

Final Report on

Development of Digital Elevation Model (DEM) and delineation of
Catchment boundaries for
Polders 43/1A and Polder 43/2F of Blue Gold Program

Barguna O&M Division



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1. Introduction

1.1 Background of the Study

The coastal region of Bangladesh is regarded as a zone of multiple vulnerabilities. About 38% of the population in this region live below the poverty line and face high vulnerabilities in terms of insecurity of food, income, water and health. Water is the blessings as well as curse for the coastal population. Management of this natural resource is very crucial for achieving wellbeing of the coastal population. Participatory water resources management is successfully operating in coastal area of Bangladesh by BWDB, where Government of the Netherlands (GoN) participates as a development partner. Blue Gold is a collaboration program between the Government of the Netherlands (donor) and the Government of Bangladesh which is undertaken to uplift the socio-economic status of households living in coastal polders and its surroundings.

Blue gold is such a project of GoN and GoB which emphasizes active involvement of rural communities concerned and other stakeholders. Under the Blue Gold project the consultant Euroconsult Mott MacDonald assigned CEGIS to prepare Digital Elevation Model (DEM) and catchment boundaries for seven polders in Patuakhali and Khulna Districts. Under this project CEGIS has been assessed certain parameters, (topography, hydrology, drainage system, interventions and cropping practice) that usually govern overall drainage and hydrological dynamics within the polders.

1.2 Study area

The study areas of the project are situated in South-Central hydrological region of Bangladesh. The Polders under the South-Central region are Polder 43/1A and Polder 43/2F (Figure 1.1). The study area covers about 77.01 sq. km. Specific locations of the Polders, governing rivers and areas of the polders are mentioned in the following Table 1.1.

Table 1.1: Specific location of the Polders

SL	Polder Name	Location (union)	Major River/Khal	Area (ha)
01	Polder 43/1A	Atharagashia, Kukua unions under Amtali Upazila.	Nalua, Gazipura khal, Kukua, Nauli, Gazipura khal, Lohalia	3,568
02	Polder 43/2F	Gulishakhali union under Amtali Upazila	Gulishakhali, Payra and Kukua.	4,133

1.3 Objectives

The overall objective is to assess the existing condition of topography, hydrology, drainage system, interventions and existing cropping practice of selected polders coastal areas of Bangladesh.

Specific objectives:

The specific objectives of the study are:

- To identify detail topographic features, landforms and elevation;
- To assess the drainage pattern and tidal dynamics within the delineated catchment boundary;
- To identify the present condition of cropping pattern;

1.4 Scope of works

The scope of works as per the ToR is as follows:

- Digital Elevation Model development based on contour and point data from FINNMAP/BWDB Maps.
- Catchment area delineation including updated water management infrastructure layout along with roads and culverts/bridges.
- Tidal dynamics assessment around the polders and suggest drainage plans.

1.5 Deliverables and outcomes

As per the ToR and Scope of works a number of deliverables and outcomes identified. The major deliverables and outcomes are stated bellows:

- Inception Report
- DEM preparation & Elevation Mapping
- Catchment area delineation and detail mapping.
- Drainage pattern/direction maps
- Technical Report

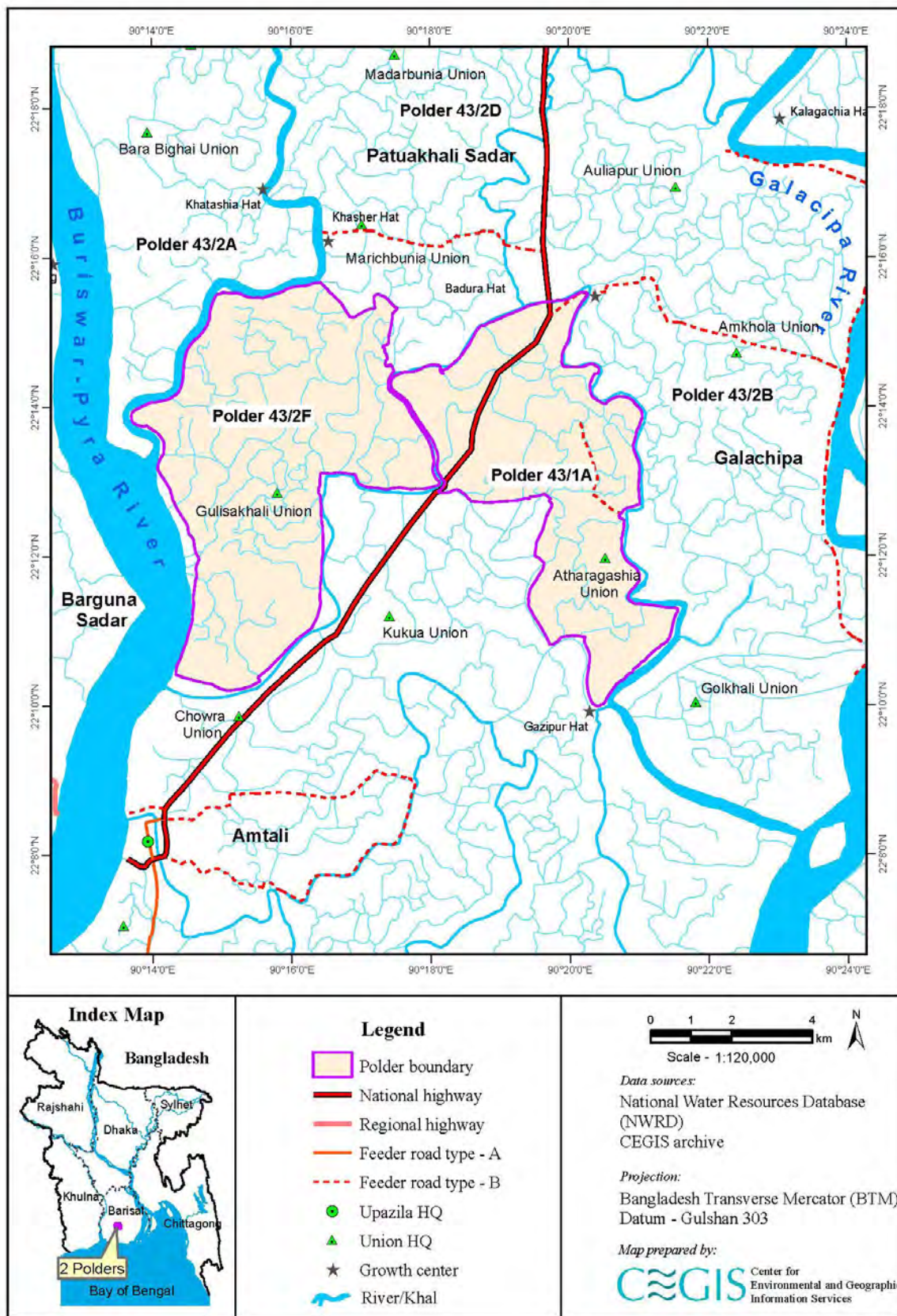


Figure 1.1: Study area of Polder 43/1A and Polder 43/2F

2. Approach and Methodology

2.1 Initial consultation meeting

At the inception phase all works have been identified and a step-by-step approach and methodology has been developed. The major activities are presented in Figure 2.1 and described in the following sections.

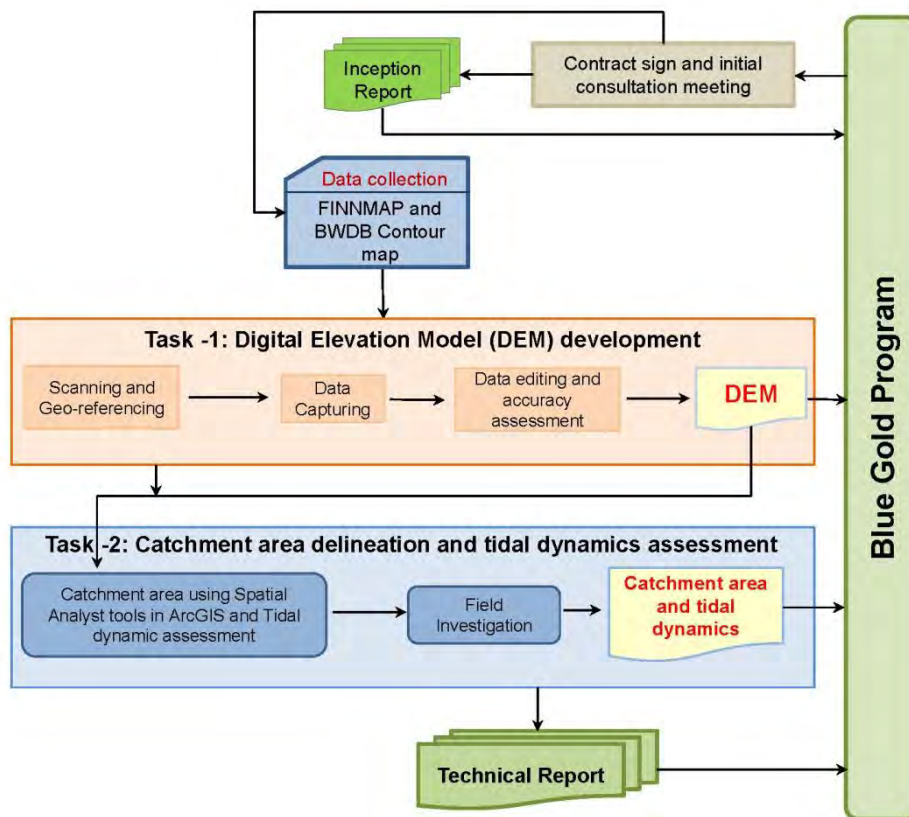


Figure 2.1: Overall methodology of the activities

2.2 Contract Signing

The contract was signed between Euroconsult Mott MacDonald and Center for Environmental and Geographic Information Services (CEGIS) on 27 March 2016. Mr. Guy Jones, Team Leader, Blue Gold Project and Engr. Md. Waji Ullah, Executive Director, CEGIS signed the contract.

