourashava is shown in **Table 7.24**.

Table 7.24: Cost Estimate of Proposed Solid Waste Management Items - Galachipa

Particulars (Items)	Quantity	Unit cost	Total cost
i) Ricksha-van	5	0.25	1.25
ii) Push cart /hand trolley.	10	0.10	1.00
Total cost in BDT Lakh =			**2.25**
Total coat =	USD million @ BDT 78/$		**0.003**

Source: PPTA Consultant.

D. Summary of Municipal Infrastructure Cost Estimates – Galachipa

Table 7.25: Summary of Municipal Infrastructure Cost Estimates – Galachipa

Component	Unit	Capital cost	CCR cost	Total cost
1. Cost for Roads & related items	BDT Lakh	899.00	158.00	1057.00
2. Cost for Cyclone Shelter	BDT Lakh	682.00	68.00	750.00
3. Cost for SWM facilities	BDT Lakh	2.25	0.00	2.25
Grand Total =	BDT Lakh	**1583.25**	**226.00**	**1809.25**
Grand Total =	USD million @ BDT 78/$	**2.03**	**0.29**	**2.32**

Source: PPTA Consultant.

7.2.3 Drainage and Flood Control - Galachipa

382. Field surveys were done for the inventory of canals and drains in Galachipa Pourashava considering necessary issues like existing conditions, re-excavation of silted up canals and widening to their right-of-way (RoW), making new street drains etc., with a view to prepare preliminary designs and cost estimates. The detailed inventory of the drains was assessed with the assistance of pourashava engineers.

383. The priority of the canals and drains was determined through participatory approaches during the workshop held on April 16, 2013 in Amtoli Pourashava in the presence of the mayor, councilors, engineers, PPTA consultants and others officials of relevant government agencies. The drains were finally selected to satisfy the selection criteria which are also in conformity with the CDTA report and draft master plan prepared by LGED.

384. Preliminary designs have been made, and cost estimates of re-excavations of earthen and lined canals, RCC drains etc. estimated as per LGED schedule of rates, July 2012.

385. Considering climate change resilience and adaptation issues, items like the raising up of canal banks and re-excavation to protect flooding and to improve flow capacities of the drains etc., have been included in the proposed interventions.

386. The inventory and proposed interventions on the drainage and flood control structures are listed on a priority basis in the annex in **Volume 5**.

387. The summary of quantities, and tentative capital cost (capex) (FY-2012-2013) and O&M cost (opex) for the proposed drainage and flood control structures, are stated in **Table 7.26**.

Table 7.26: Quantity and Cost Estimate for Proposed Drainage and Flood Control Structures – Galachipa Pourashava

SL No	Proposed Drainage & Flood Control Interventions	Unit	Unit Cost (Million Taka)	Quantity (Km)	Capital Cost (Million Taka)		O&M cost (Million Taka)	
					With CCR	Without CCR	From year 3 to 10 (% of capital cost per year)	From year 11 & Beyond (% of capital cost per year)
1	Earthen channel	Km	4.0	0.31	1.22	0.976	1	2
2	CC Block lined channel	Km	25	2.44	62.13	49.704	1	2
3	RCC Box culvert	Km	30	0.04	1.20	0.96	0.2	0.4
4	RCC covered drain	Km	22	3.54	76.54	65.059	0.2	0.4
5	RCC open drain	Km	28	4.06	113.67	96.62	0.2	0.5
6	RCC pipe drain	Km						
7	Brick drain	Km						
8	RCC sluice gate structures	Nos.						
9	Box culvert cleaning & Gate repair	Nos.						
10	RCC flood wall	Km						
11	Maintenance Equipment				4.0	2.4	3	5
				10.39				
				BDT million	**258.76**	**216.96**		
				USD million @ BDT78/$	**3.32**	**2.78**		
				Additional cost due to CCR (BDT million)	**41.80**			
				Additional cost due to CCR (USD million)	**0.54**			

Source: PPTA Consultant.

7.2.4 Water Supply - Galachipa

A. Existing Water Supply System

388. **Water sources.** The current source of piped water supply of Galachipa Pourashava is based on groundwater resources. Underground water of sufficient quantity is available within the area. The good potential abstraction rate and the acceptable water quality make the aquifer suitable as a source for the town water supply.

389. A hydro-geological investigation in Galacipa Pourashava was carried out under the DPHE-DANIDA Water Supply and Sanitation Project in Coastal Belt. The investigation shows that there are three main fresh water sand aquifers each separated by clay in Galachipa Pourashava: the first aquifer from 210m below GL is 20m thick; the second one from 253m below GL is 28-36m thick; and the third is from 310m below GL is 50m thick and confined by clay layer of 12m thick above and 18m thick below. Above this fresh water sand, there is a fresh to brackish water sand aquifer from 100m to 150m below the GL, where a fresh water lens is floating over the brackish water and separated from main fresh water aquifer by a clay layer of 45m thick. Static water levels are approximately 1m below GL and vary depending on tidal and barometric effects.

390. **Production Tube Wells (PTW).** Two production tubewells **(illustrated in Photograph 7.3)** to supply the Pourashava water supply system, and were installed in 1998 by DANIDA. Both the wells were installed in the BWDB compound. The tubewells were subsequently handed over to Pourashava Authority for operation and maintenance. The summary of the well details are presented in **Table 7.27**.

Photograph 7.3: Existing Pump House and Production Tube Well – Galachipa Pourashava

Source: PPTA Consultant.

Table 7.27: Details of Existing Production Tube Wells - Galachipa

Sl No.	Production Tubewell Details	PTW - 01	PTW - 02
1	Year of Installation	1998	1998
2	Size of Well	150mmx600mm	150mmx600mm
3	Drilled Depth	380 m	375 m
4	Cased Depth	356 m	355 m
5	Base of Pump	37 m	37 m
6	Top of Screen	307-332 m	307-332 m
7	Base of Screen	337-352 m	337-352 m
8	Production Capacity	90 m^3/h	60 m^3/h
9	Specific Capacity	16 m^3/h/m	10 m^3/h/m

Source: DPHE-DANIDA WSS Project.

391. The PPTA Consultant monitored the PTWs with assistance of the Pourashava Water Supply Section (PWSS) in April 2013, and the findings are shown in **Table 7.28**.

392. The two production wells run for average 17 hours in a day at 120m^3 per hour. The average water production is estimated 2040 m^3/day.

Table 7.28: Performance Data of Production Tube wells - Galachipa

Sl No.	Production Tubewell Details	PTW - 01	PTW - 02
1	Static Water Level (SWL)	2.70 mbgl	3.00 mbgl
2	Dynamic Water Level (DWL)	8.00 mbgl	8.00 mbgl
3	Water Production Rate	80 m^3/h	40 m^3/h
4	Specific Capacity	15 m^3/h/m	8 m^3/h/m

Source: PPTA Consultant.

393. **Water Quality.** Under the DPHE-DANIDA WSS Project, water samples were collected from the two PTWs and analyzed in the BUET Laboratory. Both wells were found to be below the limit of the WHO Guideline Value. The results are shown in the **Table 7.29**

Table 7.29: Water Quality Data - Galachipa

PTW	Date	Laboratory	pH	Fe (mg/l)	Cl (mg/l)	As (mg/l)	Mg (mg/l)
01	Feb'99	BUET	7.8	0.2	21	0.00288	ND
02	Apr'00	DANIDA	7.65	0.23	25	0.01	-
Bangladesh Standard			**6.5~8.5**	**0.3~1.0**	**150~600**	**0.05**	**0.10**

(Source: DPHE-DANIDA WSS Project).

PTW	Date	Laboratory	pH	Fe (mg/l)	Cl (mg/l)	As (mg/l)	Mg (mg/l)
01	May'12	DPHE	8.2	0.21	7.0	0.007	<0.05
02	May'12	DPHE	8.0	0.29	7.0	<0.001	<0.05
Bangladesh Standard			**6.5~8.5**	**0.3~1.0**	**150~600**	**0.05**	**0.10**

(Source: CDTA Draft Final Report).

PTW	Date	Laboratory	pH	Fe (mg/l)	Cl (mg/l)	As (mg/l)	Mg (mg/l)
01	April'13	DPHE	8.4	0.17	14.0	<LOQ	0.00
02	April'13	DPHE	8.4	0.42	14.0	<LOQ	0.00
Bangladesh Standard			**6.5~8.5**	**0.3~1.0**	**150~600**	**0.05**	**0.10**

Note: LOQ = Level on Quantization
Source: Barisal DPHE Laboratory.

394. The CDTA consultant team collected water samples from the above mentioned PTWs and analyzed in the DPHE Central Laboratory in Dhaka. All the tested parameters were found well below the WHO Guideline Value this time also. The results are shown in Table 7.29.

395. As requested by the PPTA Consultant, water samples of the PTWs were collected and tested in the Barisal DPHE Laboratory by the Pourashava Authority. The test results are shown in Table 7.29.

396. The water quality from all of the test results indicates that aquifer is confined and fully protected by an impermeable layer. The potential abstraction rate and acceptable water quality make the aquifer suitable for town water supply.

397. **Water distribution pipelines.** Under DPHE-DANIDA Water Supply and Sanitation Project, the first piped water supply system based on ground water source, was built up and commissioned in 2005. Under the project, 2 nos. production wells, an overhead tank of capacity 500m^3, 1 km transmission pipeline and 16 km distribution line were installed **(Table 7.30)**. Later on the Pourashava installed other 5 km pipelines of diameter 40 mm to a total of 21 km at present. Potential abstraction rate and acceptable water quality make the aquifer suitable for town water supply.

Table 7.30: Details of Existing Distribution Pipelines - Galachipa

Sl No.	Pipe Diameter (mm)	Length (km)	Material	Remarks
1	200	1.00	uPVC	Total length 21.00 km of PVC pipelines of diameter ranging from 50 mm to 200 mm.
2	150	4.00	uPVC	
3	100	5.50	uPVC	
4	75	6.50	uPVC	
5	50	4.00	uPVC	

(Source: Galacipa Pourashav, March 2013, April 2013).

398. **Service connections and population coverage.** Under the present water supply system, there are 1,946 domestic service connections and 34 commercial connections, mostly hotels and restaurants. Details of connections are given in **Table 7.31**. The service coverage 40% of the total population, and the population served is 6 persons/ service connection.

Table 7.31: Details of Existing Service Connections - Galachipa

Ward No.	Domestic Connections				Commercial Connections				Population Served
	Φ13 mm	Φ19 mm	Φ25 mm	Total	Φ13 mm	Φ19 mm	Φ25mm	Total	
1	164	13	-	177	8	3	-	11	1,128
2	160	7	-	167	1	-	-	1	1,008
3	85	5	-	90	-	-	-	-	540
4	204	12	-	216	7	1	-	8	1,344
5	90	8	-	98	3	-	-	3	606
6	261	13	-	274	-	-	-	-	1,644
7	408	19	-	427	10	-	-	10	2,622
8	265	10	-	275	-	-	-	-	1,650
9	212	9	-	221	-	1	-	1	1,332
Total	**1,849**	**96**	**-**	**1,945**	**29**	**5**	**-**	**34**	**11,874**

(Source: Galacipa Pourashav, March 2013).

B. Population Projection

399. According to the census reports, the average annual population growth rate in Galacipa Urban Area during 1981–1991 and 1991–2001 was 3.68% and 1.38% respectively. Galacipa Pourashava was established in 17 March 1997 and population growth calculated based on the census of 2001 and 2011 indicatesd a growth rate of 2.00% which seems to be acceptable for the baseline growth rate of population **(Table 7.32)**. Galacipa Pourashava is already densely populated and it is assumed that the growth rate will decrease in the coming years.

Table 7.32: Population Projection Data - Galachipa

Galacipa Pourashava	Area (sq. km)	Population				
		2,011	2020	2030	2040	2050
Ward No -01	0.27	2,483	2,997	3,582	4,239	5,017
Ward No - 02	0.28	2,122	2,561	3,031	3,588	4,247
Ward No - 03	0.39	1,430	1,726	2,063	2,442	2,890
Ward No - 04	0.16	2,275	2,746	3,282	3,885	4,598
Ward No - 05	0.23	1,755	2,118	2,532	2,997	3,547
Ward No - 06	0.68	3,352	4,046	4,836	5,724	6,775
Ward No - 07	0.35	3,148	3,812	4,556	5,393	6,383
Ward No - 08	0.36	2,301	2,778	3,321	3,931	4,653
Ward No - 09	0.67	2,334	2,817	3,367	3,985	4,717
Total	**3.40**	**21,200**	**25,603**	**30,571**	**36,182**	**42,828**
Growth Rate			1.96%	1.90%	1.80%	1.70%

Source: PPTA Consultant.

C. Water Demand Projection

400. The water demand projection for Galacipa Pourashava is shown in a**Tble 7.33**.

Table 7.33: Water Demand Projection - Galachipa

Parameter	Unit	2020	2030	2040
Predicted Total Municipal Population	Nr	25,603	30,571	36,182
W S Service Area Population (% of total municipal population)	%	100	100	100
W S Service Area Population	Nr	25,603	30,571	36,182
People Using the Service	%	85	90	90
Design Population	Nr	21,760	27,515	32,564
Population Served by Domestic Connection (100%)	Nr	21,760	27,515	32,564
Population served by street hydrants	Nr	Nil	Nil	Nil
Daily Per Capita Consumption				
Domestic Demand (DD)	m^3/day	2,176	2,751	3,256
Non-domestic Demand (NDD) : 15% of DD	m^3/day	326	412	488
Total DD + NDD	m^3/day	2,502	3,163	3,744
Unaccounted for Water (UFW)				
15% of Total production for 2020 and 2040	m^3/day	392	474	561
Average Daily Demand (ADD)=DD+NDD+UFW	m^3/day	2,894	3,673	4,305
Increased Water Demand Due to Temperature Rise				
15% of ADD	m^3/day	434	550	645
Total Average Daily Demand	m^3/day	3,328	4,223	4,950
Design Demand for Transmission System (1.20 x Peak day demand)	**m^3/day**	**3,993**	**5,067**	**5,940**

Source: PPTA Consultant.

401. The two existing production wells run for average 17 hours in a day at 120m^3 per hour. The average water production is estimated 2,040 m^3/day. Additional water demand till 2040 is 3,900 m^3/day.

D. Proposed Water Supply Interventions

402. The interventions to improve water supply system and increase coverage, has been proposed based on the results of the field investigations, analysis and review of current water supply system, water demand projection for the year 2040 and climate change impacts for the year 2050.

403. The proposed water supply interventions in Galacipa Pourashava with and without climate change adaptation are presented in **Table 7.34.**

Table 7.34: Proposed Water Supply Interventions, and Cost Estimates - Galachipa Pourashava

Sl. No.	Items	Unit	Rate (Lac Tk.)	Qty	Amount (Lac Tk.)		Remarks
					With Climate Change Adaptation	Without Climate Change Adaptation	
1.0	**Installation of Production Tube wells:** • Capacity = 100 m^3/h • Well Size = 150x350 mm • Drilling Depth = 350 m • Upper Well Casing = 35 m • Lower Well Casing = 250 m • Screen Length = 35 m • Column Pipe Dia = 125 mm • Column Pipe Length = 30 m • Pump = Submersible	No.	100.00	2	200.00	200.00	-
2.0	**Construction of Overhead Tank (OHT):** • Capacity = 500 m^3 • Height = 25 m	No.	220.00	1	220.00	200.00	10% (assumed) of total cost will be increased if the cyclonic strong wind is taken into account for designing the structure.
3.0	**Installation of Water Transmission and Distribution Pipelines**						
3.1	100 mm dia.	Km	12.00	17.00	204.00	204.00	-
3.2	150 mm dia.	km	16.00	6.00	96.00	96.00	-
3.3	200 mm dia.	Km	25.00	2.00	50.00	50.00	-
4.0	**Replacement of Existing 50 mm Distribution Pipelines by 100 mm pipes**	km	12.00	4.00	48.00	48.00	-
5.0	**Laying of Service Connections including Water Meter Chambers**						
5.1	13 mm connection	Nos.	0.06	2,100	126.00	126.00	-
5.2	20 mm connection	Nos.	0.065	360	23.40	23.40	-
5.3	25 mm connection	Nos.	0.07	30	2.10	2.10	-
5.4	50 mm connection	Nos.	0.075	10	0.75	0.75	-
6.0	**Reconnection of Existing Service Connections with 50 mm Pipelines**	Nos.					

Sl. No.	Items	Unit	Rate (Lac Tk.)	Qty	Amount (Lac Tk.)		Remarks
					With Climate Change Adaptation	Without Climate Change Adaptation	
6.1	13 mm connection	Nos.	0.06	570	34.20	34.20	-
6.2	20 mm connection	Nos.	0.065	30	1.95	1.95	-
7.0	**Procurement & Installation of Water Meters in Service Connections**						
7.1	13 mm	Nos.	0.03	2,100	63.00	63.00	-
7.2	20 mm	Nos.	0.035	360	12.60	12.60	-
7.3	25 mm	Nos.	0.04	30	1.20	1.20	-
7.4	50 mm	Nos.	0.05	10	0.50	0.50	-
8.0	**Procurement & Installation of Bulk Water Meters**						
8.1	150 mm dia.	Nos.	0.40	4	1.60	1.60	-
9.0	**Mini Water Testing Laboratory**	LS	0.50	1	0.50	0.50	
10.0	**Logistics**						
10.1	Pick-up	No.	50.00	1	50.00	50.00	-
10.2	Motor Cycle	No.	1.00	2	2.00	2.00	-
10.3	Computers, software etc.	LS	2.00	1	2.00	2.00	-
10.4	Generator for Existing and Proposed Water Supply System	LS	25.00	2	50.00	-	Power backup for water supply is urgently needed if infrastructures get damaged by cyclone/storm
	Total (BDT)				**1189.80**	**1119.80**	
	Total (USD)				**1.53 million**	**1.44 million**	Conversion Rate: 1 USD @ 78 BDT
	Climate Change Adaptation Cost (USD)				**0.09 million or 5.9 % of Total Cost**		

Source: PPTA Consultant.

404. **Distribution zones.** The entire service area under Galacipa Pourashava is proposed for the division into two service zones:

> Service Zone – 01 consists of the area to be supplied by the existing two production wells and the over head tank through the existing net work with proposed rehabilitation and extension towards north boundary. The area includes ward no. 1, 2, 4, 5, 6, 7 and part of ward no. 3 of Galacipa Pourashava.
>
> Service Zone – 02 includes the area to be served by two production wells and an over head tank proposed to be constructed in the Galacipa Degree College Compound in Ward No. 09. The area will cover ward no. 8, 9 and major part of ward no. 3 of Galacipa Pourashava

405. The two service zones with proposed extension in water supply have been shown on **Figure 7.2**.

406. It is also proposed setting up District Metering Areas (DMA) within the service zones to monitor production, supply and consumption of water supplied and monitor UFW and NRW.

407. The primary criterion for the establishment of a DMA is that the distribution network for the demarcated area can be easily isolated by installation of control valves and other such mechanisms. Bulk meters will be installed to monitor the total volume of water supplied to the demarcated area. The DMA Junction points have been identified and shown on the drawings in **Volume 6**. The detailed individual DMA junctions with the location of control valves and bulk meters shall be done during the detailed design phase**.**

408. All the Service Zones will be supplied for 24 hours with minimum residual pressure of 5 m in the distribution system.

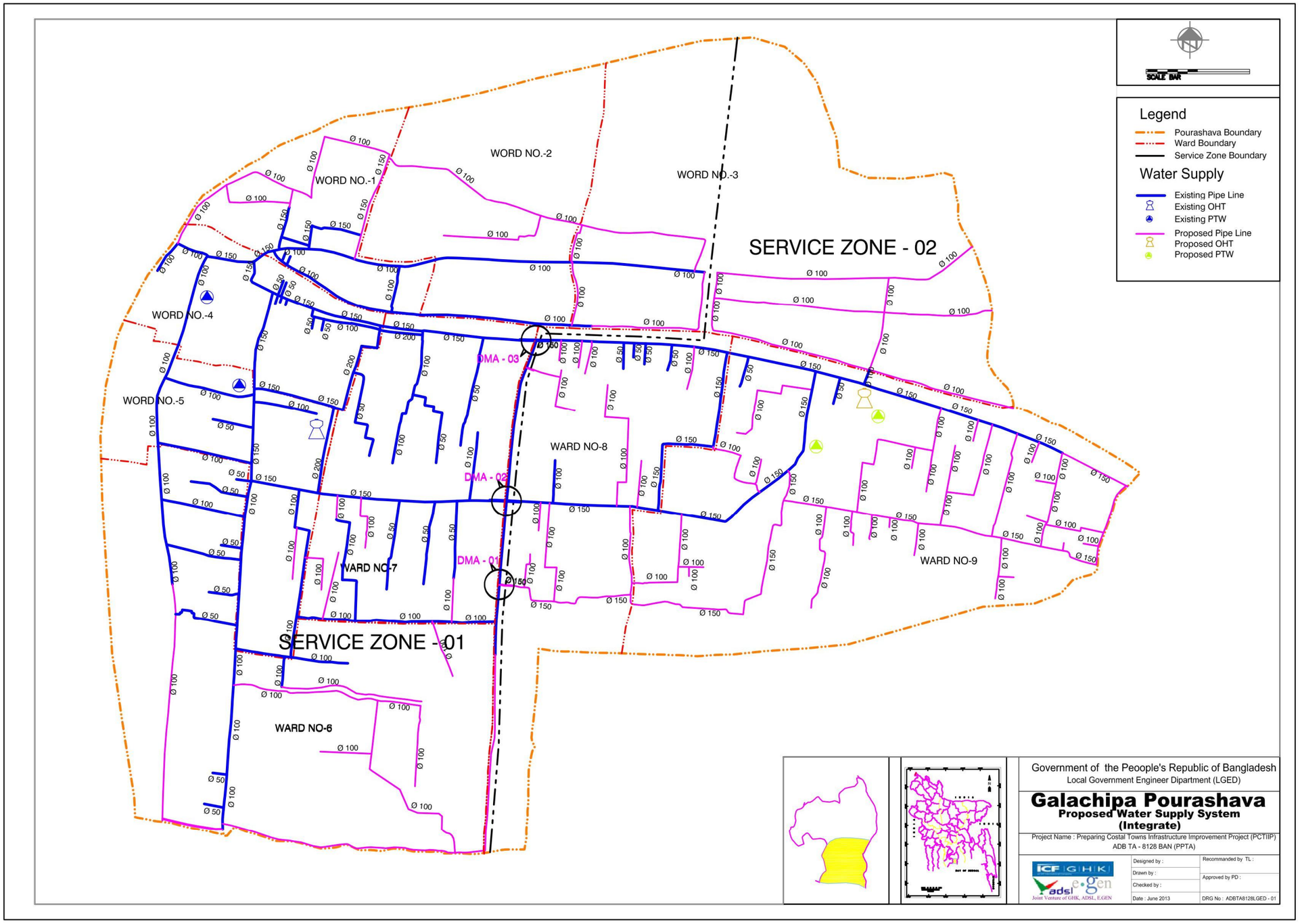
409. **Production tube wells.** The existing piped water supply system in Galacipa Pourashava covers only about 40% (ward 1, 4, 5, 6, 7 and part of 2 & 3) of the total urban area. In order to meet the estimated demand of water supply for 2040, two additional production wells for the service zone – 02 have been proposed. The well depth and capacity will be 300 m and 100 m^3/hr respectively.

410. The proposed location of production wells is Galacipa Degree College Compound situated in the city centre. The area may be inundated due to monsoon flooding. Provision for proper drainage of the area is necessary to make the infrastructure climate resilient. The upper well casing of production wells will also be extended vertically to protect the wells from inundation due to monsoon flooding. The location of the proposed PTWs and typical PTW drawing has been shown in Figure 7.2.

411. **Overhead tank.** One overhead tank (OHT) has been proposed for the Service Zone 02. The capacity of the over head tanks will be 500 m^3 which is within 15% of total production capacity. The cyclonic strong wind will be taken into account during detail design of the structure to make it strong enough to withstand the cyclones and can be climate resilient. The location of the proposed OHT is shown on Figure 7.2.

412. **Water distribution pipelines.** Preliminary designs of water distribution systems for each of the Service Zones have been prepared and shown on Figure 7.2 and other drawings in Volume 6. A total of about 25 km pipelines of different diameters ranging from 100 mm to 200 mm are required to be laid. The uPVC pipes will be used for the water distribution system.

Figure 7.2: Map of Proposed Water Supply Extension in Galachipa Pourashava



Source: PPTA Consultant.

413. **Replacement of existing smaller diameter pipes.** About 4 km of 50 mm diameter pipes were laid by the Pourashava with DANIDA implemented distribution system in order to extend the coverage of water supply in the town. The pipelines will be replaced by higher diameter pipes.

414. **Service connections.** As per BBS 2011, there are 4,967 households (HH) in Galacipa Pourashava; out of which 2,900 HHs (assumed 1.5 HHs per connection) are already connected to water supply by 1,945 service connections. The projected population of 25,603 by 2020 has been considered for calculating the additional number of service connections and to determine the costing for that. The total predicted number of service connections by 2020 is 4,270 and the additional number of service connections needed is 2,325, as 1,945 connections already exist. In addition to that about 600 service connections from existing 50 mm pipelines will be relayed and reconnected to the new pipelines replacing the existing 50 mm pipelines.

415. **Water meters.** All the new connections will be metered. A total of 2,500 water meter will be procured for the new service connections. Multijet water meter of metrological class B as per ISO 4064 is recommended for procurement under the project. The meter will be semi-dry dial type. All the water meters will be protected by water meter chambers.

416. **Bulk water meters.** There are three DMA junctions connecting the two service zones in the distribution network. The bulk meters will be installed at each of the DMA junctions. Horizontal Helix Woltmann type bulk water meter of metrological class B as per ISO 4064 is recommended for DMA junctions.

417. **Power backup.** Generally, water production is interrupted due to frequent power failure and load-shedding. The situation becomes worse if a big storm/cyclone strikes and damages infrastructures resulting in uncertainty of power supply recovery. Power backup (generator) is needed to recover the crucial water supply situation after disaster took place.

418. **Water testing laboratory.** A mini water testing laboratory will be established in the Pourashava in order to create facilities to monitor water quality produced and supplied to the consumers. The laboratory should have the testing facilities of the followings: pH, Fe (mg/l), Cl (mg/l), As (mg/l), Mg (mg/l),fecal Coli form and E. coli.

419. **Logistics.** Necessary logistics such as transportation facilities, computers etc. have been proposed for Galacipa Pourashava for smooth operation of the proposed water supply system after implementation.

E. Operation and Maintenance of Water Supply System

420. An indicative O&M cost has been calculated for the proposed water supply interventions which is presented in **Table 7.35**, based on:

Hours of Operation	: 15 hours/day
Hours of Supply	: 24 hours/day
Manpower Proposed	: 16 persons
O&M Cost	: Tk. 457,000.00/month.

Table 7.35: Indicative O&M Cost of Water Supply - Galacipa Pourashava

Sl. No.	Description of Items	Unit	Rate/Month (Tk.)	Nr.	Amount/month
1.0	Water Superintendent	Person	18,000.00	1	18,000.00
2.0	Bill Clark	Person	12,000.00	2	24,000.00
3.0	Pump Operator Cum Guard	person	10,500.00	6	63,000.00
4.0	Plumber/Mechanic	Person	10,500.00	4	42,000.00
5.0	Electricity	LS	45,000.00	4	180,000.00
6.0	Chemical	LS	20,000.00	1	20,000.00
7.0	Repair (Fittings, Spares)	LS	20,000.00	1	20,000.00
8.0	Generating Operating Cost including Fuel, Repair and Maintenance etc.	LS	45,0000.00	2	90,000.00
	Total =				**457,000.00**

Source: PPTA Consultant.

7.2.5 Sanitation - Galachipa

A. Existing Sanitation

421. **Household sanitation.** As per BBS 2011, about 41.2% of the latrines are sanitary water sealed, 38.5% latrines are sanitary non-water sealed, 18.3% latrines are non-sanitary and 2% have no toilets. Examples of existing toilets are iullstrated on **Photograph 7.4**.

422. The latrines are generally located in relatively low areas in the household. The latrines consists of 4/5 nos. rings placed to the depth of around 3-4ft (0.9-1.2m) in the ground; a platform is simply positioned on the uppermost ring of the pit which is almost at the ground level. Consequently the latrines are easily inundated due to rain water accumulation in the monsoon season, resulting in a loss of accessibility to the latrine and pollution caused by discharge of the contents. It was observed in some places during the field visit that holes have been made on the surface of ring of the latrine pit to allow the flow of sludge over the ground to a nearby ditch, *khal* or canal, which is really environmentally and health hazardous.No disposal and treatment facility are available inside the Pourashava. No sewerage system is available.

Photograph 7.4: Existing Household Pit Latrines in Galachipa Pourashava

Source: PPTA Consultant.

423. **Public toilets.** There are two public toilets in Galacipa Pourashava, the status of which are presented in the **Table 7.36**.

424. There are few public toilets in Galacipa Pourashava but those are in worse condition as the pits/septic tanks and superstructures are mostly damaged, no arrangement for electricity and water supply, lack of separate provision for girls. A few of public toilets are needed to be constructed at some strategic locations which may contribute to improve sanitation status of Galacipa city area.

Table 7.36: Public Toilets - Galachipa

Sl No.	Location	Existing Facilities	Leased out	Observations
1	Thana Mosque Attached, Ward No- 04	Chamber 4 nos. Urinal 2 nos.	Yes	Electricity and water supply exist
2	Poura Monch Attached Ward No- 07	Chamber 3 nos. Urinal 2 nos.	Yes	Electricity and water supply exist

Source: Galachipa Pourashava.

425. **School latrines.** Most of the schools (Primary schools, High Schools and Madrashas) of Galacipa Pourashava have inadequate sanitation facilities. Existing latrines are in a bad condition as the pits/septic tanks and superstructures are mostly damaged, there is no arrangement for electricity and water supply, and there is a lack of separate provision for girls. School latrines with all facilities should be provided in both primary and secondary schools, and in madrashas, in order to promote and propagate hygienic behavior.

426. **Community latrines.** There are no community latrines in Galacipa Pourashava. Community sanitation facilities are required to be implemented in Shantibagh and Rotanpur Sluice Gate Slums in Galacipa Pourashava. The community sanitation system should consist of toilet, shower and laundry facilities.

427. **De-sludging equipment.** The Pourashava does not have de-sludging equipment for cleaning latrines pits and septic tanks. As a result the poura dwellers themselves take initiative of cleaning these facilities, mainly through sweepers. At present sweepers manually clean the latrines, and sludge is buried underground at the cost of Tk 500 to Tk. 1,000 depending on the size of pit and septic tank.

B. Proposed Sanitation Interventions – Galachipa Pourashava

428. A number of public toilets, community latrines and school latrines have been proposed by the authority of Galachipa Pourashava **Table 7.37**.

Table 7.37: Proposed Sanitation Interventions - Galachipa

Sl No	Items	Unit	Rate (Lac Tk.)	Qty	Amount (Lac Tk.)
1.0	**Public Toilet**				
1.1	College Para Bailey Bridge, Ward No - 9	No.	6.0	1	6.0
1.2	Galacipa Chou Rashta, Ward No - 8	No.		1	6.0
1.3	Lipi Tokij Mor, Ward No - 5	No.		1	6.0
1.4	Dhaka Launch Ghat, Ward No - 1	No.		1	6.0
1.5	Ferry Ghat, Ward No - 4	No.		1	6.0
1.6	Near Galacipa Girls High School, Ward No - 4	No.		1	6.0
2.0	**School Latrine**				
2.1	Ratandi Palli Unnayan Govt. Primary School, Ward No - 9	No.	6.0	1	6.0
2.2	Galacipa Degree College, Ward No - 9	No.		1	6.0
2.3	Ratandi Shishu Sadan Hafizia Madrasa Ward No - 9	No.		1	6.0
3.0	**Community Latrine**				
3.1	Shantibagh Sluice Gate Basti, Ward No - 3	No.	2.0	4	8.0
3.2	Ratanpur Sluice Gate Basti, Ward No - 6	No.		4	8.0
4.0	**Truck Mounted Desludging Equipment**	No.	60.0	1	60.0
Total (DBT)					**130.0**
Grand Total (USD)			**0.17 million**		
Climate Change Adaptation Cost, USD (Assumed 15% of Base Cost excluding Desludging Equipment)			**0.03 million**	Conversion Rate: 1 USD @ 78 BDT	
Grand Total, USD			**0.20 million**		

Source: PPTA Consultant.

7.3 PIROJPUR POURASHAVA

7.3.1 Pirojpur Pourashava Profile

429. A Pourashava Summary Profile wasprepared on the basis of the master plan of Pirojpur Pourashava, with CDTA findings on the draft master plan; reference should be made to Appendix 7.4 of the Interim Report.

430. **Background.** Pirojpur town was established as a Pourashava in 1885. It has been an 'A' class Pourashava since its establishment because of the good collection of taxes and revenues. It is generally believed that the name of Pirojpur Pourashava is derived from the name of famous Mughal Zamider 'Firojshah'. Pirojpur Pourashava is sited in Pirojpur District.

431. Pirojpur Pourashava consists of 9 wards, 30 *mahallahs* and 23 *mouzas*.

432. **Location.** Pirojpur Pourashava is located between $22^0$23' and $22^0$42' north and between $89^0$52' and $90^0$03' east. It is bounded on the north by Nazirpur and Nesarabad upazila, on the east by Kaokhali upazila, on the south by Bhandaria upazila, and on the west by Kochua upazila.

433. **Area and population.** Pirojpur Pourashava, with an area of 29.46 km^2 lies within the centre of Pirojpur Upazila which occupies an area of 166.81 km^2. Information about the total number of households, with average size, and population of Pirojpur Pourashava is presented in **Table 7.38**.

Table 7.38: Population of Pirojpur Pourashava

Administrative Unit	Area (km^2)	Households (nos.)	Population			Average HH Size	Density (per km^2)
			Total	Male	Female		
Pirojpur Pourashava	**29.46**	**13,646**	**60,056**	**30,048**	**30,008**	**4.40**	**2038**
Ward No - 01	4.5	1311	5707	2802	2905	4.35	1268
Ward No - 02	2.62	1369	6455	3157	3302	4.72	2463
Ward No - 03	4.70	1023	4717	2358	2359	4.61	1003
Ward No - 04	1.81	2548	10421	5199	5222	4.08	5757
Ward No - 05	2.31	1687	7528	3979	3549	4.46	3258
Ward No - 06	3.60	1330	6143	3170	2973	4.61	1706
Ward No - 07	1.01	1665	7112	3376	3736	4.27	7041
Ward No - 08	2.85	1490	6474	3214	3260	4.34	2271
Ward No - 09	6.06	1223	5495	2793	2702	4.49	906

Source: BBS Community Report, Zilla: Pirojpur, 2011.

7.3.2 Municipal Infrastructure - Pirojpur

A. Roads - Pirojpur

434. Roads necessary for improvement /rehabilitation were surveyed and an inventory of required works was conducted with the assistance of the pourashava engineers considering all necessary issues and findings such as existing condition, type, formation level (rise), widening, shoulder/footpath, side protection works, side-drain, cross-drain/culvert, tree plantation, etc. with a view to perform preliminary design and cost estimation.

435. The identified roads were finalized through the workshop organized in the pourashava in the presence of the mayor, councilors, engineers, PPTA consultants and invited officials from relevant organizations. Then the roads were finally selected and prioritized according to the selection criteria and scoring matrix (weight) developed for this project (as outlined in Section 6.1).

436. Basic data on the proposed roads and related works in Pirojpur Pourashava are shown on **Table 7.39**.

437. The cost estimate of the proposed roads and other related (variable) works in Pirojpur Pourashava are shown in **Table 7.40**.

Table 7.39: Basic Data on Proposed Roads - Pirojpur

No.	Item	Qty	Unit
1.1	Number of road	17	No.
1.2	Length of road	34.20	Km
1.3	BC pavement, length	11.60	Km
1.4	RCC pavement, length	22.60	Km
1.5	Width ranges	3.0 to 3.7	m
1.6	Total Pavement Area	110,300	m^2
1.7	BC pavement area	40,050	m^2

No.	Item	Qty	Unit
1.8	RCC pavement area	70,250	m^2
2.1	Road side drain	4.60	Km
2.2	Cross-drain /Culvert	39	No.
2.3	Side protection works	4.30	m
2.4	Tree plantation	4,300	No.
2.5	Rise of road (avg.)	0.30	m

Source: PPTA Consultant.