2.3 Initial consultation meeting

After signing of the contact an initial consultation meeting was organized with the officials and relevant professionals of the client on 14 April 2016 to finalize the understanding of the requirements; identify the data sources, data format, spatial resolution, coordinate system, probable outcomes and priorities.

2.4 Inception Report

The Inception Report (this report) consists of detail activities, methodology, deliverables, and work plan for performing the project activities was prepared and submitted on 29 July 2016.

2.5 Data collection

The contours and spot elevations have been collected from FINNMAP. The FINNMAPs were published by Bangladesh Inland Water Transport Authority (BIWTA) in 1998 at 1:10000 scale. Twenty seven (27) numbers sheets have been collected under this study. The collected FINNMAPs are shown in Table 2.1.

Table 2.1: FINNMAP collection from BIWTA

SL No.	FINNMAP	Number of Sheet
1	2450 – 520, 525, 530, 535, 540	5
2	2455 – 520, 525, 530, 535, 540	5
3	2460 – 520, 525, 530, 535, 540	5
4	2465 – 520, 525, 530, 535, 540	5
5	2470 – 525, 530, 535, 540	4
6	2495 – 435, 440	2
7	2500 - 440	1
Total		27

The contour intervals of FINNMAP is 0.25 m. East-west spacing of spot elevation is about 300 m and spacing in north-south direction is about 100m. Sample of a FINNMAP is shown in Figure 2.2. Rivers and khal networks will be digitized from these maps.

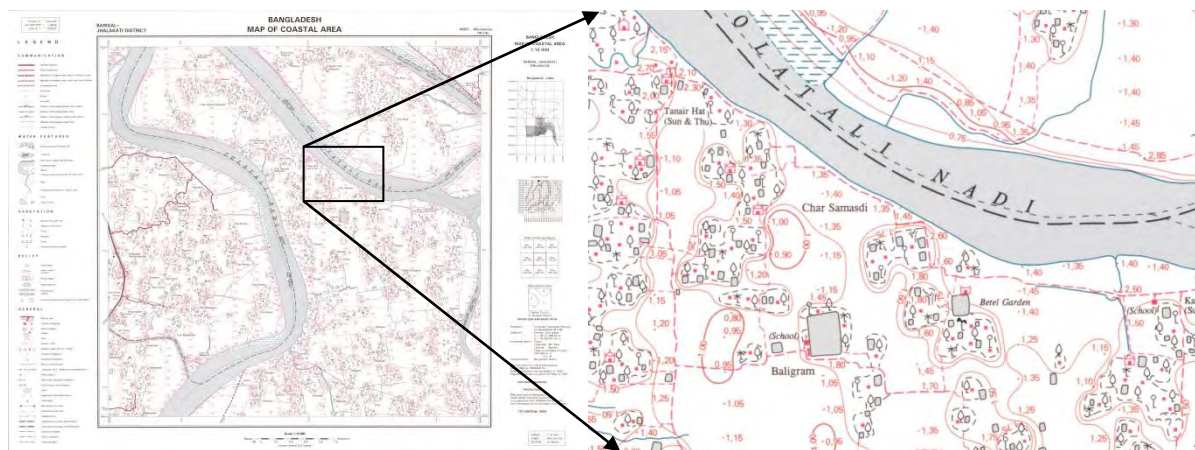


Figure 2.2 : Sample of BIWTA FINNMAP

2.6 Digital Elevation Model (DEM) development

2.6.1 Scanning and geo-referencing

All the collected FINNMAP sheets have been scanned using a high precision scanner at 300 dpi in JPG file format. The maps are scanned in such a way, that all the features are clearly visible and digitization done accurately. Geo-referencing are done using ArcGIS software.

Bangladesh Transverse Mercator (BTM) projection has been preferred by the client and used to geo-reference those images.

Projection parameters

Bangladesh Transverse Mercator (BTM) projection parameters will be used to geo-reference those images. The parameters of BTM projection are:

Projection Type	Transverse Mercator
Datum Name	Everest
Scale Factor at central meridian	0.99960000
Longitude of central meridian	90:00:00.000000E
Latitude of origin of projection	0:00:00.000000N
False easting	500000.000000 meters
False northing	-2000000.000000 meters

2.6.2 Data capturing

FINNMAP Maps are very reliable source for providing contour lines, spot height with fine details and accuracy. These data were captured from geo-referenced FINNMAP Maps. Settlement, detail roads network, rivers, khals, water bodies and water management infrastructure (Drainage and flushing regulators) were captured from these maps. The features were identified considering size, shape, pattern, texture and description available in the map.

2.6.3 Data editing and accuracy assessment

The good quality of the report was ensured from data accuracy, authentic source of information and inclusion of necessary parameters of accuracy. Data editing and accuracy assessment were carried out for quality output. The accuracy assessment was done through visual inspection and interpretation by comparing with the original FINNMAP maps. The contour values for each digitized map sheet were checked visually. GIS Expert and Quality Control Specialist were involved in accuracy assessment.

2.6.4 Develop Digital Elevation Map (DEM)

From the objectives it is clear that the study is deemed to be assessing topographic features, landforms, elevation, drainage patterns and tidal dynamics within the delineated catchment areas. The cropping patterns were assessed within all 7 polders. As per the undulating nature of the landform the drainage systems are governed. To get ideas about the landform variation within the study area appropriate Digital Elevation Maps were be prepared.

Original elevation of FINNMAP is in SoB datum, which is in Mean Sea Level (MSL). After capturing, the MSL values have been transferred to PWD datum. Roads and embankments are elevated based on the surrounding elevations and survey. The rivers, khals and other water bodies were lowered considering lowest elevation. Road were considered as dominant factor where khal are closed. Digital Terrain Model (DTM) were prepared using Spatial Analyst tool of ArcGIS. The DEM are prepared with 50m X 50m spatial resolution.

2.7 Field Investigation

After data capturing and initial assessment based on secondary data (FINNMAPs, Topo Sheet, Google Images and development of initial DEM) a field investigation were conducted to verify the collected ground information of flow pattern and structure with parameters. The field office of Blue Gold Project has identified consult to identify the available information and location of features in the field.

- Collection of detail information on Hydraulic structures (Drainage sluices, Outlets, Bridge and Culvert) in the study area.
- Flow direction and pattern assessment through visual inspection in stream and public consultation with local people for overland flow.
- Identify man made obstruction/barrier on the khal through visual inspection and satellite image
- Identify the location name, hat-bazars etc. through physical visit and public consultation.
- Considering all these collected information and knowledge gained from the BWDB officials, Blue Gold professionals, local people and direct field inspection were incorporated. These parameters are considered in DEM and catchment delineation.

Considering all these collected information and knowledge gained from the BWDB officials, Blue Gold professionals, local people and direct field inspection are incorporated. These parameter are considered in DEM and catchment delineation.

2.8 Catchment Area and tidal dynamics assessment

Catchment/watershed delineation is one of the most commonly performed activities in hydrologic analysis. A catchment of an outlet or pour point is the upslope area which drains its accumulated runoff through that point. Watershed delineation was performed with the Spatial Analyst Tools of ArcGIS using the Developed Digital Elevation Model (DEM) and rivers/khals network as inputs. All the watershed delineation steps such as filling sink, defining flow direction and accumulation will be done in ArcGIS using SWAT (Soil and Water Assessment Tool) hydrological model. Catchment wise drainage pattern and area elevation curves were derived from the DEM and watersheds.

CEGIS team installed ten (10) water level gauge stations to understand the tidal water level variations in and around the study area. Daily water level data at one (01) hour interval (from 6:00 AM to 6:00 PM) for 1 tide cycle (15 days) has been collected during monsoon. This water level data has been used to analyses the tidal dynamics.