Table 7.40: Cost Estimate of Proposed Roads - Pirojpur

Particulars	Unit	Cost
BC road :		
i) Standard (fixed items) cost for roads without CCR cost	BDT Lakh	806
ii) Cost for CCR stands 22% on standard /capital cost	BDT Lakh	177
iii) Cost for related (variable) works	BDT Lakh	166
Cost in total for BC road =	***BDT Lakh***	1149
RCC road :		
i) Standard (fixed items) cost for roads without CCR cost	BDT Lakh	1604
ii) Cost for CCR - stands 30% on standard /capital cost	BDT Lakh	481
iii) Cost for related (variable) works	BDT Lakh	151
Cost in total for RCC road =	***BDT Lakh***	2236
Grand Total for all roads =	BDT Lakh	**3385**
Grand Total for all roads =	USD million @ BDT 78/$	**4.34**

Source: PPTA Consultant.

B. Bridges

438. There exists a big canal network in Pirojpur Pourashava and there are many locally built bridges over the canals. These are mainly foot-bridges such as iron-sleeper bridges, wooden bridges (*pul*) and bamboo bridges (*sako*). Vehicles cannot move over these bridges. In many place new RCC bridges are necessary to establish connectivity among the adjacent areas.

439. A few sites of existing risky foot-bridges were identified with the assistance of pourashava engineers and councilors. The identified bridges were finalized through the workshop organized in the pourashava. Four small bridges on the proposed roads were finally selected adopting the selection criteria and scoring matrix of this project.

440. Basic data on the proposed bridges in Pirojpur Pourashava are shown on **Table 7.41**.

441. The cost estimate of the proposed bridges in Pirojpur Pourashava is shown in **Table 7.42**.

Table 7.41: Basic Data on Proposed Bridges - Pirojpur

No.	Item	Qty	Unit
1.1	Bridge proposed	4	No.
1.2	Length required	38	m
1.3	Width proposed	5.5	m
1.4	Cost per meter	5	BDT Lakh

Source: PPTA Consultant.

Table 7.42: Cost Estimate of Proposed Bridges - Pirojpur

Particulars	Unit	Cost
RCC Bridge :		
i) Capital cost - without CCR cost for 4 nos.	BDT Lakh	173
ii) Cost for CCR - approx. 10% on capital cost	BDT Lakh	17
Total cost =	BDT Lakh	**190**
Total coat =	USD million @ BDT 78/$	**0.24**

Source: PPTA Consultant.

C. Cyclone Shelters - Pirojpur

442. In Pirojpur Pourashava there are no existing cyclone shelters. During the field visit some important sites for cyclone shelters were identified with the assistance of pourashava engineers. The identified cyclone shelters were finalized through the workshop organized in the pourashava. Then four sites for cyclone shelters, based at schools, were finally selected and prioritized according to the selection criteria and scoring matrix (weight) developed for this project.

443. Basic data on the proposed cyclone shelters in Pirojpur Pourashava are shown in **Table 7.43**.

444. The cost estimate of the proposed cyclone shelters in Pirojpur Pourashava is shown in **Table 7.44**.

Table 7.43: Basic Data on Proposed Cyclone Shelters - Pirojpur

No.	Item	Qty	Unit
1.1	Cyclone shelter –cum-school	4	No.
1.2	Floor area (1st) [2655 sft] /shelter	247.73	m^2
1.3	Capacity /shelter	1,328	No.
1.4	Cost per CS-cum-school	250	BDT Lakh

Source: PPTA Consultant.

Table 7.44: Cost Estimate of Proposed Cyclone Shelters - Pirojpur

Particulars	Unit	Cost
Cyclone Shelter-cum-school :		
i) Capital cost - without CCR cost for 4 nos.	BDT Lakh	909
ii) Cost for CCR - approx. 10% on capital cost	BDT Lakh	91
Total cost =	BDT Lakh	**1000**
Total coat =	USD million @ BDT 78/$	**1.28**

Source: PPTA Consultant.

D. Solid Waste Management (SWM) - Pirojpur

445. Proposed items for solid waste management in Pirojpur Pourashava are (i) ricksha-van and (ii) hand trolley. The existing status of solid waste collection and disposal will be accelerated and improved by these items.

446. The cost estimate of the proposed solid waste management items for Pirojpur Pourashava is shown in **Table 7.45**.

Table 7.45: Cost Estimate of Proposed Solid Waste Management Items - Pirojpur

Particulars (Items)	Quantity	Unit cost	Total cost
i) Ricksha-van	6	0.25	1.50
ii) Push cart /hand trolley.	15	0.10	1.50
Total cost in BDT Lakh =			**3.00**
Total coat =	USD million @ BDT 78/$		**0.004**

Source: PPTA Consultant.

E. Summary of Municipal Infrastructure Cost Estimates – Pirojpur

Table 7.46: Summary of Municipal Infrastructure Cost Estimates – Pirojpur

Component	Unit	Capital cost	CCR cost	Total cost
1. Cost for Roads & related items	BDT Lakh	2710.00	658.00	3385.00
2. Cost for RCC bridge	BDT Lakh	173.00	17.00	190.00
3. Cost for Cyclone Shelter	BDT Lakh	909.00	91.00	1000.00
4. Cost for SWM facilities	BDT Lakh	3.00	0.00	3.00
Grand Total =	BDT Lakh	**3795.25**	**766.00**	**4578.00**
Grand Total =	USD million @ BDT 78/$	**4.850**	**0.982**	**5.87**

Source: PPTA Consultant.

7.3.3 Drainage and Flood Control - Pirojpur

447. Field surveys were done for the inventory of canals and drains in Piorjpur Pourashava considering necessary issues like existing conditions, re-excavation of silted up canals and widening to their right-of-way (RoW), making new street drains etc., with a view to prepare preliminary designs and cost estimates. The detailed inventory of the drains was assessed with the assistance of pourashava engineers.

448. The priority of the canals and drains was determined through participatory approaches during the workshop held on April 12, 2013 in Amtoli Pourashava in the presence of the mayor, councilors, engineers, PPTA consultants and others officials of relevant government agencies. The drains were finally selected to satisfy the selection criteria which are also in conformity with the CDTA report and draft master plan prepared by LGED.

449. Preliminary designs have been made, and cost estimates of re-excavations of earthen and lined canals, RCC drains etc. estimated as per LGED schedule of rates, July 2012.

450. Considering climate change resilience and adaptation issues, items like the raising up of canal banks and re-excavation to protect flooding and to improve flow capacities of the drains etc., have been included in the proposed interventions.

451. The inventory and proposed interventions on the drainage and flood control structures are listed on a priority basis in the annex in **Volume 5**.

452. The summary of quantities, and tentative capital cost (capex) (FY-2012-2013) and O&M cost (opex) for the proposed drainage and flood control structures, are stated in **Table 7.47**.

Table 7.47: Quantity and Cost Estimate for Proposed Drainage and Flood Control Structures – Pirojpur Pourashava

SL No	Proposed Drainage & Flood Control Interventions	Unit	Unit Cost (Million Taka)	Qty (Km)	Capital Cost (Million Taka)		O&M cost (Million Taka)	
					With CCR	Without CCR	From year 3 to 10 (% of capital cost per year)	From year 11 & Beyond (% of capital cost per year)
1	Earthen channel	Km	4	16.92	67.66	54.12	1	2
2	CC Block lined channel	Km	25	1.53	38.25	30.47	0.25	0.5
3	RCC Box culvert	Km						
4	RCC covered drain	Km	24.20	3.40	82.28	69.96	0.2	0.4
5	RCC open drain	Km	30	3.45	103.50	87.98	0.2	0.4
6	RCC pipe drain	Km						
7	Brick drain	Km						
8	RCC sluice gate structures	Nos.						
9	Box culvert cleaning & Gate repair	Nos.						
10	RCC flood wall	Km						
11	Maintenance Equipment				6.00	3.60	3	5
				25.3				
				BDT million	**297.69**	**246.13**		
				USD million @ BDT78/$	**3.82**	**3.16**		
				Additional cost due to CCR (BDT million)	**51.56**			
				Additional cost due to CCR (USD million)	**0.66**			

Source: PPTA Consultant.

7.3.4 Water Supply

A. Existing Water Supply System

453. **Water sources.** The current source of water for Pirojpur Pourashava is surface water from the Baleshwar River. Based on previous studies, DPHE concluded that the river is the only reliable source for the municipality. The southern region of the country to which Pirojpur belongs has limited groundwater resources. Although no exploration records could be retrieved, an exploration borehole drilled in the Pourashava area about 10 years ago led DPHE to conclude that groundwater abstraction through DTWs in Pirojpur is not a viable source of water supply as most of the groundwater is saline. As there is no dependable aquifer, a surface water source on the Baleshwar River was developed in 1983 for safe water supply (*Source: STWSSP, DPHE*). Water samples from Baleshwar River were tested by DPHE in 2006 and it was found that water quality parameters are within the Bangladesh Standard.

454. **Water Quality.** The CDTA Consultant team collected water samples from the Baleshwar and Kocha Rivers that were analysed in DPHE Central Laboratory in Dhaka. All the tested parameters were also found to be well within the Bangladesh Standard. The results are shown in the **Table 7.48**.

Table 7.48: Surface Water Quality of Baleshwar River - Pirojpur

Raw water Sample	Date	Laboratory	pH	TDS (mg/l)	Cl (mg/l)	Chromium (mg/l)	Sulphate (mg/l)
River Baleshwar	2006	DPHE, Rajshahi	7.6	26	112	0.002	48.1
Bangladesh Standard			**6.5~8.5**	**1,000**	**150~600 1000** (for coastal zone)	**0.05**	**400**

Source DPHE Pirojpur, CDTA, May, 2012

Raw water sample	Date	Laboratory	pH	TDS (mg/l)	Cl (mg/l)	Colour (Hazen)	Turbidity (NTU)
River Baleshwar	May'12	DPHE Dhaka	7.0	215	60	3.7	
River Kacha	May'12	DPHE Dhaka	7.8	90	16	2.9	
Bangladesh Standard			**6.5~8.5**	**1,000**	**150~600 1000** (for coastal zone)	**15**	**10**
Treated water sample							
SWTP	May'12	DPHE	7.3	250	77	1.0	1.0

Source CDTA Team, May 2012.

455. **Surface water source and treatment.** The Pourashava water supply system is supplied by water from the Baleshwar River. The river water flows to a surface pre-resettling unit and finally a settling pond by gravity when the water level becomes high enough during high tide. Most of the sediment is settled down in the settling pond and water is pumped to the water treatment plant. The plant has a capacity of 100m^3/hour (2.4 MLD). The treated water is stored in a clear water reservoir of capacity 680 m^3 from where water is pumped directly into the water supply system using two centrifugal pumps. The system has no overhead tank (OHT). A river intake was constructed on the bank of the Baleshwar River within the treatment plant compound, with the objective of pumping water from the river during low tide. However, it is reported that the intake has not been used for pumping water, as a sufficient quantity of raw water for a treatment plant of capacity 100m^3/hour is stored in the settling pond during high tide. The system is operated for around 20 hours a day. Chlorination is undertaken in the clear water chamber using bleaching powder containing around 30-33% available chlorine.

456. Construction an additional river intake on the Baleshwar River: a new surface water treatment plant (SWTP) of capacity 300m^3 per hour (7.2 MLD) and two overhead tanks (OHT) of capacity 680 m^3 each are in progress under Phase 2 of the Secondary Town Water Supply and Sanitation Project (STWSSP). After completion of the construction, 6,000m^3/day (6.0 MLD) water will be available to distribute in the supply system, which will cover almost all the urban area of the pourashava.

457. However, problems have been reported in that flows in the Baleshwar River have been declining, with the river silting up; upstream flows have been reducing due to upstream changes in the river morphology.

458. **Groundwater supplies.** Apart from the Pourashava water supply system, there are around 1,995 hand tube wells, of which 116 are deep tube wells and 1,879 shallow tube wells. While the hand tube wells are reportedly inefficient mainly due to maintenance problems, they are still being used, although to a limited extent. The Municipality reported that all tube wells and shallow wells had iron < 1mg/l, salinity <100mg/l and arsenic

<10ppb—however, these data are thought to be optimistic. Recently a small area has been identified for hand pump deep tube well supplies (source: CDTA Final Report).

459. Apart from the Pourashava water supply system, there are around 420 Hand Tube Wells (HTWs) of which 220 are private and 200 belong to the Pourashava. While the HTWs are reportedly inefficient mainly due to maintenance problems, these are still being used, although to a limited extent (source: STWSSP, DPHE).

460. There are around 122 nos. hand tube wells which belong to the Pourashava and mostly not in operation as water is saline contaminated (source: Pourashava)

461. **Water distribution pipelines.** The piped water supply system in Pirojpur town was first commissioned in 1983 based on surface water from Baleshwar River, with one SWTP and a limited length of pipeline. In 2006, the system consisted of 32 km distribution pipelines, 2,210 house connections and 65 street taps. A breakdown of water pipe system is given in **Table 7.49**.

462. Under the Secondary Towns Water Supply & Sanitation Project (STWSSP), the existing water supply system has been renovated. Under Phase 1 of this project, 13.8 km new pipeline has been laid, along with rehabilitation of 9.1 km of pipes, and the present water supply system has 45.8 km of supply and distribution pipelines (75~250 mm diameter), 2,600 water meters, and material for 2,308 new service connections have been arranged by the project. The breakdown of the water pipe system after rehabilitation is presented in **Table 7.50**.

463. Construction of 45.28 km new water pipeline is in progress under Phase 2 of STWSSP. The breakdown of proposed the water pipe system is shown in **Table 7.51**.

Table 7.49: Breakdown of Existing Water Distribution Pipelines - Pirojpur

Sl No.	Diameter (mm)	Length (km)	Material	Remarks
1	250	3.00	AC	Total length 32 km including 3 km of 75 mm dia.
2	200	4.00	PVC	
3	150	15.00	PVC	
4	100	7.00	PVC	
5	75	3.00	PVC	

Source: STWSSP, DPHE.

Table 7.50: Breakdown of Distribution System after Rehabilitation (STWSSP) - Pirojpur

Sl No.	Diameter (mm)	Length (km)	Material	Remarks
1	250	3.00	PVC	Total length 45.50 km of PVC pipelines of diameter ranging from 75mm to 250mm.
2	200	4.00	PVC	
3	150	18.50	PVC	
4	100	17.00	PVC	
5	75	3.00	PVC	

Source: Pourashava, 30 March 2013.

Table 7.51: Breakdown of Proposed Water Pipelines (STWSSP) - Pirojpur

Sl No.	Diameter (mm)	Length (km)	Material	Remarks
1	250	4.12	PVC	Total length 45.28 km of PVC pipelines of diameter ranging from 100mm to 250mm.
2	200	4.76	PVC	
3	100	36.40	PVC	

Source: Pourashava, 30 March 2013.

464. **Service connections**.There is a total of 4,076 service connections in Pirojpur Pourashava. The service connections can categorized into (i) residential and (ii) commercial. The details of the service connection are given in **Table 7.52**.

Table 7.52: Details of Service Connections - Pirojpur

Sl No.	Diameter (mm)	Residential	Commercial	Total
1	13 mm	2682	-	2682
2	13 mm	-	70	70
3	19 mm	1179	-	1179
4	19 mm	-	88	88
5	25 mm	-	28	28
6	38 mm	-	23	23
7	50 mm	-	4	4
8	75 mm	-	2	2
			Total =	**4,076**

Source: Pourashava, 30 March 2013.

B. Demand Analysis

465. **Population projection.** The current population of Pirojpur is 60,056 (2011). Its population in the last censuses were 52,176 (2001) and 32,720 (1991). The population growth rates of 1991-2001 and 2001-2011 are 4.77% and 1.42% respectively. The population growth rate of 1991-2001 is higher due to almost doubling of the Pourashava Area. Ward wise population growth rate and projection is not possible because the Pourashava had 3-wards during 1991-2001 and 9-wards during 2001-2011. So, population projection has been made based on a growth rate of 1.42% for all 9 wards of Pirojpur Pourashava, and .is presented in **Table 7.53**.

Table 7.53: Population Projection - Pirojpur

Pirojpur Pourashava	Area (sq. km)	Population				
		2011	**2020**	**2030**	**2040**	**2050**
Ward No -01	**29.46**	5,707	6577	7580	8736	10068
Ward No -02	4.5	6,459	7444	8579	9887	11395
Ward No -03	2.62	4,717	5436	6265	7220	8321
Ward No -04	4.70	10,421	12009	13841	15952	18385
Ward No -05	1.81	7,528	8676	9999	11524	13282
Ward No -06	2.31	6,143	7080	8160	9404	10838
Ward No -07	3.60	7,112	8197	9447	10888	12549
Ward No -08	1.01	6,474	7461	8599	9910	11421
Ward No -09	2.85	5,495	6333	7299	8412	9695
Total	6.06	**60,213**	**69,231**	**79,769**	**91,933**	**105,894**
Growth Rate			1.43%	1.43%	1.43%	1.43%

(Source: CDTA Draft Final Report).

466. **Water demand. Table 7.54** shows the assessment of Average Daily Demand for Pirojpur which is based on the projected population, area served, peak daily demand, non-revenue water (NRW), etc.

Table 7.54: Water Demand Projection – Pirojpur

Parameter	Unit	2020	2030	2040
Predicted Total Municipal Population	Nr	**69,213**	**79,769**	**91,933**
W S Service Area Population (% of total municipal population)	%	50	55	60
W S Service Area Population	Nr	34,606	43,873	55,160
People Using the Service	%	85	90	90
Design Population	Nr	29,415	39,486	49,644
Population Served by Domestic Connection (100%)	Nr	29,415	39,486	49,644
Population served by street hydrants	Nr	Nil	Nil	Nil
Daily Per Capita Consumption				
Domestic Demand (DD)	m^3/day	2,941	3,947	4,964
Non-domestic Demand (NDD) : 20% of DD	m^3/day	588	790	993
Total DD + NDD	m^3/day	3529	4,737	5,957
Unaccounted for Water (UFW)				
25% of Total production for 2020	m^3/day	882	-	-
20% of total production for 2030 and 2040	m^3/day	-	947	1191
Average Daily Demand (ADD)=DD+NDD+UFW	m^3/day	4,411	5,684	7,148
Increased Water Demand Due to Temperature Rise				
15% of ADD	m^3/day	661	853	1072
Total Average Daily Demand	m^3/day	5,072	6,537	8,220
Design Demand for Transmission System (1.20 x Peak day demand)	m^3/day	6,086	7,845	9,864

Source: PPTA Consultant.

467. Production capacity is summarized below:

i. Previous SWTP of capacity 100m^3/h (18 hr. operation) = 100x18 = 1,800 m^3/day
ii. New SWTP of capacity 300m^3/h (20 hr. operation) = 300x20 = 6,000 m^3/day
Iii Total water production capacity/day = 7,800 m^3/day

468. The existing water production capacity of Pirojpur Pourashava will be able to meet the demand of the core area till 2030. Therefore it is recommended not to construct any treatment plant under CTIIP.

7.3.5 Sanitation

469. Results from the Socioeconomic and Willingness to Pay (SEWTP) Survey conducted in Pirojpur concerning sanitation are summarized below:

- Toilets with Septic Tank : 32.6% (of households)
- Pit Latrine with Slab and Water Seal : 9.7%
- Pit Latrine with no Water Seal : 0.3
- Ring Slab Latrine with Water Seal : 34.5%
- Ring Slab Latrine with no Water Seal : 21.6%
- Hanging Latrine : 0.80%
- No Facilities or Bush Field : 0.30%

- Other/Toilet releasing Waste Directly into Drain : 0.30%

470. **Household Pit Latrines:** Household latrines (examples are illustrated in **Photograph 7.5**) are generally located in relatively low areas. The latrines generally consists of 4/5 nos. rings placed to the depth of around 3-4ft (0.9-1.2m) in the ground; a platform is simply placed on the upper most ring of the pit which is almost at the ground level. Consequently the latrines are easily getting inundated due to rain water accumulation around the latrines in the monsoon, resulting in a loss of accessibility to the latrine and pollution caused by discharge of the contents. It was observed in some places during the field visit that holes have been made on the surface of ring of the latrine pit to allow the flow of sludge over the ground to the nearby ditch, *khal* or canal which is really an environmental and health hazard.

Photograph 7.5: Existing Household Pit Latrines in Pirojpur Pourashava

Source: PPTA Consultant.

471. **Toilets/latrines under implementation:** A considerable number of community latrines, public toilets, school latrines and household latrines are being constructed at different locations of Pirojpur Pourashava under STWSSP. A summary of this sanitation work is presented in **Table 7.55**.

472. Due to the coverage from STWSSP, toilets are not proposed to be constructed under CTIIP in Pirojpur Pourashava.

Table 7.55: Summary of Sanitation Work (STWSSP) - Pirojpur

Sl No.	Type of Latrines/Toilets	No. of Units
1	Community Latrines	25
2	Public Toilets	5
3	School Latrines	8
4	Household Latrines	45
Total =		**83**

Source: Pirojpur Pourashava.

7.4 MATHBARIA POURASHAVA

7.4.1 Mathbaria Pourashava Profile

473. **Background.** Mathbaria came into existence in 1981 as a *thana*. Nothing is definitely known about the origin of its name. The local people are of the opinion that there was a temple meaning Math in the present place of the *upazila* headquarters. The name of the *upazila* is said to have been derived from the name Math as Mathbaria bazaar.

474. Mathbaria Pourashava was established on 1 June 1993 and classified as a Class-C Pourashava. Later it was upgraded as Class-A Pourashava on 3 June 2010. The Pourashava is divided into 9 wards consisting of 16 *mouzas/mahallas*.

475. **Location.** Mathbaria is the largest *upazila* of Pirojpur District in respect of both area and population. It is located between $22^0$09' and $22^0$24' north latitude and between $89^0$52' and $90^0$03' east longitude. It is located in Pirojpur District of Barisal Division. The Pourashava is bounded by Dhanisafa Union to the north, Bara Masua Union to the west, Tushkhali to the north and Tikikata Union to the south-east.

476. **Topography.** The topography Matbaria Pourashava is mostly flat. The elevation ranges mostly between 0.2 m to 4.5 m. Mostly of the pourashava area is below 2.3 m PWD only the patches of land along *khal* banks and built up town area have elevation more than 2.5 m PWD. However, there are some small patches of land having elevation as high as 4.5 m PWD.

477. The Pourashava area is located on the southern part of Bengal Basin making a part of Barisal Gravity High. The sedimentary layers are mostly horizontal to sub-horizontal and are free from major tectonic deformation in the fore deep area covering the central part of the basin and this is expressed as river to delta plain topography of the land.

478. **Area and population.** Mathbaria is the largest *upazila* of Pirojpur District in respect of both area and population. The *upazila* occupies a total area of 344.23 km^2 including 8.55 km^2 forest area. Mathbaria Pourashava is the only urban area of the *upazila*, and occupies an area of 6.55 km^2.

479. Information about the total number of households with average size and population of Mathbaria Pourashava is presented in **Table 7.56**.

Table 7.56: Mathbaria Pourashava Population Data

Administrative Unit	Area (sq. km)	Households (nos.)	Population			Average HH Size	Density (per sq.km)
			Total	Male	Female		
Mathbaria Pourashava	**6.55**	**4,330**	**18,375**	**9,124**	**9,251**	**4.24**	**2,805**
Ward No - 01	0.73	334	1,565	838	727	4.68	2,143
Ward No - 02	0.24	587	2,281	1,115	1,166	3.88	9,504
Ward No - 03	1.21	695	2,844	1,355	1,489	4.09	2,350
Ward No - 04	0.20	277	1,047	582	465	3.78	5,235
Ward No - 05	1.13	600	2,507	1,275	1,232	4.18	2,218
Ward No - 06	0.71	401	1,711	786	925	4.26	2,409
Ward No - 07	0.71	523	2,268	1,142	1,126	4.33	3,194
Ward No - 08	0.77	606	2,207	1,065	1,142	3.64	2,866
Ward No - 09	0.85	407	1,945	966	979	4.77	2,288

Source: BBS Community Report, Zilla: Pirojpur, 2011.

7.4.2 Municipal Infrastructure - Mathbaria

A. Roads - Mathbaria

480. Roads necessary for improvement /rehabilitation were surveyed and an inventory of required works was conducted with the assistance of the pourashava engineers considering all necessary issues and findings such as existing condition, type, formation level (rise), widening, shoulder/footpath, side protection works, side-drain, cross-drain/culvert, tree plantation, etc. with a view to perform preliminary design and cost estimation.

481. The identified roads were finalized through the workshop organized in the pourashava in the presence of the mayor, councilors, engineers, PPTA consultants and invited officials from relevant organizations. Then the roads were finally selected and prioritized according to the selection criteria and scoring matrix (weight) developed for this project (as outlined in Section 6.1).

482. Basic data on the proposed roads and related works in Mathbaria Pourashava are shown on **Table 7.57**.

483. The cost estimate of the proposed roads and other related (variable) works in Mathbaria Pourashava are shown in **Table 7.58**.

Table 7.57: Basic Data on Proposed Roads - Mathbaria

No.	Item	Qty	Unit
1.1	Number of road	5	No.
1.2	Length of road	8.00	Km
1.3	BC pavement, length	8.00	Km
1.4	RCC pavement, length	0.00	Km
1.5	Width ranges	3.0 to 5.5	m
1.6	Total Pavement Area	37,660	m^2
1.7	BC pavement area	37,660	m^2
1.8	RCC pavement area	0	m^2
2.1	Road side drain	9.80	Km
2.2	Cross-drain /Culvert	13	No.
2.3	Side protection works	0.10	m
2.4	Tree plantation	1,500	No.
2.5	Rise of road (avg.)	0.30	m

Source: PPTA Consultant.

Table 7.58: Cost Estimate of Proposed Roads - Mathbaria

Particulars	Unit	Cost
BC road :		
i) Standard (fixed items) cost for roads without CCR cost	BDT Lakh	780
ii) Cost for CCR stands 22% on standard /capital cost	BDT Lakh	172
iii) Cost for related (variable) works	BDT Lakh	231
Cost in total for BC road =	**BDT Lakh**	**1183**
Grand Total for all roads =	**USD million @ BDT 78/$**	**1.52**

Source: PPTA Consultant.

B. Bridges

484. There are many locally built bridges in Mathbaria Pourashava over the canals. These are mainly foot-bridges such as iron-sleeper bridges, wooden bridges (*pul*) and bamboo bridges (*sako*). Vehicles cannot move over these bridges. In many place new RCC bridges are necessary to establish connectivity among the adjacent areas.

485. A few sites of existing risky foot-bridges were identified with the assistance of pourashava engineers and councilors. The identified bridges were finalized through the workshop organized in the pourashava. Then only one location for a RCC bridge was finally selected adopting the selection criteria and scoring matrix of this project.

486. Basic data on the proposed bridge in Mathbaria Pourashava are shown on **Table 7.59**.

487. The cost estimate of the proposed bridge in Mathbaria Pourashava is shown in **Table 7.60**.

Table 7.59: Basic Data on Proposed Bridge - Mathbaria

No.	Item	Qty	Unit
1.1	Bridge proposed	1	No.
1.2	Length required	42	m
1.3	Width proposed	5.5	m
1.4	Cost per meter	6	BDT Lakh

Source: PPTA Consultant.

Table 7.60: Cost Estimate of Proposed Bridge - Mathbaria

Particulars	Unit	Cost
RCC Bridge :		
i) Capital cost - without CCR cost for 1 no.	BDT Lakh	229
ii) Cost for CCR - approx. 10% on capital cost	BDT Lakh	23
Total cost =	**BDT Lakh**	**252**
Total cost =	**USD million @ BDT 78/$**	**0.32**

Source: PPTA Consultant.

C. Cyclone Shelters - Mathbaria

488. In Mathbaria Pourashava there are no existing cyclone shelters. During the field visit some important sites for cyclone shelters were identified with the assistance of pourashava engineers. The identified cyclone shelters were finalized through the workshop organized in the pourashava. Then four sites for cyclone shelters, based at schools, were finally selected and prioritized according to the selection criteria and scoring matrix (weight) developed for this project.

489. Basic data on the proposed cyclone shelters in Mathbaria Pourashava are shown in **Table 7.61**.

490. The cost estimate of the proposed cyclone shelters in Mathbaria Pourashava is shown in **Table 7.62**.

Table 7.61: Basic Data on Proposed Cyclone Shelters - Mathbaria

No.	Item	Qty	Unit
1.1	Cyclone shelter –cum-school	1	No.
1.2	Floor area (1st) [2655 sft] /shelter	247.73	m^2
1.3	Capacity /shelter	1,328	No.
1.4	Cost per CS-cum-school	250	BDT Lakh

Source: PPTA Consultant.

Table 7.62: Cost Estimate of Proposed Cyclone Shelters - Mathbaria

Particulars	Unit	Cost
Cyclone Shelter-cum-school :		
i) Capital cost - without CCR cost for 1 nos.	BDT Lakh	227
ii) Cost for CCR - approx. 10% on capital cost	BDT Lakh	23
Total cost =	**BDT Lakh**	**250**
Total coat =	**USD million @ BDT 78/$**	**0.32**

Source: PPTA Consultant.

D. Solid Waste Management (SWM) - Mathbaria

491. Proposed items for solid waste management in Mathbaria Pourashava are (i) ricksha-van and (ii) hand trolley. The existing status of solid waste collection and disposal will be accelerated and improved by these items.

492. The cost estimate of the proposed solid waste management items for Mathbaria Pourashava is shown in **Table 7.63**.

Table 7.63: Cost Estimate of Proposed Solid Waste Management Items - Mathbaria

Particulars (Items)	Quantity	Unit cost	Total cost
i) Ricksha-van	5	0.25	1.25
ii) Push cart /hand trolley.	10	0.10	1.00
		Total cost in BDT Lakh =	**2.25**
Total cost =	**USD million @ BDT 78/$**		**0.003**

Source: PPTA Consultant.

E. Summary of Municipal Infrastructure Cost Estimates – Mathbaria

Table 7.64: Summary of Municipal Infrastructure Cost Estimates – Mathbaria

Component	Unit	Capital cost	CCR cost	Total cost
1. Cost for Roads & related items	BDT Lakh	1011.00	172.00	1183.00
2. Cost for RCC bridge	BDT Lakh	229.00	23.00	252.00
3. Cost for Cyclone Shelter	BDT Lakh	227.00	23.00	250.00
4. Cost for SWM facilities	BDT Lakh	2.25	0.00	2.25
Grand Total =	BDT Lakh	**1469.25**	**218.00**	**1687.25**
Grand Total =	USD million @ BDT 78/$	**1.88**	**0.28**	**2.16**

Source: PPTA Consultant.

7.4.3 Drainage and Flood Control - Mathbaria

493. Field surveys were done for the inventory of canals and drains in Mathbaria Pourashava considering necessary issues like existing conditions, re-excavation of silted up canals and widening to their right-of-way (RoW), making new street drains etc., with a view to prepare preliminary designs and cost estimates. The detailed inventory of the drains was assessed with the assistance of pourashava engineers.

494. The priority of the canals and drains was determined through participatory approaches during the workshop held on April 13, 2013 in Amtoli Pourashava in the presence of the mayor, councilors, engineers, PPTA consultants and others officials of relevant government agencies. The drains were finally selected to satisfy the selection criteria which are also in conformity with the CDTA report and draft master plan prepared by LGED.

495. Preliminary designs have been made, and cost estimates of re-excavations of earthen and lined canals, RCC drains etc. estimated as per LGED schedule of rates, July 2012.

496. Considering climate change resilience and adaptation issues, items like the raising up of canal banks and re-excavation to protect flooding and to improve flow capacities of the drains etc., have been included in the proposed interventions.

497. The inventory and proposed interventions on the drainage and flood control structures are listed on a priority basis in the annex in **Volume 5**.

498. The summary of quantities, and tentative capital cost (capex) (FY-2012-2013) and O&M cost (opex) for the proposed drainage and flood control structures, are stated in **Table 7.65**.

Table 7.65: Quantity and Cost Estimate for Proposed Drainage and Flood Control Structures – Mathbaria Pourashava

SL No	Proposed Drainage & Flood Control Interventions	Unit	Unit Cost (Million Taka)	Quantity (Km)	Capital Cost (Million Taka)		O&M cost (Million Taka)	
					With CCR	Without CCR	From year 3 to 10 (% of capital cost per year)	From year 11 & Beyond (% of capital cost per year)
1	Earthen channel	Km	4	7.475	29.9	23.92	1	2
2	CC Block lined channel	Km	25	1.675	41.88	33.504	0.25	0.5
3	RCC Box culvert	Km						
4	RCC covered drain	Km	40	1.65	66	56.1	0.2	0.4
5	RCC open drain	Km						
6	RCC pipe drain	Km						
7	Brick drain	Km						
8	RCC sluice gate structures	Nos.						
9	Box culvert cleaning & Gate repair	Nos.						
10	RCC flood wall	Km						
11	Maintenance Equipment				2.62	1.5	3	5
				10.8				
				BDT million	**140.40**	**115.02**		
				USD million @ BDT78/$	**1.80**	**1.47**		
				Additional cost due to CCR (BDT million)	**25.38**			
				Additional cost due to CCR (USD million)	**0.33**			

Source: PPTA Consultant.

7.4.4 Water Supply - Mathbaria

A. Water Resources

499. **Hydrology.** The Baleswar River flowing 8 km west and the Bishkahali River 12 km east of Mathbaria influences the surface water hydrological condition of the pourashava. Both the rivers are tidal river which shows semidiurnal tidal fluctuation. Mathbaria-Machua Khal from Baleswar river and Mathbaria-Dowatola Khal from Bishkhali river are meeting in the Mathbaria city and connecting both the rivers. A number of khals which are drainage arteries of the pourashava run through the pourashava.

500. There are about 300 ponds within the pourashava. The water is available round the year in 67% of the ponds. The remaining ponds hold water for 6-7 months. About 30% ponds are being used for culture fishery (source: Baseline Survey Final Report, Ground Water Management and Feasibility Study for 148 Pourashavas, DPHE).

501. **Surface water quality.** A good number of *khals* run through the pourashava and the ponds make the surface water resource of the pourashava. All canals are tidal and get the flow of water from the Baleshwar or Bishkhali River. In the wet season the *khals* remain full but some of them get water during spring tide in the dry season only. The *khal* water is somewhat turbid and contains algae. Water hyacinth is found to float on it. The water of canals coming from Baleswar River is saline except in the monsoon months.

502. **Groundwater availability and quality.** The water table (WT) in the Pourashava area varies generally from 1.5m to 3.0m and does not go beyond suction limit. Shallow hand tube wells (HTW) are used by the general population to abstract water from the ground. But most of the water from hand tube wells is iron and saline contaminated, and in some cases arsenic contaminated. Consequently, most of the tube well water is not used for drinking, but used for other domestic purposes.

503. The water in the deep aquifer in Mathbaria is also severely saline contaminated. The deep aquifer salinity data, collected from BWDB Ground Water Circle, show that the salinity level in the groundwater is much higher than the Bangladesh Standard. Available data on the water quality of the deep aquifer are shown in **Volume 5**, and indicate that the deep groundwater is highly saline and unsuitable as a source for municipal water supply.

B. Present Water Supply Status

504. Presently, there is no piped water supply in Mathbaria Pourashava. Shallow hand tube well water is the main source of water supply for majority of the Pourashava population for domestic use only and not for drinking as the water has extreme salinity. In Mathbaria Pourashava, there are 225 hand tube wells which have been installed by the Pourashava and DPHE; most of which (about 115) are reportedly dysfunctional at the moment due the presence of extreme salinity in the groundwater. About 150 hand tube wells are installed by the individual owners sunk at their homestead. There are deep tubewells inside the pourashava.

505. Surface water sources include four canals (Tushkhali, Boyratala, Mirukhali and Machua/Ramna khals) flowing inside the pourashava area; tidal water is available round the year in these *khals*. The people of the area use the water for domestic use, and drinking after filtration and sometimes after boiling.

506. There are 65 pond sand filters (PSF) in the pourashava area; out of which about 40 are in a functional condition. The PSF consists of (i) raw water pump (ii) raw water chamber (iii) filter bed of sand and charcoal (iv) clear water chamber with clear water outlets. The raw water from ponds is pumped to the filter bed and the filtered water flows through the outlet of the PSF. The capacity of the each PSF is 1,500 to 2,000 liters per day.