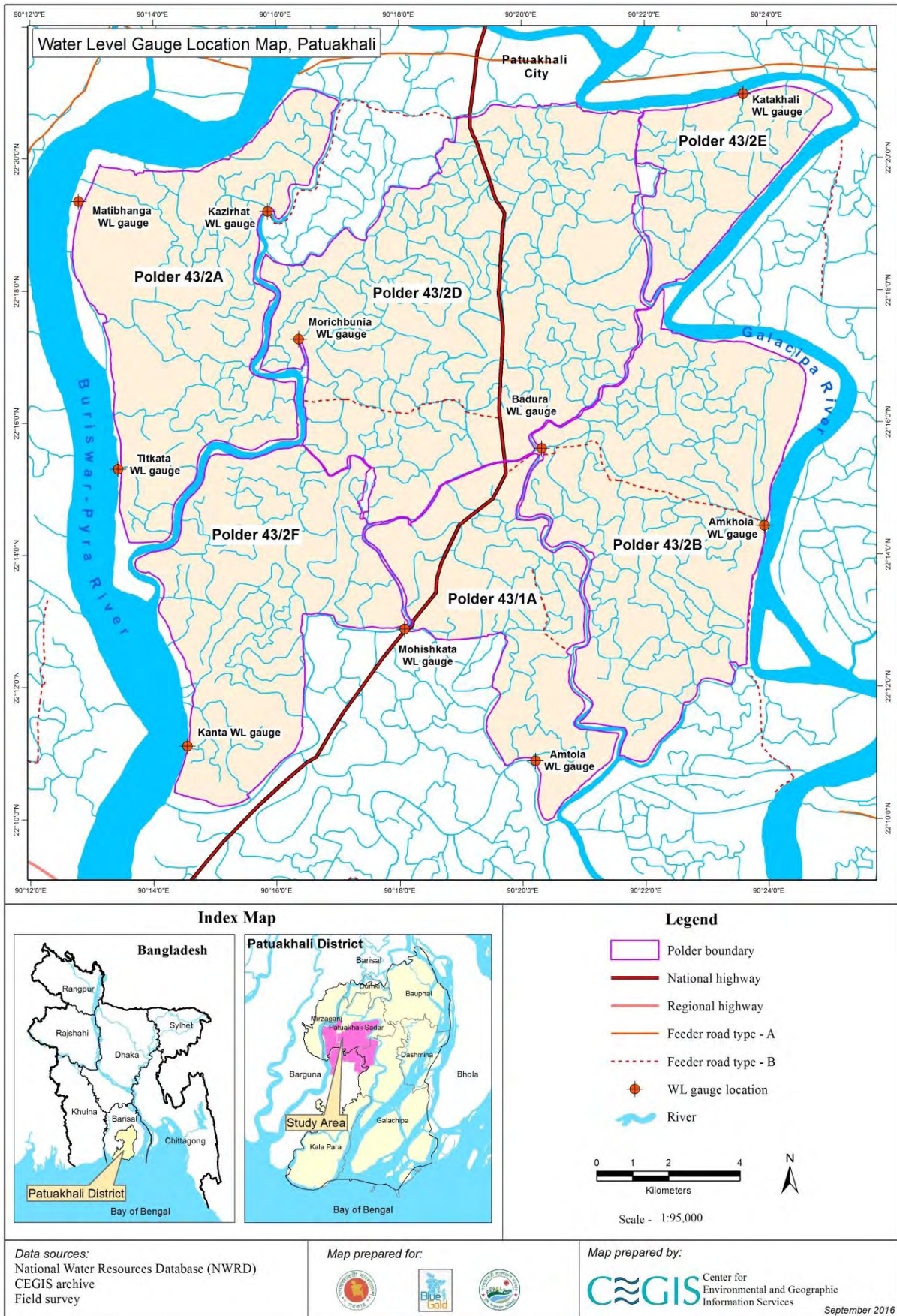


Figure 2.3: Water level gauge stations around the Study area

2.9 Catchment of Polder 43/1A

In this study, for polder 43/1A, Catchment has been delineated for five (05) drainage outlets. The drainage outlets were selected at five (05) hydraulic structure locations. Figure 2.4, 2.5 and 2.6 shows the Base map, Intervention with catchment and Digital Elevation Model (DEM) map of Polder 43/1A. Area of each catchment boundary has been presented in Table 2.2. From the Figure 2.5 and Table 2.2 shows that catchment of Amtola Sluice is the largest catchment which is about 1127 ha.

Table 2.2: Drainage outlet/ hydraulic Structure wise drainage catchment for polder 43/1A

Description of Catchment 1

Catchment Name	Cat – 1 (Mohishkata Catchment)
Location	Khagodon (230 ha), Roybala (216 ha), Kukua (105 ha), Keowabunia (84 ha), Purba Chunakhali (78 ha), Atharagashia (57 ha) and Sakharia (12 ha)
Catchment area (ha)	782 ha
Drainage Outlet	Mohishkata Sluice at Ch. 0+000 km (2V- 1.5 m X1.8 m)
Main Drainage Canal	Mohishkata khal
Land elevation of Catchment (m PWD)	Max: 2.77 Min: 1.22
Length of Stream within catchment (Km)	26.78
Drainage Density (m/ha)	34.24
Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Kukua River Condition: Partially active (silted up) ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Partially silted up (<i>proposed for re-excavation under Bluegold program</i>) • Branch khal: Moderately silted up ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Moderate (usually takes 3-4 days to properly drain out rain water) • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Moderate (Lt Aman and HYV Aman Seed bed affected by drainage congestion) • Water Scarcity: Roybala mauza is affected by water scarcity during winter season (mainly affects Rabi crops); • Re-excavation of Mohishkata khal and Katali Khal may reduce the scarcity of irrigation water for Rabi crops. ➤ <i>Hydraulic structure condition</i> <ul style="list-style-type: none"> • Functional (Flap gate is corroded)



Figure: C/S of Moishkata Sluice



Figure: Moishkata khal

Description of Catchment 2

Catchment Name	Cat – 2 (Kewabunia Catchment)
Location	Kewabunia (262 ha), Purba Chunakhali (54 ha) and Bazarghona (12 ha)
Catchment area (ha)	330 ha
Drainage Outlet	Kewabunia Sluice at Ch. 0+440 km (1V- 1.5 m X1.8 m)
Main Drainage Canal	Kewabunia khal
Land elevation of Catchment (m PWD)	Max: 2.96 Min: 1.40
Length of Stream within catchment (Km)	6.78
Drainage Density (m/ha)	20.54
Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Kukua River Condition: Highly silted up (Average Bed level of kukua river is about 0.45 mPWD whereas sill level of Kewabunia sluice is (-)1.00 mPWD) ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Moderately silted up • Branch khal: Moderately silted up ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Severe, usually takes 5-7 days to properly drain out rain water as the bed level of Kukua River is higher than the Kewbunai khal. • Re-excavation of Kukua River and Kewbunia khal may reduce the drainage congestion problem • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i>

	<ul style="list-style-type: none"> • Crop damage: Severe (Mainly affects Lt Aman and Rabi crops due to drainage congestion) • Water Scarcity: Purbo Kewabunia area is affected by water scarcity during winter season (mainly affects Rabi crops). • Re-excavation of Kewabunia and its connecting branch khal will available irrigation water for Rabi crops. <p>➤ <i>Hydraulic structure condition</i></p> <ul style="list-style-type: none"> • Functional
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Figure: C/S of Kewabunia Sluice



Figure: Outfall of Kewabunia catchment

Description of Catchment 3

Catchment Name	Cat – 3 (Gulbunia Catchment)
Location	Kewabunia (262 ha), Purba Chunakhali (54 ha) and Bazarghona (12 ha)
Catchment area (ha)	330 ha
Drainage Outlet	Gulbunia Sluice at Ch. 6+155 km (1V- 1.5 m X1.8 m)
Main Drainage Canal	Gulbunia khal
Land elevation of Catchment (m PWD)	Max: 3.25 Min: 1.27
Length of Stream within catchment (Km)	13.25
Drainage Density (m/ha)	40.14
	<p>➤ <i>Outfall</i></p> <ul style="list-style-type: none"> • Outfall Khal: Kukua River Condition: Highly silted up <p>➤ <i>Condition of Drainage Khal</i></p> <ul style="list-style-type: none"> • Main drainage Khal: Partially silted up (Average bed level is 0.3 to 0.4 mPWD) • Branch khal: Partially silted up

Catchment Description	<ul style="list-style-type: none"> ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Severe (usually takes 5-7 days to properly drain out rain water as the bed level of Kukua River is high) • Re-excavation of Kukua River may reduce the drainage congestion problem • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Severe (Mainly affects Lt Aman and Rabi crops due to drainage congestion) • Water Scarcity: Not found ➤ <i>Hydraulic structure condition</i> <ul style="list-style-type: none"> • Functional
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Figure: C/S of Gulbunia Sluice



Figure: Outfall of Gulbunia catchment

Description of Catchment 4

Catchment Name	Cat – 4 (Chowla Catchment)
Location	Atharagashia (327 ha), Sakharia (284 ha), Gerabunia (40 ha), Chhailabunia (31 ha) and Khagodon (12 ha)
Catchment area (ha)	695 ha
Drainage Outlet	Chowla Sluice at Ch. 0+000 km (2V- 1.5 m X1.8 m)
Main Drainage Canal	Chowla khal
Land elevation of Catchment (m PWD)	Max: 3.48 Min: 1.00
Length of Stream within catchment (Km)	19.36
Drainage Density (m/ha)	28.36

Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Nauli River Condition: Active ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Partially silted up • Branch khal: Moderately silted up (Khatasia khal is proposed for re-excavation) ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Moderate (usually takes 3-4 days to properly drain out rain water) • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Minor • Water Scarcity: Northern part of Khatasia khal is affected by water scarcity during winter season (mainly affects Rabi crops) as the bed level of this khal is higher; • Re-excavation of Khatasia khal may available irrigation water for Rabi crops. ➤ <i>Hydraulic structure condition</i> <ul style="list-style-type: none"> • Functional
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Figure: C/S of Chowla Sluice



Figure: Outfall of Chowla catchment

Description of Catchment 5

Catchment Name	Cat – 5 (Amtola Catchment)
Location	Atharagashia (336 ha), Gerabunia (18 ha), Kukua (31 ha), Sonakhali (712 ha) and Bara Gabua (30 ha)
Catchment area (ha)	1127 ha
Drainage Outlet	Amtola Sluice at Ch. 25+970 km (3V- 1.5 m X1.8 m)
Main Drainage Canal	Amtola khal
Land elevation of Catchment (m PWD)	Max: 3.18 Min: 1.08

Length of Stream within catchment (Km)	27.29
Drainage Density (m/ha)	25.98
Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Gazipura khal Condition: Active ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Partially silted up • Branch khal: Moderately silted up ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Minor (usually takes 2-3 days to properly drain out rain water) • Permanent Water logging: About 16 ha area near Hazartakar bandh remains waterlogged from October to December. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Minor • Water Scarcity: Not found ➤ <i>Hydraulic structure condition</i> <ul style="list-style-type: none"> • Functional



Figure: R/S of Amtola Sluice



Figure: Outfall of Amtola catchment

2.10 Tidal dynamics assessment

CEGIS team installed three (03) water level gauge stations (**Mohishkata, Badura and Amtola**) outside the polder 43/1A (shown in Figure 2.10) to understand the tidal water level variations. Daily water level data at one (01) hour interval (from 6:00 AM to 6:00 PM) for 1 tide cycle (15 days) from 20st August 2016 to 03rd September 2016 has been collected presented in Table 2.3. All water level data was collected in mPWD datum.

Daily water level data were collected on an hourly basis. Water level hydrographs were plotted as water level versus time. The water level hydrograph at Mohishkata, Badura and Amtola stations are shown in Figure 2.7 to 2.9 respectively.

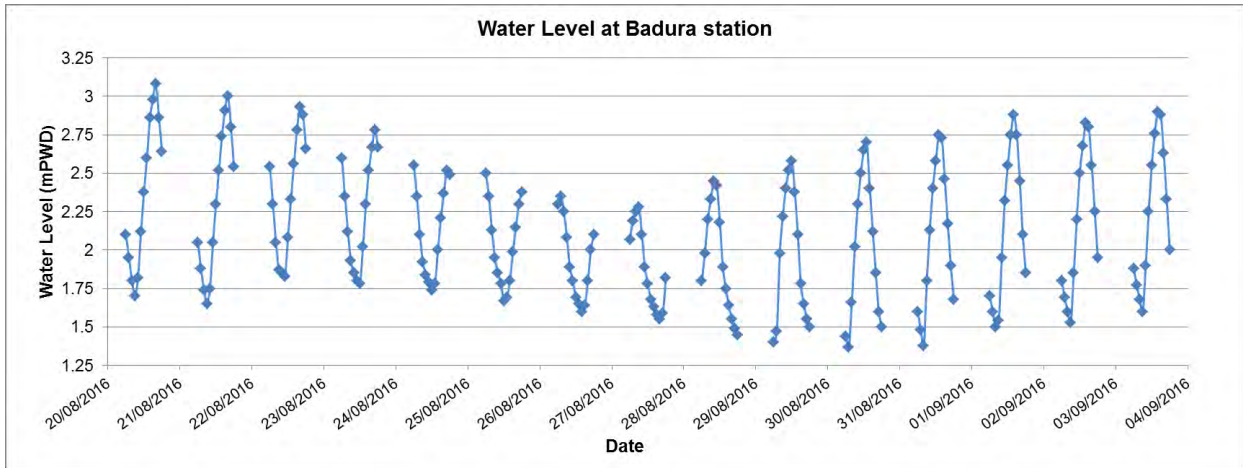


Figure 2.7: Water level analysis at Badura station

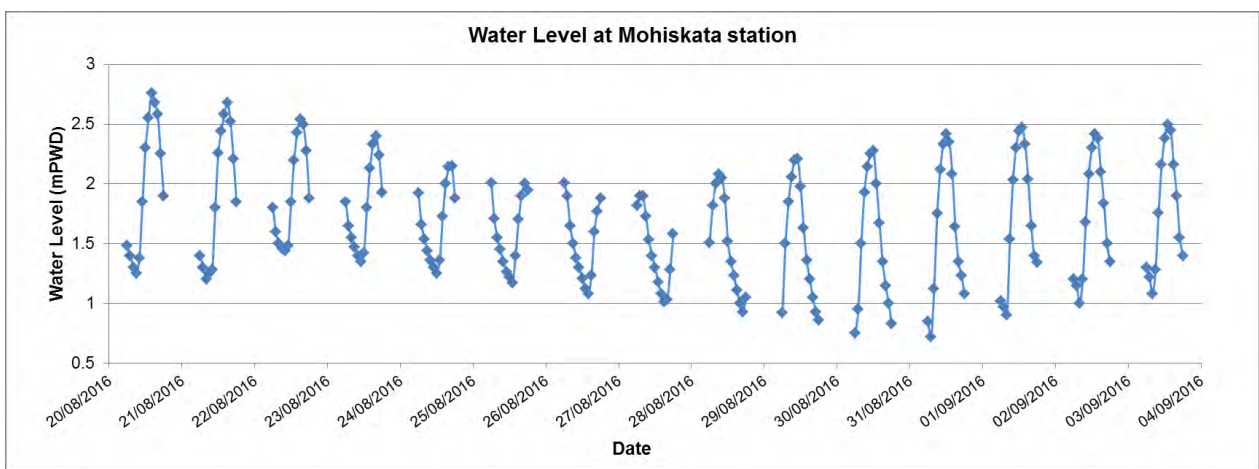


Figure 2.8: Water level analysis at Mohiskata station

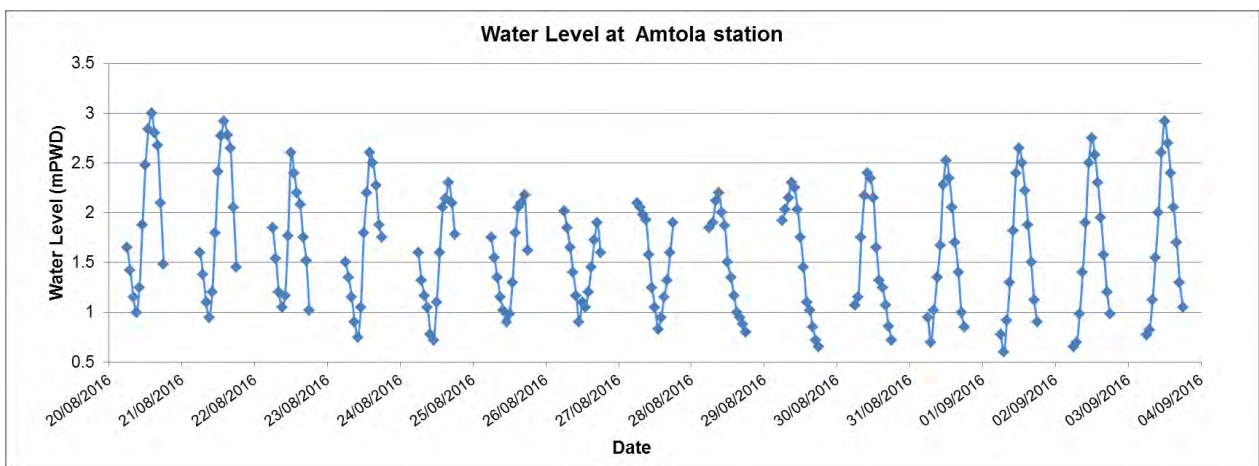
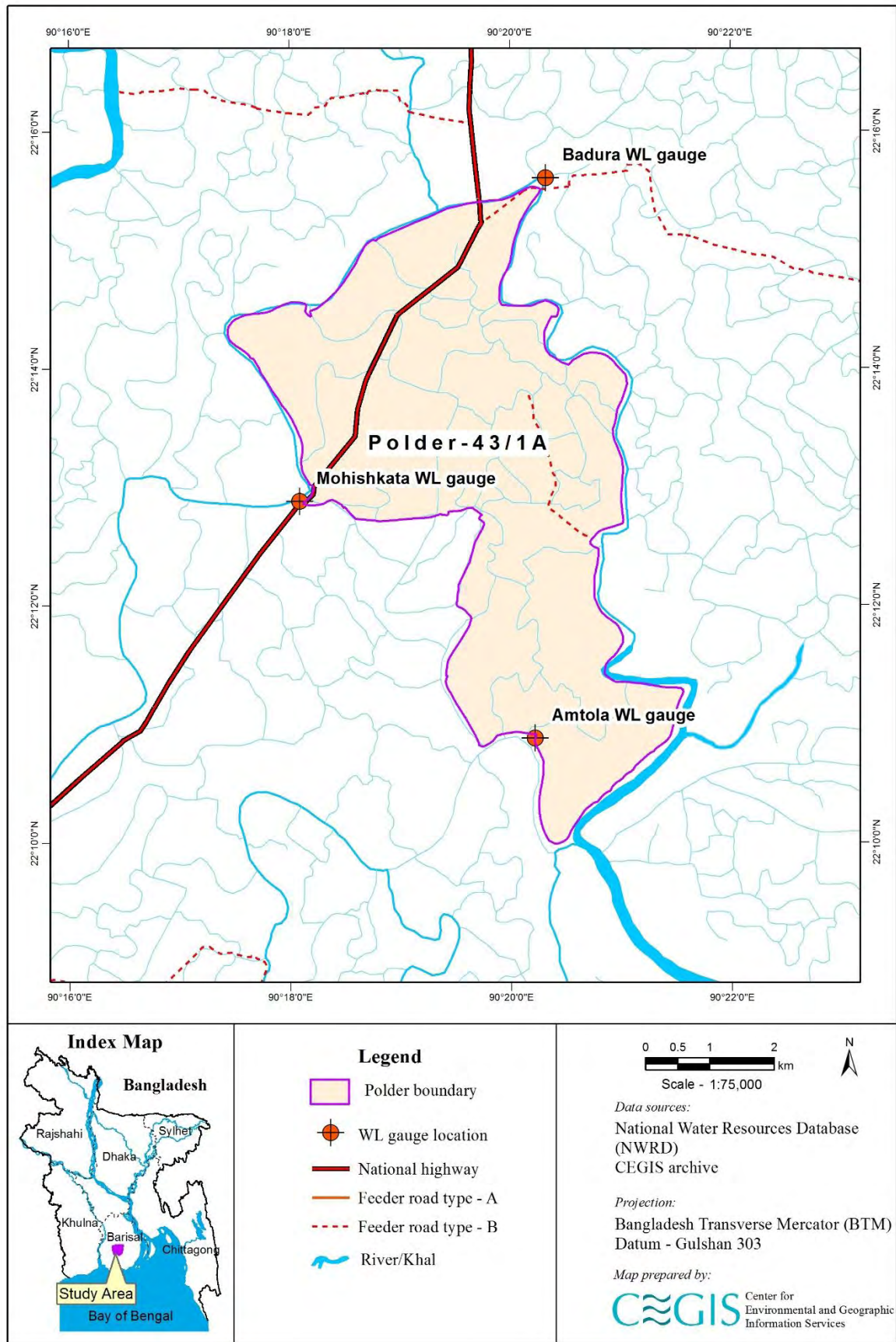


Figure 2.9: Water level analysis at Amtola station



June 2016

Figure 2.10: CEGIS installed gauge location at Polder 43/1A

Table 2.3: Water level gauge data from 20/08/2016 to 03/09/2016

Date	Time	Moishkata	Badura	Amtola
20/08/2016	6:00	1.48	2.10	1.65
	7:00	1.40	1.95	1.42
	8:00	1.30	1.80	1.15
	9:00	1.25(LTL)	1.7(LTL)	1(LTL)
	10:00	1.38	1.82	1.25
	11:00	1.85	2.12	1.88
	12:00	2.30	2.38	2.48
	13:00	2.55	2.60	2.84
	14:00	2.76 (HTL)	2.86	3 (HTL)
	15:00	2.68	2.98	2.80
	16:00	2.58	3.08 (HTL)	2.68
	17:00	2.25	2.86	2.10
18:00	1.90	2.64	1.48	