507. PROSHIKA, an NGO, is operating a mini water treatment plant in Mathbaria **(Photograph 7.6)**. The plant was established in 2003 in the Upazilla Office Compound. The pond water in the compound is being used as a water source. Water from the pond is pumped to the chamber where alum and chlorine is added and the water is allowed to a filter of stone chips, carbon and sand layers. The treatment capacity of the plant is 5,000 liter/day. The cost of 20 liters water is 2 taka only.

508. Rain water harvesting (RWH) facilities are hardly found in practice in the pourashava.

Photograph 7.6: PSF in Mathbaria Upazilla Compound Operated by PROSHIKA

Source: PPTA Consultant.

C. Water Supply System Implementation

509. **Selection of water supply source.** The residents of Mathbaria Pourashava have been suffering for want of safe potable water supply. They are using pond and canal water for drinking after filtration. The shallow hand tube well water is iron and saline contaminated and some is arsenic contaminated as well. It is reported that a few deep hand tube wells were installed in the area before but those became nonfunctional with time as the water of the wells was also saline contaminated. No deep hand tube well (functional/nonfunctional) was found in the poura area during the consultant's visit in Mathbaria Pourashava.

510. Groundwater quality data of the tube wells (depths 61.0m, 152.4m and 280.5m) in Mathbaria have been collected from BWDB Groundwater Circle; the data are shown in **Volume 5**, which indicate that the salinity level in the groundwater is extremely higher than the Bangladesh Drinking Water Standard.

511. Electrical conductivity and salinity data of BWDB surface water sampling stations have been collected from BWDB Groundwater Circle. The sampling stations are (i) SW107.2 Rayenda, opposite (bank) to the offtake of Masuakhal in Baleswar River, and (ii) SW38.1 Barguna, 16 km downstream of Dowatola khal outfall to Bishkhali River. The Baleswar River is above the permissible limit of drinking water standards, whereas the Bishakhali River is within the permissible limit around the year. So it seems that the Bishkhali River is a better source of water supply for Mathbaria rather than the Baleswar River.

D. Population Projection

512. Information on population for Mathbaria Pourashava is only available in the censuses of 2001 and 2011, as Mathbaria Pourashava was established on 1 June 1993. The current population of Mathbaria Pourashava is 18,375 (2011) and its population in the 2001 census was 15,407. The population growth rate is 1.78%. The population projection has been made considering continuation of the current growth rate of 1.78% till 2040 **(Table 7.66)**.

Table 7.66: Predicted Population till 2040 - Mathbaria

Mathbaria Pourashava	Area (km^2)	Population				
		2011	2020	2030	2040	2050
Ward No-01	0.73	334	1,866	2,226	2,655	3,167
Ward No-02	0.24	587	2,721	3,246	3,872	4,619
Ward No-03	1.21	695	3,392	4,046	4,826	5,757
Ward No-04	0.20	277	1,249	1,490	1,777	2,119
Ward No-05	1.13	600	2,990	3,566	4,254	5,074
Ward No-06	0.71	401	2,041	2,434	2,903	3,463
Ward No-07	0.71	523	2,705	3,226	3,848	4,590
Ward No-08	0.77	606	2,632	3,139	3,744	4,466
Ward No-09	0.85	407	2,320	2,767	3,300	3,936
Total	**6.55**	**18,375**	**21,916**	**26,140**	**31,179**	**37,191**
Growth Rate			1.78	1.78	1.78	1.787

Source: PPTA Consultant.

E. Water Demand Projection

513. The water demand projection for Mathbaria Pourashava is shown on **Table 7.67**.

Table 7.67: Water Demand Projection - Mathbaria

Parameter	Unit	2020	2030	2040
Predicted Total Municipal Population	Nr	21,916	26,140	31,179
W S Service Area Population (% of total municipal population)	%	100	100	100
W S Service Area Population	Nr	21,916	26,140	31,179
People Using the Service	%	80	85	90
Design Population	Nr	17,532	22,219	28,061
Population Served by Domestic Connection (100%)	Nr	17,532	22,219	28,061
Population served by street hydrants	Nr	Nil	Nil	Nil
Daily Per Capita Consumption				
Domestic Demand (DD)	m^3/day	1,753	2,222	2,806
Non-domestic Demand (NDD) : 15% of DD	m^3/day	263	333	421
Total DD + NDD	m^3/day	2,016	2,555	3,227
Unaccounted for Water (UFW)				
10% of Total production for 2020 and 2040	m^3/day	202	256	323
Average Daily Demand (ADD)=DD+NDD+UFW	m^3/day	2,218	2,811	3,550
Backwash & Wastage				
5% of ADD	m^3/day	110	140	177
Increased Water Demand Due to Temperature Rise				
15% of ADD	m^3/day	333	423	533
Total Average Daily Demand	m^3/day	2,551	3,234	4,083
Design Demand for Transmission System (1.20 x Peak day demand)	m^3/day	3,171	4,020	5,077

Source: PPTA Consultant.

F. Proposed Water Supply Interventions

514. The interventions to introduce water supply system in Mathbaria Pourashava have been proposed based on the results of the field investigations and consultation with Mayor, Councillors and peoples of Mathbaria Pourashava. The projected water demand for the year 20140 and climate change impacts for the year 20150 have also been taken into account. The proposed water supply interventions in Mathbaria with and without climate change adaptation are presented in the **Table 7.68**.

515. The outline of the proposed system is shown on **Figure 7.3**.

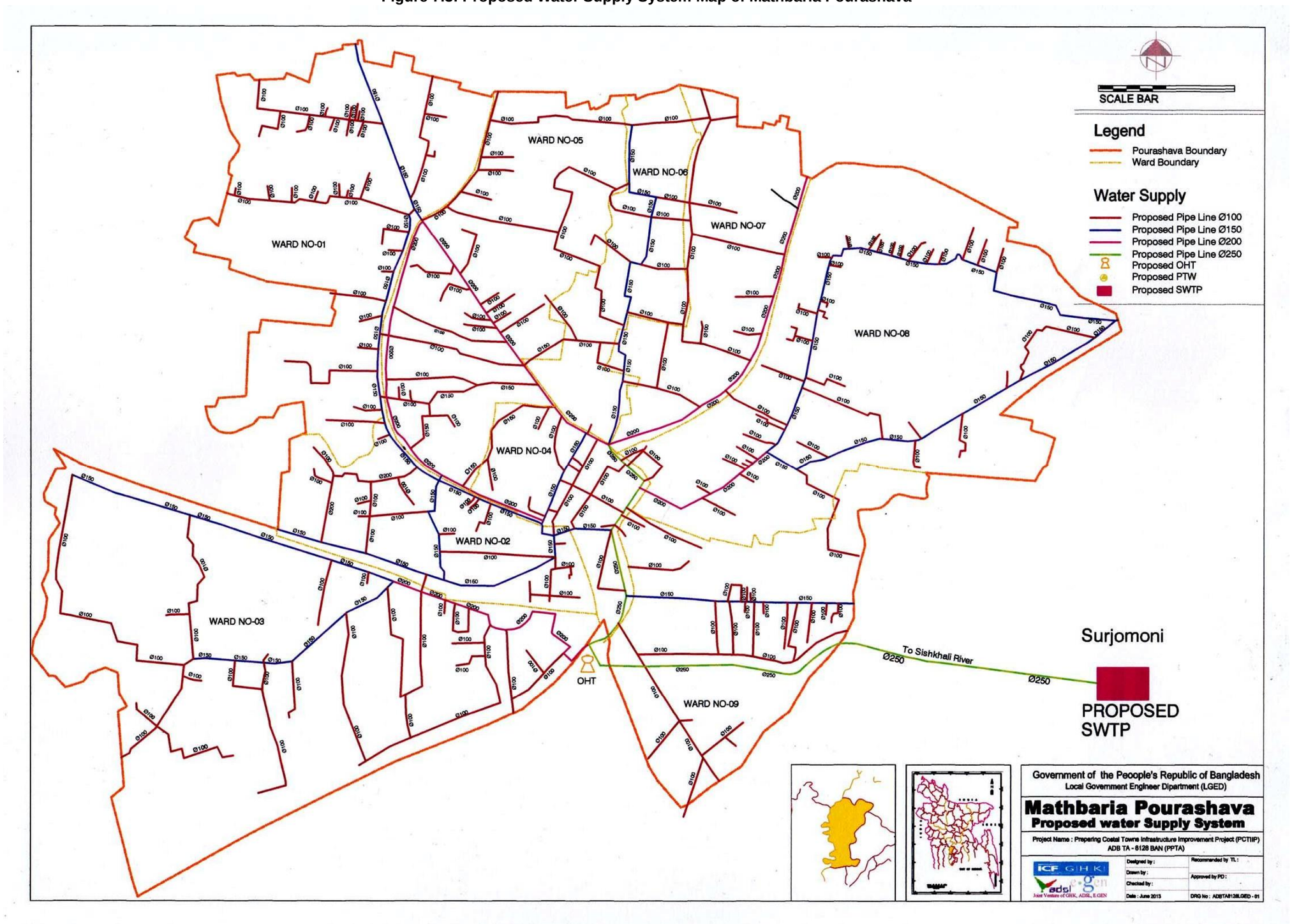
Table 7.68: Proposed Water Supply Interventions - Mathbaria

Sl. No.	Items	Unit	Rate (Lac Tk.)	Qty	Amount (Lac Tk.)		Remarks
					With Climate Change Adaptation	Without Climate Change Adaptation	
1.0	**Land Acquisition**	Acre	15.00	10	150	15(	
2.0	**Construction of SWTP**						
2.1	Surface water Treatment Plant (300 m^3 per hour)	No.	1000.00	1	1000.00	1000.00	
2.2	Sedimentation Pond (100 m x 120 m)	No.	200.00	1	200.00	200.00	
2.3	River Intake	No.	70.00	1	70.00	70.00	
2.4	Pond Intake	No.	40.00	1	40.00	40.00	
3.0	**Construction of Water Storage Facilities**						
3.1	Over Head Tank (OHT) of Capacity 680 m^3	No.	200.00	1	253.00	230.00	10% (assumed) of total cost will be increased if the cyclonic strong wind is taken into account for designing the structure.
3.2	Ground Reservoir of Capacity 2000 m^3 for Emergency Water Storage Provision	No.	600.00	1	600.00	-	Water storage facility for emergency use after cyclone/storm surge.
4.0	**Installation of Water Transmission and Distribution**						
4.1	100 mm dia	km	12.00	32	384.00	384.00	
4.2	150 mm dia	km	16.00	7	112.00	112.00	
4.3	200 mm dia	Km	25.00	5.5	137.50	137.50	
4.4	250 mm dia	km	35.00	4.5	157.50	157.50	
5.0	**Laying of Service Connection**						
5.1	13 mm connection	Nos.	0.06	3000	180.00	180.00	
5.2	20 mm connection	Nos.	0.065	175	11.38	11.38	
5.3	25 mm connection	Nos.	0.70	25	17.50	15.00	
6.0	**Procurement and Installation of Water Meters in Service Connections**						
6.1	13 mm connection	Nos.	0.03	3000	90.00	90.00	
6.2	20 mm connection	Nos.	0.035	450	15.75	15.75	
6.3	25 mm connection	Nos.	0.04	50	2.00	2.00	
7.0	**Construction of Protection Embankment surrounding the SWTP Compound**	M	0.10	800	80.00	-	Protection of SWTP compound from cyclone/storm surge

Sl. No.	Items	Unit	Rate (Lac Tk.)	Qty	Amount (Lac Tk.)		Remarks
					With Climate Change Adaptation	Without Climate Change Adaptation	
8.0	**Re-sectioning of Khal**	Km	5.00	3.0	15.00	15.00	
9.0	**Exploratory Drilling**	Nos.	1.50	10	15.00	15.00	
10.0	**Mini Water Testing Laboratory**	LS	0.50	1	0.50	0.50	
11.0	**Pourashava Water Supply Office cum Residence**	No.	25.00	1	25.00	25.00	
12.0	**Logistics**						
12.1	Pick-up	No.	50.00	1	50.00	50.00	
12.2	Motor Cycle	No.	1.00	2	2.00	2.00	
12.3	Computers, software etc.	LS	2.00	1	2.00	2.00	
12.4	Generator for proposed System	LS	25.0	1	25.00	-	Power backup for water supply is urgently needed if infrastructures get damaged by cyclone/storm
	Total (BDT)				**3635.13**	**2907.13**	
	Total (USD)				**4.66 million**	**3.73 million**	Conversion Rate: 1 USD @ 78 BDT
	Climate Change Adaptation Cost (USD)				**0.93 million or 20.0% of Total Cost**		

Note: *Assumed exchange rate $1.00=BDT78.
Source: PPTA Consultant.

Figure 7.3: Proposed Water Supply System Map of Mathbaria Pourashava



Source: PPTA Consultant.

516. **Land acquisition:** About 10 acres of land will be acquired for construction of SWTP, pre-settling and sedimentation basin, raw water intake, pump house, water storage, storage for chemical, office cum residence etc.

517. **Water source development and treatment plant:** In order to meet the estimated water demand of around 5,000 m^3/day, one Surface Water Treatment Plant (SWTP) with a capacity of 300 m^3/hr (5.5 mld.) is proposed to be constructed at Surjamoni near Boddhabhumi under Tikikata Union; about 3.5 km east from Mathbaria town. The raw water source will be Mathbaria – Kholpatua khal connecting the river Bishkhali about 12 km east and the Boleshwar about 11 km west from the proposed SWTP site. The khal has perennial tidal flow of sufficient quantity to full fill the daily raw water demand of SWTP.

518. The salinity of Baleswar River is higher than permissible limit of Bangladesh drinking water standard where as Bishakhali River water remains under permissible limit of salinity round the year. In order to take delivery of Bishkhali River water to treat, the SWTP and intake have been proposed 3.5 km up to the Bishkhali River from Mathbaria Town.

519. **Raw Water Intake:** The proposed raw water intake will be constructed to pump water from Shurjomoni khal originates from Mathbaria – Kholpatua khal. There is a sluice gate named Surjomoni Sluice located at the junction of Mathbaria – Kholpatua khal and Surjomoni khal. The sluice is operated to raise water level inside polder during summer and kept open to allow water discharge during monsoon. The intake should have provision of gravity flow in the pre-sedimentation basin of the proposed SWTP from Surjomoni khal. This arrangement will save huge amount of power consumption from operation of pump in the intake.

520. **Water Storage:** An over head tank (OHT) has been proposed to be constructed near Tikikata Union Compound. The capacity of the over head tank will be 680 m^3 which is about 15% of total production capacity. The cyclonic strong wind will be taken into account during detail design of the structure to make it strong enough to withstand the cyclones and climate resilient.

521. River and pond water gets saline during cyclone and storm surge. A ground reservoir of capacity 2,000m^3 is proposed for provision of water storage for emergency use. The construction cost of the reservoir will be treated as climate change adaptation cost.

522. **Water distribution and transmission mains:** Water distribution and transmission mains form the main arterial system of the water supply net work. The Consultant visited the site and studied the existing road network and households in the city. A tentative plan of distribution pipelines has been prepared with the objective to water coverage almost 100% of the Pourashava area. About 3.5 km transmission pipeline will be laid from SWTP to overhead tank.

523. **Service connections:** As per BBS 2011, there are 4330 households (HHs) in Mathbaria Pourashava; and the average household size is 4.6 persons (as per SEWTP carried out under CTIIP). Projected population of 21,916 by 2020 has been considered for estimating number of service connections and to determine the costing for that. The total predicted number of service connections based on population 21,916 by 2020 (@ 1.5 HH/ service connection) will be about 3,200.

524. **Water meters:** All future connections will be metered. A total of 3,200 water meters will be procured and installed in the future service connections. Multijet water meter of metrological class B as per ISO 4064 is recommended for procurement under the project. The meter will be of the semi-dry dial type.

525. **Embankment surrounding SWTP compound:** The proposed water works compound at Surjamoni near Boddhabhumi under Tikikata Union will be protected from cyclone, storm surge etc. Earthen embankment of height 4.0m above mean sea level with cc block pitching, will be constructed along the boundary of the compound. The width of the embankment crest will be 3 m, outside slope and inside slope will be 1:2 and 1:1 respectively.

526. **Re-sectioning of *khal*:** About 3 km of Mathbaria–Kholpatua Khal and Surjomoni Khal will be re-sectioned by removing silts from the bottom to make it wider and deeper so that it can provide sufficient raw water flow for the SWTP round the year.

527. **Groundwater investigation:** Exploratory drilling to deep aquifer will be conducted to ascertain potable ground water potentiality in Mathbaria. Water supply source for the town will be chosen based on the result of the investigation**.**

528. **Water testing laboratory:** A mini water testing laboratory will be established in the Pourashava in order to create facilities to monitor water quality produced and supplied to the consumers. The laboratory should have the testing facilities for the following parameters: pH, Fe (mg/l), Cl (mg/l), As (mg/l), Mg (mg/l),fecal Coli form and E. coli.

529. **Water supply office cum residence:** An office cum residence will be constructed in the SWTP compound in order to facilitate smooth operation and maintenance of the plant.

530. **Logistics:** Necessary logistics such as transportation facilities, computers etc. will be provided to the Pourashava for smooth operation of the water supply system of Pourashava.

G. Operation and Maintenance

531. An indicative O&M cost has been calculated for the proposed water supply interventions which are presented in **Table 7.69**.

- Hours of Operation : 16 hours/day
- Hours of Supply : 24 hours/day
- Manpower Proposed : 16 persons
- O&M Cost : Tk. 368,500/month.

Table 7.69: Indicative O&M Cost of Water Supply – Mathbaria Pourashava

Sl. No.	**Description of Items**	**Unit**	**Rate/Month (Tk.)**	**Nr.**	**Amount/month**
1.0	Water Superintendent	Person	18,000.00	1	18,000.00
2.0	Bill Clark	Person	12,000.00	2	24,000.00
3.0	Operator	person	10,500.00	6	63,000.00
	Guard	Person	10,500.00	3	31,500.00
4.0	Plumber/Mechanic	Person	10,500.00	4	42,000.00
5.0	Electricity	LS	80,000.00	1	80,000.00
6.0	Chemical	LS	40,000.00	1	40,000.00
7.0	Repair (Fittings, Spares)	LS	25,000.00	1	25,000.00
8.0	Generating Operating Cost including Fuel, Repair and Maintenance etc.	LS	45,000.00	1	45,000.00
	Total =				**368,500.00**

7.4.5 Sanitation - Mathbaria

A. Existing Status

532. **Household sanitation/ latrines.** The sanitary condition in Mathbaria Pourashava is relatively poor. The types of toilets in use in Mathbaria Pourashava **(**examples are illustrated in **Photograph 7.7)** are presented below:[73]

- Toilets with Septic Tank : 4.4% (of households)
- Water Sealed Latrines : 50%
- Pit Latrines : 45.6%.

533. The latrines are generally located in relatively low areas in the household. The latrines consists of 4/5 nos. rings placed to a depth of around 3-4' (0.9-1.2m) in the ground; a platform is simply placed on the upper most ring of the pit which is almost at the ground level. Consequently the latrines are easily getting inundated due to rain water accumulation around the latrines in monsoon, resulting in a loss of accessibility to the latrine and pollution caused by discharge of the contents. It was observed in some places during the field visit that holes have been made on the surface of ring of the latrine pit to allow the flow of sludge over the ground to the nearby ditch, *khal* or canal which is really environment and health hazardous.

Photograph 7.7: Existing Household Pit Latrines in Mathbaria Pourashava

Source: PPTA Consutlant.

534. **Public toilets.** There are five public toilets in Mathbaria Pourashava, the status of which are presented in **Table 7.70**:

535. Some additional public toilets are also required be constructed at some strategic locations in the markets, bus stand, and other public places in Mathbaria Pourashava. It is proposed that these public toilets are leased out to private operators who will pay a fixed rate that will be determined by the Pourashava, so that the operator can cover the operation and maintenance expenses and make a reasonable profit. These toilets may also be used by the people during natural calamities like floods, cyclones, etc.

[73] Source: Baseline Survey Final Report, Groundwater Management and Feasibility Study for 148 Pourashava of DPHE.

Table 7.70: Public Toilets in Mathbaria Pourashava

Sl No.	Location	Existing Facilities	Leased out	Problem observed
1	Merukhali Tempo stand, Ward No- 07	Chamber 4nos. Urinal 4 nos.	Yes	No electric Connection and no water supply
2	Pirojpur Bustand' Ward No- 05	Chamber 2 nos. Urinal 4 nos.	Yes	-
3	Sadar Road Boro Bridge Attached, Ward No- 04	Chamber 2 nos. Urinal 4 nos.	Yes	-
4	Dakhin Bandar Eidgah Attaced, Ward No- 02	Chamber 2 nos. Urinal 4 nos.	Yes	-
5	Central Jama Mosque, Ward No- 06	Chamber 2 nos. Urinal 4 nos.	Handed over to Masjid Committee	Structure damaged, reconstruction needed

Source: PPTA Consultant.

536. **School latrines.** Most of the schools (Primary schools, High Schools and *Madrashas*) of Mathbaria Pourashava have inadequate sanitation facilities. The condition of existing latrines is bad as the pits/septic tanks and superstructures are mostly damaged, there are no arrangements for electricity and water supply, and there is a lack of separate provision for girls. School latrines with all facilities should be provided in both primary and secondary schools, and in *Madrashas* in order to promote and propagate hygienic behavior.

537. **Community latrines.** There are no community latrines at present in Mathbaria Pourashava. Community sanitation facilities are required to be implemented in the slums. On-site individual latrines are not feasible in the slums due to the housing density and ground condition. The community sanitation system should consist of toilet facilities, and shower and laundry facilities.

538. **De-sludging equipment.** The Pourashava does not have de- sludging equipment for cleaning latrines pits and septic tanks. As a result the poura dwellers themselves take the initiative of cleaning latrine pits and septic tanks mainly through sweepers. At present sweepers manually clean the latrines, and sludge is buried underground at the cost of Tk 500 to Tk. 1,000 depending on the size of pit and septic tank.

B. Proposed Interventions in Sanitation – Mathbaria Pourashava

539. A number of public toilets, community latrines and school latrines have been proposed by the authorities of Mathbaria Pourashava (**Table 7.71)**.

Table 7.71: List of Proposed Sanitation Interventions – Mathbaria

Sl No	Items	Unit	Rate (Lac Tk.)	Qty	Amount (Lac Tk.)
1.0	**Public Toilet**				
1.1	In front of Alarafa Islami Bank, Ward.No.-04.	No.	6.0	1	6.0
1.2	Behind Kali Mandir, Ward No.-04	No.		1	6.0
1.3	Near K.M. Latif Super Market, Ward No.-04	No.		1	6.0
1.4	Banikpara, Ward No.-04	No.		1	6.0
1.5	Near Holy Child Pre-cadet School, Ward No.-07	No.		1	6.0
1.6	Central Jeme Mosque (Behind Poura Bhaban), Ward No.-06	No.		1	6.0
2.0	**School Latrine**				
2.1	Government Model Primary School, Ward No.-06	No.	6.0	1	6.0

Sl No	Items	Unit	Rate (Lac Tk.)	Qty	Amount (Lac Tk.)
2.2	Owahabia Girls Madrasa, Ward No.-03	No.		1	6.0
2.3	Momena Madrasa School, Ward No.-01	No.		1	6.0
2.4	Mohiuddin Ahmed Mohila Degree College, Ward No.-01	No.		1	6.0
2.5	Mathbaria Degree College, Ward No.-07	No.		1	6.0
2.6	Udayan Madhyamik Biddaloy, Ward No.-07	No.		1	6.0
2.7	Udayan Registered Primary School, Ward No.- 07	No.		1	6.0
3.0	**Community Latrine**				
3.1	WAPDA Basti, Ward No.-03	No.	2.0	4	8.0
3.2	Nabinagar Basti, Ward No.-03	No.		4	8.0
4.0	**Truck Mounted Desludging Equipment**	No.	60.0	1	60.0
	Total (BDT)				**154.0**
	Total (USD)		**0.20 million**		
	Climate Change Adaptation Cost, USD (Assumed 15% of Base Cost excluding Desludging Equipment)		**0.03 million**	Conversion Rate: 1 USD @ 78 BDT	
	Grand Total, USD		**0.23 million**		

Source: PPTA Consultant.

7.5 SUMMARY OF PROPOSED STAGE I INFRASTRUCTURE INTERVENTIONS

540. The proposed Stage I infrastructure interventions and base cost estimates in the four study pourashavas resulting from the field activities, pourashava consultations and workshops, and revisions during the ADB review mission 30 June – 7 July 2013, are summarized in **Table 7.72** based on infrastructure category, and in **Table 7.73** based on pourashava.

Table 7.72: Summary of Proposed Stage I Infrastructure Interventions by Category

Sl. No.	Infrastructure Category	Pourashava	Summary Key Interventions, including Climate Change Resilience (CRR) Measures	Base Cost Estimate (including CCR)	
				BDT million	USD million (@ BDT78/$)
1.	**Roads**	Amtali	8 no., 8.38 km	116.60	1.50
		Galachipa	7 no., 7.00 km	105.70	1.36
		Pirojpur	17 no., 34.20 km	338.50	4.34
		Mathbaria	5 no., 8.00 km	118.30	1.52
		Subtotal		**679.10**	**8.72**
2.	**Bridges**	Amtali	None	0.00	0.00
		Galachipa	None	0.00	0.00
		Pirojpur	4 no., length 38m	19.00	0.24
		Mathbaria	1 no., length 42m	25.20	0.32
		Subtotal		**44.20**	**0.56**
3.	**Cyclone shelters**	Amtali	3 no.	75.00	0.96
		Galachipa	3 no.	75.00	0.96
		Pirojpur	4 no.	100.00	1.28
		Mathbaria	1 no.	25.00	0.32
		Subtotal		**275.00**	**3.52**
4.	**Solid waste**	Amtali	5 no. rickshaw vans, 10 push carts	0.23	0.003

Sl. No.	Infrastructure Category	Pourashava	Summary Key Interventions, including Climate Change Resilience (CRR) Measures	Base Cost Estimate (including CCR)	
				BDT million	USD million (@ BDT78/$)
		Galachipa	5 no. rickshaw vans, 10 push carts	0.23	0.003
		Pirojpur	6 no. rickshaw vans, 15 push carts	0.30	0.004
		Mathbaria	5 no. rickshaw vans, 10 push carts	0.23	0.003
		Subtotal		**0.99**	**0.013**
5.	**Drainage and flood control**	Amtali	2.66 km drains	44.45	0.57
		Galachipa	10.39 km drains	258.76	3.32
		Pirojpur	25.3 km drains	297.69	3.82
		Mathbaria	10.8 km drains	140.40	1.80
		Subtotal		**743.28**	**9.54**
6.	**Water supply**	Amtali	2 PTWs, OHT, 37 km pipelines, 1,560 SCs, 30 no. hand DTWs, mini water testing equipment, 2 no. gensets	126.97	1.62
		Galachipa	2 PTWs, OHT, 25 km pipelines, 2,325 SCs, mini water testing equipment, 2 no. gensets	118.98	1.53
		Pirojpur	None	0.00	0.00
		Mathbaria	1 no. SWTP 5.5 MLD capacity, river intake, 1 no. OHT, 1 no. ground reservoir, embankment, 10 no. expoloratory wells, 3.5 km transmission pipeline, 3,200 SCs, mini water testing equipment, 1 no. genset	363.51	4.66
		Subtotal		**609.46**	**7.81**
7.	**Sanitation**	Amtali	6 no. public toilets, 2 no. community toilets, 1 no. desludging truck	10.40	0.13
		Galachipa	6 no. public toilets, 6 no. school latrines, 2 no. community toilets, 1 no. desludging truck	13.00	0.17
		Pirojpur	None	0.00	0.00
		Mathbaria	6 no. public toilets, 6 no. school latrines, 2 no. community toilets, 1 no. desludging truck	15.40	0.20
		Subtotal		**38.80**	**0.50**
			Total	**2,388.85**	**30.63**

CC=climate change; DTW=deep tubewell; GR=ground reservoir; OHT=overhead tank; PTW=production tubewell; RCC=reinforced cement concrete; SC=service connection; SWTP=surface water treatment plant

Source: PPTA Consultant.

Table 7.73: Summary of Proposed Stage I Infrastructure Interventions by Pourashava

Sl. No.	Pourashava	Infrastructure Category	Summary Key Interventions, including Climate Change Resilience (CRR) Measures	Base Cost Estimate (including CCR)	
				BDT million	USD million (@ BDT78/$)
1.	**Amtali**	Roads	8 no., 8.38 km	116.60	1.50
		Bridges	None	0.00	0.00
		Cyclone shelters	3 no.	75.00	0.96
		Solid waste	5 no. rickshaw vans, 10 push carts	0.23	0.003
		Drainage and flood control	2.66 km drains	44.45	0.57
		Water supply	2 PTWs, OHT, 37 km pipelines, 1,560 SCs, 30 no. hand DTWs, mini water testing equipment, 2 no.	126.97	1.62

Sl. No.	Pourashava	Infrastructure Category	Summary Key Interventions, including Climate Change Resilience (CRR) Measures	Base Cost Estimate (including CCR)	
				BDT million	USD million (@ BDT78/$)
			gensets		
		Sanitation	6 no. public toilets, 2 no. community toilets, 1 no. desludging truck	10.40	0.13
		Subtotal		**373.65**	**4.78**
2.	**Galachipa**	Roads	7 no., 7.00 km	105.70	1.36
		Bridges	None	0.00	0.00
		Cyclone shelters	3 no.	75.00	0.96
		Solid waste	5 no. rickshaw vans, 10 push carts	0.23	0.003
		Drainage and flood control	10.39 km drains	258.76	3.32
		Water supply	2 PTWs, OHT, 25 km pipelines, 2,325 SCs, mini water testing equipment, 2 no. gensets	118.98	1.53
		Sanitation	6 no. public toilets, 6 no. school latrines, 2 no. community toilets, 1 no. desludging truck	13.00	0.17
		Subtotal		**571.67**	**7.34**
3.	**Pirojpur**	Roads	17 no., 34.20 km	338.50	4.34
		Bridges	4 no., 38m length	19.00	0.24
		Cyclone shelters	4 no.	100.00	1.28
		Solid waste	6 no. rickshaw vans, 15 push carts	0.30	0.004
		Drainage and flood control	25.3 km drains	297.69	3.82
		Water supply	None	0.00	0.00
		Sanitation	None	0.00	0.00
		Subtotal		**755.49**	**9.68**
4.	**Mathbaria**	Roads	5 no., 8.00 km	118.30	1.52
		Bridges	1 no., length 42m	25.20	0.32
		Cyclone shelters	1 no.	25.00	0.32
		Solid waste	5 no. rickshaw vans, 10 push carts	0.23	0.003
		Drainage and flood control	10.8 km drains	140.40	1.80
		Water supply	1 no. SWTP 5.5 MLD capacity, river intake, 1 no. OHT, 1 no. ground reservoir, embankment, 10 no. expoloratory wells, 3.5 km transmission pipeline, 3,200 SCs, mini water testing equipment, 1 no. genset	363.51	4.66
		Sanitation	6 no. public toilets, 6 no. school latrines, 2 no. community toilets, 1 no. desludging truck	15.40	0.20
		Subtotal		**688.04**	**8.82**
			Total	**2,388.85**	**30.63**

CC=climate change; DTW=deep tubewell; GR=ground reservoir; OHT=overhead tank; PTW=production tubewell; RCC=reinforced cement concrete; SC=service connection; SWTP=surface water treatment plant

Source: PPTA Consultant.

541. An additional cost, related to water supply, is a requirement from DPHE for the procurement of equipment, spare parts and chemicals for four water quality testing laboratories in the coastal region, amounting to about $0.38 million (see **Annex D, Volume 6** for the list of requirements). This is subject to further review.

8 STRENGTHENING LOCAL GOVERNANCE, CAPACITY BUILDING

8.1 INTRODUCTION

542. Pourashavas in Bangladesh are classified based upon a combination of factors, mainly revenue generation. There are three types of pourashavas—A, B and C Classes—which have different rules, responsibilities and staffing levels, with the project pourashavas a mix of A and B classes and thus with variable responsibilities and capacities.

543. CTIIP's precursor project, TA 7890-BAN: *Strengthening the Resilience of the Urban Water Supply, Drainage, and Sanitation to Climate Change in Coastal Towns*, carried out various climate change-related awareness raising and capacity building activities in the towns and in Dhaka. CTIIP's capacity building will look to build upon this preliminary work.

544. In the Batch 1 towns, there does not seem to be a great awareness to climate change or even key environmental per se. However, as described in Chapter 4 on Climate Change Adaptation and Resilience there is awareness of more polarized weather patterns reflected in longer dry periods and more severe and frequent storms. CTIIP's and downstream capacity building activities need to recognize this localization of climate change issues and be designed accordingly, particularly at the community and civil society levels.

545. In the same manner, capacity building will focus on developing the technical capacities of the project pourashavas. It would seem evident that a pourashava that can respond positively to its citizens' demands for better services, and deliver these services more effectively and efficiently, is going to be much better placed to deal with climate change than a pourashava that is unable to do this.

546. For pourashavas and other local government units, capacity development is largely dependent on the decentralization initiatives of GOB, such as allocation of financial and technical staff, which has been under consideration for a long time. Recommendations within the Sector Delevelopment Plan (SDP) include the formulation of village level committees, the requirement for pourashava approval of all water supply and sanitation (WSS) investment plans in the pourashavas by government agencies, and improving working procedures and developing capacities of the pourashavas and their staff in areas such as accounting, financial management, procurement and good governance.

547. **Technical assistance (TA).** Besides the Project Design Advance (PDA) consultants for detailed engineering design, contract documents preparation and safeguards facilitation, it is envisaged that there will be three technical assistance (TA) teams to assist and support the PMU and PIUs with project implementation:

(i) A Project Management and Supervision Consultant (PMSC) team for project management and administration support, and assistance in supervising the construction of improved municipal infrastructure interventions, and with improving the operation and maintenance (O&M) for water supply.

(ii) An Institutional Strengthening and Awareness Building Consultant (ISABC) team for the strengthening of local governance for sustainable service delivery and urban planning, and to conduct studies, surveys and research on flood inundation, climate change impacts, etc. for the Batch 2 towns.

(iii) A non-government organization (NGO) for community mobilization, communication and behavioral change (CMCBC) in water, sanitation and hygiene (WASH) activities, and community-based climate adaptation and livelihood development (see Chapter 9 for details).

548. The ISWBC team in particular will work closely with the Urban Management Support Unit (UMSU) or urban wing of LGED to support the capacity development of pourashavas with regards to public service delivery improvements in infrastructure project implementation and good governance. Activities of the TA will include:

- Strengthening the organizational structure of the LGED urban wing.
- Enhancing the capacity of the LGED urban wing.
- Establishment of training modules in key areas of capacity development in pourashavas.
- Pilot activities to improve pourashavas' capacity.
- Enhancing horizontal learning programs on the public service delivery of pourshavas.
- Assistance to pourashavas for master plan preparation and implementation.
- Assistance to pourashavas for the enforcement of the Building Construction Act and rules.

8.2 ABSORPTIVE CAPACITY OF POURASHAVAS TO OPERATE AND MAINTAIN PROJECT INFRASTRUCTURE INVESTMENTS

549. The proposed investments under CTIIP for infrastructure improvements, based on the PPTA study pourashavas (Batch 1 towns), have a higher cost (average $9.9 million per pourashava, incorporating climate change resilience and with contingencies) compared to other projects such as UGIIP ($2.6 to 3.2 million per pourashava, depending on class). This is because the main aim of the project is to make the participating pourashavas climate change resilient, and the infrastructure scope has to be more holistic to achieve this aim.

550. The higher investment amounts for CTIIP raises the issue of the technical, institutional and financial capacity of the pourashavas to manage project implementation activities and the long-term and sustainable operation and maintenance of the infrastructure facilities, particularly for water supply installations, after they have been constructed.

551. Generally the existing capacity in the pourashavas is limited in all aspects, and constrained by the provisions of the Local Government (Pourashava) Act, 2009. There will need to be a lot of strengthening of resources during project implementation and the preparation of a more flexible enabling environment to ensure that the pourashavas are sufficiently prepared to take on the responsibilities for the sustainable O&M of the physical facilities and assets. Although this aspect has been built into the project design, through the provision of technical assistance (outlined in the following sections) and guidance from the project management unit and the Management Support Unit of LGED, a lot will depend on the leadership and motivation of the pourashava authorities and elected officials, and pressure from customers and communities for services to be provided and maintained to acceptable levels.

552. On a positive note, financial analyses conducted for the four Batch 1 towns for revenue earning sectors—water supply, sanitation, solid waste management, boat landing stations, market and bus terminals—indicate financial sustainability, as the revenue account will be in surplus (see Section 13.1). Also, for non-revenue-generating sectors—urban drainage, roads, bridges, and cyclone shelters—the financial projections show that the pourashavas can absorb the investment in appraised subprojects, as they are expected to have a revenue account surplus and a positive close balance for the revenue account.

553. Key points concerning the absorptive capacity of the pourashavas and proposed measures are outlined in **Table 8.1**.

Table 8.1: Absorptive Capacity of Pourashavas

Aspect	Issues	Proposed Measures
1. Institutional	• Holistic thinking is generally lacking, e.g. concerning the impacts of unregulated development and encroachments on drainage and similar services.	• Improvement of governance through the performance criteria mechanism.
	• Pourashavas are constrained by the organogram[74] in the Local Government (Pourashava) Act, and are not empowered to recruit additional permanent people as required. They can only hire people on a muster role (daily) basis, especially for solid waste management/conservancy services & O&M of drainage infrastructure.	• Engagement of community groups, formation of community user groups, through stakeholder/participatory performance evaluation.
	• There is a shortage of manpower municipal services, especially for expanded water supply systems or new systems.	• Assessment of the feasibility of contracting certain performance-based services, e.g. pre-monsoon drain maintenance, street cleaning & solid waste management, and then trying to implement.
	• Urban planner post for Class A pourashavas is often vacant, and the planning role is often limited to checking and approving development applications, i.e. regulation, with planning function. • There is no urban planner post for Class B pourashavas.	• Vacant urban planner posts for Class A pourashavas need to be filled, and there should be a planning officer for Class B pourashavas.
	• Transferring of trained staff between pourashavas often happens, and the appointment of a replacement is delayed, depriving pourashavas of key staff.	• The transferring of trained staff between pourashavas should be stopped during project implementation, needs to be regulated by the Ministry of Local Government, Rural Development and Cooperatives.
	• There is limited capacity for the management of civil works contracts and quality monitoring/control.	• Use of detailed design and supervision consultants, for training & capacity building on procurement & project management, works supervision, etc.
	• There are many vacant DPHE posts at district/upazila level.	• Existing vacant posts of DPHE at district/upazila level should be filled up, so that the proper level of support for water supply services can be provided to the pourashavas.
	• Organizations that are not under the control of pourashavas are responsible for the operation or O&M of infrastructure that has a key impact on the pourashava, e.g. BWDB – primary-level flood defense infrastructure, Roads & Highways – national roads & associated infrastructure, water user groups	• Seek formal mechanisms for pourashavas to be consulted and have an input into the design and implementation of infrastructure provided by other institutions, e.g. cross-drains on national roads. • Seek formal arrangements with WUGs and other relevant bodies for managing irrigation sluices that

[74] See **Additional Appendix D, Volume 2** for pourashava organograms.

Aspect	Issues	Proposed Measures
	(WUGs) – irrigation sluices.	impact on urban areas, particularly during and after depressions and cyclones. • The project could lobby for the respective agencies to allocate sums for the pourashavas to use for O&M, but the agencies are highly unlikely to agree without a considerable 'sales' pitch.
2. Technical	• Equipment and spare parts for efficient and effective O&M are lacking for virtually all types of infrastructure, especially for water supply, solid waste management/conservancy services & O&M of drainage infrastructure.	• Key equipment for basic drain O&M is provided by the project.
	• Planned O&M is rare and O&M manuals are lacking or weak.	• Capacity building of senior managers and elected representatives on impacts of climate change and need for resilient infrastructure, materials, planned O&M, etc. • Preparation of operation and maintenance manuals and as-built drawings by contractors, to facilitate O&M of all infrastructure built under the project (manuals to be in Bangla); to include guidance on selecting and using optimum materials and methods. • Planned, needs-based periodic and regular cleaning of drains, and awareness raising on preventive measures, e.g. not to dispose of garbage in drains. • Solid waste collection services strengthened/implemented.
	• Poor quality materials and methods are used.	• Specify better quality materials.
	• Chemicals for water treatment are lacking, and there is a lack of knowledge on the quality of chemicals, especially for surface water treatment.	• Improvement of the specification and procurement for water treatment chemicals.
	• Main non-revenue water losses are at the point of service because of the poor quality of materials used.	• Pourashava water supply staff are trained to use appropriate quality material for service connections, if possible from pourashava based stores.
3. Financial	• Low capacity for the financial management of project funds, and for post-project operation and maintenance.	• Capacity building to improve financial management and budget preparation. • Application of a mechanism to increase water supply tariffs in line with O&M costs and budgetary requirements, energy charges, etc.

Source: PPTA Consultant.

554. **Water supply management in pourashavas.** Of the range of municipal infrastructures, water supply has the highest O&M requirements, since it is important as a source of revenue for the pourashava and O&M cost recovery.

555. The SDP is committed to the decentralization of decision-making and financial management to the Local Government Institutions (LGI) in regard to hygiene, sanitation and water supply. WSS services are one of the mandated functions of the pourashavas and responsibilities are being gradually decentralized (with LGIs implementing piped networks and O&M and managed by the Engineering Sections and Conservancy Sections (for sanitation). The Local Government Acts give pourashavas the authority to recruit staff and fix water rates. However, this authority is not fully exercised (due to the need for approval from the LGD or their own reluctance) and the autonomy in the functions of the water sections and the low capacity is the principal concern in effective service delivery and its sustainability. The smaller the size, the higher the need for capacity support.

556. A number of core areas have been identified in order for LGIs to carry out WSS functions. These include:

- ensuring a satisfactory level of independence in operating water supply sections (for example, through establishing an autonomous water section in pourashavas or establishing a supervisory board),
- approving regulations (under the Local Government Acts, 2009) for the individual city corporations and pourashavas regarding the staffing in the Engineering Section for water supply,
- improving the working procedure and accounting through staff training and systems development,
- involving Town/Ward Level Coordination Committees (TLCC/WLCC) in planning, implementing and monitoring activities,
- collaborating with DPHE and other relevant organizations for technical assistance,
- setting and monitoring water quality and service standards through water safety planning, and
- making WSS committees effective.

557. However, despite these guidelines, there are shortcomings in the present arrangements for water supply management in the pourashavas **(Table 8.2)**, and the Department for Public Health Engineering (DPHE) and other partners are promoting and advocating the establishment of more sustainable O&M procedures and a performance based monitoring system.

Table 8.2: Present Water Supply Problems, and Proposed Mitigation Measues

Present Situation	Proposed Mitigation Measures
• Pourasava Water Supply Section (PWSS) works under the supervision of Engineering Section.	• Water supply system should be a separate section (not under Engineering section) and it should be given more athourity to make decisions. PWSS needs to be put directly under the Mayor's control and supervision.
• The Executive Engineer or the Assistant Engineer or the in-charge of the Engineering Section has little or is without experience on managing the PWSS, The Engineering Section has other responsibilities apart from water	• Post of Executive Engineer/Senior Assistant Engineer/Assistant Engineer, depending on the grade of the Pourashava and the charecteristics of water supply, need to establish or create who can lead the PWSS Section. • At the initial stage, Executive Engineer/

Present Situation	Proposed Mitigation Measures
supply.Accordingly, proper attention is not given to water supply by this section	Assistant Engineer may be deputed from DPHE. As time goes on, the water super may be promoted to the post of Assistant Engineer and Executive Engineer. However, they will get their salary and allowances from the pourashava. Such system would open the door for both technical and career development of the water super.
• The in-charge of PWSS is the Water Superintendent having educational background diploma in engineering. • This is a block post. There is no scope for his/her promotion. There is no scope for his/her technical development as well as career development.	• There should be a regular mechanism for continuous update the knowledge and skill of PWSS staffs. • As the technologies and management system are developing, periodic training for the PWSS is required to adopt more efficient systems. • DPHE's capacity and logistic support should be expand at least up to Division level to provide the technical support and capacity building of PWSS.
• The Water Supers in first few years works with enthusiasm. However, with time his/her enthusiasm goes down slowly and finally she/he become totally disappointed as she/he sees that his/her colleague who joined the pourashava at the same time with same educational background becomes his/her boss.	• The proposed mechanism would minimize the risk of disappointment and loss of enthusiasm.
• There is no one in the pourashava who can provide technical assistance to the Water Super. She/he may seek assistance from DPHE on adhoc basis. However, it entirely depends upon personal relationships. There is no formal institutional arrangement for seeking such assistance. • Lack of technical knowledge and experience constrain her/him to make a sustainable O&M system of PWSS and to make a performing pourashava. At present, project base training is given to PWSS but experiences show that such training is not enough for sustainable O&M. There should be a regular mechanism for continuous update the knowledge and skill of PWSS staffs.	• The proposed system would ensure better linkage between Pourasavas and DPHE. • Establishment of formal institutional arrangement for providing technical assistance to PWSS would become easier and chances of proper functioning of such arrangement would be very high. • A committee headed by a senior officer (in the rank of Additional Chief Engineer/Superintending Engineer) DPHE may be formed to explore the proposed system. Representatives from Local Government Division, Ministry of Finance and relevant ministry/agency may be the member of the committee.

Source: DPHE.

8.3 SUSTAINABLE WATER SUPPLY SERVICE DELIVERY

558. Water samples from many piped water sytems and tubewells in Bangladesh are found to be microbially contaminated—a study carried out by the International Training Network-Bangladesh and DFID found that 29% of shallow tubewells and 9% of deep tubewells are contaminated with bacteria, mainly due to the poor maintenance of tubewells and pipe networks, and poor hygiene practices.[75]

[75] Sector Development Plan (FY 2011-20125) Water Supply and Sanitation in Bangladesh.

559. **Water safety plan.** These problems emphasize the need for a holistic plan, known as a Water Safety Plan (WSP), to ensure that people are actually consuming safe water and the desired health benefits are achieved, as well as contributing to a sustainable water supply delivery service. A WSP can be defined as a management plan to secure drinking water safety from the water source to the point of consumption through continuous monitoring and preventive maintenance of water systems. The WSP works under the Framework for Safe Drinking Water (WHO, 2004) which consists of establishing health-based targets, implementing the measures to meet these targets, and setting up a surveillance system.

560. DPHE and several NGOs, for example BRAC under its WASH program, have so far piloted WSPs in 32 rural communities and 6 urban areas to test the practical application under different conditions.The results of these pilots have been positive and have set the grouind for scaling up WSPs at a the national level. A Working Document (No. 20) on WSP has been prepared.

561. Based on the work that has been done so far, there is a need to disseminate the benefits of the WSP to the pourashavas. Information-education-communication (IEC) materials need to be prepared for presenting to pourashava officials and community stakeholders to advocate and raise awareness on WSP, and capacity building is needed to facilitate the actual implementation of WSPs.

562. Capacity building for the implementation of WSPs at pourashava level would be facilitated by DPHE. However, there would need to be some capacity building within DPHE itself to further develop expertise in non-engineering disciplines such as gender, hygiene, environment and social development, which will be very important for implementing WSPs. Training courses can be organized by the Bangladesh University of Engineering and Technology (BUET) for the training of trainers.

563. **Water conservation.** Water conservation is inherent in the Water Safety Plan, and activities will be conducted to encourage water saving measures and the reductions of losses/leakages. Water conservation activities will include the following:

- Review of tariff setting regulations, and the promotion of water demand management (WDM).
- Proposals for new pricing structures through process of public participation and dialogue with water users.
- Examination of records of water production, costs and sales, consumer profiles to determine real level of demand.
- Review of existing and proposed service levels.
- Assessment of unmeasured legitimate water use, recommendations for checking existing customer meters and installing further new meters where appropriate.
- Review of current working practices for detection of illegal connections and unreported leakage, recommendations for improvements.
- Development of an appropriate active leakage detection programme.
- Estimation of possible reduction in abstraction with reduced distribution leakage scenarios.
- Assessment of the requirement for equipment such as district water meters and leakage detection equipment.
- Coordination with NGOs working in the water supply and sanitation sector in the coastal region.
- Community mobilization for water supply consumers to regularly check household pipes and fittings for leaks, and replace defective parts.

8.4 URBAN PLANNING

8.4.1 Purpose and Background

564. The proposed technical assistance (TA) aims at enabling GOB, and pourashavas in the coastal zone, to effectively address the problems encountered in developing an urban planning system and ensuring that this system enhances the resilience of towns to projected climate change and the anticipated impacts arising from this. The urban planning system in Bangladesh is evolving and the TA attempts to respond to, and work within, the orientation of this change.

565. There are four critical planning functions for supporting sustainable urban development in Bangladesh and beyond in relation to climate change: (i) controlling land use by preventing development in areas of high risk and in areas that exacerbate levels of risk, (ii) promoting, directing and enabling development in areas of least risk and that are compatible with a climate resilient urban development strategy, (iii) allocating and reserving sufficient land for critical climate resilient infrastructure (such as water supply, drainage and roads) including sufficient rights-of-way and land availability, and (iv) identifying, on a continuing basis, priority capital climate resilient investments (for both new and rehabilitated infrastructure, and including 'natural' eco-systems infrastructure). The TA tackles these through four core urban planning components: (i) urban plans, (ii) development and building control systems, (iii) infrastructure investment programming, and (iv) urban planning capacity.

566. To achieve this the TA will need to address four core components of urban planning (the 'pillars' for developing an effective planning system): (i) climate resilient master plans, (ii) development and building control systems, (iii) investment programming for climate resilient infrastructure, and (iv) the capacity (skills and resources) required to operate and manage the urban planning system. The TA, whilst focused on the coastal towns, has broader currency in supporting the development of local urban planning in Bangladesh generally, and strengthening the urban planning response to climate change and disaster risk management specifically (see Section 8.5).

567. The TA has been developed on the basis of three lines of inquiry: (i) a town level survey conducted in the study towns (Amtali, Galachipa, Mathbaria and Pirojpur) to better understand the on-the-ground realities of operating what is a fledging urban planning system, (ii) measuring the existing master plan material against an ideal-type framework for climate resilient plans: the preparation of plans, the plan product, and its implementation, and (iii) setting the analysis of the coastal towns in the broader context of urban planning in Bangladesh by reviewing and building recommendations on current and past practice—practically what has worked and what has not. The TA is set within the context of option development of 'TA 7890-BAN: Strengthening the Resilience of the Urban Water Supply, Drainage and Sanitation to Climate Change in Coastal Towns'.[76]

[76] Option 10—'Planning considerations at regional and local level'—records a level of medium effectiveness: 'Involvement of the Pourashava and local stakeholders in urban planning will ensure that their current climate related problems are addressed. The master plans prepared under the UTIDP should be discussed and accepted by pourashavas; pourashava level urban planning capacity needs to be built.' (p.146), Draft Final Report Volume 1 Main Report (March 2013).

8.4.2 Situation Assessment

568. The Bangladesh urban sector, and the role of urban planning within this, faces a number of distinct and protracted challenges. Constraints on the urban sector include: (i) accelerating, unplanned and uncontrolled urbanization, some which is attributable to the push factors of increased vulnerability to climate change impacts, (ii) severe deficits in urban infrastructure provision and basic service delivery, (iii) planning instruments that have been historically inadequate, lack an implementation-orientation and/or are un-enforced, (iv) the growth in urban poverty and lack of inclusiveness in municipal planning, (vi) severe constraints in local government capacity and governance structures, and (v) historically weak and fragmented urban sector institutional frameworks at national and local level (including an outdated and inadequate legislative framework).

569. Beyond the role of urban planning in responding to the potential impacts of climate change, ensuring effective municipal planning to manage and guide urban growth and development are vital for the future of urban Bangladesh. In the absence of planning, as many urban areas testify, the provision of municipal infrastructure becomes conditional on responding to demand generated from uncontrolled development, and in turn results in inefficiency in service coverage and levels, and the O&M costs that follow. But the speed of urban development, together with the varying capacity of pourashavas, must be matched by a degree of responsiveness and flexibility in the methods and tools (a 'one size fits all' approach is likely to prove inefficient and ineffective).

570. **Urban plans.** The absence of master plans in Bangladesh has historically hampered better management of the urban development process. This has resulted in arbitrary decision-making on building and development control, and has worked against the efficient (planned) provision of basic infrastructure. The major effort to redress this has been the GOB Local Government Engineering Department (LGED) projects: (i) Upazila Towns Infrastructure Development Project (UPTDP) covering 223 pourashavas, commencing in 2008 and with scheduled closure by June 2013); and (ii) District Towns Infrastructure Development Project (DTIDP) preparing master plans for 22 district level pourashavas and Rangpur Division Town. These projects share a common method. The Urban Development Directorate (UDD), MHPW, has also developed master plans in a number of larger urban areas (but also including one coastal town—Galachipa). The master plans for Amtali, Galachipa and Pirojpur are close to finalisation. The Mathbaria master plan is at an early stage of development.

571. Such a large-scale and centrally driven master plan making process is first of its kind in Bangladesh. This, coupled with the recent creation (within the past 15 years) of most pourashavas, is manifest in insufficient capacity of pourashavas to handle the tasks of master plan development and implementation. Similarly, the urban planning profession is a young discipline in Bangladesh and there are understandable gaps in capacity throughout the system (centrally, locally and in the private sector). Nevertheless, the drive to develop master plans and instigate the local urban planning process is an important step forward, and this TA is designed to support and strengthen these advances.

572. In their current form, and assessed in the context of climate change, the master plans do not currently include: (i) localised climate change projections (whilst the current problems faced with flooding and drainage are commonly addressed, probable future impacts are not), (ii) vulnerability and adaptation assessments - a quickly emerging standard measure in the promotion of, and response to, climate change issues, (iii) a method for identifying, prioritizing and financing (climate resilient) infrastructure, (iv) consideration of the relationship between long-listed investment needs and municipal finance, and (v) sufficient consideration of the capacity required to utilize and implement the plan once adopted.

573. Implementation of the master plans and the urban planning system more generally

involves two principal activities: (i) the control of development through land use zoning and other control mechanisms through the current building permit system, and (ii) the means for identifying and bringing forward priority infrastructure investments, both new and rehabilitated infrastructure. This balance of controlling and facilitating urban development is critical to the efficiency and effectiveness of plan implementation

574. **Development and building control systems.** The principal mechanism for the control of development in urban Bangladesh is the building permit sanctioned under the Building Construction Act (1952) and Building Construction Rules (1996). The Bangladesh National Building Code (2006, and currently under revision) specifies minimum standards for design, construction, quality of materials, use and occupancy, location and maintenance of buildings. In the absence of statutorily adopted plans the permit system works primarily as a building control mechanism (ensuring buildings are safe, accessible and efficient and conform to construction standards), rather than a planning control (for example related to the permitted use of land and buildings, and in conformity with zoning rules). This will change once master plans are officially adopted, and the development control system will, in principle, be expanded to include land use clearance and development permit approval; functions that are guaranteed under the Local Government (Pourashava) Act, 2009. At this point the pourashavas will have both planning development control (conformity with the master plan) and building control (safe and resilient buildings), both of which are critical in ensuring climate resilience. No specific rules have so far been framed for operationalising this system. A draft Urban and Regional Planning Act (2012) proposes for a unifying national authority under which planning practices in the country will be functioning, the coordinating office being in the Ministry of Housing and Public Works.

575. Whilst the building permit system is being practiced, this practice varies widely from pourashava to pourashava, and the benefits of common standards and the need for enhanced administration and enforcement is widely recognised. In addition, there are considerable areas of informal settlement in towns that are effectively beyond the building control net where poor populations mainly live in government *khas* lands and are at greater risk of climate change impacts.

576. **Infrastructure investment programming.** One of six objectives for the preparation of the master plans in Bangladesh is the development of a multi-sector short and long term investment plan through participatory process. With master plans still subject to finalization, it is premature to judge whether these are efficient implementation vehicles. However, based on recent past experience in Bangladesh (and the Asia-Pacific region more generally), master plans are insufficient in themselves for prioritising, programming and phasing investments over the lifecycle of the master plan (20-years). Rather than signaling a structural flaw in the master plans per se, it does suggest that in dynamic urban development situations, investment priorities are continually shifting, and that pourashavas require a degree of flexibility (and opportunism) to respond to changing circumstances.

577. Several external assistance projects have sought to address the deficiency in urban plans: most notably the ADB Urban Governance and Infrastructure Improvement Project (UGIIP) 1 and 2 and the World Bank Municipal Services Project (MSP), and the up-coming UGIIP-3 and Municipal Governance and Services Project. In general, these approaches seek to identify infrastructure needs as part of a broader municipal development framework and involved linking infrastructure identification, programming and financing to mandatory governance improvements and to training-oriented capacity development activities.

578. The mechanism for identifying and prioritizing investments in UGIIP-1 and 2 has been the Municipal Development Infrastructure Plan (MIDP) and the Pourashava Development Plan (PDP) respectively. In the World Bank MSP the production of town-level feasibility studies to support prioritized infrastructure investments was used. Both the MIDP and PDP

were conceived as a town wide planning framework founded on a participatory needs identification process. Both present a vision of the pourashava. The PDP seeks to determine development priorities and support elaboration through technical and feasibility studies. Prioritization of infrastructure starts at the ward level using a simple template recording the current status (adequate, average and poor), what needs to be done (short to medium term), and a priority ranking. Prioritization is carried out through stakeholder discussion, and there does not appear to be the application of any other method. The final 'short-listing' of infrastructure appears to be carried out by the TLCC, but in the absence of technical support.

579. Recent assessments suggest that the approach is on the 'right track'. UGIIP has demonstrated that visioning is significant in enhancing the ownership of plans by pourashavas and supporting the mind-set change required at the local level; this is critical to nurturing an effective approach to municipal planning and management. Equally, there is recognition that more-focused, shorter-range and regularly revised capital investment plans are better suited to the size and capacity of pourashavas.

580. **Urban planning capacity.** The capacity to effectively run a local urban planning system requires three aspects: (i) representatives and pourashava personnel with the necessary competencies to make decisions and operate the system, (ii) organization capacity encompassing the capability and resources to lead, manage and administer the system, and (iii) the policies, legal and regulatory frameworks that control and guide the way that the urban planning works, and condition the capacity of organisations and individuals. The capacity constraints faced by coastal towns are not exceptional. They are typical of the issues faced throughout Bangladesh urban local government. Pourashavas have insufficient capacity and resources and are finding it difficult to respond to the need for forward planning and investment in basic urban infrastructure and services. This undercuts sustainable local urban governance, makes local planning ineffective and undermines local economic development. The impacts of climate change if anything exacerbates the weaknesses in municipal management more generally.

581. Additionally, there are broader capacity development issues, such as the strength of human resource management or the culture of continuous training and learning in an organization, that affect the veracity of the urban planning process. Three critical areas that bear on the performance of urban planning are: (i) finance and financial management capacity with pourashavas heavily constrained by a lack of finance from both own-source revenues and inter-governmental block grant transfers, (ii) organization and operational planning, with insufficient capacity for organizational management, and (iii) skilled staff with human resources representing a major constraint in number and in relevant skills.

582. The organizational and staffing capacity context for urban planning in Bangladesh is conditioned by structurally constrained local government. Most notably there are prescriptive and out-dated standardized organograms and job descriptions, fixed levels of staffing (coupled with key appointments and deputations from central government) and standardised conditions (rules and terms). The staffing composition bears little relation to the scope and nature of the urban challenges faced by pourashavas. Only Class A pourashavas have an Urban Planner (based in the Engineering Department). The presence of the Urban Planner is considered a prerequisite for the effective implementation of the master plan. The absence of urban planners in category B and C pourashavas results in a lack of stimulus amongst officials in understanding the significance and scope of urban planning, and little or no foresight as to the capacity and leadership required to implement, monitor the emergent master plans and evolve the urban planning system on the basis of practical application. A Committee was established within the Local Government Division to recommend changes to the staffing structure for urban planning, including the recommendation for urban planners in all classes of pourashavas, with additional staff resources in larger (Class A) pourashavas.

583. Positively, UGIIP-1 and 2 specifically targeted the enhancement of multi-stakeholder participation, accountability and transparency, and have demonstrated the significance of enhancing the mechanisms for participation in urban planning with the initiation of Town and Ward Level Citizens Committees (TLCC and WLCC [T/WLCC]). This has been mainstreamed in urban local government through the mandatory initiation of T/WLCC required by the Local Government (Pourashava) Act 2009. T/WLCC represents an important mechanism for enhancing participation in, and understanding of, urban planning, and for significantly improving the level of scrutiny, transparency and accountability of urban planning matters (ranging from the development of plan proposals to the exercising of development control). Supporting participation in planning remains a critical area.

584. The institutional framework for urban planning is determined at a national level. This policy and legal framework. It is recognized that the current framework is outdated and fragmented. It is not enforced, in part a reflection of considerable under-resourcing and capacity for operating the system. Land grabbing, unlawful construction and construction that does not comply with the permitted development is commonplace, if not universal. Currently there is no urban planning law as such. As discussed the weaknesses in both policy and legislative framework are being addressed through a National Urban Sector Policy and a new Urban and Regional Planning Act (UPRA). Policy and legislative reform could have an impact on the CTIIP, and there should be adequate flexibility that capacity development activities respond to the opportunities presented (most especially from new development control mandates to pourashavas granted through the new legislation).

8.4.3 Objectives

585. The overall TA objective is to strengthen local urban planning practice in general, and climate resilient urban planning in particular, in project towns. The goal is to achieve climate resilient urban development over the medium to long term. The TA will achieve this through four interrelated sub-components:

(i) Undertake a vulnerability and adaptation assessment in project towns, identify the main vulnerabilities (sectors, facilities, areas), and (as necessary) propose revisions to the master plans.

(ii) Review systems of planning and building control, identify and compile a user-friendly 'Climate Change Adaptation Building Standards Guide', and formulate a standardised guideline on planning control (based upon the guidelines contained in Volume 4 Climate Change Assessment and Adaptation Strategy). Apply, adapt and revise.

(iii) Review existing capital investment planning approaches and guidelines, fully adapt to climate resilience on the basis of the vulnerability and adaptation assessment (i), and implement a pilot guideline in the project towns. Revise on the basis of practical application.

(iv) Support (i) to (iii), and the overall enhancement in capacity in, and understanding of urban planning in general, and its significance in climate change and disaster risk management in particular.

8.4.4 Scope of Work

586. The TA will consist of four interrelated components designed, in combination, to enhance the climate resilience of urban planning, and the operational effectiveness of urban planning more generally **(Table 8.3)**. Terms of reference are outlined in **Appendix 10, Volume 2**.

Table 8.3: Overview of Urban Planning Technical Assistance Components

Objective: Strengthen local urban planning practice in general, and climate resilient urban planning in particular, in four coastal towns			
Component A	**Component B**	**Component C**	**Component D**
Climate Sensitive Land Use / Master Plans built or revised on the basis of climate change vulnerability and adaptation assessments	**Planning and building control adapted to climate change** that can be implemented and is enforceable	Straight-forward and continual **infrastructure investment programming methods that prioritise climate adapted investments** that are affordable and sustainable	**Sufficient capacity and skills** (of the pourashava and individuals) **in urban planning** to effectively run the planning system, and to make it a joint, multi-stakeholder, enterprise
Outputs Vulnerability and Adaptation Assessment Revised urban master plan	**Outputs** Climate Change Adaptation Building Standards Guide Planning and Building Control Guideline	**Outputs** Municipal Adaptation Investment Plans	**Outputs** Climate Change in Coastal Cities Training Package Geographical Information Systems

Source: PPTA Consultant.

8.4.5 Scope for Replication

587. The TA has been designed to capture and compile the learning from practical application in the participating coastal towns. Wherever possible the TA utilises and/or adapts, tried-and-tested urban planning related methods from Bangladesh and therefore both supports replication, and enhances the probability of CTIIP replication.

8.5 CLIMATE CHANGE ADAPTATION AND DISASTER RISK PREPAREDNESS

8.5.1 Objectives

588. The overall objective of the climate adaptation and disaster risk management component of the TA is to strengthen pourashava and community level preparedness for climate change, in all selected CTIIP towns. The goal is to achieve climate resilient urban development over the medium to long term. The TA will achieve this through four interrelated sub-components:

(i) develop technical tools to better project, plan, and assess the impacts of future climate change;

(ii) engrain community level awareness of climate change hazards and climate resilience options, especially in the slum areas and for marginalized communities and individuals;

(iii) strengthen community level disaster preparedness through support for the Pourashava Disaster Risk Management Committees; and

(iv) resource pro-poor community-level adaptation through locally managed climate resilience funds in each project town.

8.5.2 Scope of Work

589. The TA will consist of four interrelated components designed, in combination, to enhance the climate resilience of each of the project towns, and the operational effectiveness of climate change preparedness and disaster risk more generally, as outlioned in **Table 8.4**.

Table 8.4: Overview of Climate Change and Disaster Preparedness Technical Assistance Component

Objective: Strengthen Pourashava and community level preparedness for climate change, in all CTIIP towns			
Component A	**Component B**	**Component C**	**Component D**
Climate and disaster technical tools to inform adaptation and DRM decision making	**Community-level awareness raising and warning systems for climate hazards and resilience options,** especially for the poor and marginalized	**Disaster preparedness** through support for Pourashava level Disaster Risk Management Committees	Resource pro-poor, community level adaptation through **locally managed climate resilience funds**
Outputs Downscaled climate model outputs Improved tropical cyclone projections Flood inundation monitoring and mapping Cyclone and flood loss and damage assessments/tools	**Outputs** Community awareness raising events Fishing community early warning system Community DRM hazard mapping and planning	**Outputs** Orientation system for new civil servants/officials Technical support for DRM Committees	**Outputs** Funds Design/Management Plans Locally managed funds for each subject pourashava

8.6 INSTITUTIONAL DEVELOPMENT AND GOVERNANCE

590. The overall TA objective is to strengthen urban local governments' institutional capacity in general and mainstreaming climate resilient issues in the planning process of the project participating pourashavas in particular. The goal is to achieve climate resilient institutional development in the pourashavas over the medium to long term.

591. There are three critical areas of where interventions are needed for supporting sustainable institutional arrangements in relation to climate change:

1. Review the existing organizational set up of the pourashavas in line with the existing Local Government (Pourashava) Act, 2009 which encompasses a range of functions and activities.
2. Activation of the town level co-ordination committees (TLCC) and ward level coordination committees (WLCC) so as to put in the citizens' participation in the planning process of the pourashavas.

3. Establishment and development of a strong and effective monitoring and evaluation (M&E) system in the project participating pourashavas.

592. These three aspects are the vital areas not for only sustainable municipal capacity development but also helpful for mainstreaming the climate change resilient issues in the pourashavas' affairs.

8.7 FINANCIAL MANAGEMENT

593. **Financial management.** Pourashava staff will need to be trained on ADB disbursement procedures, along with improving their budgeting, expenditure and financial reporting activities. LGED will be extending this training to the pourashavas directly or through the National Institute of Local Governance (NILG). In addition, training under ongoing projects is also available.

594. There is no separate training proposed under the project. If required, supplementary support will be provided by the project management and supervision consultants proposed under the project.

9 COMMUNITY AWARENESS RAISING AND BEHAVIORAL CHANGE

595. The socio-economic and willingness-to-pay survey and group discussions conducted as part of the PPTA with people from different income groups in the four *pourashavas* revealed the need for awareness creation. A large proportion of community members, both male and female, lack awareness on hygiene practices and solid waste management at household and community levels, impacting health and environment. Focus group discussion (FGD) findings suggest that the poor are the worst sufferers due to inadequate service access and poor sanitation and hygiene practices. The poor also bear the brunt of disasters and are often least equipped to deal with them.

596. It is proposed that awareness raising of communities on behavioral change in water, sanitation and hygiene (WASH) activities, community-based climate adaptation and livelihood development, as well as on the resettlement framework, entitlements of affected persons (AP) and perform activities to support implementation of the resettlement plan, will be carried out by a non-government organization (NGO). The NGO will also help form water and sanitation user groups to ensure sustainability of community facilities provided under the project. Outline terms of reference for the NGO package are shown in **Appendix 10, Volume 2**.

597. **Main activities.** There will be four major tasks:

(1) Creating awareness among the people, especially the poor and vulnerable in disaster-prone areas about climate change adaptation and disaster preparedness.[77] This will include awareness on safe evacuation routes, early warning signals and actions/steps to be taken in the event of a natural disaster, actions to be taken to avoid losses etc. to ensure climate resilience. The NGO will generate awareness among different stakeholders about issues in disaster management specific to each pourashava under the project.

(2) Conducting a WASH campaign among all sections of the population across the project pourashavas, to ensure improved health, sanitation and hygiene outcomes. The campaign will be implemented through a group of citizens (educated people, religious and community leaders) identified with the support of pouroshavas, to help motivate more people and disseminate information under the WASH campaign. The WASH campaign will target men and women community members from all income groups.

(3) Community mobilization and formation of water and sanitation user groups (WSUG) wherever community facilities are proposed under the project and training of community members on 'how to use the facility', minor maintenance and repairs, as a sustainability initiative. The NGO will target women as agents of change in managing water supply (through common water sources e.g. standpipes and/or hand deep tubewells, wherever required or proposed) and sanitation facilities and hygiene and sanitation practices in their communities including solid waste disposal practices. WSUGs will be run by a management committee, which will have both men and women members, including those from disadvantaged sections. The NGO will train the committee members and any other interested community member in financial management, conflict resolution and minor repairs and maintenance work. It will generate awareness on water use practices, cost of water production and the importance of paying for water in order to enjoy and demand a better water supply service. The groups will take

[77] The consultation and participation plan (CPP) for the project outlines specific outreach activities to raise awareness and ensure meaningful participation of communities and stakeholders.

responsibility for payment of nominal charges for maintenance of common facilities by members.

(4) Awareness creation among the community on the project and its envisaged benefits, potential negative impacts, both temporary and permanent, grievance redress mechanism, entitlements of affected persons, jobs available under the project etc. The NGO will provide support to APs for grievance registration and follow-up. In addition, it will work with the PMU, PIUs and contractors appointed for the project to ensure that all affected persons receive their entitlements.

598. The NGO/partner organisation shall be the link between the PIU/pourashava and the communities, including the poor and vulnerable.

599. **Specific tasks.** The NGO will work in close coordination with the pourashava/PMU with the following specific activities:

(i) Identify and enlist the support of community leaders/members for the awareness campaign on climate resilience, the WASH campaign, awareness on the project and its impacts etc. and implement the campaign with their involvement.

(ii) Ensure dissemination of key messages that are gender-sensitive, in a format easily understood by the service user group; prepare pictorial and easy-to-grasp communication tools and training materials for community mobilization and awareness generation.

(iii) Undertake the public information campaign in the local language to inform affected communities about the project, potential temporary/permanent impacts (as applicable), the project's resettlement policy, Resettlement Framework and entitlement packages, likely benefits and opportunities offered by the project (e.g. improved services, job opportunities for skilled or unskilled work, transitional allowances), eligibility and procedures to avail/access the same; and undertake timely dissemination of information on implementation schedule and possible disruptions during project implementation.

(iv) Identify APs through surveys and assist the pourashava/ LGED to distribute identity cards to eligible persons. Assist APs in getting compensation against loss as a result of the project and in receiving resettlement assistance as per the Resettlement Plan/ Entitlement Matrix. Generate awareness on the grievance redress procedures, expected average response time and assist APs with grievance registration and follow up.

(v) Identify vulnerable APs through surveys and ensure their inclusion in project benefits including access to services provided by project, project-related employment, etc.

(vi) Organise training of community members (men and women) in operation and maintenance of standpipes, deep hand tubewells and community toilets provided under the project and reporting issues that they cannot resolve.

(vii) Prepare an action plan for sustainability of project initiatives at the end of the fourth year; and demonstrate an exit strategy such that sustainability of WSUGs formed is ensured beyond the project period.

(viii) Train staff within pourashavas on community mobilization, gender issues through on-the-job training and in-house presentations, ensuring institutional capacity within pourashavas to handle such issues in future;

(ix) Assist the PMU in monitoring the gender action plan.

10 SELECTION CRITERIA FOR BATCH 2 TOWNS

600. The long-list of candidate Batch 2 towns consists of 36 towns in 11 coastal districts in three divisions (Barisal, Dhaka and Khulna). The locations of the towns are shown on **Figure 10.1**.

601. In consultation with LGED and ADB and with reference to UGIIP and STWSSP project preparation documents, a two-step selection process was developed based on criteria for which data were easily available from existing documents (without the need to conduct time consuming interviews or data collection at the pourashava level):

Step 1: Basic eligibility criteria for entry, based on the following three criteria:

(i) population (data source: BBS, 2011 Census);
(ii) population density (data source: BBS, 2011 Census); and
(iii) investment amount from previous donor- and government-finded projects (data source: LGED).