Date	Time	Moishkata	Badura	Amtola
21/08/2016	6:00	1.40	2.05	1.60
	7:00	1.30	1.88	1.38
	8:00	1.2 (LTL)	1.74	1.10
	9:00	1.25	1.65 (LTL)	0.95 (LTL)
	10:00	1.28	1.75	1.20
	11:00	1.80	2.05	1.80
	12:00	2.26	2.30	2.41
	13:00	2.44	2.52	2.77
	14:00	2.58	2.74	2.92 (HTL)
	15:00	2.68 (HTL)	2.91	2.78
	16:00	2.52	3 (HTL)	2.65
	17:00	2.21	2.80	2.05
18:00	1.85	2.54	1.45	

Date	Time	Moishkata	Badura	Amtola
22/08/2016	6:00	1.80	2.54	1.85
	7:00	1.60	2.30	1.54
	8:00	1.50	2.05	1.20
	9:00	1.46	1.87	1.05 (LTL)
	10:00	1.44 (LTL)	1.85	1.17
	11:00	1.48	1.83 (LTL)	1.77
	12:00	1.85	2.08	2.6 (HTL)
	13:00	2.20	2.33	2.40
	14:00	2.43	2.56	2.20
	15:00	2.54 (HTL)	2.78	2.08
	16:00	2.50	2.93 (HTL)	1.75
	17:00	2.28	2.88	1.52
18:00	1.88	2.66	1.02	

Date	Time	Moishkata	Badura	Amtola
23/08/2016	6:00	1.85	2.60	1.50
	7:00	1.65	2.35	1.35
	8:00	1.55	2.12	1.15
	9:00	1.47	1.93	0.90
	10:00	1.40	1.85	0.75 (LTL)
	11:00	1.35 (LTL)	1.80	1.05
	12:00	1.42	1.78 (LTL)	1.80
	13:00	1.80	2.02	2.20
	14:00	2.13	2.30	2.6 (HTL)
	15:00	2.33	2.52	2.50
	16:00	2.4 (HTL)	2.67	2.27
	17:00	2.24	2.78 (HTL)	1.88
	18:00	1.93	2.67	1.75

Date	Time	Moishkata	Badura	Amtola
24/08/2016	6:00	1.92	2.55	1.60
	7:00	1.66	2.35	1.32
	8:00	1.54	2.10	1.17
	9:00	1.44	1.92	1.05
	10:00	1.36	1.84	0.78
	11:00	1.30	1.79	0.72 (LTL)
	12:00	1.25 (LTL)	1.74 (LTL)	1.10
	13:00	1.36	1.78	1.60
	14:00	1.73	2.00	2.05
	15:00	2.00	2.21	2.14
	16:00	2.14	2.37	2.3 (HTL)
	17:00	2.15 (HTL)	2.52 (HTL)	2.10
	18:00	1.88	2.49	1.78

Date	Time	Moishkata	Badura	Amtola
25/08/2016	6:00	2.01	2.50	1.75
	7:00	1.71	2.35	1.55
	8:00	1.55	2.13	1.35
	9:00	1.45	1.95	1.15
	10:00	1.35	1.85	1.02
	11:00	1.26	1.78	0.9 (LTL)
	12:00	1.22	1.67 (LTL)	0.98
	13:00	1.17 (LTL)	1.69	1.30
	14:00	1.40	1.80	1.80
	15:00	1.70	1.99	2.05
	16:00	1.90	2.15	2.10
	17:00	2 (HTL)	2.30	2.18 (HTL)
	18:00	1.95	2.38 (HTL)	1.62

Date	Time	Moishkata	Badura	Amtola
26/08/2016	6:00	2.01 (HTL)	2.30	2.02 (HTL)
	7:00	1.90	2.35 (HTL)	1.85
	8:00	1.65	2.25	1.65
	9:00	1.50	2.08	1.40
	10:00	1.38	1.89	1.17
	11:00	1.30	1.80	0.9 (LTL)
	12:00	1.21	1.69	1.10
	13:00	1.12	1.65	1.05
	14:00	1.08 (LTL)	1.6 (LTL)	1.20
	15:00	1.23	1.64	1.45
	16:00	1.60	1.80	1.72
	17:00	1.77	2.00	1.90
	18:00	1.88	2.10	1.60

Date	Time	Moishkata	Badura	Amtola
27/08/2016	6:00	1.82	2.07	2.1 (HTL)
	7:00	1.9 (HTL)	2.19	2.05
	8:00	1.90	2.25	1.98
	9:00	1.73	2.28 (HTL)	1.93
	10:00	1.53	2.10	1.58
	11:00	1.40	1.89	1.25
	12:00	1.30	1.78	1.05
	13:00	1.18	1.68	0.83 (LTL)
	14:00	1.08	1.63	0.95
	15:00	1.01 (LTL)	1.58	1.15
	16:00	1.03	1.55 (LTL)	1.32
	17:00	1.28	1.59	1.60
	18:00	1.58	1.82	1.90

Date	Time	Moishkata	Badura	Amtola
28/08/2016	6:00	1.51	1.80	1.85
	7:00	1.82	1.98	1.90
	8:00	2.00	2.20	2.12
	9:00	2.08 (HTL)	2.33	2.2 (HTL)
	10:00	2.05	2.45 (HTL)	2.00
	11:00	1.88	2.42	1.87
	12:00	1.52	2.18	1.50
	13:00	1.35	1.89	1.35
	14:00	1.23	1.75	1.17
	15:00	1.11	1.64	1.00
	16:00	1.00	1.55	0.95
	17:00	0.93 (LTL)	1.49	0.88
	18:00	1.05	1.45 (LTL)	0.8 (LTL)

Date	Time	Moishkata	Badura	Amtola
29/08/2016	6:00	0.92	1.4 (LTL)	1.92
	7:00	1.50	1.47	2.03
	8:00	1.85	1.98	2.15
	9:00	2.06	2.22	2.3 (HTL)
	10:00	2.20	2.40	2.25
	11:00	2.21 (HTL)	2.52	2.03
	12:00	1.98	2.58 (HTL)	1.75
	13:00	1.63	2.38	1.45
	14:00	1.36	2.10	1.10
	15:00	1.20	1.78	1.02
	16:00	1.05	1.65	0.85
	17:00	0.93	1.55	0.72
18:00	0.86	1.50	0.65	

Date	Time	Moishkata	Badura	Amtola
30/08/2016	6:00	0.75 (LTL)	1.44	1.07 (LTL)
	7:00	0.95	1.37 (LTL)	1.15
	8:00	1.50	1.66	1.75
	9:00	1.93	2.02	2.17
	10:00	2.14	2.30	2.4 (HTL)
	11:00	2.25	2.50	2.35
	12:00	2.28 (HTL)	2.65	2.15
	13:00	2.00	2.7 (HTL)	1.65
	14:00	1.67	2.40	1.32
	15:00	1.35	2.12	1.25
	16:00	1.15	1.85	1.07
	17:00	1.00	1.60	0.86
18:00	0.83	1.50	0.72	

Date	Time	Moishkata	Badura	Amtola
31/08/2016	6:00	0.85	1.60	0.95
	7:00	0.72 (LTL)	1.48	0.7 (LTL)
	8:00	1.12	1.38 (LTL)	1.02
	9:00	1.75	1.80	1.35
	10:00	2.12	2.13	1.67
	11:00	2.33	2.40	2.28
	12:00	2.42 (HTL)	2.58	2.52 (HTL)
	13:00	2.35	2.75 (HTL)	2.35
	14:00	2.08	2.73	2.05
	15:00	1.64	2.46	1.70
	16:00	1.35	2.17	1.40
	17:00	1.23	1.90	1.00
18:00	1.08	1.68	0.85	

Date	Time	Moishkata	Badura	Amtola
01/09/2016	6:00	1.02	1.70	0.78
	7:00	0.97	1.60	0.6 (LTL)
	8:00	0.9 (LTL)	1.5 (LTL)	0.92
	9:00	1.54	1.54	1.30
	10:00	2.03	1.95	1.82
	11:00	2.30	2.32	2.40
	12:00	2.44	2.55	2.65 (HTL)
	13:00	2.47 (HTL)	2.75	2.50
	14:00	2.33	2.88 (HTL)	2.22
	15:00	2.04	2.75	1.88
	16:00	1.65	2.45	1.50
	17:00	1.40	2.10	1.12
	18:00	1.34	1.85	0.90

Date	Time	Moishkata	Badura	Amtola
02/09/2016	6:00	1.20	1.80	0.65 (LTL)
	7:00	1.15	1.69	0.70
	8:00	1 (LTL)	1.60	0.98
	9:00	1.20	1.53 (LTL)	1.40
	10:00	1.68	1.85	1.90
	11:00	2.08	2.20	2.50
	12:00	2.30	2.50	2.75 (HTL)
	13:00	2.42 (HTL)	2.68	2.58
	14:00	2.38	2.83 (HTL)	2.30
	15:00	2.10	2.80	1.95
	16:00	1.84	2.55	1.58
	17:00	1.50	2.25	1.20
	18:00	1.35	1.95	0.98

Date	Time	Moishkata	Badura	Amtola
03/09/2016	6:00	1.30	1.88	0.77 (LTL)
	7:00	1.22	1.77	0.82
	8:00	1.08 (LTL)	1.68	1.12
	9:00	1.28	1.6 (LTL)	1.55
	10:00	1.76	1.90	2.00
	11:00	2.16	2.25	2.60
	12:00	2.38	2.55	2.92 (HTL)
	13:00	2.5 (HTL)	2.76	2.70
	14:00	2.45	2.9 (HTL)	2.40
	15:00	2.16	2.88	2.05
	16:00	1.90	2.63	1.70
	17:00	1.55	2.33	1.30
	18:00	1.40	2.00	1.05

2.11 Catchment of Polder 43/2F

In this study, for polder 43/2F, Catchment has been delineated for sixteen (16) drainage outlets. The drainage outlets were selected at sixteen (16) hydraulic structure locations. Figure 2.11, 2.12 and 2.13 shows the Base map, Intervention with catchment and Digital Elevation Model (DEM) map of Polder 43/2F. Area of each catchment boundary has been presented in Table 2.4. From the Figure 2.12 and Table 2.4 shows that catchment of Gojkhali Sluice is the largest catchment which is about 1049 ha.