Step 2: Vulnerability ranking criteria, based on the following five criteria:

(i) location of the town, whether in the 'exposed' or 'interior' zones as defined in the Map of Coastal Zone of Bangladesh, Coastal Development Strategy, Ministry of Water Resources, 2006,
(ii) poverty: the proportion of population below the upper poverty line (head count rate - HCR), as shown in Updating Poverty Maps of Bangladesh, 2009, World Programme;
(iii) water salinity (data source: CEGIS – Map: Susceptible to Different Natural Hazards in Bangladesh);
(iv) exposure to storm surges 2050 (data source: IWM – Map: Storm Surge Inundation Depth Very High Risk Area (2050); and
(v) coastal embankments: existing/ ongoing/ planned, including possible polder embankment improvement under the World Bank funded Coastal Embankment Improvement Project (CEIP) Phase 1 (data source: BWDB database).

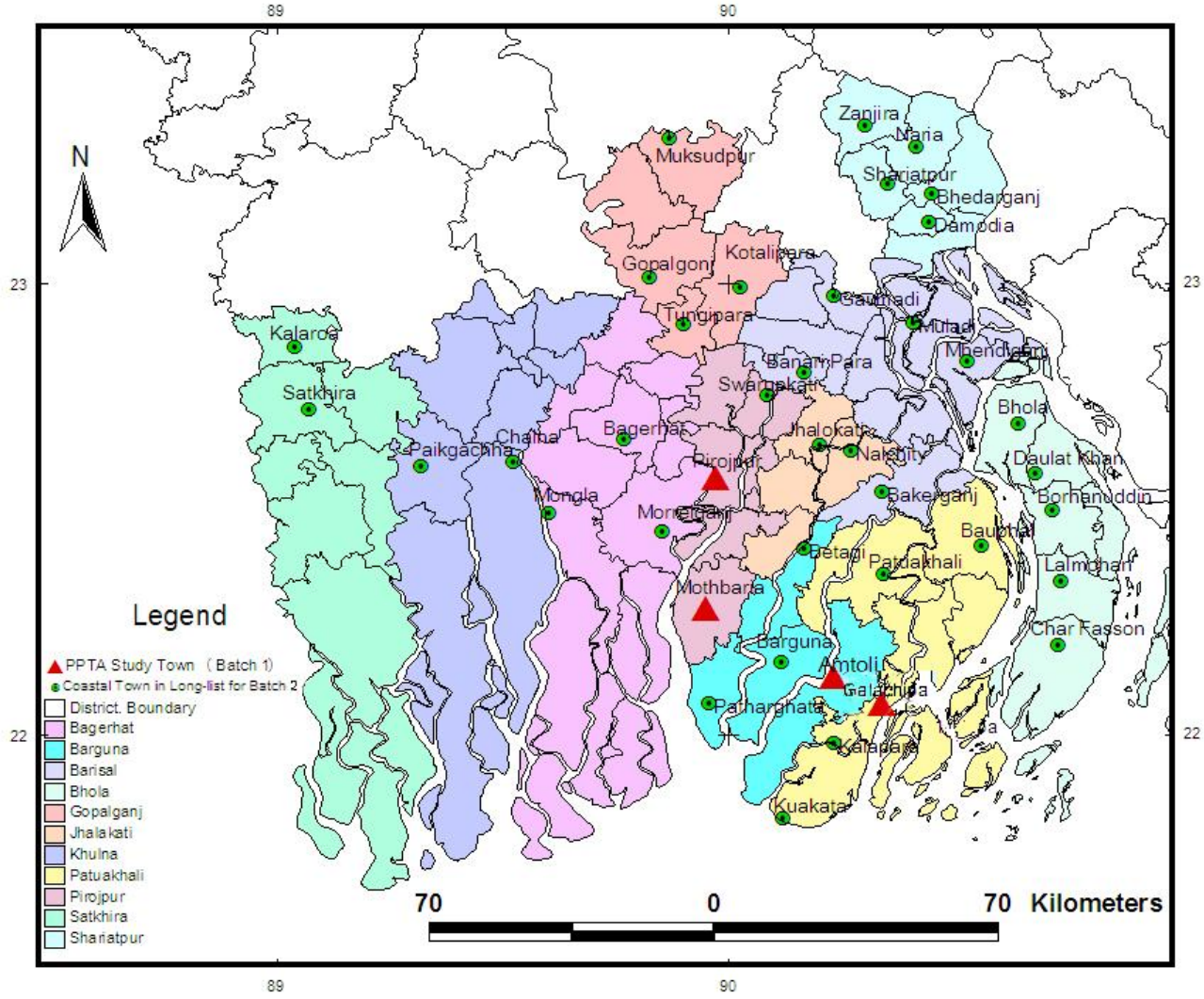
602. Weighted scores were assigned to the criteria for ranking the towns. From the step 1 analysis, generally the most populous and larger towns are ranked highest—seven of the 12 highest ranked towns are district capitals. However, from the step 2 analysis, based on the towns' vulnerability to environmental hazards, the most vulnerable towns which have the highest ranking are smaller in size—only two of the 12 highest towns are district capitals from the step 1 ranking list.

603. The step 1 and step 2 totals were then combined to arrive at a single composite ranking.

604. The results of the screening runs and rankings are shown in **Appendix 6, Volume 2**.

605. From the costing for the Batch 1 towns, it is estimated there is sufficient funding available for four more towns, for Batch 2. LGED will need to confirm that the highest ranked towns from the long-list will be included in Batch 2.

Figure 10.1: Location of Towns in Long-list for Batch 2



Source: PPTA Consultant.

11 INVESTMENT AND FINANCING PLAN

11.1 INVESTMENT WITH CLIMATE CHANGE RESILIENCE MEASURES

606. The total cost of the investment in the Coastal Towns Infrastructure Improvement Project (CTIIP) is estimated at $115.6 million, inclusive taxes, duties, and interest and other charges on the loan during construction. Indicative cost estimates for the project are shown in **Table 11.1**.

Table 11.1: Project Cost Estimates – with CCR

($ Million)

Details	Total US $ Million	ADB and SCF	GoB	% to Total
A. Base Costs				
1. Climate Resilient Infrastructure Improvements				
Drainage	9.41	9.40	0.01	8.1%
Roads	8.71	8.71	0.00	7.5%
Bridges	0.57	0.57	0.00	0.5%
Cyclone Shelters	3.53	3.53	0.00	3.0%
Solid Waste	0.01	0.01	0.00	0.0%
Sanitation	0.54	0.54	0.00	0.5%
Water Supply	7.90	7.90	0.00	6.8%
Stage II	3.40	3.40	0.00	2.9%
Batch II towns infrastructure	34.75	34.75	0.00	30.1%
Resettlement and Land Acquisition	0.19	0.00	0.19	0.2%
Subtotal (1)	**69.00**	**68.8**	**0.2**	59.7%
2. Consultant Packages				
Project Design Advance Consultants	3.44	3.44	0.00	3.0%
Project Management and Supervision Consultants	3.74	3.74	0.00	3.2%
Institutional Strengthening and Awareness Building Consultants	1.99	1.99	0.00	1.7%
NGO	0.62	0.62	0.00	0.5%
Subtotal (2)	**9.78**	**9.78**	**0.00**	8.5%
3. Project Management Support				
Incremental Administration	2.81	2.81	0.00	2.4%
Subtotal (3)	**2.81**	**2.81**	**0.00**	2.4%
Total Base Cost (A)	**81.59**	**81.39**	**0.20**	70.6%
B. Contingencies	11.10	11.10	0.00	9.6%
C. Duties and Taxes	20.26	0.00	20.26	17.5%
D. Financing Charges	2.65	0.00	2.65	2.3%
Total Project Cost	**115.60**	**92.49**	**23.11**	100.0%

Notes:
1. Costs are at 201**3** prices.
2. Physical contingencies: Civil Works and Equipments - 5%
3. Price contingencies - as per SARD circular for BANGLADESH
4. Taxes: 5.5%, International Consultants – 25%
5. Exchange Rate used 1 US$ = BDT 78

Source: PPTA Consultant estimates.

11.2 FINANCING PLAN – WITH CCR

607. The proposed financing plan is an ADB loan of US$52 million (inclusive of US$3.5 million PDA), Pilot Program for Climate Resilience (PPCR) 20% to 30% of capital costs, and GOB counterpart funds amounting to 20% **(Table 11.2)**.

608. CTIIP is intended to be financed with assistance from ADB from its Asian Development Fund (ADF) resources. The loan will have an equal amortization period of 25 years, including a grace period of 5 years, an interest rate of 2% per year throughout the loan.

609. The Borrower will be the Government of Bangladesh (GOB). The GOB counterpart contribution is expected to be in the range of 20% of the project cost. During the project preparation stage, the modality for sub-lending to the project towns would be discussed with GOB, i.e. loan:grant ratio, interest rate, and repayment period.

Table 11.2: Financing Plan – with CCR

Sources	Amount ($ million)	Percentage of Total (%)
Asian Development Bank	52.0	45.0
SCF (Strategic Climate Fund)	40.5	35.1
Government of Bangladesh and Pourashavas	23.1	20.0
Total	**115.6**	**100.0**

Source: PPTA Consultant estimates.

11.3 INVESTMENT WITHOUT CLIMATE CHANGE RESILIENCE MEASURES

610. The total cost of the investment in the project is estimated at $115.5 million, inclusive taxes, duties, and interest and other charges on the loan during construction. Indicative cost estimates for the project are shown in **Table 11.3**.

Table 11.3: Project Cost Estimates – without CCR

($ Million)

Details	Total US $ Million	ADB and SCF	GoB	% to Total
A. Base Costs				
1. Climate Resilient Infrastructure Improvements				
Drainage	7.83	7.80	0.03	6.8%
Roads	7.80	7.80	0.00	6.8%
Bridges	0.52	0.52	0.00	0.4%
Cyclone Shelters	3.21	3.21	0.00	2.8%
Solid Waste	0.01	0.01	0.00	0.0%
Sanitation	0.50	0.50	0.00	0.4%
Water Supply	6.79	6.79	0.00	5.9%
Stage II	3.40	3.40	0.00	2.9%
Batch II towns infrastructure	38.52	38.52	0.00	33.4%
Resettlement and Land Acquisition	0.19	0.00	0.19	0.2%
Subtotal (1)	**68.75**	**68.5**	**0.2**	59.5%
2. Consultant Packages				
Project Design Advance Consultants	3.44	3.44	0.00	3.0%

Details	Total US $ Million	ADB and SCF	GoB	% to Total
Project Management and Supervision Consultants	3.74	3.74	0.00	3.2%
Institutional Strengthening and Awareness Building Consultants	1.99	1.99	0.00	1.7%
NGO for Community Awareness and Outreach	0.62	0.62	0.00	0.5%
Subtotal (2)	**9.78**	**9.78**	**0.00**	8.5%
3. Project Management Support				
Incremental Administration	2.81	2.81	0.00	2.4%
Subtotal (3)	**2.81**	**2.81**	**0.00**	2.4%
Total Base Cost (A)	**81.34**	**81.12**	**0.22**	70.4%
B. Contingencies	11.35	11.35	0.00	9.8%
C. Duties and Taxes	20.26	0.00	20.26	17.5%
D. Financing Charges	2.52	0.00	2.52	2.2%
Total Project Cost	**115.48**	**92.47**	**23.01**	100.0%

Notes:
1. Costs are at 2013 prices.
2. Physical contingencies: Civil Works and Equipments - 5%
3. Price contingencies - as per SARD circular for BANGLADESH
4. Taxes: 5.5%, International Consultants – 25%
5. Exchange Rate used 1 US$ = BDT 78

Source: PPTA Consultant estimates.

11.4 FINANCING PLAN – WITHOUT CCR

611. The proposed financing plan is an ADB loan of US$52 million (inclusive of US$3.5 million PDA), Pilot Program for Climate Resilience (PPCR) 20% to 30% of capital costs, and GOB counterpart funds amounting to 20% **(Table 11.4)**.

612. CTIIP is intended to be financed with assistance from ADB from its Asian Development Fund (ADF) resources. The loan will have an equal amortization period of 25 years, including a grace period of 5 years, an interest rate of 2% per year throughout the loan.

613. The Borrower will be the Government of Bangladesh. The GOB counterpart contribution is expected to be in the range of 20% of the project cost. During the project preparation stage, the modality for sub-lending to the project towns would be discussed with GOB, i.e. loan:grant ratio, interest rate, and repayment period.

Table 11.4: Financing Plan – without CCR

Sources	Amount ($ million)	Percentage of Total (%)
Asian Development Bank	52.0	45.0
SCF	40.5	35.1
Government of Bangladesh and Pourashavass	23.0	19.9
Total	**115.5**	**100.0**

Source: PPTA Consultant estimates.

12 PROJECT IMPLEMENTATION ARRANGEMENTS

12.1 INTRODUCTION

614. Proposed implementation arrangements for the Coastal Towns Infrastructure Improvement Project (CTIIP) are presented in this chapter. Detailed arrangements are specified in the Project Administration Manual (PAM) and the Government of Bangladesh's Development Project Proforma (DPP). The estimated schedule of the loan and DPP preparation process is shown on **Table 12.1**.

615. The PAM includes the following key elements (the first draft of the PAM is shown in **Volume 3**):

- implementation schedule/ work plan;
- fund channeling mechanism;
- project management organization structure of the EAs and IAs (for project management units and project implementation units respectively), and roles and responsibilities;
- design and monitoring framework (DMF);
- outline TOR for consultants to assist with project management and implementation; and
- procurement plan.

616. To avoid the risk of start-up delays as a result of recruiting project implementation consultants, a project design advance (PDA) TA will initiate these tasks prior to loan approval. It is anticipated that the PDA detailed design consultants will start in November/December 2013.

617. Project readiness will be scrutinized based on the following criteria:

- Detailed engineering design completed.
- Advanced procurement bids have been evaluated, and contracts to be awarded.
- Safeguard measures are in place for at least the first 24 months of the project.
- Local counterpart funding has been secured.
- The project director and team have been selected and are in place.
- Local permits and clearances have been obtained.

Table 12.1: Loan Processing and DPP Processing Schedule

Time Line	ADB Loan Processing Milestones	GOB's DPP Processing Milestones	Other Project Readiness Activities
July 2013	Submission of PPTA Draft Final Report	Draft DPP	Government endorsement of safeguards documents.
August 2013		Finalization of DPP documents by LGED	Begin land acquisition process for Stage I subprojects in pourashavas.
September 2013	ADB fact-finding mission and final workshop	Issue requests for expressions of interest for 3 TA packages	
October 2013	- ADB Management Review Meeting - Loan negotiations	DPP approval by Ministry, LGD	
November 2013		DPP approval by Project Evaluation Committee, Planning Commission	Mobilization of PDA detailed design consultants

Time Line	ADB Loan Processing Milestones	GOB's DPP Processing Milestones	Other Project Readiness Activities
December 2013		DPP approval by Executive Committee of National Economic Council (ECNEC)	
January 2014	ADB Board approval		
February 2014			- Submission of draft bid documents and final safeguards documents for Batch 1 subprojects in to ADB for review and approval. - Completion of all land acquisition.
March 2014			- Approval of bid documents by ADB. - Issuance of invitation for bids for Stage I packages.
April 2014			Mobilization of 3 TA teams
May 2014			Submission of bid evaluation reports for Stage I packages.
June 2014	Loan effectiveness		First contracts awarded

Source: Adapted from ADB Final Review Mission draft Aide Memoire, July 2013.

12.2 PROJECT MANAGEMENT ORGANIZATION STRUCTURE

618. The scope of CTIIP infrastructure for Stage I consists of seven categories: (i) roads, (ii) bridges, (iii) solid waste management, (iv) cyclone shelters, and (v) drainage and flood control—which are the responsibility of the Local Government Engineering Department (LGED) in the Local Government Division (LGD) of the Ministry of Local Government, Rural Development, and Cooperatives; and (vii) water supply and (viii) sanitation—which are the responsibility of the Department of Public Health Engineering (DPHE), in the Rules of Business. The LGED will also be responsible for providing support and guidance to pourashavas concerning performance criteria and pourashava development planning.

619. In this context, LGED will be the Executing Agency (EA) for the project, and DPHE will be a co-executing agency. Overall coordination of the project, and the primary point of contact with ADB, will be provided by a Project Director (PD) from LGED who will head a Project Management Unit (PMU) in LGED. There will be three Deputy Project Directors (DPD) in the PMU: two from LGED (one for municipal infrastructure, and one for governance and institutional capacity building), and one from DPHE.

620. In addition, because flood protection and disposal of flood waters are key for climate change resilience there will be a need for good coordination with the Bangladesh Water Development Board (BWDB), to ensure that embankments and outfall structures are completed to required standards and are adequately maintained. This coordination will be based on the existing memorandum of understanding (MOU) between LGED and BWDB.

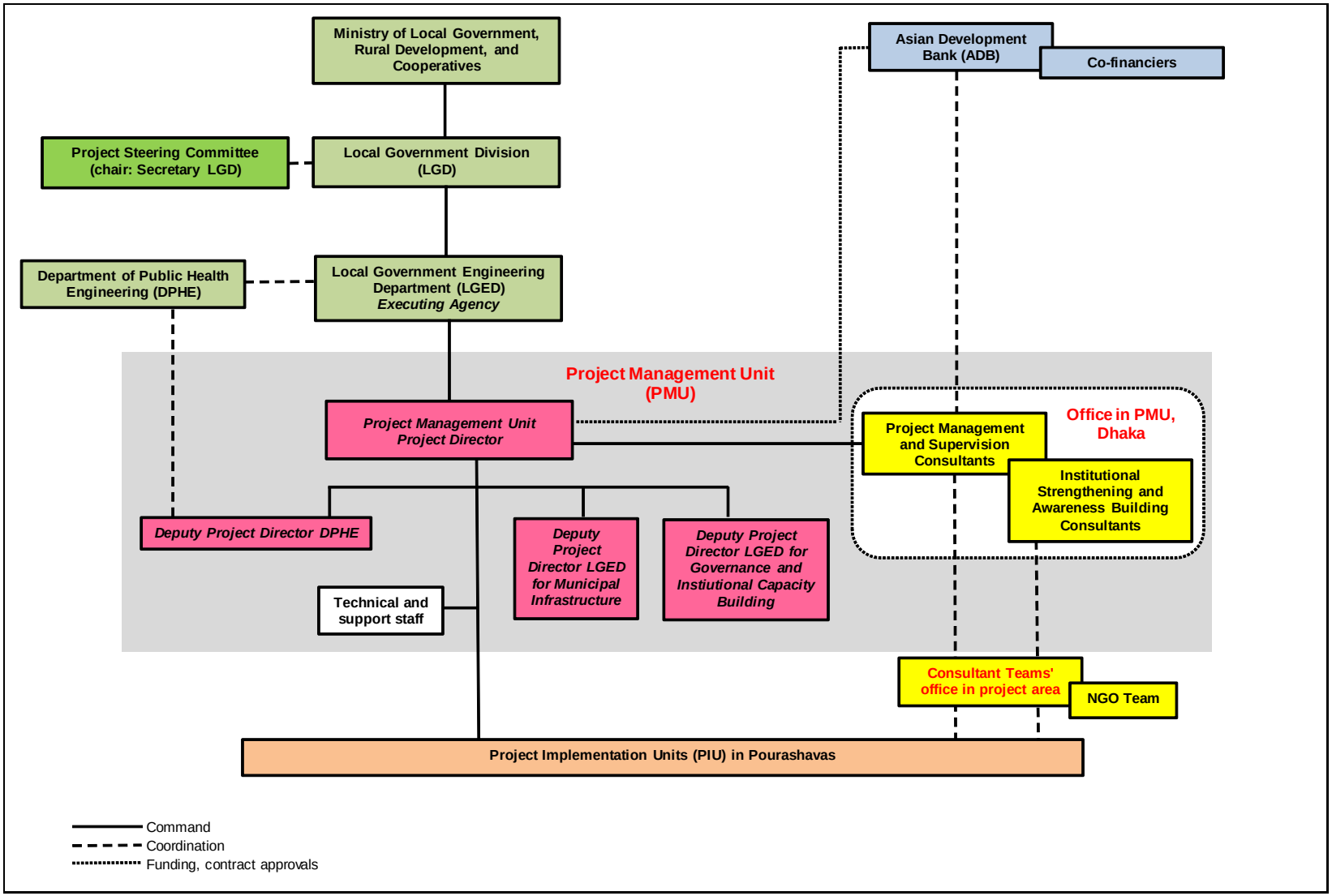
621. The PMU will be responsible for engaging technical assistance (TA) services under the Project—three TA packages are envisaged: (i) Project Management and Supervision Consultants, (ii) Institutional Strengthening and Awareness Building Consultants, and (iii) a non-government organization (NGO) team for community-based climate adaptation and livelihood development.

622. The participating pourashavas will be the Implementing Agencies (IA), and will establish a project implementation unit (PIU) within the pourashava structure. Local LGED and DPHE offices will be involved in the functioning of the PIUs to provide technical support. BWDB, if necessary, will provide technical support as per the MOU.

623. An inter-ministerial project steering committee at national level, chaired by the Secretary LGD, will provide overall policy guidance to the project. The committee will include key government stakeholders, including local government representatives from the participating pourashavas.

624. The proposed organization structure for CTIIP is shown on **Figure 12.1**.

Figure 12.1: Proposed CTIIP Project Management Organization Structure



Source: PPTA Consultant

12.2.1 Project Management Unit

625. The roles and responsibilities of the PMU are outlined in **Table 12.2**, and the proposed structure of the PMU is illustrated in **Figure 12.2**.

Table 12.2: Project Management Unit – Roles and Responsibilities

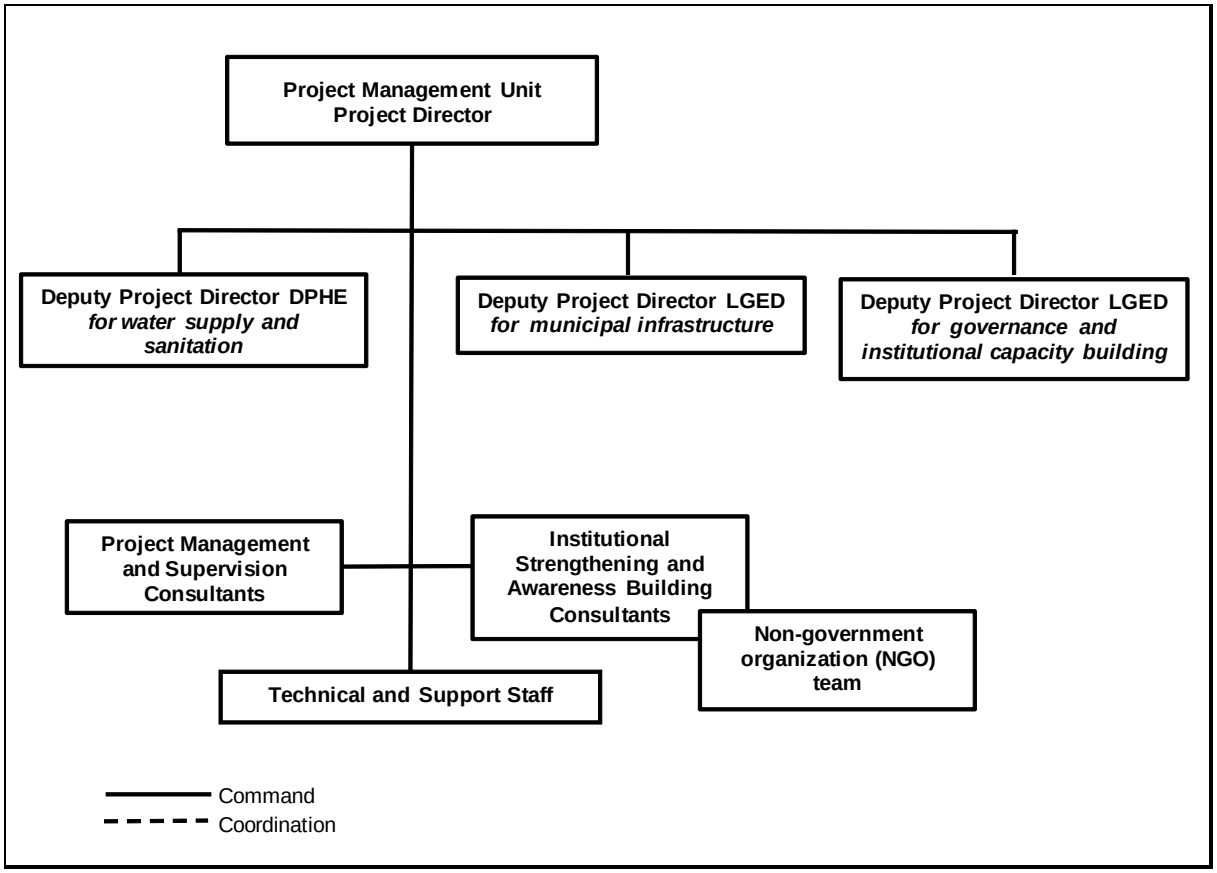
Topic	Roles and Responsibilities
1. General management	• Liaise and correspond with ADB on all issues related to the investment plan. • Facilitate the establishment of PIUs in the participating pourashavas. • Coordinate overall project implementation among PIUs. • Prepare and submit periodic progress reports to ADB. • Establish, maintain and update the investment plan performance monitoring system. • Assist PIUs with compliance of performance criteria.
2. Financial management	• Prepare periodic financing requests to ADB after compilation of constituent subproject components. • Maintain project accounts and prepare consolidated monthly reports. • Establish an imprest account with a commercial bank. • Adhere to sound financial management requirements during the implementation of the project. • Maintain separate project records and accounts adequate to identify the: - goods and services financed from loan proceeds; - financing resources received; - expenditures incurred on the components of each project; and - counterpart funds received and expended. • Facilitate auditing, and taking steps to resolve any issues.
3. Project planning	• Facilitate the process of the preparation of Batch 2 towns to participate in the project. • Assist the pourashavas to comply with the Stage I and Stage II performance criteria and mechanism.
4. Procurement of goods and services (consultants)	• Procure goods such as vehicles, equipment, etc. • Recruit technical assistance teams under the project. Two consultant services packages, and an NGO team, are envisaged: (i) Project Management and Supervision Consultant Team, and (ii) Institutional Strengthening and Awareness Building Consultant Team), and (iii) Community Mobilization, Communication and Behavioral Change NGO Team. • Manage and supervise project consultant and NGO teams, and administer their contracts.
5. Public relations, community development	• Disseminate information related to the investment project to the public domain, including climate change resilience and disaster risk management.
6. Environmental and social safeguards	• Monitor safeguard compliance activities. • Monitor implementation of safeguards plans, guide the PIUs as and when necessary, and prepare reports.
7. Monitoring and evaluation	• Facilitate the establishment and operation of a project

Topic	Roles and Responsibilities
	performance management system. • Monitor physical and non-physical investment activities under the project. • Evaluate monitoring data, as a means of improving project performance and management.
8. Reporting	• Report the progress of the project to ADB by consolidating PIUs' monthly progress reports. • Prepare and submit to ADB quarterly progress reports which will include: (i) a narrative description of progress made during the reporting period; (ii) changes in the implementation schedule; (iii) problems or difficulties encountered; and (iv) activities to be undertaken in the next reporting period. • Prepare and submit: - internal audit report; - reports mandated under the loan agreements and the framework financing agreement to ADB; - disbursement application to ADB. • Preparation of project completion report.
9. Specific Role and Responsibilities for LGED DPD for Municipal Infrastructure	• Take necessary action for obtaining statutory clearances for municipal infrastructure works. • Coordinate for obtaining right of way clearances for municipal infrastructure with related national agencies. • Recommend detailed engineering designs and cost estimates for municipal infrastructure, for approval process. • Recommend/ assist with approval of contract bid documents for municipal infrastructure works. • Recommend/ assist with approval of evaluation of bids for municipal infrastructure works. • Monitor contract implementation progress for municipal infrastructure works. • Overview quality control inspections of PIUs on construction of municipal works and on completed works, and recommend any remedial measures that may need to be taken to ensure compliance with specifications. • Assist with procurement of laboratory equipment for quality control of construction work. • Coordinate with the PIU and subproject towns on general matters relating to municipal infrastructure construction. • Provide technical advice and support to PIUs concerning municipal infrastructure construction and maintenance. • Assist the Project Director (PD) in his day-to-day work, and conduct any other tasks assigned to him by the PD.
10. Specific Role and Responsibilities for LGED DPD for Governance and Institutional Capacity Building	• Facilitate the implementation of the institutional reform component under the investment program. • Provide standard modules of capacity building programs. • Manage training and capacity building program. • Ensure that climate change resilience and disaster risk management are integral elements of the capacity building programs. • Coordinate with Urban Management Support Unit (UMSU) of LGED. • Assist the Project Director (PD) in his day-to-day work, and conduct any other tasks assigned to him by the PD.

Topic	Roles and Responsibilities
11. Specific Role and Responsibilities for DPHE DPD for water supply and sanitation	• Provide technical and management advice and support to PIUs for the strengthening of existing water supply units or establishment of new such units in the pourashavas. • Take necessary action for obtaining statutory clearances for water supply works. • Coordinate for obtaining right of way clearances for water supply works with related National agencies. • Recommend detailed engineering designs and cost estimates for water supply and sanitation works, for approval process. • Recommend/ assist with approval of contract bid documents for water supply and sanitation works. • Recommend/assist with approval of evaluation of bids for water supply and sanitation works. • Monitor contract implementation progress for water supply and sanitation works. • Overview quality control inspections of PIUs on construction of water supply and sanitation works and on completed works, and recommend any remedial measures that may need to be taken to ensure compliance with specifications. • Asssit with procurement of laboratory equipment kits for water quality testing. • Coordinate with the PIU and subproject towns on general matters concerning water supply and sanitation. • Assist the Project Director (PD) in his day-to-day work, and conduct any other tasks assigned to him by the PD.

Source: PPTA Consultant.

Figure 12.2: Proposed Project Management Unit (PMU) Structure



Source: PPTA Consultant.

12.2.2 Project Implementation Units

626. The roles and responsibilities of the PIUs are outlined in **Table 12.3**, and the proposed structure of the PIUs is illustrated in **Figure 12.3**.

Table 12.3: Project Implementation Units - Roles and Responsibilities

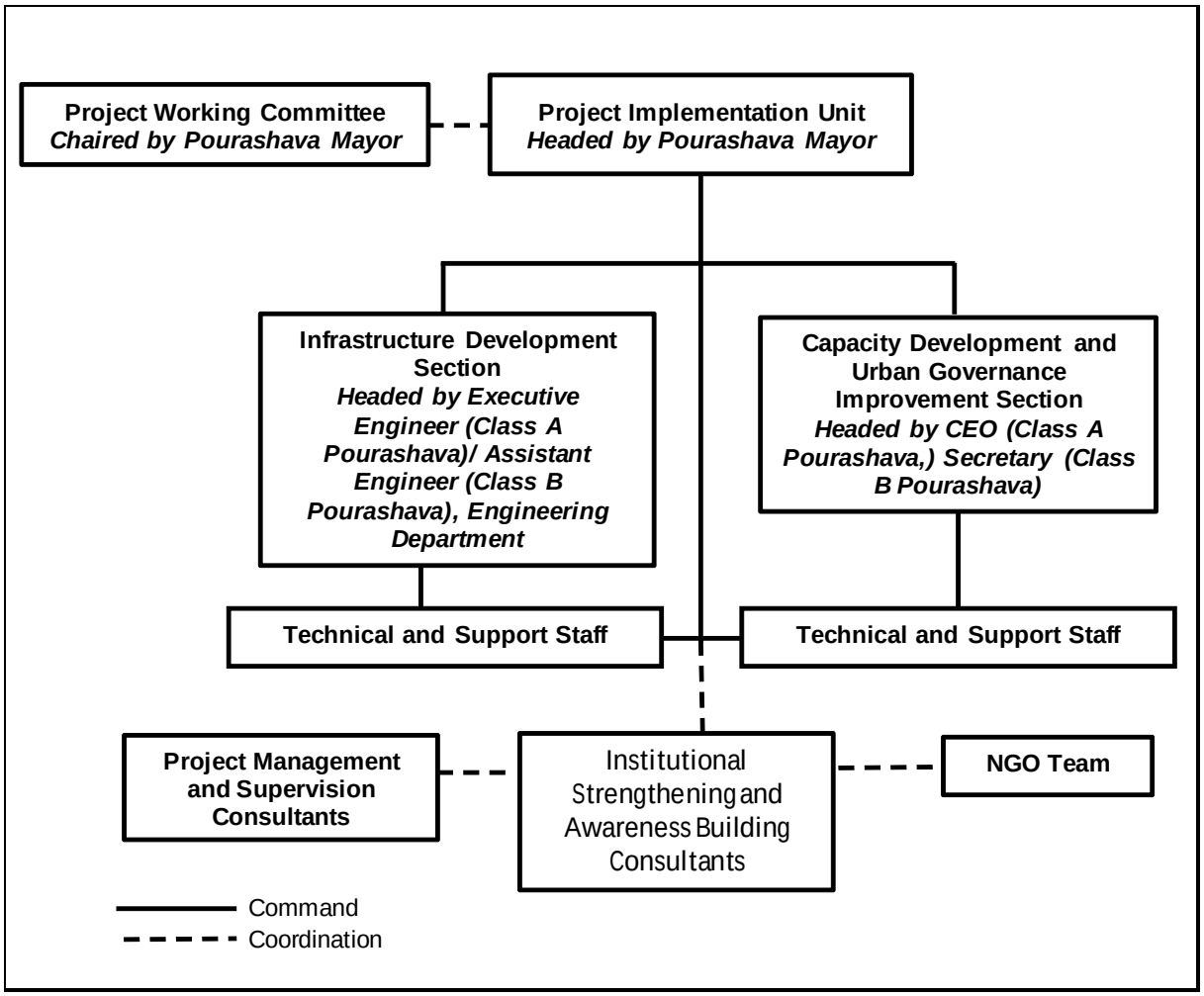
Topic	Roles and Responsibilities
1. General management	• Establish project working committee chaired by pourashava mayor. Should meet at least once a quarter. • Liaise and correspond with the PMU on all issues related to the investment plan. • Prepare and submit periodic progress reports to the PMU. • Collect and submit data for the project performance monitoring system operated by the PMU. • Prepare annual development plans for the subprojects. • Facilitate the preparation of detailed subproject component proposals with the PDA consultants.
2. Financial management	• Prepare periodic financing requests after compilation of constituent subprojects and other components and submit to the PMU for approval. • Maintain project accounts and prepare consolidated monthly reports. • Establish an imprest account with a commercial bank.

Topic	Roles and Responsibilities
	• Adhere to sound financial management requirements during the implementation of the project. • Maintain separate project records and accounts adequate to identify the: - goods and works financed from loan proceeds; - financing resources received; - expenditures incurred on the components of each project; and - counterpart funds received and expended. • Facilitate auditing and taking steps to resolve any issues at PIU level.
3. Procurement of works	• Facilitate site investigations and detailed engineering designs. • Facilitate the preparation of contract bid documents. • Advertise tenders. • Evaluate tenders/bids, and prepare an evaluation report for approval by the PMU. • Award contracts. • Administer contract implementation and payments to contractors.
4. Physical works	• Land acquisition. • Take necessary action for obtaining rights of way. • Conduct quality control inspections during construction of municipal, water supply and sanitation works and on completed works, and report to PMU.
5. Institutional reform and capacity building	• Implement institutional reform as required under the project. • Take measures to ensure compliance with performance criteria. • Facilitate training and capacity building programs. • Participate in capacity building programs.
6. Public relations, community development	• Plan, implement and monitor: • public relations activities; • gender mainstreaming initiatives; • community participation activities; • Disseminate information related to the investment project to the public domain.
7. Environmental and social safeguards	• Ensure compliance with loan covenants concerning safeguards measures (environmental management plan, resettlement plan). • Facilitate implementation of safeguards plans, and prepare required reports.
8. Consultants	• Provide necessary support to consultant and NGO teams.
9. Supervision and quality control	• Supervise and ensure the quality of physical and non-physical investment activities, and report to the PMU as required.
10. Reporting	• Submit monthly activity reports to the PMU. • Prepare and submit to the PMU quarterly progress reports which will include: (i) a narrative description of progress made during the reporting period; (ii) changes in the implementation schedule; (iii) problems or difficulties encountered; and (iv) activities to be undertaken in the next

Topic	Roles and Responsibilities
	reporting period.