Table 2.4: Drainage outlet/ hydraulic Structure wise drainage catchment for polder 43/2F

Description of Catchment 1

Catchment Name	Cat – 1 (Kanta Catchment)
Location (mauza wise)	Western part of Khekuani mauza (100 ha)
Catchment area (ha)	100 ha
Drainage Outlet	Kanta Sluice at Ch. 3+447 km (1V- 0.9 m X1.2 m)
Main Drainage Canal	Kanta khal
Land elevation of Catchment (m PWD)	Max: 3.28 Min: 1.81
Length of Stream within catchment (Km)	2.725
Drainage Density (m/ha)	27.25
Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Payra River Condition: Active ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Moderately silted up (<i>about 2.0 km of kanta khal is proposed for re-excavation under Bluegold program during 2016-2017 fiscal year</i>) • Branch khal: Moderately silted up ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Moderate (usually takes 3-4 days to properly drain out rain water) • Re-excavation of Kanta khal will reduce the drainage congestion problem • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Minor • Water Scarcity: Not found. ➤ <i>Structure Condition</i> <ul style="list-style-type: none"> • Functional (Gates are corroded)



Figure: C/S of Kanta Sluice



Figure: R/S of Kanta Sluice

Description of Catchment 2

Catchment Name	Cat – 2 (Angulkata Catchment)
Location (mauza wise)	Gojkhali (60 ha), Khekuani (235 ha) and Ghotkhali (19 ha)
Catchment area (ha)	314 ha
Drainage Outlet	Angulkata Sluice at Ch. 4+483 km (1V- 1.5 m X1.8 m)
Main Drainage Canal	Angulkata khal
Land elevation of Catchment (m PWD)	Max: 3.05 Min: 1.27
Length of Stream within catchment (Km)	6.86
Drainage Density (m/ha)	21.85
Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Payra River Condition: Active ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Partially silted up • Branch khal: Moderately silted up ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Minor (usually takes 2-3 days to properly drain out rain water) • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Minor • Water Scarcity: Not found. ➤ <i>Structure Condition</i> <ul style="list-style-type: none"> • Functional (C/S and R/S loose apron is damaged) • Block pitching and gate repairing (mechanical) work is ongoing under Bluegold program.



Figure: C/S of Angulkata Sluice



Figure: Outfall of Angulkata catchment

Description of Catchment 3

Catchment Name	Cat – 3 (Dalachhara Catchment)
Location (mauza wise)	Gulisakhali (166 ha), Gojkhali (374 ha)
Catchment area (ha)	543 ha
Drainage Outlet	Dalachhara Sluice at Ch. 5+226 km (2V- 1.5 m X1.8 m)
Main Drainage Canal	Dalachhara khal
Land elevation of Catchment (m PWD)	Max: 3.42 Min: 1.44
Length of Stream within catchment (Km)	30.04
Drainage Density (m/ha)	
Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Payra River Condition: Active ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Partially silted up • Branch khal: Moderately silted up ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Minor (usually takes 2-3 days to properly drain out rain water) • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Minor • Water Scarcity: Not found. ➤ <i>Structure Condition</i> <ul style="list-style-type: none"> • Functional (C/S and R/S loose apron is damaged) • Block pitching and gate repairing (mechanical) work is ongoing under Bluegold program.





Figure: On-going Block pitching work of Dalachhara Sluice



Figure: R/S of Dalachhara Sluice



Description of Catchment 4

Catchment Name	Cat – 4 (Gulishakhali Catchment)
Location (mauza wise)	Gulishakhali (188 ha) and Fakirkhali (10 ha)
Catchment area (ha)	197 ha
Drainage Outlet	Gulishakhali Sluice at Ch. 6+648 km (1V- 1.5 m X1.8 m)
Main Drainage Canal	Gulishakhali khal
Land elevation of Catchment (m PWD)	Max: 2.94 Min: 1.52
Length of Stream within catchment (Km)	5.39
Drainage Density (m/ha)	27.36
Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Payra River Condition: Active ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Moderately silted up (about 2.0 km of Gulishakhali khal is proposed for re-excavation under Bluegold program during 2016-2017 fiscal year) • Branch khal: Moderately silted up ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Moderate (usually takes 3-4 days to properly drain out rain water) • Re-excavation of Gulishakhali khal will reduce the drainage congestion problem • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Minor

	<ul style="list-style-type: none"> • Water Scarcity: Not found. ➤ <i>Structure Condition</i> <ul style="list-style-type: none"> • Functional (C/S & R/S loose apron are damaged and vertical lift and flap gates are corroded) • Block pitching and gate repairing (mechanical) work is in progress under Bluegold program.
	
Figure: C/S of Gulishakhali Sluice	Figure: Outfall of Gulishakhali catchment

Description of Catchment 5

Catchment Name	Cat – 5 (Chunakhali Catchment)
Location (mauza wise)	Gulisakhali (61 ha)
Catchment area (ha)	61 ha
Drainage Outlet	Chunakhali Sluice at Ch. 8+448 km (1V- 0.9 m X1.2 m)
Main Drainage Canal	Chunakhali khal
Land elevation of Catchment (m PWD)	Max: 3.10 Min: 1.66
Length of Stream within catchment (Km)	0.236
Drainage Density (m/ha)	3.77
Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Gulishakhali River Condition: Active ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Highly silted up • Branch khal: Highly silted up ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Minor (usually takes 2-3 days to properly drain out rain water) • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Minor

	<ul style="list-style-type: none"> • Water Scarcity: Not found. ➤ <i>Structure Condition</i> <ul style="list-style-type: none"> • Functional
	
Figure: R/S of Chunakhali Sluice	Figure: C/S of Chunakhali Sluice

Description of Catchment 6

Catchment Name	Cat – 6 (Haridrataria Catchment)
Location (mauza wise)	Gulisakhali (71 ha)
Catchment area (ha)	71 ha
Drainage Outlet	Haridrataria Sluice at Ch. 11+403 km (1V- 0.9 m X1.2 m)
Main Drainage Canal	Haridrataria khal
Land elevation of Catchment (m PWD)	Max: 2.46 Min: 1.66
Length of Stream within catchment (Km)	2.02
Drainage Density (m/ha)	28.45
Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Gulishakhali River Condition: Active ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Moderately silted up (<i>about 2.0 km of Haridrataria khal is proposed for re-excavation under Bluegold program during 2016-2017 fiscal year</i>) • Branch khal: Moderately silted up ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Moderate (usually takes 3-4 days to properly drain out rain water) • Re-excavation of Haridrataria khal will reduce the drainage congestion problem

	<ul style="list-style-type: none"> • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Minor • Water Scarcity: Not found. ➤ <i>Structure Condition</i> <ul style="list-style-type: none"> • Functional (C/S & R/S loose apron are damaged and vertical lift and flap gates are corroded) • Block pitching and gate repairing (mechanical) work is in progress under Bluegold program.
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Figure: R/S of Haridrabarua Sluice



Figure: C/S of Haridrabarua Sluice

Description of Catchment 7

Catchment Name	Cat – 7 (Solohowlader Catchment)
Location (mauza wise)	Kalagachhia (195 ha)
Catchment area (ha)	195 ha
Drainage Outlet	Solohowlader Sluice at Ch. 14+542 km (1V- 0.9 m X1.2 m)
Main Drainage Canal	Solohowlader khal
Land elevation of Catchment (m PWD)	Max: 2.60 Min: 1.32
Length of Stream within catchment (Km)	6.39
Drainage Density (m/ha)	32.76
Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Gulishakhali River Condition: Active ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Moderately silted up (about 3.0 km of Solohowlader khal is proposed for re-excavation under Bluegold program during 2016-2017 fiscal year) • Branch khal: Partially silted up

	<ul style="list-style-type: none"> ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Moderate (usually takes 3-4 days to properly drain out rain water) • Re-excavation of Solohowlader khal will reduce the drainage congestion problem • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Moderate (Lt Aman and HYV Aman Seed bed affected by drainage congestion) • Water Scarcity: Not found. ➤ <i>Structure Condition</i> <ul style="list-style-type: none"> • Functional (C/S & R/S loose apron are damaged and vertical lift and flap gates are corroded) • Block pitching and gate repairing (mechanical) work is in progress under Bluegold program.
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Figure: C/S of Solohowlader Sluice



Figure: Outfall of Solohowlader catchment

Description of Catchment 8

Catchment Name	Cat – 8 (Doachara Catchment)
Location (mauza wise)	Kalagachhia (164 ha), Kalibari (15 ha) and Fakirkhali (25 ha)
Catchment area (ha)	204 ha
Drainage Outlet	Doachara Sluice at Ch. 17+005 km (1V- 0.9 m X1.2 m)
Main Drainage Canal	Doachara khal
Land elevation of Catchment (m PWD)	Max: 2.66 Min: 1.18
Length of Stream within catchment (Km)	6.921
Drainage Density (m/ha)	33.92

Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Kukua River Condition: Partially silted up ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Partially silted up • Branch khal: Partially silted up ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Moderate (usually takes 3-4 days to properly drain out rain water) • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Moderate (Lt Aman and HYV Aman Seed bed affected by drainage congestion. • Water Scarcity: Not found. ➤ <i>Structure Condition</i> <ul style="list-style-type: none"> • Functional
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Figure: C/S of Doachara Sluice



Figure: R/S of Doachara Sluice

Description of Catchment 9

Catchment Name	Cat – 9 (Moradhana Catchment)
Location (mauza wise)	Kalibari (60 ha), Bazarghona (17 ha), Kalagachhia (13 ha) and Marichbunia (12 ha)
Catchment area (ha)	102 ha
Drainage Outlet	Moradhana Sluice at Ch. 17+888 km (1V- 0.9 m X1.2 m)
Main Drainage Canal	Moradhana khal
Land elevation of Catchment (m PWD)	Max: 2.62 Min: 1.42
Length of Stream within catchment (Km)	2.698
Drainage Density (m/ha)	26.45

Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Kukua River Condition: Partially silted up ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Partially silted up • Branch khal: Partially silted up ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Moderate (usually takes 3-4 days to properly drain out rain water) • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Moderate (Lt Aman and HYV Aman Seed bed affected by drainage congestion) • Water Scarcity: Not found. ➤ <i>Structure Condition</i> <ul style="list-style-type: none"> • Functional (Gates are corroded)
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Figure: C/S of Moradhana Sluice



Figure: Moradhana khal

Description of Catchment 10

Catchment Name	Cat – 10 (Borachi Catchment)
Location (mauza wise)	Kalibari (215 ha), Purba Chunakhali (34 ha), Paschim Chunakhali (28 ha) and Bazarghona (7 ha)
Catchment area (ha)	285 ha
Drainage Outlet	Borachi Sluice at Ch. 22+708 km (1V- 0.9 m X1.2 m)
Main Drainage Canal	Borachi khal
Land elevation of Catchment (m PWD)	Max: 3.15 Min: 1.46
Length of Stream within catchment (Km)	4.50
Drainage Density (m/ha)	15.78

Catchment Description

- **Outfall**
 - Outfall Khal: **Chatua River**
Condition: **Partially** silted up
- **Condition of Drainage Khal**
 - Main drainage Khal: **Partially** silted up
 - Branch khal: **Moderately** silted up (*about 1.0 km of Mondolbarir khal is proposed for re-excavation under Bluegold program during 2016-2017 fiscal year*)
- **Drainage Congestion**
 - Drainage congestion problem: **Moderate** (usually takes 3-4 days to properly drain out rain water)
 - Re-excavation of Borachi khal will reduce the drainage congestion problem
 - Permanent Water logging: **Not found.**
- **Agricultural condition**
 - Crop damage: **Moderate** (Lt Aman and HYV Aman Seed bed affected by drainage congestion)
 - Water Scarcity: **Not found.**
- **Structure Condition**
 - **Functional** (C/S & R/S loose apron and vertical lift and flap gates are damaged)
 - Block pitching and gate repairing (mechanical) work is in progress.



Figure: C/S of Borachi Sluice



Figure: R/S of Borachi Sluice

Description of Catchment 11

Catchment Name	Cat – 11 (Kalibari Catchment)
Location (mauza wise)	Kalibari (186 ha), Bazarghona (25 ha), Charkhali (13 ha), Paschim Chunakhali (13 ha) and Fakirkhali (11 ha)
Catchment area (ha)	249 ha
Drainage Outlet	Kalibari Sluice at Ch. 8+448 km (1V- 0.9 m X1.2 m)
Main Drainage Canal	Kalibari khal
Land elevation of Catchment (m PWD)	Max: 2.86 Min: 1.41
Length of Stream within catchment (Km)	10.267
Drainage Density (m/ha)	41.23
Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Chatua River Condition: Partially silted up ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Highly silted up • Branch khal: Moderately silted up ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Moderate (usually takes 4-5 days to properly drain out rain water) • Re-excavation of Kalibari khal will reduce the drainage congestion problem • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Moderate (Lt Aman and HYV Aman Seed bed affected by drainage congestion) • Water Scarcity: Not found. ➤ <i>Structure Condition</i> <ul style="list-style-type: none"> • Functional (C/S & R/S loose apron and vertical lift and flap gates are damaged) • Block pitching and gate repairing (mechanical) work is in progress. (Gates are corroded)



Figure: C/S of Kalibari Sluice



Figure: Outfall of Kalibari catchment

Description of Catchment 12

Catchment Name	Cat – 12 (Gojkhali Catchment)
Location (mauza wise)	Fakirkhali (557 ha), Kalagachhia (213 ha), Gulisakhali (118 ha), Gojkhali (111 ha), Kalibari (44 ha) and Charkhali (6 ha)
Catchment area (ha)	1049 ha
Drainage Outlet	Gojkhali Sluice at Ch. 26+921 km (3V- 1.5 m X1.8 m)
Main Drainage Canal	Ronachanda khal
Land elevation of Catchment (m PWD)	Max: 3.31 Min: 1.32
Length of Stream within catchment (Km)	35.873
Drainage Density (m/ha)	34.19
Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Chatua River Condition: Active ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Active • Branch khal: Partially silted up ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Minor (usually takes 2-3 days to properly drain out rain water) • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Minor • Water Scarcity: Not found. ➤ <i>Structure Condition</i> <ul style="list-style-type: none"> • Functional (C/S & R/S loose apron are damaged)



Figure: C/S of Gojkhali Sluice



Figure: Flap gate of Gojkhali Sluice

Description of Catchment 13

Catchment Name	Cat – 13 (Debpur Catchment)
Location (mauza wise)	Gojkhali (154 ha)
Catchment area (ha)	154 ha
Drainage Outlet	Gojkhali Sluice at Ch. 27+872 km (1V- 0.9 m X1.2 m)
Main Drainage Canal	Debpur khal
Land elevation of Catchment (m PWD)	Max: 2.69 Min: 1.42
Length of Stream within catchment (Km)	4.112
Drainage Density (m/ha)	26.70
Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Chatua River Condition: Active ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Moderately silted up (<i>about 2.0 km of Deppur khal is proposed for re-excavation under Bluegold program during 2016-2017 fiscal year</i>) • Branch khal: Partially silted up ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Minor (usually takes 2-3 days to properly drain out rain water) • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Minor • Water Scarcity: Not found. ➤ <i>Structure Condition</i> <ul style="list-style-type: none"> • Functional



Figure: R/S of Debpur Sluice



Figure: Debpur khal

Description of Catchment 14

Catchment Name	Cat – 14 (Bainbunia Catchment)
Location (mauza wise)	Gojkhali (120 ha)
Catchment area (ha)	120 ha
Drainage Outlet	Bainbunia Sluice at Ch. 28+689 km (1V- 0.9 m X1.2 m)
Main Drainage Canal	Bainbunia khal
Land elevation of Catchment (m PWD)	Max: 2.93 Min: 1.41
Length of Stream within catchment (Km)	3.77
Drainage Density (m/ha)	31.41
Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Chatua River Condition: Active ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Moderately silted up (<i>about 2.0 km of Bainbunia khal is proposed for re-excavation under Bluegold program during 2016-2017 fiscal year</i>) • Branch khal: Partially silted up ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Minor (usually takes 2-3 days to properly drain out rain water) • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Minor • Water Scarcity: Not found. ➤ <i>Structure Condition</i> <ul style="list-style-type: none"> • Functional

Description of Catchment 15

Catchment Name	Cat – 15 (Bazarkhali Catchment)
Location (mauza wise)	Gojkhali (95 ha) and Khekuani (52 ha)
Catchment area (ha)	147 ha
Drainage Outlet	Bazarkhali Sluice at Ch. 30+277 km (1V- 0.9 m X1.2 m)
Main Drainage Canal	Bazarkhali khal
Land elevation of Catchment (m PWD)	Max: 2.98 Min: 1.24
Length of Stream within catchment (Km)	4.728
Drainage Density (m/ha)	32.16
Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Chatua River Condition: Active ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Partially silted up • Branch khal: Partially silted up ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Minor (usually takes 2-3 days to properly drain out rain water) • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Minor • Water Scarcity: Not found. ➤ <i>Structure Condition</i> <ul style="list-style-type: none"> • Functional (C/S & R/S loose apron and vertical lift and flap gates are damaged) • Block pitching and gate repairing (mechanical) work is in progress. (Gates are corroded)



Figure: R/S of Bazarkhali Sluice



Figure: Outfall of Bazarkhali catchment

Description of Catchment 16

Catchment Name	Cat – 16 (Khekuani Catchment)
Location (mauza wise)	Khekuani (333 ha)
Catchment area (ha)	333 ha
Drainage Outlet	Khekuani Sluice at Ch. 32+778 km (1V- 1.5 m X1.8 m)
Main Drainage Canal	Khekuani khal
Land elevation of Catchment (m PWD)	Max: 3.25 Min: 1.24
Length of Stream within catchment (Km)	7.135
Drainage Density (m/ha)	21.42
Catchment Description	<ul style="list-style-type: none"> ➤ <i>Outfall</i> <ul style="list-style-type: none"> • Outfall Khal: Chatua River Condition: Active ➤ <i>Condition of Drainage Khal</i> <ul style="list-style-type: none"> • Main drainage Khal: Moderately silted up (<i>about 3.0 km of khekuani khal is proposed for re-excavation under Bluegold program during 2016-2017 fiscal year</i>) • Branch khal: Moderately silted up ➤ <i>Drainage Congestion</i> <ul style="list-style-type: none"> • Drainage congestion problem: Moderate (usually takes 3-4 days to properly drain out rain water) • Re-excavation of Khekuani khal will reduce the drainage congestion problem • Permanent Water logging: Not found. ➤ <i>Agricultural condition</i> <ul style="list-style-type: none"> • Crop damage: Moderate (Lt Aman and HYV Aman Seed bed affected by drainage congestion. • Water Scarcity: Not found. ➤ <i>Structure Condition</i> <ul style="list-style-type: none"> • Damaged <ul style="list-style-type: none"> ▪ Main structure partially settled down ▪ Gates are corroded and rubber seals are damaged which caused leakage ▪ Hoisting arrangement of both R/S and C/S gates are damaged ▪ Operation deke slab and railing are broken • Major repairing/construction of new Sluice with adequate vent size is required



Figure: Khekuani Sluice



Figure: Outfall of Khekuani catchment

2.12 Tidal dynamics assessment

CEGIS team installed three (03) water level gauge stations (**Mohishkata, Titkata and Kanta**) outside the polder 43/2F (shown in Figure 2.17) to understand the tidal water level variations. Daily water level data at one (01) hour interval (from 6:00 AM to 6:00 PM) for 1 tide cycle (15 days) from 20st August 2016 to 03rd September 2016 has been collected presented in Table 2.9. All water level data was collected in mPWD datum.