Source: PPTA Consultant.

Figure 12.3: Proposed Project Implementation Unit Structure



Source: PPTA Consultant.

4. INTER-MINISTERIAL STEERING COMMITTEE

627. The inter-ministerial steering committee membership will include:

(i) Secretary, Local Government Department, as chair;
(ii) Chief Engineer, LGED;
(iii) Chief Engineer, DPHE;
(iv) Project Director, member secretary;
(v) Representative of General Economic Division, Planning Commission;
(vi) Representative of Physical Planning, Water Supply and Housing (PPWS&H) Sector, Planning Commission;
(vii) Representative of Implementation, Monitoring, and Evaluation Division of the Ministry of Planning;
(viii) Representative of Economic Relations Division and Finance Division of the Ministry of Finance;
(ix) Representative of Ministry of Environment and Forest (Climate Change Unit);

(x) Representative of Bangladesh Water Development Board (BWDB);
(xi) Representative of Urban Development Directorate;
(xii) Representative of Disaster Management Bureau;
(xiii) Representatives of pourashavas (mayor/ engineer/ secretary/ chief executive officer; and
(xiv) Special invitees, if any, to advise the committee on technical issues.

628. The inter-ministerial steering committee will meet at least twice in the project period or as and when necessary. Duties of the steering committee include the following:

(i) Provide policy and strategic guidance, and oversee the implementation of the project.

(ii) Ensure smooth inter-ministry/ agency coordination.

(iii) Review and provide policy direction on:
- Implementation of the urban reform agenda;
- Compliance with loan covenants under the ADB loans;

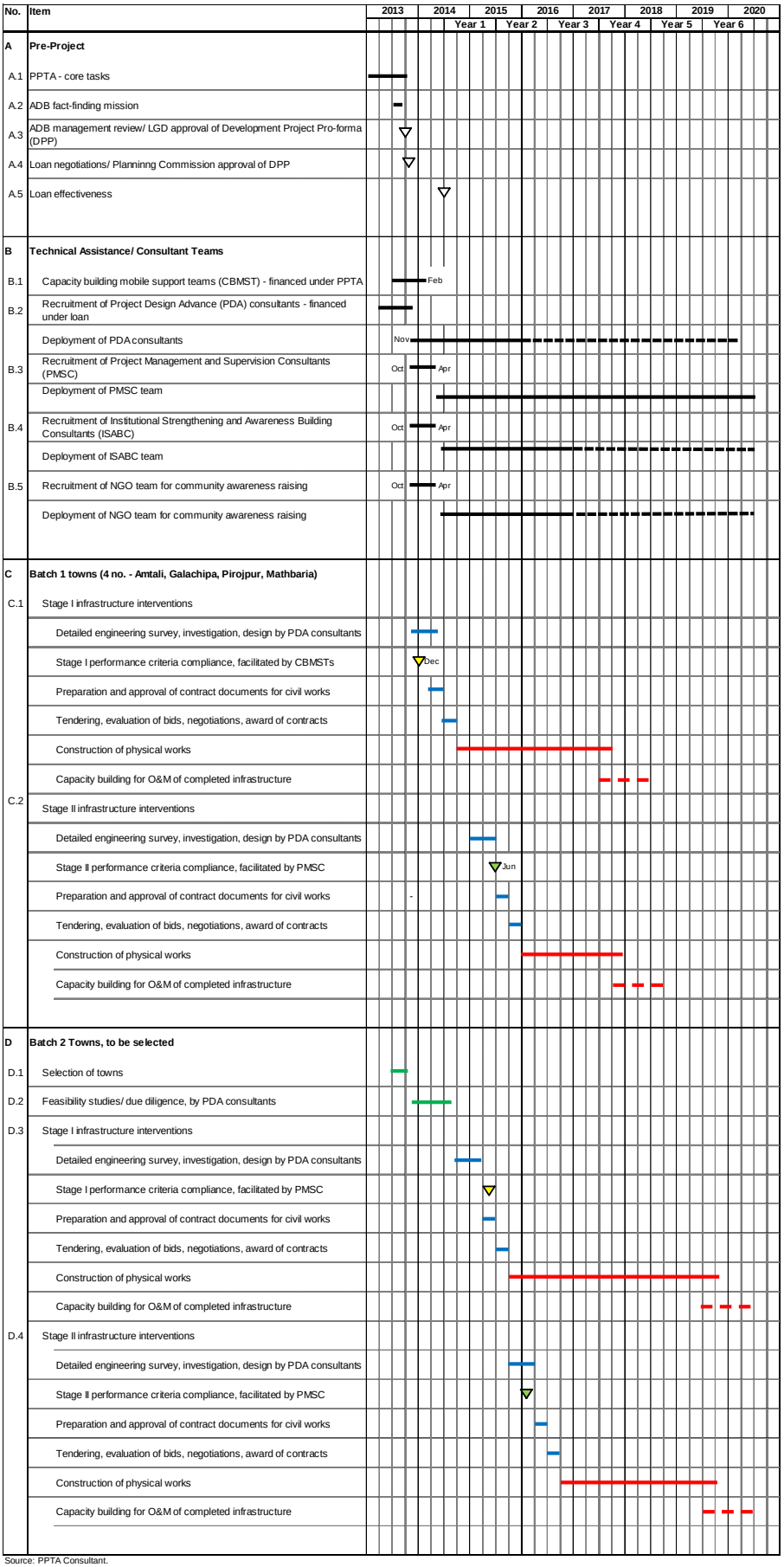
(iv) Facilitate in resolving critical project implementation issues and in inter-departmental co-ordination.

(v) Oversee site clearance activities and obtaining statutory clearances.

12.3 IMPLEMENTATION SCHEDULE

629. A 6-year implementation period is envisaged for CTIIP, from 2014 to 2020 (**Figure 12.4)**.

Figure 12.4: CTIIP Implementation Schedule



Source: PPTA Consultant.

12.4 PERFORMANCE CRITERIA MECHANISM

630. As is the case with other projects financed under a sector lending modality (such as Urban Governance and Infrastructure Improvement Project and the Secondary Towns Water Supply and Sanitation Project), the release of project funds to the pourashavas will be administered under a 2-stage process known as the Performance Criteria Mechanism, whereby the project pourashavas have to meet certain institutional capacity and governance criteria to receive funding. Infrastructure subprojects are therefore divided between Stage I funding and Stage II funding (see Figure 2.1).

631. Investments under Performance Criteria Stage I include those infrastructure components in urban core areas and considered critical for building climate change resilience such as: (i) cyclone shelters, (ii) roads, bridges and culverts which will enhance climate change resilience through improved connectivity and access to emergency services in the event of disasters caused by natural hazards, (iii) solid waste management, (iv) drainage and flood control, and (v) water supply in urban core areas, and (vi) sanitation.

632. For investments under Performance Criteria Stage II it was decided during the ADB review mission of 30 June – 7 July 2013 that these would be in the form of a lump sum of $1.0 million per town, for the pourashavas to use according to priorities and needs. Stage II investments that could be considered include: (i) other priority roads, bridges, and culverts, (ii) boat landing stations, (iii) markets, (iv) bus terminals, and (v) solid waste management, and (vi) water supply for future planned development areas.

633. The performance criteria 2-stage mechanism was developed during the PPTA and extensively discussed with LGED, ADB and the PPTA study pourashavas, and is presented in **Appendix 7, Volume 2**.

634. A performance evaluation committee will be formulated in LGED to assess compliance with the criteria. A signed Partnership Agreement submitted to the PMU is a pre-condition for entry to Stage I.

635. The criteria matrix will be used by the capacity building mobile support teams, which mobilized in June 2013, to assist and guide the PPTA study pourashavas to carry out measures to comply with the Stage I criteria.

636. The target dates for Stage I and Stage II performance criteria compliance for the Batch 1 and Batch 2 towns are shown on Figure 12.4.

12.5 DESIGN AND MONITORING FRAMEWORK

637. The draft design and monitoring framework (DMF) for the project is shown in **Appendix 8, Volume 2**.

12.6 PROJECT IMPLEMENTATION TECHNICAL ASSISTANCE TEAMS

638. Besides the PDA consultants for detailed engineering design, contract documents preparation and safeguards facilitation, it is envisaged that there will be three technical assistance (TA) teams to assist and support the PMU and PIUs with addressing the four project outputs:

(i) A Project Management and Supervision Consultant (PMSC) team for project management and administration support (Output 4), and assistance in quality

control and supervision of the construction of improved municipal infrastructure interventions, and with improving water supply O&M (Output 1). A list of proposed team members and input allocations is shown on **Table 12.4**.

(ii) An Institutional Strengthening and Awareness Building Consultant (ISABC) team for the strengthening of local governance for sustainable service delivery and urban planning; to conduct studies, surveys and research on flood inundation, climate change impacts; facilitate disaster risk management capacity building, and community level adaptation though locally managed climate resilience funds; and to promote improved groundwater management (Output 2). A list of proposed team members and input allocations is shown on **Table 12.5**.

(iii) A non-government organization (NGO) for community mobilization, communication and behavioral change (CMCBC) in water, sanitation and hygiene (WASH) activities, and community-based climate adaptation and livelihood development (Output 3). A list of proposed team members and input allocations is shown on **Table 12.6**.

639. Terms of reference for these TA teams are outlined in **Appendix 10, Volume 2**.

Table 12.4: Project Management and Supervision Consultant Team – Proposed Composition and Inputs

Name of Positions	Person-months	
	International	**National**
Output 4: Project Management and Administration Support		
1. Project Management Specialist/ Team Leader	46.0	
2. Municipal Infrastructure Engineer/ Deputy Team Leader		64.0
3. Finance Management Specialist	5.0	14.0
4. Information Technology/ Management Information System Specialist		10.0
5. Monitoring and Evaluation Expert		54.0
6. Environmental Safeguards Expert		24.0
7. Social Safeguards and Gender Expert		36.0
Subtotal Output 4	**51.0**	**202.0**
Output 1: Improved Municipal Infrastructure with Climate-Resilient Design in Project Pourashavas		
1. Quality Control Specialist	4.0	
2. Procurement and Quality Control Expert		8.0
3. Construction Supervision Engineers	12.0	142.0
4. Water Supply O&M Engineer		15.0
5. Electro-mechanical Engineer		14.0
6. CAD operator		46.0
Subtotal Output 1	**16.0**	**225.0**
Total	**67.0**	**427.0**
Grand Total	**494.0**	

Source: PPTA Consultant.

Table 12.5: Institutional Strengthening and Awareness Building Consultant Team – Proposed Composition and Inputs

Position	Technical Assistance Component	Person-month	
		International	**National**
International Consultants:			
1. Urban Planning and Development Specialist / Team Leader	Urban planning	18.5	
2. Urban Climate Change Adaptation and DRM Specialist	Urban planning	5.5	
3. Architect / Structural Engineer	Urban planning	3.0	
4. Urban Disaster Risk Management Specialist	Climate adaptation & DRM	6.0	
5. Climate Modeler and Dynamic Downscaling	Climate adaptation & DRM	5.0	

Position	Technical Assistance Component	Person-month	
		International	National
Specialist 6. Drainage Engineer ***Sub-total (International Consultants)***	Climate adaptation & DRM	6.0 ***44.0***	
National specialists:			
1. Urban Planning and Development Specialist/ Deputy Team Leader	Urban planning		39.5
2.Urban Climate Change Adaptation and DRM Specialist	Urban planning		8.5
3. Architect/ Structural Engineer	Urban planning		3.0
4. Municipal Infrastructure Specialist	Urban planning		3.0
5. Municipal Finance Specialist	Urban planning		2.0
6. Capacity Development Specialist/ Training Coordinator	Urban planning		6.0
7. Facilitators (Urban Planning)	Urban planning		20.0
8. Social Safeguards Specialist	Urban planning		2.0
9. Environmental Safeguards Specialist	Urban planning		1.0
10. GIS Technician/Specialist	Urban planning, climate		18.0
11. Computer Database Technician/Specialist	Urban planning		1.5
12. National Disaster Risk Management Expert	Climate adaptation & DRM		14.5
13.National Climate and Adaptation Expert	Climate adaptation & DRM		8.0
14.Flood hydrologist/ modeler	Climate adaptation & DRM		3.0
15. Infrastructure economist (national)	Climate adaptation & DRM		2.5
16. National fund/micro-credit expert	Climate adaptation & DRM		8.0
17. National fund/banking legal expert	Climate adaptation & DRM		1.5
18. Institutional and Governance Expert	Institutional, governance		12.0
19.Groundwater Hydrogeologist/monitoring/ mapping	Climate adaptation & DRM		14.0
Sub-total (National Consultants)			***168.0***
Total Consultant Inputs		**212.0**	
TL = Team Leader, DTL = Deputy Team Leader, GIS = Geographical Information System			

Source: PPTA Consultant.

Table 12.6: NGO Team – Proposed Composition and Inputs

S.No.	Position	Person-month
1	Team Leader	32.0
2	Community Development, Outreach and Participation Specialist	27.0
3	Social Safeguards and Gender Specialist	37.0
4	WASH Campaign Coordinator	18.0
5	Facilitators (Community Outreach) - 2 positions (1 per 2 towns)	50.0
6	Specialists on Call (WASH and Climate Change)	3.0
7	Community Organizers - 4 positions (1 per town)	176.0
	Total inputs	**343.0**

Source: PPTA Consultant.

12.7 PROCUREMENT AND CONSULTING SERVICES

640. **Procurement guidelines.** All procurement of goods and civil works will be undertaken in accordance with ADB's Procurement Guidelines (January 2013, as amended from time to time). International competitive bidding (ICB) procedures will be used for civil works contracts valued at USD 1.5 million or higher, and goods supply contracts valued at USD 0.5 million or higher. Below the thresholds for ICB, national competitive bidding (NCB) procedure may be used, in which case the procurement will follow the Public Procurement Act, 2006 and Public Procurement Rules, 2008, subject to the following conditions that will be specified in the NCB Annex incorporated in the Procurement Plan (as updated from time

to time):

a) General. The procedures to be followed for national competitive bidding shall be those set forth for the National Open Tendering Method in the Government's Public Procurement Rules, 2008 (as updated and issued pursuant to the Bangladesh Public Procurement Act, 2006) with the clarifications and modifications described in the following paragraphs required for compliance with the provisions of the Procurement Guidelines.

b) Advertising. Bidding of contracts estimated at USD 500,000 or more for goods and related services or USD 1,000,000 or more for civil works shall be advertised on ADB's website via the posting of the Procurement Plan.

c) Anti-Corruption. Definitions of corrupt, fraudulent, collusive and coercive practices shall reflect the latest ADB Board-approved Anti-Corruption Policy definitions of these terms and related additional provisions (such as conflict of interest, etc.).

d) Location of Bid Submission. Submission of bids to 'primary' and 'secondary' locations, or 'multiple droppings' of bids, shall not be required or allowed. Advertisements and bidding documents shall specify only one location for delivery of bids.

e) Rejection of All Bids and Rebidding. Bids shall not be rejected and new bids solicited without ADB's prior concurrence.

f) Member Country Restrictions. Bidders must be nationals of member countries of ADB, and offered goods must be produced in member countries of ADB.

g) Lottery. A lottery system shall not be used to determine a successful bidder, including for the purpose of resolving deadlocks.

h) Qualification Requirements. A successful bidder must be determined by an assessment process that shall include the application of qualification requirements to all bids.

i) Rejection of Bids. A bid shall not be rejected on the grounds that its bid price is not within a percentage range above or below the contract estimate.

641. The Government's electronic procurement system (eGP) may be used for NCB procurement if approved by, and subject to any conditions of, ADB. Shopping may be used for works and goods contracts worth less than USD 100,000. The detailed procedures for procurement will be described in Project Administration Manual (PAM) to be issued by ADB.

642. **Consulting services.** All consultants, including non-government organizations (NGO), will be recruited according to ADB's Guidelines on the Use of Consultants (March 2013, as amended from time to time). Most consultants will be engaged through consulting firms following the quality- and cost-based selection (QCBS) method with a standard quality/cost ratio of 90/10. Depending on the need for specific discipline of expertise for the project, some individual consultants may be engaged. The detailed procedures will be described in Project Administration Manual (PAM) to be issued by ADB.

643. NGOs, including community-based organizations (CBOs), may be engaged for certain community-based activities, such as awareness campaigns and resettlement assistance if found necessary and appropriate. For the selection of NGOs, the QCBS procedure will be used for assignments expected to cost more than USD 200,000, and the Consultants' Qualifications Selection (CQS) procedure for assignments of USD 200,000 or less.

644. **Bidding documents.** The government has its own standard documents for procurement of goods and works. These are mainly used for government funded projects.

However, these documents follow standard formats similar and comparable to ADB's standard documents, and hence could be used for the project subject to few modifications in conformity with ADB's requirements. Such adjustments would ensure compliance with ABD's policies without making major changes in the existing system or without creating an immediate need for orientation/ training only for the bidding documents.

645. For the recruitment of consultants, the Government of Bangladesh generally follows the development partner's guidelines, and use procurement documents of the funding agency.

646. For the proposed project, the EA/ IAs may:

(i) follow national standard documents after modifications to be suggested by ADB for the procurement of goods and works following the NCB method under the national act subject to the "conditions" as mentioned above;

(ii) use ADB's standard bid documents and procedures for the procurement of goods and works following the ICB method; and

(iii) recruit consultants using ADB's consultant selection documents and guidelines.

647. **Procurement planning.** According to the Public Procurement Laws (PPA) of Bangladesh, it is mandatory for all procuring entities to prepare and regularly update procurement plans. PPA also requires public disclose of the procurement plan at least annually.

648. The Batch 1 pourashavas (Amtali, Galachipa, Mathbaria and Pirojpur) have prepared a list of works contracts which will be updated and approved based on the availability of funds. Although this list contains basic information required for the mandatory format of procurement plan, all pourashavas under CTIIP should be monitored whether they prepare, regularly update and disclose procurement plans containing all contract packages including those under CTIIP and other projects (when applicable) with a view to establish the standard practice for transparent procurement process. In addition, the procurement plans have to be prepared in ADB's format for CTIIP interventions.

649. For the proposed project, an 18-month procurement plan indicating threshold and review procedures, tentative contract packages, and applicability of national competitive bidding guidelines has been prepared by the PPTA consultants in consultation with EA and concerned IAs. The plan also identifies the responsible agency for each procurement and consultancy contract.

650. The concerned infrastructure specialist of the PPTA team followed LGED schedule of rates (July 2012 version) applicable for the Barisal region for preparing the tentative cost estimates of tentative works packages. While comparing LGED unit rates of 8 basic items of works (Ordinary Portland Cement, 1st Class Brick, Coarse Sand, Fine Sand, Local Sand, Stone Chips, M.S. Rod and 80/100 Grade Bitumen) with those in the current market in Barisal during July 2013, it is observed that current prices are 10% to 30% higher. The cost of local labour also increased as much as 50% in the current market within Barisal. In the course of time up to commencement of CTIIP works implementation, further increases of price may be anticipated. During detail design of the civil works, the responsible experts may update the unit rates before preparing the estimates and bidding documents.

651. **Responsibilities of contract execution.** The Executing Agency, LGED, will implement all contracts for the procurement of goods and works that follow the ICB method. LGED will also be responsible for major goods (such as project vehicles, equipment, etc.) procured centrally using NCB for distribution to the field level. The Department of Public Health Engineering (DPHE) will be involved in the implementation of the project mostly to

provide technical expertise in design and quality control of water and sanitation related infrastructures and interventions.

652. The implementing agencies (pourashavas) will procure all civil works that follow the NCB method and procurement of all goods that follow the shopping method. The packaging of the works contracts will be location-wise, so that each pourashava could independently implement infrastructure schemes within their respective jurisdiction. The project preparatory consultants have identified the following categories of works schemes for each of the target towns: water supply, sanitation, drainage and flood control, roads, bridges, culverts, boat landing stations, cyclone shelters, markets, landscaping, bus terminal, and solid waste management. None of these works are new for local contractors, and it is less likely that international contractors will be attracted for smaller value works in remote areas. However, some of these categories of works schemes may be clustered into groups for procurement packaging purposes, so that the estimated cost of each package remains high enough for attracting better contractors available within the country.

653. **Existing capacity of pourashavas and local contractors vs. packaging of works contracts.** PPTA consultants arranged a day-long workshop on procurement of works under the proposed CTIIP; the workshop was held at LGED Barisal on 23 May 2013 (a report on the day-long procurement workshop is shown in **Additional Appendix E.2, Volume 2)**. The engineers (EEs and AEs), and secretaries of the four Batch 1 pourashavas (Amtali, Galachipa, Mathbaria and Pirojpur) participated in the workshop to familiarize themselves with the procurement guidelines of the Asian Development Bank (ADB), highlighting major differences with the Public Procurement Act and Rules (PPA & PPR), and to conceptualize requirements of the procurement planning process. The main objective of the packaging of contracts has to be balanced between the value of contracts and number of contracts depending on the capacity of pourashava officials and potential contractors.

654. Based on the information provided by the concerned engineers, it is noted that Batch 1 pourashavas have been executing small value contracts with the total number of packages ranging from 60 to 90 nos. each year, and the value of any single contract not exceeding BDT 5 million (approximate USD 62,500). Occasionally, there are several higher value contracts, for example: Pirojpur pourashava had only one contract with BDT 30 million (approximate USD 375,000) for the construction of its new office building. No other Batch 1 pourashava had implemented a contract of such a value. The total volume of works contract for one fiscal year is around BDT 80 to 100 million (approximate USD 1.0 to 1.25 million) in Pirojpur pourashava; which is found to be the highest among the four towns.

655. In part of the same workshop as mentioned above, a total 18 potential contractors also participated from the four Batch 1 towns, and the divisional HQ, Barisal. The contractors voluntarily provided information on their past performance of contracts executed through various procuring entities following the NCB method. Based on the information provided, it is observed that four contractors of Galachipa Pourashava implemented works contracts of value not exceeding BDT 10 million (approximate USD 125,000). The highest value of a single contract for 9 out of 11 participating contractors of the other three 3 towns (Amtali, Mathbaria and Pirojpur) is BDT 36 million (approximate USD 450,000). Two contractors of Amtali have experience of single contract value of BDT 100 million (approximate USD 1.25 million). However, none of these higher value contracts were implemented under the target pourashavas. Three contractors from the divisional headquarters, Barisal, have shown better experience of a single contract value ranging from BDT 20 to 120 million (approximate USD 0.25 to 1.50 million).

656. From the findings as described above, it is apparent that very few local contractors have experience of a single contract value more than BDT 40 million (approximate USD 500,000), and the pourashavas currently do not have experience of administering contracts

of such value. However, it is known from the experience of LGED and DPHE that there are many capable bidders at national and regional level to execute the categories of civil works proposed under CTIIP. But there is also the question of willingness to participate in construction activities in remote coastal towns. LGED and DPHE may arrange open discussions with potential bidders at national and regional level, e.g: Dhaka, Khulna and Chittagong, to disseminate the information on the activities of the proposed project in order to grow willingness of the bidders.

657. With a view to widen competition in the bidding process to attract participation by local bidders for works packages, a lower qualification (work experience) requirement for bidders, such as 50% of the estimated price instead of the usual 80% may be adopted for packages with repetitive works involving widely known technology and methods of construction. For example, a bidder having work experience with USD 300,000 contract may qualify bidding for a package valued at USD 600,000 for civil works of rehabilitation/ construction of roads, RCC culverts, brick / RCC drains etc.

658. Capacity building of the procurement and technical staffs of the pourashavas would be essential in order to execute higher value contracts. During the implementation of CTIIP, additional support through experts hired under the project should be provided (as part of the Project Management and Supervision Consultants). A procurement expert engaged under the project should be included in the bid evaluation committee of the pourashavas in order to ensure quality of the bidding process. Similarly, relevant technical experts engaged under the project should be assigned for quality of works implementation. Furthermore, staggering of the implementation schedule may also be adopted by commencing the lower value contract packages during earlier months of the project, and based on the performance of these packages, gradually going for procurement process of higher value packages.

659. A challenging part of pourashava capacity is the “random” transfer of staff. For example, the Assistant Engineer (AE) of Amtali Pourashava has been transferred to a new working place just some days after he received orientations on the project and hands-on training on how to prepare the contract packaging from the tentative scheme list. Since then, the position of AE Amtali Pourashava has been charged to the Sub-Assistant Engineer, who has been posted in Amtali Pourashava for less than two years. In order to ensure adequate capacity of each pourashava throughout the project period, the local government division may consider as follows: (i) suitable staff are posted against all procurement and technical positions of the selected pourashavas; (ii) these staff are not transferred during the project implementation period; and (iii) if any of these staff are transferred for any unavoidable circumstances, the vacancies are immediately filled in with appropriate replacements.

660. **Lessons from other projects.** The PPTA consultants studied the detailed procurement plan of the ADB-funded Second Urban Governance and Infrastructure Improvement Project (UGIIP-II) which deals with urban infrastructures implemented by pourashavas. It is noted that the highest value of a single works contract under UGIIP-II is BDT 23 million (approximate USD 287,500). While discussing about the recommended value of single contract with LGED engineers and pourashava officials of the Batch 1 towns of CTIIP, none of them suggested a single contract value beyond BDT 50 million (approximate USD 400,000) considering the past experiences from other urban sector projects.

661. **Choice of ICB vs. NCB.** From previous experience of implementing civil works in various pourashavas, it is understood that foreign contractors would be less likely to bid for civil works packages involving regular nature and technology of interventions, such as: rehabilitation/ construction of roads, drains, culverts etc. for which national / local contractors often enjoy competitive advantage with regard to locally available construction materials, local labors, transportation etc. It may also be noted that the main way of transportation of construction materials to the Batch 1 coastal towns from the rest of country is by the road

network which includes ferries, causing delays/ cost overrun if disrupted. The prevailing conditions would make it less attractive for international contractors to bid in these remote coastal towns.

662. The international procurement expert in the PPTA team discussed with a few international contractors working in India and other parts in the region, and inquired whether they would be interested in bidding for the proposed CTIIP civil works in the selected coastal towns of Bangladesh. The potential international contractors informed that they could be interested if the estimated value of individual package remains about USD 20 million. From the tentative procurement plan prepared by the PPTA team, it is seen that the estimated value of all works packages for a town varies from $4.7 to 10.2 million, with a grand total for all towns about USD 31 million. As such, the choice of ICB method may not be helpful in attracting international bidders. Based on prevailing conditions, the NCB method may be chosen for implementation of civil works packages, balancing the risks of procedural delay and probability of getting the work done on time. Nevertheless, the advertisement of works packages valued over USD 0.5 million would be mandatorily published in the ADB website, and also in the national web portal dedicated for posting procurement notices.

663. **Future directives for Batch 2 towns.** After selection of the Batch 2 coastal towns, the procurement capacity of the pourashavas and local bidders needs to be assessed in a process similar to that followed for the Batch 1 towns. Then, the contract packaging has to be done in consultation with the concerned procurement staff of the pourashavas after providing them adequate guidance on the concepts and requirements of procurement planning process.

664. **Procurement plan for goods and works contracts.** Indicative lists of goods and works contracts for which procurement process will commence within first 18 months of the project are shown in **Appendix 9, Volume 2**, and summarized in **Table 12.7**.

Table 12.7: Summary of Goods and Works Contracts within First 18 Months of CTIIP

Category	Total No. of Packages	Maximum No. of Contracts (Lots*[1])	Total Estimated Value of Contracts (USD million)	Comments
Goods	**7**	**7**	**1.27**	Note*2: * Exact value of each contract package yet to be decided subject to availability of adequate funds.
Works				
Works Part-1 (Amtali Pourashava)	7	10	4.65	All NCB contracts.
Works Part-2 (Galachipa Pourashava)	8	12	7.33	All NCB contracts.
Works Part-3 (Mathbaria Pourashava)	8	11	8.84	Includes 1 ICB contract of value USD 3.97 m.
Works Part-4 (Pirojpur Pourashava)	9	14	10.49	All NCB contracts.
Works - Subtotal	**32**	**47**	**31.31**	
Grand Total	**39**	**54**	**32.59**	

Note[1]*: The procurement plan for civil works includes 12 packages having 2 or 3 lots. Each lot in a package may be separately awarded to different bidders. However, if a bidder wins all lots in a package, only one contract will be signed for the package.*
Source: PPTA Consutlant.

665. **Quality control of works.** Bidding documents for each works package shall mandatorily mention the requisite quality control (QC) measures and procedures for field as well as laboratory tests, detailing name, frequency, number of tests to be performed at different stages of implementation. The quality control laboratories of LGED and DPHE at district, region and headquarters will be nominated for testing purposes. In addition, other eminent laboratory facilities shall be recommended, if necessary, when LGED and DPHE laboratories do not have adequate services. It will be the responsibility of the contractor to submit the quality control reports from designated sources before making claim for works done. The engineer-in-charge shall be responsible for certifying the works based on authentic test reports. No bill will be paid to the contractor without assuring the intended level of quality.

666. LGED and DPHE officials at Regional/ Zonal, District and Upazila level can play a pivotal role in quality control by sharing their technical expertise and knowledge during detail design, specification preparation and implemention of CTIIP works. Pourashava officials of the Batch 1 towns may learn about quality control tests at LGED's regional laboratory at Barisal and district laboratory at Patuakhali. DPHE's four costal zonal laboratories in Khulna, Barisal, Noakhali and Gopalgonj could be used for quality control tests for water and sanitation interventions. Experienced local officials of LGED and DPHE may participate as resource persons during capacity building programs (trainings/ workshops) to be arranged for pourashava staffs under the proposed project.

667. **Consultancy contracts.** In general, LGED will procure and administer all consultancy/ technical assistance contracts, unless this will be managed by the implementing agencies due to the particular nature of an assignment. **Table 12.8** summarizes the required contract pacjkages for which recruitment activity is expected to commence within the next 18 months.

Table 12.8: Consultancy Contracts under Proposed CTIIP

General Description	Contract Value* (USD million)	Recruitment Method[1]	Advertisement Date (quarter/year)	International or National Assignment	Comments
CTIIP/S-01: Project Management and Supervision Consultant (PMSC)	3.7	QCBS (90:10) International	Q3/2013	FTP	Outline TORs have been prepared **(Appendix E, Volume 3)**.
CTIIP/:S-02 Institutional Strengthening and Awareness Building Consultant (ISABC)	2.0	QCBS (90:10) International	Q3/2013	FTP	
CTIIP/S-03: NGO for Community Mobilization, Communications and Behavioral Change (CMCBC) Activities	0.6	QCBS (90:10) International	Q4/2013	FTP	
Total	**6.3**				

Note: Contract value refers to estimated "Base Cost" excluding price contingencies.*
Source: PPTA Consultant.

668. **Advance Contracting.** All advance contracting will be undertaken in conformity with ADB's Procurement Guidelines and ADB's Guidelines on the Use of Consultants. Advance contracting will be allowed upon ADB's approval for selection of consulting services, including (i) request for EOI, (ii) short-listing, (iii) request for proposals, and (iv) evaluation of proposals; and for procurement of goods and works, including (a) prequalification, (b) tendering, and (c) bid evaluation. Any approval of advance contracting does not commit ADB to finance the Project.

12.8 SUMMARY OF IMPLEMENTATION ARRANGEMENTS

669. A summary of implementation arrangements is shown in **Table 12.9**.

Table 12.9: Summary of Implementation Arrangements

Aspects	Arrangements
Implementation period	June 2014 – June 2020
Estimated completion date	30 June 2020
Management	
(i) Oversight body	Project Steering Committee Secretary, Local Government Division of the Ministry og Local Government, Rural Development and Cooperatives
(ii) Executing agency	LGED (DPHE as co-executing agency)
(iii) Key implementing agencies	Pourashavas
(iv) Implementation unit	PMU in LGED PIUs in pourashavas

Aspects	Arrangements		
Procurement	International competitive bidding	1 contract	$ 4.0 million
	National competitive bidding - goods	7 contracts (in 7 packages)	$ 1.3 million
	National competitive bidding - works	53 contracts (in 38 packages)	$ 28.6 million
	Shopping		
Technical assistance/ consulting services	PMSC team: QBCS (quality/cost ratio 90:10)	494 person-months	$ 3.7 million
	ISABC team: QBCS (quality/cost ratio 90:10)	212 person-months	$ 2.0 million
	NGO team: QBCS (quality/cost ratio 90:10)	343 person-months	$ 0.6 million

ISABC = institutional strengthening and awareness building consultants, LGED = Local Government Engineering Department, NGO = non government organization, PIU = project implementation unit, PMSC = project management and supervision consultants, PMU = project management unit, QBCS = quality- and cost-basd selection.
Source: PPTA Consultant.

13 DUE DILIGENCE

13.1 ECONOMIC AND FINANCIAL ASSESSMENTS/ ANALYSES

13.1.1 Financial Analysis

A. Summary of Financial Data of Study Pourashavas

670. The key features of current pourashava finances are:

- Own revenue: comprising of tax and non-tax revenue was 98.6% in Galachipa, 98.7% in Amtali, 99.2% in Pirojpur and 99.0% in Mathbaria pourashava of total revenue income.
- Own revenue growth was 27.2% in Amtali, 19.7% in Galachipa, 28.1% in Mathbaria and 11.3% in Pirojpur.
- Collection efficiency for property tax: was 17.5% in Galachipa, 43.3% in Pirojpur, 63.2% in Mathbaria and 75.5% in Amtali.
- Revenue expenditure growth, was 0.9% in Pirojpur, 13.3% in Mathbaria, 25.7% in Amtali and 26.3% in Galachipa pourashava.

671. **Table 13.1** shows the past financial performance of the study pourashavas over the last five years. Detailed financial performance tables of each Pourashava are given in **Annex 2.1, Volume 6**.

Table 13.1: Revenue and Expenditure – Past Financial Performance - Last Five Years

BDT Million

Amtali PS Summary of financial data	2007-08 Actual	2008-09 Actual	2009-10 Actual	2010-11 Actual	2011-12 Actual	CAGR
Revenue Income						
Income from Taxes	0.6	0.6	0.4	0.6	0.8	9.7
Non Tax Income	4.9	5.5	7.9	6.3	13.4	28.9
Total Own Revenue	5.5	6.1	8.3	6.9	14.2	27.2
Government Grants	0.3	0.2	0.2	0.2	0.2	
Other Income	0	0	0	0	0	
Total Income	**5.8**	**6.3**	**8.5**	**7.1**	**14.4**	26.1
Expenditure						
Revenue Expenditure	5.3	6.0	7.5	9.6	13.1	25.7
Total Expenditure	5.3	6.0	7.5	9.6	13.1	
Revenue Surplus / (Deficit)	**0.4**	**0.4**	**1.1**	**-2.5**	**1.3**	

Source: PS accounts.

BDT Million

Galachipa PS Summary of financial data	2007-08 Actual	2008-09 Actual	2009-10 Actual	2010-11 Actual	2011-12 Actual	CAGR
Revenue Income						
Income from Taxes	0.5	0.9	0.6	0.8	0.9	15.4
Non Tax Income	6.2	5.6	5.6	8.9	12.9	20.0
Total Own Revenue	6.7	6.5	6.3	9.6	13.8	19.7
Government Grants	0.2	0.2	0.2	0.2	0.2	7.7
Other Income	0	0	0	0	0	
Total Income	**7.0**	**6.7**	**6.4**	**9.9**	**14.0**	19.0

Expenditure						
Revenue Expenditure	4.4	5.4	7.4	11.9	11.3	26.3
Total Expenditure	4.4	5.4	7.4	11.9	11.3	
Revenue Surplus / (Deficit)	**2.6**	**1.3**	**-1.0**	**-2.0**	**2.7**	1.7

Source: PS accounts

BDT Million

Mathboria PS	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**CAGR**
Summary of financial data	**Actual**	**Actual**	**Actual**	**Actual**	**Actual**	
Revenue Income						
Income from Taxes	2.1	2.6	1.3	2.7	8.4	41.5
Non Tax Income	6.7	8.7	9.8	13.0	15.4	22.9
Total Own Revenue	8.8	11.3	11.1	15.7	23.8	28.1
Government Grants	5.1	0.2	0.3	0.3	0.2	-53.8
Other Income	0	0	0	0	0	
Total Income	**13.9**	**11.5**	**11.3**	**16.0**	**24.0**	2.5
Expenditure						
Revenue Expenditure	19.2	14.6	16.8	19.0	24.8	6.6
Total Expenditure	19.2	14.6	16.8	19.0	24.8	
Revenue Surplus / (Deficit)	**-5.3**	**-3.1**	**-5.5**	**-3.0**	**-0.8**	

Source: PS accounts

BDT Million

Pirojpur PS	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**CAGR**
Summary of financial data	**Actual**	**Actual**	**Actual**	**Actual**	**Actual**	
Revenue Income						
Income from Taxes	6.0	4.2	4.7	5.1	5.9	-0.4
Non Tax Income	17.7	18.4	19.0	22.9	30.4	14.5
Total Own Revenue	23.7	22.7	23.7	28.0	36.4	11.3
Government Grants	13.0	0.5	0.4	0.2	0.3	-61.4
Other Income	0	0	0	0	0	
Total Income	**36.8**	**23.2**	**24.1**	**28.3**	**36.7**	-0.1
Expenditure						
Revenue Expenditure	38.0	32.0	26.8	26.7	36.6	-0.9
Total Expenditure	38.0	32.0	26.8	26.7	36.6	
Revenue Surplus / (Deficit)	**-1.2**	**-8.8**	**-2.6**	**1.6**	**0.0**	

Source: PS accounts.

B. Operation and Maintenance – Water Supply and Other Services

672. Operation and maintenance of water supply is with the pourashava. Details of the annual O&M costs as per the accounts of the Pourashavas are given in **Table 13.2**. At present, operation and maintenance cost recovery is to the extent of 143 percent in Galachipa; 155 percent in case of Amtali, and 98 percent in Pirojpur Pourashava.

Table 13.2: Present Water Supply Annual Operation and Maintenance Cost

BDT Million

Particulars	Galachipa (FY 2011-12)	Amtali (FY 2011-12)	Pirojpur (FY 2011-12)
Staff costs	1.2	1.3	5.9
Power	0.8	0.6	1.2
Consummables			2.8
Repair & Maintenance	0.2	0.1	0.8
Others	0.6	0.6	1.8
Total O&M	**2.8**	**2.6**	**12.5**
Revenue	**4.0**	**4.0**	**12.3**
Cost recovery (%)	**143**	**155**	**98**

Note: Mathbaria – no piped water supply at present.
Source: Pourashava accounts sections.

C. Collection Efficiency

673. **Table 13.3** gives the collection efficiency of the study towns in the financial year 2011-12 in respect of property tax and water charges.

Table 13.3: Study Towns Demand Collection Statement

BDT Million

Towns	Total Demand	Collection	Efficiency %
Property Tax			
Galachipa	6.0	1.0	17.5
Amtali	1.3	1.0	75.6
Pirojpur	13.7	6.0	43.4
Mathbaria	13.4	8.0	59.9
Water charge			
Galachipa	3.7	3.5	96.0
Amtali	3.3	3.1	95.0
Pirojpur	13.6	11.7	86.0

Source: Pourashava accounts sections.

D. Financial Internal Rate of Return

674. The financial analysis has appraised the sustainability and viability of the subprojects proposed under the Investment Program, according to ADB's Financial Management and Analysis of Projects, 2005. For revenue-generating sectors—water supply (WS), sanitation, solid waste management, boat landing stations, market and bus terminals—incremental revenue and cost due to the subprojects were estimated on with- and without- project basis. Tariff revisions for these sub-projects are proposed to meet the project's institutional and financial reform action plan. The financial internal rate of return (FIRR) for these subprojects is given in **Table 13.4**.

675. The FIRR for these subprojects compare favorably to the weighted average cost of capital (WACC) of 3.09%. For these subprojects, the average tariff in the four pourashavas is higher than the average incremental financial cost (AIFC) for O&M. Sensitivity analysis shows FIRRs are generally robust and relatively sensitive to changes in revenues. For these earning subprojects in the four Batch 1 towns, the pourashavas total projections demonstrate that they are sustainable, as the revenue account will be in surplus.

Table 13.4: Financial Internal Rate of Return of Subprojects with CCR

%

Town	Water	Sanitation	Solid Waste
Amtali	4.8	19.9	66.5
Galachipa	6.2	18.8	78.5
Pirojpur	Not Applicable	Not Applicable	81.6
Mathbaria	3.3	18.8	72.5

Source: Consultants' analysis.

676. The financial analysis results for investments without cost of climate resilience measures are given in **Table 13.5**.

677. For non-revenue-generating sectors—urban drainage, roads, bridges, and cyclone shelters—the analysis focused on the capacity of the project pourashavas to sustain the assets created under the program by providing financial resources for maintenance and debt service, if any. Financial projections of cash flow were made over a 20-year period for the project pourashavas, incorporating the impact of the subprojects. For the four Batch 1 pourashavas, the financial projections show that the pourashavas can absorb the investment in appraised subprojects, as they are expected to have a revenue account surplus and a positive close balance for the revenue account. The financial analysis and the financial management assessment of the LGED (PMU) and pourashavas are in **Volume 7**.

Table 13.5: Financial Internal Rate of Return (FIRR) of Subprojects without CCR

%

Town	Water	Sanitation	Solid Waste
Amtali	7.1	17.8	66.5
Galachipa	7.4	17.0	78.5
Pirojpur	Not Applicable	Not Applicable	81.6
Mathbaria	3.5	17.0	72.5

Source: Consultants' analysis.

13.1.2 Economic Analysis

678. Since the project is formulated as sector lending, the economic analysis focuses on the rationale for government involvement, government plan and approach, economic policies and government capacity. The project has a clear rationale for government involvement. The infrastructure to be developed under the project is to meet the basic needs of citizens and often public goods in nature. The government's goals and approach are sound. Recognizing urban development as a driving force of economic growth, the Government of Bangladesh has adopted measures to advance priority projects and governance reforms. The government has been successfully implementing many ADB-assisted infrastructure projects like UGIIP-2, demonstrating sufficient capacity to implement this project.

679. The economic analysis of subprojects is conducted for all the subprojects under the infrastructure component, namely drainage, roads, bridges, sanitation, solid waste, water, cyclone shelters, boat landing stations, markets and bus terminals in the four PPTA study towns. The estimated economic internal rates of return (EIRRs) of these subprojects are given in **Table 13.6**, indicating sufficiently high economic return compared with the opportunity cost of capital. The result is robust against most of downside risks, such as increase of capital cost, increase of O&M cost, decrease of benefits, and delay in completion. These results are most likely underestimated, since the subprojects have benefits which are not easily quantifiable and not accounted in the analysis. The detailed analysis is in **Volume 6**.

Table 13.6: Economic Internal Rate of Return of Subprojects with CCR

%

Town	Drainage	Roads	Bridges	Cyclone Shelters	Water Supply	Sanitation	Solid Waste
Amtali	28.1	20.6	NA	15.6	17.7	16.0	60.7
Galachipa	23.9	20.9	NA	17.1	14.0	22.4	70.1
Mathbaria	45.9	20.3	22.2	35.0	15.3	26.9	64.7
Pirojpur	38.8	21.4	22.6	15.3	NA	NA	82.6

Source: Consultants' analysis.

680. The economic analysis results for investments **without** cost of climate resilience measures are given in **Table 13.7**.

Table 13.7: Economic Internal Rate of Return of Subprojects without CCR

%

Town	Drain	Road	Bridge	Cyclone Shelter	Water	Sanitation	Solid Waste
Amtali	28.5	17.9	NA	16.5	16.0	15.3	60.7
Galachipa	23.8	13.6	NA	17.1	14.2	21.6	70.1
Mathbaria	42.0	18.7	15.6	35.0	17.1	26.6	64.7
Pirojpur	48.4	21.1	15.9	19.3	NA	NA	82.6

Source: Consultants' analysis.

13.2 GOVERNANCE ASSESSMENT

13.2.1 General Assessment

681. The efficient delivery of different services to the city dwellers is one of prime concerns of urban local governments (ULG) of Bangladesh. It has been observed that the existing supply/provisions of services are not at par with the increasing demand for these. The demand for services surpasses its supply which is a common occurrence in the urban areas of Bangladesh. Again, the quality of existing urban services is also not satisfactory.

682. Financially, the urban local governments are not capable enough to provide urban services from their own sources and as such they depend solely on the central government for any investment on urban infrastructure. The existing revenue sources of the urban local governments in terms of collection of holding taxes and other non-revenue sources are not adequate to undertake any infrastructural developments. There also exist huge arrears of payment of holding taxes by the urban dwellers which actually retard the generation of funds of the urban local governments. The urban dwellers as the service receivers should have an obligation in paying the taxes regularly. In fact, there should be a good relationship between the service provider, i.e., the urban local government (pourashava) and the urban service receivers (urban dwellers) in terms of provision of services and paying for the services. And this is premise of the governance which is to be ensured at the city and town levels.

683. Here, it is also important to find out the existing problems and issues relating to governance in delivering urban services vis-à-vis uniqueness of coastal towns of Bangladesh in view of addressing the natural disasters/climate changes and thereof potentialities to be streamlined/surfaced.

684. In pursuance of the Local Government (Pourashava) Act, 2009, the Pourashavas of Amatali, Galachipa, Mathbaria, and Pirojpur are responsible to provide urban services for the people living within the territorial areas of the respective pourashavas. Usually, the

pourashavas in Bangladesh are engaged in developing and maintaining the services in the areas of water supply, roads, drains and solid waste management. Other urban services such as education, roads, electricity, telephone, etc. are being provided by the central governments and the activities of these organizations are not within the purview of the pourashavas. Apart from this, there are private sectors which make available certain services to the urban dwellers such as transportation, generation of power, cell phones, etc. Very recently, NGOs have also come forward in the areas of provision of urban services such as in managing solid wastes. The issue of management of these sector and sub-sector services in a pourashava has not so far been thought of holistically. The role of these three actors—namely public sector, private sector and the civil society—so as to ensure governance at the pourashava level have not been addressed together in view of urban services delivery and management.

685. There is urgent need for addressing the issue of people's participation in the process of project identification, planning, implementation, operation and evaluation so that people's aspirations and demand are included. In order to ensure good governance at the pourashava level, the roles of public sector, private sector and the civil society are to be studied and found out how these functioning in generating urban services.

686. According to the Government Gazette notification of March, 1992, pourashavas are classified into three categories based on their annual average revenue income in a three-year period. These are: Pourashava Class *'A'* with over Tk. 10 million; Class *'B'* with minimum Tk. 8 million; and Class *'C'* with minimum Tk. 6 million.

687. The public office of the pourashavas is democratically elected by the civic community as per the Local Government (Pourashava) Act, 2009. As per this Act, the functions of the pourashava can be categorised into (i) mandatory functions and (ii) discretionary functions.

688. According to the Local Government (Pourashava) Act, 2009, the number of ward commissioners is fixed in every pourashava, irrespective of its area and population. The pourashava is composed of one mayor, nine ward commissioners (general) and three ward commissioners of reserve seats, a total of 13 representatives.

689. As per the Act, nine ward committees have been constituted, with maximum 10 members, wherein 40% are stipulated to be women. The councillor is also designated to be chairperson of the ward committee. They are endowed with the functions of maintenance of sanitation, water supply and drainage, street lighting, roads, markets, parks and playgrounds and school buildings. They also review the revenue collection, prepare a draft annual budget, and send it to the council for incorporation in the annual budget.

690. The mayor chairs the council meetings, and is responsible for the overall, supervision and control of the administrative functions of the pourashava. The council is composed of all elected councillors. The administration of the pourashava is vested with the council. The term of office of the council is five years. The pourashava through the council has all the powers, authority and responsibilities of the local government, to enable it to function as an institution of self-government in respect of the matters entrusted to it. The panel mayor presides over the council meetings during the absence of the mayor. The CEO/Secretary of the pourashava is an officer appointed by the Local Government Ministry to administer the activities of the pourashava.

691. The Disaster Management Act introduced by the Government of Bangladesh in 2008 led to the creation of disaster management committees at pourashava level to deliver emergency response operations. This committee's responsibilities include preparation of community risk assessments and disaster risk education plans; ensure community awareness about long term risks of climate change and adaptation to its adverse effects.

692. ULGs are controlled by the central government i.e., Local Government Division (LGD) of the Ministry of Local Government, Rural Development and Cooperatives (MoLGRDC). In fact, ULGs do not enjoy adequate political, administrative or financial autonomy. Such as, ULGs are not empowered to employ officers needed to execute the activities of the pourashavas, whereas the officers are recruited and appointed by the LGD. ULGs are mostly dependent on government grants; hence ULGs have to work as per government directives. By and large, it can be said that by legal provisions the LGD can supersede an elected body and appoint an administrator in certain conditions, if such a situation arises.

13.2.2 Assessment of Governance in Batch 1 Pourashavas

693. **Pirojpur Pourashava.** Pirojpur Pourashava was established in the year 1885. It is the oldest and largest pourashava within the district both in terms of population and size. It has an area of 29.46 km^2 having a population of 60,056 and 13,646 households according to the 2011 Census. It consists of 30 *mahallas* with 9 wards.

694. Pirojpur Pourashava is within the category of 'A' class. However, all the approved posts of the organogram have not been filled-in. The post of the town planner has remained vacant for a long time.

695. The standing committees (SC) of the pourashava as per directives of the LGD of the MoLGRDC though have been formed but are not been activated. The disaster management standing committee which supposedly takes care of issues related climate change is not functioning well. Exclusively, there is no trained manpower in the pourashava to address the emerging problems relating to climate change.

696. **Matbaria Pourashava.** Mathbaria Poursahava was established in 1993. It has an area of 6.55 km^2 having a population of 18,375 and 4,330 households according to the 2011 Census. It consists of 15 *mahallas* with 9 wards.

697. Mathbaria Pourashava is within the category of 'A' class. However, all the approved posts of the organogram have not been filled-in. The post of the town planner has remained vacant for a long time.

698. SCs of the pourashava as per directives of the LGD of the MoLGRDC though have been formed but are not been activated. The disaster management standing committee supposedly takes care the issues related to climate change, but is not functioning well.

699. **Amtali Pourashava.** Amtali Pourashava was established in the year 1998. It has an area of 8.75 km^2, having a population of 17,311 and 4,067 households according to the 2011 Census. It consists of 15 *mallahs* with 9 wards.

700. Amtali Pourashava is within the category of 'B' class. However, all the approved posts of the organogram have not been filled-in. There is no post for a town planner in this pourashava category.

701. SCs of the pourashava as per directives of the LGD of the MoLGRDC though have been formed but have not been activated. The disaster management standing committee supposedly takes care of the issues related to climate change, but is not functioning well.

702. **Galachipa Pourashava.** It was established in 1998. It covers an area of 3.39 km^2 having a population of 21,2300 and 4,967 households according to 2011 Census. It consists of 9 *mahallahs* with 9 wards.

703. Galachipa Pourashava was previously a B-Class pourashava, and was upgraded to A-Class in 2013. However, all the approved posts of the organogram have not been filled-in. There is a post for the town planner under this category of the pourashava.

704. SCs of the pourashava as per directives of the LGD of the MoLGRDC though have been formed but not been activated. The disaster management standing committee supposedly takes care of issues related to climate change, but is not functioning well.

705. **Conclusion.** In conclusion, it can be said that the issue of ensuring governance in the affairs of the pourashavas vis-à-vis addressing climate change resilience needs much support from the project.

13.2.3 Procurement Capacity Assessment

706. The capacity of the executing agency and the implementing agencies to carry out proper procurement, including advance contracting, has been assessed by the PPTA consultants. The four PPTA study towns (Batch 1) were assessed at this stage: Amtali, Golachipa, Pirojpur and Mathbaria pourashavas. The executing agency, LGED and the partner agency DPHE, have extensive experience in procurement for ADB-funded projects. Some implementing agencies (such as Batch 1 pourashavas) have experience of implementing several projects through either LGED or DPHE. It is obvious that a few of the agency staff have received training under previous projects and have some knowledge on procurement. For the remaining staff, additional training should be provided under the project. During the assessment process, a brief profile on the officials and staff concerned with procurement processing have been collected in order to determine the immediate needs for appropriate trainings on procurement. The data collection forms for the assessment of procurement capacity and training needs is shown in **Additional Appendix E.1, Volume 2**.

13.3 POVERTY AND GENDER ANALYSIS

13.3.1 Introduction

707. People living in the four study coastal towns in the CTIIIP project area are vulnerable in their everyday life to natural calamities like floods, cyclones and water surges subjugating the coastal belt very frequently. In addition to these regular events, the impact of climate change is deteriorating the usual vulnerable situation of the coastal population, especially the poor people who live by the riverside

708. To get an idea of the situation of the four municipality towns in the project location, a socioeconomic and willingness-to-pay survey (SEWTPS) with 1,528 sample households, focus group discussions (FGD) and participant observations were conducted with different stakeholders to identify and assess the socio-economic situation of the communities.

709. The poor and vulnerable population for the socioeconomic sample survey was identified by using the 'Expenditure Groups' obtained from the Household Income Expenditure Survey (HIES) 2010 of Bangladesh Bureau of Statistics. According to the HIES 2010 report, 7.7% of households in urban areas are below the 'Lower Poverty Line' and 21.3% are below the 'Upper Poverty Line'. Considering the data tables of the HIES 2010 by expenditure classes in the Annex Table No.3 (p.205 of HIES 2010) and followed by the national guideline, the study categorized households by monthly expenditure into five classes, i.e. 'Extreme Poor (Lowest - Tk.4,999)', Poor Group (Tk.5,000-Tk.6,999)', 'Low Income Group (Tk.7,000-Tk.12,499), 'Middle Income Group (Tk.12,500-Tk.24,999)' and

'Upper Income Group (Tk.25,000-Highest)'.

710. Vulnerabilities of the affected people are determined with indicators. First, those households or persons are considered vulnerable who are at the bottom of their subsistence status. By considering the socio economic status of women headed households, they are usually considered as the most vulnerable among the vulnerable. And again, those families who have an income below the poverty line and their condition will be further worsened in terms of earning with the implementation of the project, also are to be treated as vulnerable. Therefore, the households who are having an income of less than Tk. 5,000 per month would be considered as vulnerable, and from Tk.5001 – 10,000 are to be considered poor.

711. FGDs and observation methods were used to get an in-depth scenario of the communities and their poverty situation. FGDs were conducted with different stakeholders including poor communities in each pourashava; they are Muslim Para (Pirojpur), Nobinagar Village (Mathbaria), Japan Barak slum (Galachipa) and Mas Bazaar (Amtali).The focus group discussions were mainly conducted with women groups of the community (in a few cases with men) who are mostly very poor, living in low-lying river bank sides.

712. In general, the areas of these poor communities have a common scenario. The people are living without a pourashava holding identity and so they are not enjoying any utility services delivered by the pourashava. Most of the community members are living on government *khash* land and a few live in private land as tenants. The poor people living in these locations came from the adjacent areas in search of livelihood for their survival; they don't own any source of drinking water and rarely have access to a common source. In general, they collect drinking water from other households or ponds. The sanitation service is also very poor. The land where they live is mostly low-lying areas by the river or canal, which goes under water either during high tide or heavy downpour, cyclone or storm. Living in such a constant vulnerable situation, this poor population is bereft of all human rights. Nevertheless, the situation in Mathbaria, Amtali and Galachipa is worsened by high tidal surges, as the low-lying areas are easily inundated and poor people's houses and latrines go under water, making their living condition highly unhygienic.

713. These people are destitute, with many women of the community being abandoned or divorced. They earn their bare living working at others' houses. Other than this wage work, they rarely receive any support from the pourashava as the members of a poor community. Very few of them are reported to get an old age pension and widow allowance. Children from the communities have to pay Taka 500 or above as monthly tuition fee when they go to high school, but they don't need to pay in a primary school. Only a few number of children from this community go to high school, braving severe hardship, even starvation, to manage their high education costs. In some schools these poor children are not socially accepted by the school authority for they can't afford to buy proper clothes. These poor children are usually looked down upon by their well-off peer groups and their parents also .They think poor children need a separate school.

13.3.2 Socioeconomic Information and Poverty indicators in the Study Pourashavas

A. Pirojpur Pourashava

714. A sample survey on the socio-economic situation of the community was conducted on 390 sample households, and the following findings are presented based on this sample survey. 53.6% of these household members are male and the rest 46.4% are female. The average household size is 5.3, which is higher than the national average of 4.4 (BBS, 2011).

715. The findings show almost half of the population (48.2%) had primary education and 16.2% has gone up to secondary level, and 10.4% reached higher secondary level. Only 9.28% have been identified who have done their graduation and post-graduation levels. However, 4% of household members can sign (their names) only, and 3.2% of household members are illiterate. The remaining members are children bellow 6 years of age who do not attend school.

716. A significant number of respondents (26.6%) reported doing household chores as their primary occupation. The second largest number (20.8%) of household members are students. Both business and employment as occupations are 9.2% each. A very low number of respondents (5.4%) are skilled workers and wage work in agriculture 3.2%. Unemployed people from 3.3%. There are some other categories such as older people, who are 7.1 % of all respondents.

717. Monthly income of respondent households constituting different ranges is illustrated as follows: The majority of respondents (36.7%) are identified to be in the group ranging from Taka 5,001- 10,000. The second closest income group (20.8%) has an income range of Taka 10,001- 20,000, and the third group (18.4%) earn the highest amount amongst the three, and their monthly income is above Taka 20,000. However, 12.8% of the households are the most poor, with monthly incomes below Tk 5,000. The average monthly income is Tk.14,620. The average household expenditure per month is Tk 12,874.

718. According to the expenditure survey, 13.3% (below Tk 5,000) of families would be considered as vulnerable, 45.9% (Tk 5,000-6,999) as poor families, and 4.4% of women-headed households are treated as poor as well as being vulnerable.

719. People with physical disability who need additional attention for their survival, and people who are mentally incapacitated, are considered vulnerable. The study survey identified 0.3% disable persons among members of the affected households.

720. **Muslim Para in Pirojpur.** A poor community comprising of 200 to 300 families live at Muslim Para in Pirojpur Pourashava. The people of this community come from outside the pourashava and other parts of the district live here in a crammed situation. Some people here live in their own purchased land, some live on government *khash* land, and others as tenants. People here earn their living by physical labor, with men pulling rickshaws or doing other wage works, while women work as domestic workers in the affluent neighborhoods.

721. There is no common source of drinking water for the community. People here collect their daily necessary water from pipeline supply from the houses outside Muslim Para. Sometimes they have to travel to a distant tubewell to fetch water, which is stressful for the women. There is no road within the para that could connect the inhabitants with the main road. *Kutcha* (open type) latrines people use here go under water during the rainy season, worsening the already unhygienic situation they live in.

B. Matbaria Pourashava

722. A sample survey on the socio-economic situation of the community was conducted on 380 sample households, and findings are presented based on this sample survey. 48.5% of household members are male and the rest, 51.5%, are female. The average household size is 4.6, which is slightly higher than to the national average of 4.4 (BBS, 2011),

723. The findings show almost half of the population (44.1%) have primary education, and 18.3% has gone up to secondary level, and 13.% reached higher secondary level. Only 13.3% have been identified who have done their graduation and post-graduation levels.

However, 1.1% of household members can sign only, and 2.7% of household members are illiterate. The remaining members are children bellow 6 years of age, who do not attend school.

724. A significant number of respondents (27%) reported doing household chores as their primary occupation. Nearly thirty percent (28.5%) of household members are students. Both business and employment as occupations are 13.2% each. A very low number of respondents (2.9%) are skilled workers, and unemployed people form 2%. There are some other categories such as older people, who are 4.1 % of all respondents.

725. Monthly income of respondent households constituting different ranges is illustrated as follows: The majority of the respondent (43.2%) are identified to be in the group ranging from Taka 10,001- 20,000. The second closest income group (35.2%) have an income above Tk 20,000, the third group (17.4%) has an income range of Tk 5,001 -10,000. 4.2% of households are the most poor, with monthly income below Tkm 5,000. The average monthly income is Tk.21,744, and the average expenditure per month is Tk 17,554.

726. According to the expenditure survey, 4.2% (below Tk 5,000) of families would be considered as vulnerable, 27.9% (Tk 5,000-6,999) as poor families, and 4.5% of women-headed households are treated as poor as well as vulnerable.

727. People with physical disability who need additional attention for their survival and people who are mentally incapacitated are considered vulnerable. The study survey identified 0.1% disabled persons among the members of the affected households.

728. **Nobinagar Slum in Mathbaria.** The poor people of the area usually live by the canal and drink its water. Their latrines are situated on the edge of the same canal which they use as the source of water for drinking purpose. Diarrhea and other water borne diseases are regular sicknesses these poor people suffer from. Information from hospital sources also confirm that diarrhea is the common disease of these poor people. As the soil of the land they live on is very thick, the latrines often go drowned or sometimes water oozes out of these latrines. Because of this soil condition, the whole area is very vulnerable. There is no flood protection embankment. The people have to move to the nearest hospital in case of any flood as there is no cyclone shelter in the locality. The people complain that they do not get any treatment facility from the government hospital. They think their poor treatment is synonymous of their being poor and vulnerable.

729. Most of the inhabitants come from adjacent locations to find some space to live in and try some livelihood options. Both male and female members of this poor community have to work outside the home to earn their sustenance. Men pull rickshaws or vans and work in the market place as day laborers, while women work as domestic maids with a very low pay and also work as occasional day laborers in earth digging work.

C. Amtali Pourashava

730. A sample survey on the socio-economic situation of the community was conducted on 377 sample households, and findings are presented based on this sample survey. 54.0% of household members are male, and the rest (46.0%) are female. The average household size is 4.6, which is a little higher than the national average of 4.4 (BBS, 2011).

731. The findings show almost half of the population (43.9%) had primary education and 14.% has gone up to secondary level, and 11.5% reached higher secondary level. Only 7.7% have been identified who have done their graduation and post-graduation levels. However, 5% of household members can sign only and 3.8% household members are illiterate. The

remaining members are children below 6 years of age who do not attend school.

732. A significant number of respondents (27.3%) reported doing household chores as their primary occupation. Nearly thirty percent (29.7%) of household members are students. Both business and employment as occupations are 11.5% each. A very low number of respondents (5.7%) are skilled workers and wage work in agriculture 1.5%. Unemployed people are 1.7%, and other categories such as older people who are 3% of all respondents.

733. The monthly income of respondent households constituting different ranges is illustrated as follows: The Majority of respondents (36.3%) are identified to be in the group ranging from Taka 5,001- 10,000. The second closest income group (43.7%) with income range Taka 10,001- 20,000, and the third group (13.3%) earn the highest amount amongst the three—their monthly income is above Taka 20,000. However, 37.5% of households are the most poor, with monthly income below Tk 5,000. The average monthly household income is Tk.13,841 and the average expenditure per month is Tk 11,834.

734. According to the expenditure survey, 25.5.% (below Tk 5,000) of families would be considered as vulnerable, 41.6% (Tk 5,000-6,999) as poor families, and 4.2% women-headed households are treated as poor as well as vulnerable.

735. People with physical disability who need additional attention for their survival and people who are mentally incapacitated are considered vulnerable. The study survey identified 0.3% disable persons among the members of the affected households.

736. **Mas Para in Amtali.** 300 poor families are living at Mas Para by the river with a market nearby in Amtali Pourashava. During overflowing of the river the area gets inundated with people leaving their houses for the market with whatever household items they could carry with them. They stay there in an utmost miserable situation till the water recedes. The community does not have the facilities of electricity, water supply and sanitation. They have to collect water from other communities outside their area. People take shelter at the pourashava building during natural calamities such as floods and storms, as there is no cyclone shelter. Very few children go to school, where they experience severe discrimination from both other children of well off families, and their teachers also pay little attention to them.

737. Some NGO field staff visit the community to collect information, but which is not followed by support. People only get some food support during floods and cyclones but this support hardly reaches to those who are living here as tenants. However, the pourashava occasionally provides some paltry support to the poor members of the community.

D. Galachipa Pourashava

738. A sample survey on the socio-economic situation of the community was conducted on 381 sample households, and findings are presented based on this sample survey. 40.2.% of household members are male and the rest (59.8%) are female. The average household size is 4.8, which is a little higher than the national average of 4.4 (BBS, 2011),

739. The findings show almost half of the population (47.5%) had primary education and 8.4% has gone up to secondary level, and 3.6% reached higher secondary level. Only 2.4% have been identified who have done their graduation and post-graduation levels. However, 19.2% of household members can sign only, and 9.2% household members are illiterate. The remining members are children bellow 6 years of age who do not yet attend school.

740. A significant number of respondents (27.3%) reported doing household chores as

their primary occupation. Nearly thirty percent (27.2%) of household members are students. Both business and employment as occupations are 12.2% each. A very low number of respondents (5.8%) are skilled workers, and wage work in agriculture 0.7%. Unemployed people are 3.3%, fisherman 0.8%, and other categories such as older people who are 1.6% of all respondents.

741. The monthly income of respondent households constituting different ranges is illustrated as follows: The majority of the respondents (46.5%) are identified to be in the group ranging Taka 5,001- 10,000. The second closest income group (27.7%) is in the income range Taka 10,001- 20,000, and the third group (13.7%) earn the highest amount amongst the three and their monthly income is above Taka 20,000. However, 12.3% of the households are the most poor, with monthly income below Tk 5,000. The average monthly household income is Tk.13,167 and expenditure per month is also Tk 13,167.

742. According to the expenditure survey, 15.7% (below Tk 5,000) of families would be considered as vulnerable, 42.3% (Tk 5,000 – 6,999) as poor families, and 7.1% of women-headed households are treated as poor as well as vulnerable.

743. People with physical disability who need additional attention for their survival and people who are mentally incapacitated are considered vulnerable. The study survey identified 1.0% disable persons among the members of the affected households.

744. **Japan Barack slum in Galachipa.** A poor community is living in a slum called Japan Barak in Galachipa Pourashava. Most of the people here live in 10 barracks constructed by the Navy and the government for the settlers. Nearly 150 or more families live in the slum. The place is outside the embankment and during high water surge the houses and latrines are flooded. Tubewells installed by the government are the only source of drinking water but they become non-functional during cyclones. As the area is cyclone prone, people here have to live with aregular suffering from the lack of drinking water. Men here mostly work as fishermen while women work as maids in other affluent houses outside the community. People here suffer from perennial malnutrition and unhygienic conditions.

13.3.3 Gender Analysis

745. The key objective of this gender analysis is to ensure women's participation in the design and construction of the infrastructure project so that effective interventions are given to improve poor women's access to all project components. The assessment is based on consultations with various economic groups of male and female and household survey in the project locations. The analysis is focused on gender roles and responsibilities in water, sanitation, solid waste management to improve the overall situation of the community at household level. Women's participation in the project is to increase their decision making capacity, their level of knowledge and behavioral change and practice by awareness raising campaigns. The study findings also focused on women's specific needs in community/ public latrines, cyclone shelters and road and drainage improvements and also focused on women's access to project's labor work, training on hygiene education and awareness raising on climate change and resilience, and adaptation mechanism, helped to prepare an effective gender action plan for the project. The gender action plan is outlined in **Appendix 15, Volume 2**.

746. Findings also focused on gender disparities, as well as differences across poor and vulnerable families of the community. The findings identified problems of water and sanitation practices; gender roles and responsibility of male and females. The findings also provided an understanding of how far the community could meet their needs using existing scopes. The study also measures the extent of their vulnerable situation and identified possible scopes of

employment that could be created for women through project implementation. This new scopes are deemed to contribute to women's economic empowerment. The findings identified discrimination to the poor community for the access to health services, and education for children.

747. The findings also explore unequal wages for women of the poor community who work as day laborers in earth digging work or civil constructions. Income from household work earns them a meager amount of Tk 300 per month with some food of low quality. Daily wage rate of Tk 200, but such work is very irregular. Male family members of some of these women also work as day laborers or rickshaw pullers, or assist masons. Their wage rate is Tk 300 a day in earth digging work, and helping masons in civil construction they get Tk 400. But women's wage is always Tk 200.

748. However women's work outside the home for income earning, including nontraditional types, is gradually gaining community acceptance, and an increasing number are employed in road maintenance work.

13.3.4 Existing Situation of Women in the Project Area

749. **Water for drinking and cooking:** Findings from discussions with women groups and communities, especially the poor women groups, identified acute scarcity of water, sanitation and solid waste management; road and drainage problems and highly inadequate infrastructure facilities for women use, and roles and responsibilities of women to overcome these hindrances.

750. Every day, a small household collects 3 to 4 buckets of water, while a large family collects 5 to 10 buckets, with each bucket holding 5 to 7 liters of water. Usually women collect water, as their male members do other wage works. Women who fetch water from other households said, "It is not easy to get water as they have to collect from different houses on every alternative day and every time we wait a long time to get water". "We go to many different houses to collect water, wait for hours together, while source owners sometimes ask us to do their household work in exchange for water. Once we were to give penalties to fix the point that was broken." Some of them informed, "Sometimes we fail to get water as it totally depends on the owner's wish. Sometimes owners flatly refuse us and having no alternative we have to collect canal water and get it purified with alum." One woman said, "I don't go to others' houses to collect water as people behave very badly with poor women like us. Instead, I go far to collect water from a tubewell. I have to bear physical pain going to a distant place but it saves me from insulting treatment."

751. The majority of the women fetch drinking water from tubewells, though it involves some physical hardship as well as embarrassment, but still they prefer it believing that drinking pond or canal water would get them sick. Most of the women said that they use pond water for cooking, washing and bathing, some of them use canal water for bathing and washing and also cleaning utensils. Not any of them own a pond in the area of their own household. Usually they use other's ponds and open water bodies.

752. **Situation concerning latrines and solid waste management:** Most members of this community use *kacha* (open) latrines. Those latrines are connected with water bodies that unite with canals during the rainy season. The entire area goes under water at that time. People cannot have other choices, instead they use open latrines. There is no sanitary latrine in the community .Most of them never received latrines from the pourashava or DPHE. Only a few of them reported to receive a sanitary latrine from these sources. Women dump their household wastes in open places and in the surrounding water bodies and natural drain ways, causing these bodies to become clogged. They have no knowledge about waste

management at all.

753. **Knowledge on awareness on hygiene:** There are some NGOs who formed credit groups and operate in the locality and also sometimes train women on some hygiene issues. However, most of these NGOs are more concerned with credit programs, women and their children watch television in the neighboring houses and learn about issues such as washing hands before taking meal or after defecation, "family planning for less children" such and such. Such television campaigns on hygiene issues have some lasting effect on women and children viewers.

754. Although most of the women said they want to have hygiene education as they have never received it, but at the same time they also said they need access to clean water and sanitary latrines. They also want to use soap. They think awareness is not the only way to improve their situation; at the same time they must have access to those services also.

755. **Cyclones and disasters:** There is no cyclone shelter close to any of the poor communities. During storms of high intensity and flooding of houses entire communities are inundated, and people seek their refuge in nearby schools/ health complexes or pourashava office. During Sidr, which they consider as the most damaging storm ever visited, many of them lost their houses and took shelter in trees that could remain standing. Some of them also took shelter in schools. However, they found difficulty to keep *purdah* (veil) and other situations like pregnant women needing a separate space for childbirth; these are kinds of problems women face during their stay in shelters.

756. Some of them received Tk 1,000 and 10 kg rice from the pourashava, but not everyone had this support. In some cases only land owners and household owners of some areas received; not any tenants.

13.4 WILLINGNESS-TO-PAY

757. During the socioeconomic and willingness-to-pay survey, respondents were asked to tell about their willingness to pay for improved water supply. The questionnaire was designed as per requirements of the contingent valuation technique, which provides a range of options to consumers to choose from.

758. Preliminary information on willingness-to-pay for water, wastewater and solid waste services in the PPTA study towns is summarized in **Table 13.8**.

Table 13.8: Summary of Preliminary Willingness-to-Pay Results from SEWTPS*

Q No.	Indicator	Unit	Value			
			Amtali	**Galachipa**	**Pirojpur**	**Mathbaria**
Water Supply						
F.10	Connection to municipal piped supply					
	Yes	%	37.1	22.0	27.9	0.0
	No	%	62.9	78.0	72.1	100.0
	N		*377*	*381*	*390*	*380*
G.11	Average amount of water bill	BDT/mth	234	182	256	664 (non-piped)
	N		*141*	*78*	*117*	*42*
G.13	Willing to pay for consumption-based tariff for improved water supply, for 24 hours piped supply					
	Yes	%	37.7	63.8	79.0	94.1
	No	%	62.3	36.2	21.0	5.9

Q No.	Indicator	Unit	Value			
			Amtali	**Galachipa**	**Pirojpur**	**Mathbaria**
	N		*377*	*381*	*390*	*380*
G.14	Reasons for lack of willingness to pay a consumption-based tariff for improved water supply					
	Inability to pay due to economic situation/poverty	%	22.6	42.5	25.5	42.9
	Since they live in a rented house	%	9.6	22.5	30.9	42.9
	Should observe the bill first	%	2.1	1.3	1.8	14.3
	Not essential due to present situation is well	%	50.0	33.8	40.0	0.0
	Water supply system is bad	%	6.8	1.3	1.8	0.0
	Do not pay due to unhappiness of the activities of municipalities	%	8.9	0.0	0.0	0.0
	N		*146*	*80*	*55*	*7*
G.15	Will be able to pay the amount as average bill for piped water					
	75 taka	%	3.4	5.5	4.6	1.3
	150 taka	%	5.3	21.0	9.2	7.1
	225 taka	%	19.9	26.2	14.4	21.6
	300 taka	%	35.5	16.0	19.2	26.3
	375 taka	%	10.6	1.8	12.6	6.3
	450 taka	%	4.5	0.5	1.0	3.4
	525 taka	%	0.8	1.0	5.9	1.6
	Non response/not applicable	%	19.9	27.8	33.1	32.4
	N		*377*	*381*	*390*	380
H.2	Willingness to pay for water connection from project by HHs that do not have municipal connection					
	Yes	%	67.3	71.8	80.2	79.3
	No	%	32.7	28.2	19.8	20.7
	N		*260*	*298*	*247*	*372*
H.8	Whether respondent would like to pay monthly user charge on consumption basis for water from other sources (non piped supply)					
	75 taka	%	0.8	6.3	10.5	7.1
	150 taka	%	8.0	28.3	22.3	17.4
	225 taka	%	15.9	11.3	10.5	18.2
	300 taka	%	14.6	5.0	8.7	20.0
	375 taka	%	5.3	1.8	.8	13.7
	450 taka	%	0.5	1.0	1.3	10.3
	525 taka	%	0.5	.8	.3	7.4
	Non response/not applicable	%	54.4	45.4	45.6	6.1
	N		*377*	*381*	*390*	*381*
Wastewater						
G.18	Willing to pay additional fee (surcharge) for for safe disposal of waste water					
	Yes	%	50.7	36.6	31.8	37.1
	No	%	49.3	63.4	68.2	62.9
	N		*282*	*298*	*280*	*224*
K.13	Whether interested to spend money for maintenance of the sewerage and improved water drainage system					
	Yes	%	35.2	18.7	44.5	33.8
	N		*343*	*298*	*276*	*313*
Solid Waste						
L.7	Whether willing to pay more for better service for waste management					
	Yes	%	32.6	46.2	19.0	50.7
	N	*%*	*122*	*30*	*190*	*65*

Note:* Subject to checking and revision of output tables.
Source: SEWTPS, PPTA.

759. **Main preliminary conclusions:**[78]

- Of the four towns, Mathbaria does not have a piped water supply system, and residents are paying a high price (two to four times that for piped supplies in the other towns) for drinking water of much inferior quality (sourced from surface ponds, because groundwater is saline). The survey results indicate a very high willingness to pay (94%) for an improved water supply system, and connection to a project piped system (79%). With the proposed system, based on a surface water treatment plant, the household water bill is estimated to be only about BDT300/month (compared to the almost BDT700 residents are paying at present), for a continuous supply of good quality water for all household purposes, not just for drinking. A piped water supply system for Mathbaria is thus high priority.
- There is also high willingness to pay for improved water supply in Galachipa and Pirojpur.
- The majority of respondents are willing to pay in the region of BDT200-300 per month for a piped water supply, which is similar to current water bill amounts.
- In Galachipa, Pirojpur and Mathbaria there is little interest in paying a surcharge to the water bill for wastewater disposal. However, in Amtali half of the respondents would be willing to pay for this.
- For payments to improve solid water management, the highest interest is shown in Galachipa and Mathbaria, but by no more than half of the respondents. Pirojpur residents indicated very low interest to pay for improved solid waste management services.

13.5 SAFEGUARDS

13.5.1 Environmental Safeguards

760. **Environmental Assessment and Review Framework (EARF).** An EARF is prepared to ensure that subprojects or project components implemented under the project comply with and government rules and laws and ADB Safeguard Policy Statement (SPS, 2009) objectives, principles and requirements. The EARF will provide guidance on screening and categorization, assessment, planning, institutional arrangements, and processes to be followed for subprojects and/or components that are prepared after ADB Board approval. Components or subproject selection will be based on the environmental selection criteria outlined in the EARF.

761. The EARF is attached as **Appendix 17, Volume 2**. The EARF (i) reflects fully the policy objectives and relevant policy principles and safeguard requirements governing preparation and implementation of subprojects and/or components; (ii) explains the general anticipated impacts of the subprojects and/or components to be financed under the proposed project; (iii) specifies the requirements that will be followed for subproject screening and categorization, assessment, and planning, including arrangements for information disclosure, meaningful consultation with measures to involve vulnerable groups including women, grievance redress mechanism, and where applicable, safeguard criteria that are to be used in selecting subprojects and/or components; (iv) describes implementation procedures, including budgets, institutional arrangements, and capacity development requirements; (v) specifies monitoring and reporting requirements; and (vi) specifies the responsibilities and authorities of the borrower/client, ADB, and relevant government agencies in relation to the preparation, submission, review, and clearance of subproject environmental assessment

[78] Subject to checking and revision of survey output tables.

documents, and monitoring and supervision of environmental management plan implementation.

762. **Environmental categorization.** CTIIP is considered to be a low risk category project. Environmental categorization as per ADB SPS, 2009 (expected to be Category B) will be supported by completed ADB rapid environmental assessment checklist for each proposed infrastructure improvement.

763. **Environmental assessment reports.** As part of the PPTA, environmental assessments for the four study towns were conducted and five initial environmental examination reports (IEEs) with environmental management plans (EMPs) were prepared for sample subprojects (drainage, water supply [surface water source], water supply [groundwater source], roads/bridges/culverts, and others) in accordance with requirements of SPS. The IEEs concluded that the project will have only small-scale, localized impacts on the environment which are readily mitigated. The potential adverse environmental impacts are mainly related to the construction period, which can be minimized by the mitigating measures and environmentally sound engineering and construction practices. Therefore, the project has been classified into environmental category B. It is likely that future subprojects will seek to replicate the sample subprojects in other town areas thus are expected to be category B due to the low-impact nature of such works. No category A type of works (with significant impacts) will be considered.

13.5.2 Social Safeguards

764. **Resettlement Framework (RF).** A Resettlement Framework is prepared with the aim of providing guidance on social safeguard screening, assessment, categorisation, institutional arrangements, and processes to be followed for project components, in compliance with Government of Bangladesh laws and policies and ADB Safeguard Policy Statement (SPS), 2009. The RF delineates processes to be followed for subprojects/components, where design takes place after ADB Board approval.

765. The resettlement framework: (i) explains the general anticipated impacts of the projects to be financed under the proposed sector loan; (ii) specifies (a) the requirements that will be followed in relation to project screening and categorization, assessment, and planning, including arrangements for meaningful consultation with affected people and other stakeholders; (b) information disclosure requirements; and (c) where applicable, safeguard criteria to be used in selecting projects and components; (iii) assesses the adequacy of the client's and project local bodies' capacity to implement national laws and ADB's requirements, and identify needs for capacity building; (iv) specifies implementation procedures, including the budget, institutional arrangements, and capacity development requirements; (v) specifies monitoring and reporting requirements; and (vi) describes the responsibilities of the client and of ADB in relation to the preparation, implementation, and progress review of social safeguard documents of projects. Project selection shall be in accordance with the social project selection criteria as outlined in the RF.

766. **Involuntary Resettlement (IR) categorization.** IR Categorisation for CTIIP shall be undertaken as per ADB SPS 2009, when social safeguards surveys are completed and the survey data collected for all towns and components is available. Site visits and preliminary assessments indicate the possibility of Category A, which will be confirmed, post completion of surveys and data analysis.

767. **Resettlement Plans.** As part of the PPTA, assessment of involuntary resettlement impacts of proposed subprojects/components for the four study towns were conducted. Assessments conducted for proposed municipal infrastructure—roads, bridges, cyclone

shelters and solid waste management—reveal that the subprojects/components will have largely temporary impacts, except for permanent impacts on about 8 affected persons (AP) for a proposed bridge at Mathbaria; the solid waste management component is not envisaged to have any IR impacts.

768. In case of water supply, proposed pipe laying work is not likely to have any permanent IR impacts, as pipes are proposed to be laid along road rights of way; temporary loss of income for hawkers and vendors likely at certain locations. Excavation required for proposed pipe widths is estimated to vary between 2.5 - 3 feet; narrow roads requiring full/partial closure during construction are identified. Private land acquisition (10 acres) is envisaged at Mathbaria for a proposed water treatment plant complex; surveys of permanently affected persons (landowners, sharecroppers and labourers) are under way.

769. Sanitation interventions are not envisaged to entail permanent resettlement impacts; however, temporary impacts are envisaged at locations where existing toilets are to be demolished and new toilets constructed.

770. No widening is proposed in case of drainage and canal improvement works; social safeguards surveys of proposed drain stretches have been completed and the data are being processed. Four town-level Resettlement Plans (RPs) are being prepared. Each RP deals with all subprojects/components in a project town. The RPs are being prepared in accordance with requirements of ADB's SPS 2009.

13.6 RISKS AND MITIGATING MEASURES

771. A multi sector project such as the Coastal Towns Infrastructures Improvement Project (CTIIP) will be executed at different geographical locations involving different stakeholders, and is expected to have risks for its effective implementation. An early acknowledgment of potential risks and introducing mitigation measures will help minimize or even eliminate the challenges that they may cause during project implementation and beyond.

13.6.1 Climate Change Risk Assessments

772. As **Table 13.9** indicates, climate change could either exceed the climate scenario, or be less than projected. Alternatively, it could be that climate changes and their impacts are unforeseen. The CTIIP's approach to manage these risks is shown in the table.

Table 13.9: Risk Assessment Matrix for Climate Change

Risks	Assessment without Mitigation	Management Plan or Measures	Assessment with Mitigation
Climate change exceeds climate scenario	Medium	Project plans and designs should treat scenario as mid-point and plan for margin of error	Costs are higher but risks are managed for all but run-away climate change
Climate change is less than climate scenario	Medium	Accept risk: impact is higher average project costs	NA
Climate change impacts unforeseen by CTIIP (and broader scientific community)	Medium	Project plans and designs should be robust in ability to handle a variety of physical stresses	Costs are higher but risks minimized (but not eliminated).

Source; PPTA Consultant.

13.6.2 Technical/Operational Risk Assessment

773. An assessment of technical and operational risks is summarized in **Table 13.10**.

Table 13.10: Technical/Operational Risk Assessment for CTIIP

Risks	Assessment Without Mitigation	Management Plan or Measures	Assessment With Mitigation
▪ Civil works structures may not be built tostandard. ▪ Improved infrastructure may not be utilized properly, reducing the impact ▪ Tariff and charges required for O&M are not affordable or socially acceptable. ▪ Beneficiaries are not willing or cannot afford to connect to the water supply systems	Medium	▪ Selection of qualified contractors, and adequate supervision. ▪ Adequate tariff levels to cover O&M costs ▪ Phasing of tariff increases, public consultations. ▪ Staggered payment of connection charge over period of time, subsidized rates for low income groups	Low
<u>Drainage & Flood Control</u> ▪ Key National Water Policy and National Water Management Plan actions continue to delay: o Designation of flood risk zones (NWP 4.2(p)) o District & upazila towns provided with reasonable degree of protection against flood. (NWP 4.2(p)) o Peripheral embankment protection of urban areas (NWMP Vol 5) ▪ Complementary primary flood defense infrastructure absent or inadequate, e.g. embankments incomplete, not raised to 2050 levels, sluice vents under capacity, ▪ Complementary water management systems unsuitable, e.g. ineffective flood management systems, sluices and vents operated only for farming/irrigation interests	High	▪ Pourashavas and LGED lobby at national level for implementation of relevant policies and plans ▪ Select subprojects where a) existing complementary infrastructure is adequate, b) plans to upgrade it are underway c) impacts of not improving it are minimal ▪ Strengthen pourashava and LGED relations with key bodies, e.g. BWDB, Roads & Highways Dept., for complementary upgrading ▪ Strengthen pourashava & LGED's relations with key bodies to develop/improve flood management system, e.g. BWDB, farmers/Water Users Groups, Union Councils, etc.	Medium
▪ Poor planning and/or implementation of other infrastructure affects efficient and effective drainage ▪ Encroachments reduce/remove retention capacity of water bodies, reduce/remove channel capacity, prevent/restrict O&M ▪ Local stakeholders restrict improvement works on existing infrastructure, e.g. retro-fitting	Medium	▪ Local planning capacity and enforcement strengthened ▪ Implement holistic and integrated infrastructure planning and implementation, with provision for easy upgrading wherever possible ▪ Design infrastructure for	Low

Risks	Assessment Without Mitigation	Management Plan or Measures	Assessment With Mitigation
cross drains to roads ▪ Climate change effects more severe than predicted ▪ Revenue/funds insufficient for effective O&M ▪ Insufficient human and/or material resources for O&M		simple/minimum O&M ▪ Permit pourashavas to recruit staff/contract services based on performance standards ▪ Capacity building for improved understanding of climate resilience and importance of integrated action, etc.	

Source: PPTA Consultant.

13.6.3 Urban Planning Risk Assessment

774. Urban planning risk assessment is summarized in **Table 13.11**.

Table 13.11: Urban Planning Risk Assessment for CTIIP

Risks	Assessment without Mitigation	Management Plan or Measures	Assessment with Mitigation
Urban plans are not gazetted and do not therefore have statutory force	High	LGED is placing all master plans with the MLGRDC for gazette notification. In addition, final master plans must be approved and adopted by the Pourashava Council. Whilst not amounting to statutory adoption this emphasises the need for pourashava ownership and control of the master plan.	Medium
Adopted master plans inadequately reflect climate change and disaster risk management issues arising from change	High	Progression through CTIIP (stage 1 to 2 – infrastructure interventions) is dependent on review and revision (where necessary) of master plans for climate resilience based. This will be based on detailed vulnerability and adaptation assessments.	Low
Master plan identified investments remain unimplemented	High	Master plan listed investments are notoriously difficult to implement reflecting a lack of prioritisation, no (pre)-feasibility assessment and no linkage to available financing. CTIIP will introduce a straightforward capital investment planning method to help bring forward infrastructure improvements.	Medium
Mathbaria may remain without a finalised urban plan for a substantial period of CTIIP first stage (since it has not yet received the survey report)	High	LGED will need to ensure that survey and plan development work is accelerated and finalised for Mathbaria to proceed from stage I to stage II.	Medium
Poor development control undercuts efforts in climate resilience	High	Development control (based on master plans) and enforcement systems are critical to effective urban planning. CTIIP sets out a number of measures to help ensure systems are made more transparent and accountable, supported by training and briefing sessions for both elected	Medium

Risks	Assessment without Mitigation	Management Plan or Measures	Assessment with Mitigation
		representatives and pourashava staff. The activation of the Pourashava Standing Committee on Town Planning, Citizen Services and Development for the review of building permits (and land use clearance once activated) is a performance criteria for progression from stage I to stage II. A proposal has been recently submitted by MHPW to Cabinet for building permit approval to be transferred from pourashavas to district administrations, but no decision has been taken.	
Unlawful development continues and accelerates in line with urbanisation	High	As above, development control (based on master plans) and enforcement systems are critical to effective urban planning, and CTIIP will introduce, test and adapt measures to improve enforcement.	Medium
New building control administrative systems at the district level are implemented, with responsibility for control and enforcement removed from the pourashava	Medium	Following the major disaster in the collapse of Rana Plaza, Savar (24 April 2013) a proposal was tabled with the Cabinet by MHPW addressing new building control system based at the district administration level. GOB plans to introduce new approaches to building control based at the district level. CTIIP will nevertheless build the capacity of the pourashava in planning and building control systems and enforcement, and will ensure that there is an effective interface between potentially new systems and local knowledge and understanding. Practically, pourashavas will strongly resist, and will not endorse, any such move by GOB remove the responsibility for building permits.	Low
A lack of political will for implementing urban planning measures renders technical assistance and capacity building ineffective	High	An emphasis on shared learning, training and briefing events, together with the involvement of TLCC/WLCC in the planning process, will help ensure that the scope for peer 'persuasion' and demonstration is optimised, and that an recalcitrant approach to urban planning and project implementation is challenged and engagement encouraged.	Medium
The absence of an Urban Planner and/or understanding of urban planning amongst pourashava representatives and officials, renders CTIIP (UP) implementation unfeasible	High	The performance criteria for moving from stage 1 to stage 2 of the project requires the presence of an Urban Planner in Class A pourashavas, with the appointment made or underway in Class B pourashavas. Capacity building activities will develop the level of practical understanding of urban planning with both elected representative and planning related officials.	Low
Overall	**High**		**Medium**

Source: PPTA Consultant.

13.6.4 Institutional and Governance Risk Assessment

775. The major assumption of CTIIP is that performance-based allocation of investment funds will generate sufficient incentive for the project and that the project pourashavas carry out a series of activities for governance reform as defined in the performance criteria. Also, it is assumed that citizens are willing to participate in decision-making through TLCCs and WLCCs; and the public representatives (i.e., mayors and councilors) and the pourashava officials will listen and respond to their voices accordingly. The successful experience in UGIIP-1 and UGIIP-2 indicates that performance-based allocation will create sufficiently strong incentives for governance improvement in the municipal affairs of pourashavas.

776. However, given limited fund availability, it is unlikely that pourashavas will find significant alternative funding sources, which could undermine the incentive mechanism of performance-based allocation. Further, it is assumed that enhanced citizen participation will establish a sustainable incentive mechanism for elected leaders to respond to citizens' demands for better delivery and management of municipal services.

777. Other assumptions are the timely placement of the urban planner in the pourashava, and reluctance of carrying out assessment/reassessment of holding taxes by the public representatives of the pourashavas. The risk of these factors having significant impacts on the project pourashavas need to be qualified. Experience so far has shown that the 'soft' activities envisaged in the performance based criteria seem to be uncomfortable jobs for the pourashavas.

778. The issues concerning climate change resilient is not much attuned in the mainstream activities of the coastal pourashavas of Bangladesh which is mostly limited to relief and ad-hoc works.

779. The mindset of public representatives i.e., the mayors and the ward councilors, in ensuring governance in the form of endorsing public participation and social accountability, introducing improved urban planning system, financial sustainability and accountability and administrative transparency needs to be taken into consideration by the appropriate authorities. For this purpose, there is need for adequate orientation and training for the public representatives.

780. A summary of institutional and governance risks is shown in **Table 13.12**.

Table 13.12: Summary of Institutional and Governance Risks

Risks	Mitigating Measures
1. Ensuring citizen participation and social accountability	Holding of TLCC and WLCC meetings regularly
2. Transfer of key officials to other non-project pourashavas	To be regulated/stopped by LGD
3. Development of improved urban planning system in the pourashava	Placement of urban planner in A Class pourashavas; and creation of the post in B Class pourashavas
4. Regular assessment of holding taxes	Mayor of the pourashava is to take appropriate action in consultation with TLCC
5. Interim reassessment of holding taxes	Mayor of the pourashava is to take appropriate action in consultation with TLCC
6. Computerization of tax and accounting system	Orientation and training to the staff and officials of the pourashavas; placement of computers at the disposal of the pourashavas
7. Mainstreaming the affairs of climate change	Effective activation of standing committees on

resilient in the pourashava	disaster management; impart training on this issue to dedicated officials of the pourashavas
8. Effective implementation of performance criteria in time so as to move into the next stage	Establishment and development of a strong monitoring and evaluation (M&E) system within the pourashavas

Source: PPTA Consultant.

13.6.5 Financial Management Risk Assessment

781. Financial management risk analyses for the Local Government Engineering Department (LGED) and the study pourashavas are shown in **Tables 13.13 and 13.14** respectively.

Table 13.13: Financial Management Risk Analysis - LGED

Topic	Comment	Risk Assessment	Proposed Mitigation
1. Implementing Agency	LGED's Finance Section will be responsible for project financial management, accounting and reporting LGED will continue to follow project financial management and accounting systems. LGED Staff have project management experience –including donor funded projects - including previous experience of ADB procedures.	Low	Not applicable
2. Funds flow disbursement arrangements. Use of Imprest Accounts(s) Use of Direct Payment arrangements Need for the Statement of Expenditure	LGED will control project funds Direct payments will be used for all major contracts A project imprest account will be used to cover other payments	Low	Not applicable
3. Staffing	The Finance Section is adequately staffed by competent appropriately qualified and experienced personnel The Section provides a good standard professional quality service.	Low	Not applicable
4. Accounting Policies and Procedures	Policies and procedures well documented LGED had adopted Bangladesh Government accounting standard	Low	Not applicable
5. Internal Audit	LGED has an internal audit cell. Most staff are qualified and experienced in the field of audit and they also receive regular training.	Low	Not applicable
6. External Audit	Yes. Foreign Aided Project Audit Directorate (FAPAD) on behalf of C & AG which is constitutionally responsible for conducting external audit. The annual audit report is typically produced within 6 months after the 30th June Year End	Low	Not applicable
7. Reporting and Monitoring	A comprehensive monthly and	Low	Not Applicable

Topic	Comment	Risk Assessment	Proposed Mitigation
	quarterly financial management reporting system is in place Routine reports are produced from the Accounting System – Others prepared through spreadsheets with numbers extracted from the accounting system.		
8. Computerisation	LGED's accounts are computerized under Unified Financial Management Software system.	Low	Not applicable
Overall Control Risk	LGED's financial management practices and procedures are considered to be adequate for management and control of project finances.	Low	As above

Source: PPTA Consultant.

Table 13.14: Financial Management Risk Analysis – Study Pourashavas

Topic	Comment	Risk Assessment	Proposed Mitigation
1. Implementing Agency	The ULBs will be the implementing agency for their respective towns, A dedicated team (to be established) in the PIU which will cover technical, procurement and payment approval processes. The Finance Section is responsible for project financial management, accounting and reporting PIU will adopt project financial management and accounting systems and will be assisted by LGED in this regard. *Staff in PIU have project management experience but have no previous experience of ADB procedures except Pirojpur to certain extent as it is implementing ADB assisted STWSS project*	Low	LGED to provide relevant training.
2. Funds flow disbursement arrangements. Use of Imprest Accounts(s) Use of Direct Payment arrangements Need for the Statement of Expenditure	PIU will receive project funds from LGED Direct payments will be used for all major contracts	Low	Not applicable

Topic	Comment	Risk Assessment	Proposed Mitigation
3. Staffing	**Galachipa**: The Finance Section is adequately staffed by competent appropriately qualified and experienced personnel The Section provides a good standard professional quality service to PIU **Mathbaria**: The Accounts Officer position is vacant. Present staff competent, appropriately qualified and experienced personnel. **Pirojpur**: The Finance Section is adequately staffed by competent appropriately qualified and experienced personnel The Section provides a good standard professional quality service to PIU. **Amtali**: The Finance Section is adequately staffed by competent appropriately qualified and experienced personnel The Section provides a good standard professional quality service to PIU.	Galachipa - Low Mathbaria: Medium Pirojpur: Low Amtali: low	Not applicable LGED to ensure placement of Accounts Officer All accounts staff of all Pourashavas requires further training in UFMS of LGED. To be extended by LGED.
4. Accounting Policies and Procedures	Policies and procedures well documented PIUs have adopted Government of Bangladesh accounting standards	Low	Not applicable
5. Internal Audit	Internal audit done by audit and inspection committee as and when required	Low	Not applicable
6. External Audit	PIUs will be audited by CAG's office The annual audit report is typically produced around 6 months after the 31st March Year End Audit is delayed in case of Mathbaria and Pirojpur – done till FY 2008 Galachipa and Amtali – done till FY 2011	Low	GOB to ensure that these pourashavas' audit is covered by FAPAD to ensure timely audits
7. Reporting and Monitoring	Routine reports are manually produced from the Accounting System – Others prepared through spreadsheets with numbers extracted from manual records A project specific reporting system will be set up – as per ADB's requirements.	Low	LGED to provide relevant assistance and training
8. Computerisation	PIUs' accounts are computerized under LGED UFMS being implemented.	Low	Not applicable
Overall Control Risk	**PIU's financial management practices and procedures are considered to be adequate for management and control of project finances**	**Low**	**As above**

Source: PPTA Consultant.

13.6.6 Project Implementation Risks

782. The potential project implementation risks concern:

- Active coordination with the Bangladesh Water Development Board (BWDB) for improvement works to flood embankments and facilities, to adequately protect CTIIP infrastructure investments from tidal and storm surges.
- Level of ownership by the government and participating pourashavas for undertaking national level policy reforms and governance improvement program respectively.
- Partnerships and integration with government institutions and civil society where complementary actions are required.
- Pourashavas' commitments to institutional change and financial reforms, with particular emphasis on cost recovery and long-term sustainability of the assets/services (new as well as the old ones).
- Introduction/increase of tariffs, implementation of increases in holding (property) tax reassessment and reforms of holding tax and non-holding taxes in order to achieve cost recovery within a reasonable timeframe.
- GOB's continuous support to the decentralization and devolution process of decision-making and financial independence of pourashavas.
- Pourashavas' commitments to citizens' participation in planning and customer orientation.
- Delays in implementation due to slow progress.
- Lack of suitably qualified personnel in the pourashavas and at the PMU which may eventually lead to weak implementation and low sustainability of subprojects at pourashava levels, especially because of weak O&M.

14 KEY ISSUES

783. **Flood protection and coordination with BWDB.** A major issue is the vulnerability of the project pourashavas to extensive and prolonged flooding from rivers if flood protection embankments and facilities such as outfalls and sluice gates, for which the Bangladesh Water Development Board (BWDB) of the Ministry of Water Resources is responsible, are not complete—particularly in view of the projected impacts of climate change in the area.

784. Drainage and flood protection are key for climate change resilience. However, in the study pourashavas, and probably in the Batch 2 towns also, BWDB's infrastructure along the rivers is not always to the necessary standards because of gaps, low levels, insufficient outfalls, poor condition/operation, etc.[79]

785. Infrastructure developed by CTIIP will be compromised if these flood defenses are not complete. The Master Plan for Pirojpur in particular, and the vulnerability survey of Mathbaria both indicate possible impacts in their urban cores if the flood defenses are not upgraded to meet the expectations of 2050. This includes the capacity to mitigate the effects of storm surges, which is currently inadequate for both.

786. Also, because of the expected increase in rainfall, and therefore run-off, and the reduction in the time sluices and outfalls will be able to operate at their maximum capacity,[80] there is a need for:

1) greater capacity to detain and temporarily store surface runoff when it is not possible to dispose of it directly to the rivers because their levels are too high, and
2) increased discharge capacity, to cope with the increased volumes of runoff to be disposed of, and the shorter times in which it will be possible to do this.

787. The first item, 1), is the responsibility of the pourashavas, but is difficult because most of them lack suitable locations.[81] However, installing sluices on the open *khals* in Pirojpur and Mathbaria pourashavas could help achieve some of the storage suggested under (1), especially when the need can be forecast, e.g. cyclones and severe depressions, and pre-emptive actions are possible. Even so this storage will be limited. There should therefore be complementary steps to manage inundation of urban and rural areas separately, for example, by implementing differentiated flood management arrangements and infrastructure for urban and rural areas, e.g. peripheral embankments and structures for urban areas,[82] and implantation of measures to improve integrated action on flood management by the various stakeholders.

788. Along the rivers and main channels, where the need for increased capacity is greatest, (2) is the responsibility of BWDB. BWDB is also considered to be the primary stakeholder in implementing suitable infrastructure and organisational arrangements for differentiated urban and rural flood management. Arrangements for operating and maintaining these systems will have to be negotiated and agreed with the stakeholders, including the funding required.

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[79] Reasons for this are still to be determined, and may include such practical matters as land acquisition problems, inadequate funds, and/or higher priority needs elsewhere.

[80] Estimates indicate that the present operating times could reduce by about 30% by 2065, possibly reducing capacity by as much 50%, because of reduced differences in head, while rainfall could increase by 25%.

[81] Amatali has two large water bodies that can help in this respect. The potential for this in the other pourashavas is virtually non-existent unless it becomes possible to use their *khals*. In all of them it is necessary to have a flood management plan, to regulate flows in ways that minimise impacts in the most vulnerable and valuable areas to the maximum extent possible. Ideally this should be a participatory plan, so that it can be implemented with the partnership and the consent of the public, rather than their ignorance or opposition.

[82] National Water Management Plan 2001, Vol 2.

789. In conclusion, achieving more climate resilient services and infrastructure through CTIIP will be severely reduced unless there is coordinated action by the project and BWDB, to ensure BWDB's existing infrastructure is upgraded to the necessary levels, and necessary new infrastructure is implemented too.

790. BWDB should therefore be an active partner in CTIIP's implementation, and a meeting was eventually held with BWDB on 4 July 2013 during the ADB final review mission to initiate contact for the project. This has been followed up with a letter from the LGED Chief Engineer to request BWDB to nominate a focal person to actively coordinate and cooperate with LGED for the further preparation of CTIIP and during implementation of the project.

791. It is hoped that part of a BWDB program should be to implement/upgrade primary flood defense infrastructure to the required levels and capacity for 2050, including the effects of climate change, for the CTIIP towns.[83]

792. **Performance criteria mechanism.** As is the case with other projects financed under a sector lending modality (such as Urban Governance and Infrastructure Improvement Project and the Secondary Towns Water Supply and Sanitation Project), the release of project funds to the pourashavas will be administered under a 2-stage process known as the Performance Criteria Mechanism, whereby the project pourashavas have to meet certain institutional capacity and governance criteria to receive funding. Infrastructure subprojects are therefore divided between Stage I funding and Stage II funding.

793. Investments under Performance Criteria Stage I include those infrastructure components in urban core areas and considered critical for building climate change resilience such as: (i) cyclone shelters, (ii) roads, bridges and culverts which will enhance climate change resilience through improved connectivity and access to emergency services in the event of disasters caused by natural hazards, (iii) solid waste management, (iv) drainage and flood control, and (v) water supply in urban core areas, and (vi) sanitation.

794. For investments under Performance Criteria Stage II it was decided during the ADB review mission of 30 June – 7 July 2013 that these would be in the form of a lump sum of $1.0 million per town, for the pourashavas to use according to priorities and needs. Stage II investments that could be considered include: (i) other priority roads, bridges, and culverts, (ii) boat landing stations, (iii) markets, (iv) bus terminals, and (v) solid waste management, and (vi) water supply for future planned development areas.

795. A performance evaluation committee will be formulated in LGED to assess compliance with the criteria. A signed Partnership Agreement submitted to the PMU is a pre-condition for entry to Stage I.

796. There will need to be substantial support from the project to assist the pourashavas with the effective implementation of the performance criteria mechanism in line with the proposed compliance schedule, and for the establishment and development of a strong monitoring and evaluation (M&E) system with the pourashavas to achieve this. For the PPTA study pourashavas (Batch 1 towns), this support will be provided by the capacity building mobile support teams,[84] which mobilized in June 2013, to assist and guide the towns to carry out measures to comply with the Stage I criteria.

[83] An important criterion for the selection of Batch 2 towns was the presence or otherwise of BWDB primary flood defense infrastructure.

[84] The capacity building mobile support teams are being financed from additional PPTA funds.

797. **Project scope, number of towns.** During the ADB review mission of 30 June – 7 July 2013, scope and costs for the Stage I interventions for the PPTA study towns (Batch 1) were revised to $5.7-11.5 million base cost per town including climate change resilience (average $9.9 million per pourashava, incorporating and with contingencies). These proposed investments have a higher cost compared to other projects such as UGIIP ($2.6 to 3.2 million per pourashava, depending on class). This is because the main aim of CTIIP is to make the participating pourashavas climate change resilient, and the infrastructure scope has to be more holistic to achieve this aim, which is reflected in the higher cost.

798. Based on the costs for the four Batch 1 towns and available budget allocation, it is estimated that four more towns could be included in the project, as Batch 2.

799. **Absorptive capacity of pourashavas to manage and maintain proposed infrastructure interventions**. The higher investment amounts for CTIIP raises the issue of the technical, institutional and financial capacity of the pourashavas to manage project implementation activities and the long-term and sustainable operation and maintenance of the infrastructure facilities, particularly for water supply installations, after they have been constructed.

800. Generally the existing capacity in the pourashavas is limited in all aspects, and constrained by the provisions of the Local Government (Pourashava) Act, 2009. There will need to be a lot of strengthening of resources during project implementation and the preparation of a more flexible enabling environment to ensure that the pourashavas are sufficiently prepared to take on the responsibilities for the sustainable O&M of the physical facilities and assets. Although this aspect has been built into the project design, through the provision of technical assistance and guidance from the project management unit and the Management Support Unit of LGED, a lot will depend on the leadership and motivation of the pourashava authorities and elected officials, and pressure from customers and communities for services to be provided and maintained to acceptable levels.

801. On a positive note, financial analyses conducted for the four Batch 1 towns for revenue earning sectors—water supply, sanitation, solid waste management, boat landing stations, market and bus terminals—indicate financial sustainability, as the revenue account will be in surplus. Also, for non-revenue-generating sectors—urban drainage, roads, bridges, and cyclone shelters—the financial projections show that the pourashavas can absorb the investment in appraised subprojects, as they are expected to have a revenue account surplus and a positive close balance for the revenue account.

802. **Procurement for civil works contracts.** Contracts for civil works will be awarded, managed and supervised by the concerned pourashavas' project implementation units (PIU). Although ADB would prefer to have large contract packages to minimize the time and effort needed for contract tender documentation preparation and related administrative procedures; the pourashavas favor smaller packages which are more within their capacity, and would cause less disruption due to massive construction activities within a small pourashava area, and encourage more bidders to participate. Also, smaller packages would be within the proposed threshold of $1.5 million for national competitive bidding (NCB) contracts. While discussing about the recommended value of single contracts with LGED engineers and pourashava officials of the Batch 1 towns of CTIIP, none of them suggested a single contract value beyond BDT 50 million (approximate USD 400,000) considering the past experiences from other urban sector projects.

803. For international competitive bidding (ICB), regional contractors are unlikely to be interested in contracts valued at less than $20 million as found from discussion with some potential contractors in the neighboring country India because of many factors/ reasons, including lengthy procedures to obtain the necessary permits and fulfill requirements to work

in Bangladesh. From the tentative procurement plan prepared by the PPTA team, the estimated value of all works packages for a town varies from $4.7 to 10.5 million, with a grand total for all towns about USD 32.6 million. As such, the choice of ICB method may not add value in attracting international bidders. Based on prevailing conditions, the NCB method has been recommended for implementation of civil works packages, balancing the risks of procedural delay and possibility of getting the work done within the designated time. Nevertheless, the advertisement of works packages valued over USD 1.0 million would be mandatorily published in the ADB website, and also in the national web portal dedicated for posting procurement notices.

804. A challenging part of pourashava procurement capacity is the “random” transfer of staff. For example, the Assistant Engineer (AE) of Amtali Pourashava has been transferred to a new working place just some days after he received orientations on the project and hands-on training on how to prepare the contract packaging from the tentative scheme list. Since then, the position of AE Amtali Pourashava has been charged to the Sub-Assistant Engineer, who has been posted in Amtali Pourashava for less than two years. In order to ensure adequate capacity of each pourashava throughout the project period, the local government division may consider as follows: (i) suitable staff are posted against all procurement and technical positions of the selected pourashavas; (ii) these staff are not transferred during the project implementation period; and (iii) if any of these staff are transferred for any unavoidable circumstances, the vacancies are immediately filled in with appropriate replacements.

805. **Quality control of construction works.** A common problem in Bangladesh, and in many other developing countries, is ensuring adequate quality control on construction works, particularly where local governments have limted capacity in terms of qualified and motivated staff, which is the case in the project pourashavas. One measure proposed is to include international and national quality control specialists in the Project Management and Supervision Consultant team, to support the PMU and PIUs with assessing construction progress and completed works, and advising on remedial measures before payments are made to contractors.

806. **Hartals.** Since the ADB Interim Mission on 5-13 May 2013, there have been 12 days of *hartals*, over half a month’s worth of work days—when international consultants could not get to the office and face-to-face contacts with national colleagues and LGED counterparts were severely compromised. During the final stages of completing this Draft Final Report there were four straight days of *hartals*, which caused difficulties and delays in finalizing certain parts of the report.

807. Further *hartals* are expected over the next months (leading up the General Election that must be held by 24 January 2014).