Daily water level data were collected on an hourly basis. Water level hydrographs were plotted as water level versus time. The water level hydrograph at Mohishkata, Titkata and Kanta stations are shown in Figure 2.30 to 2.32 respectively.

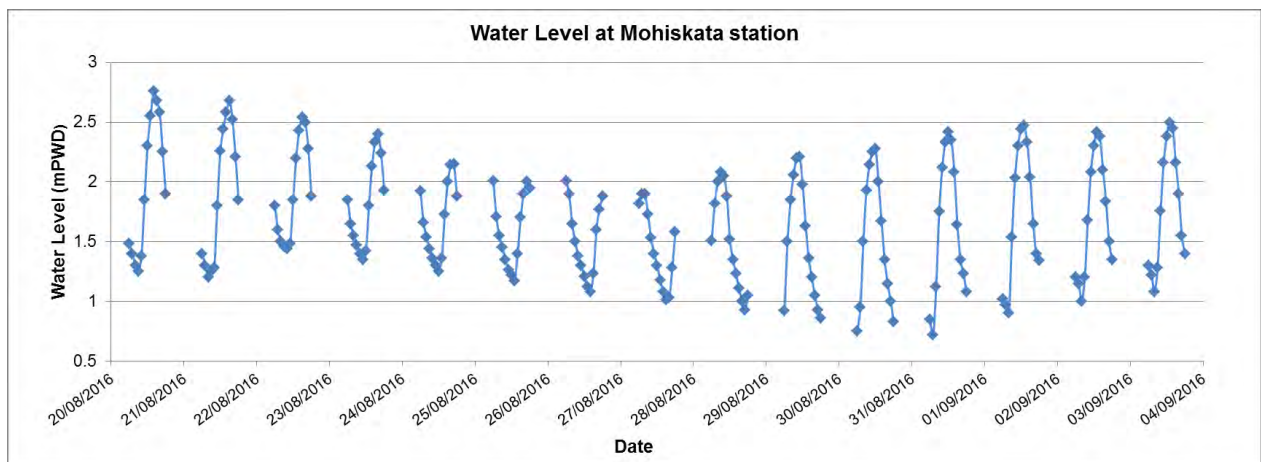


Figure 2.14: Water level analysis at Mohishkata station

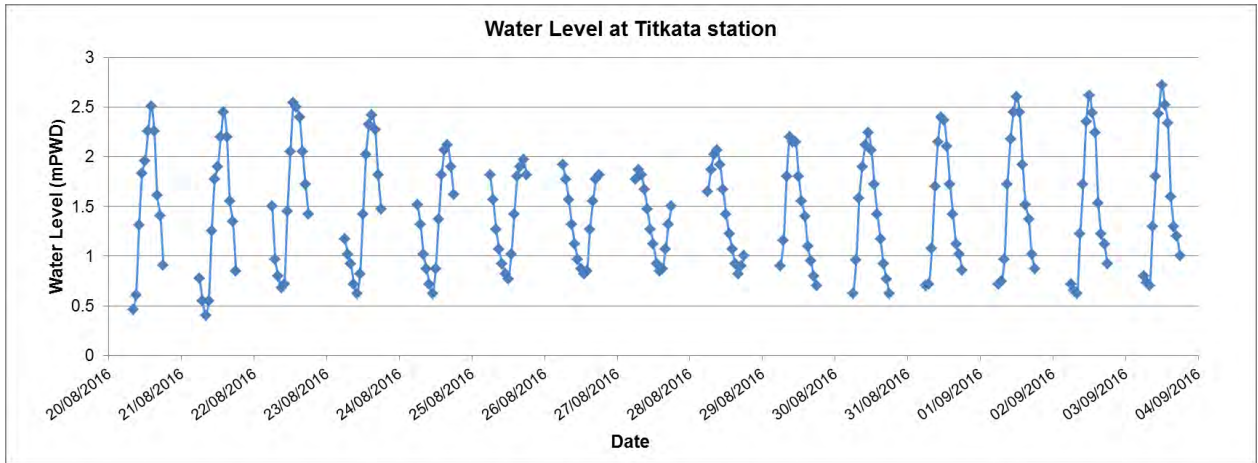


Figure 2.15: Water level analysis at Titkata station

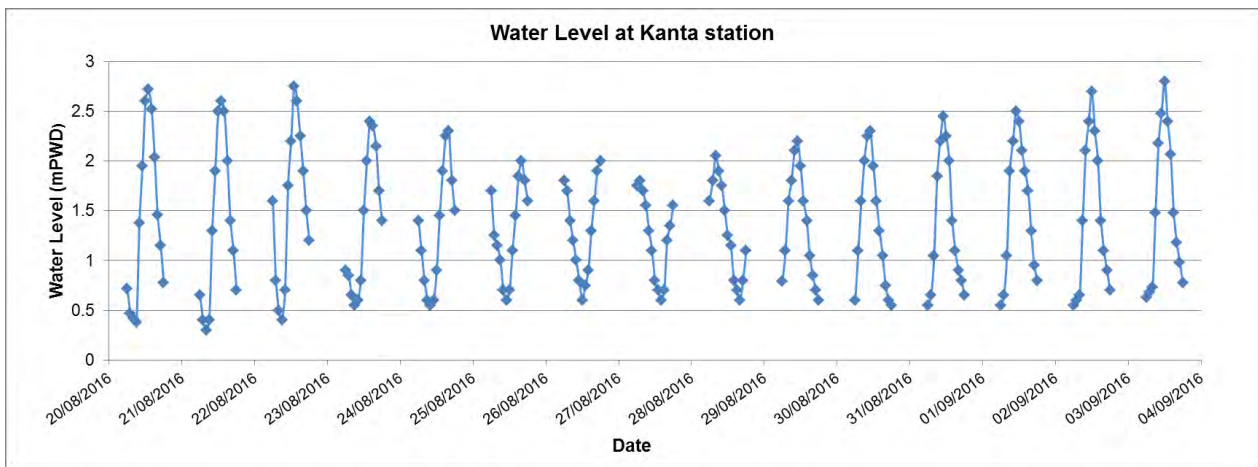
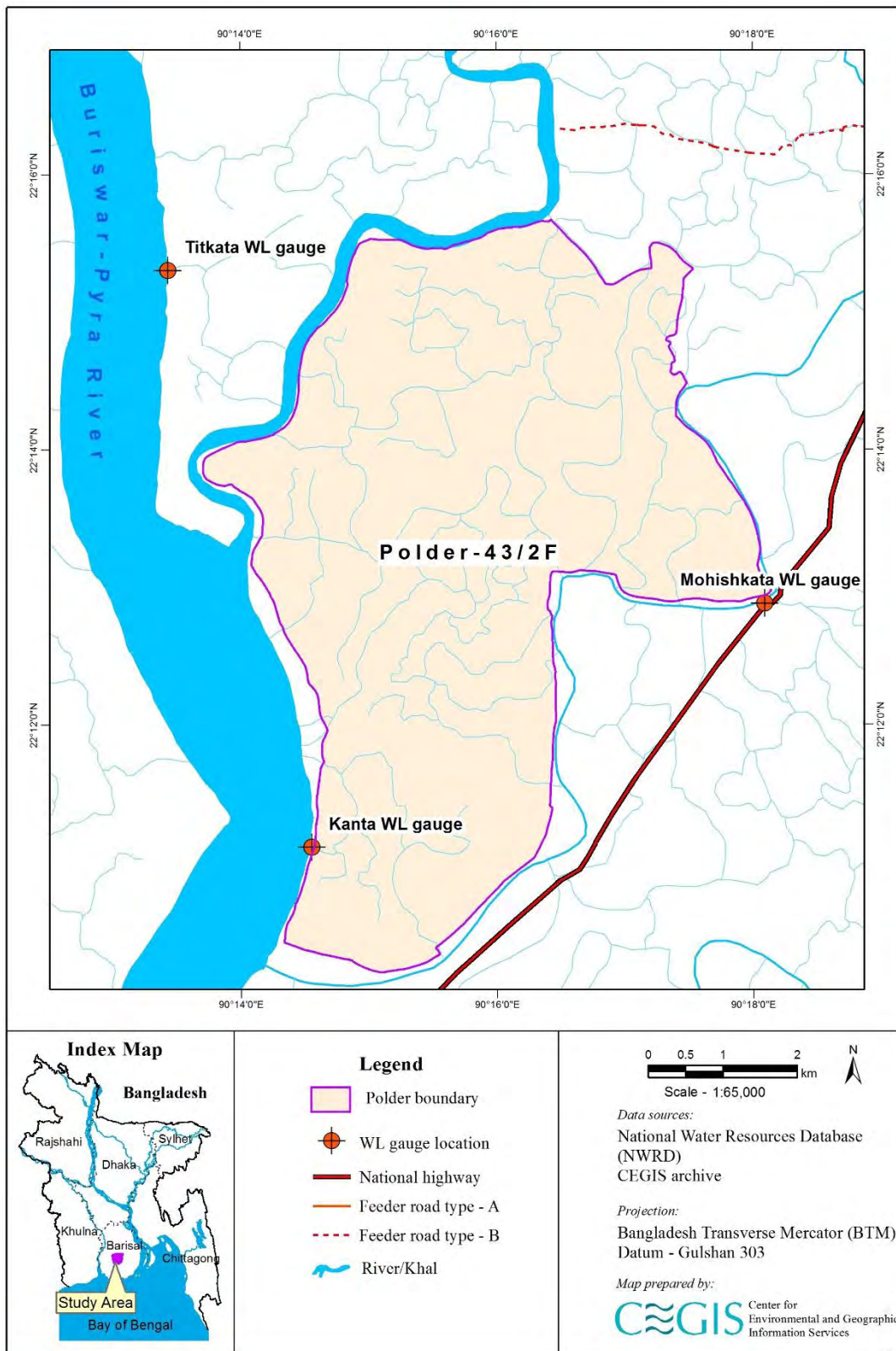


Figure 2.16: Water level analysis at Kanta station



June 2016

Figure 2.17: CEGIS installed gauge location map

Table 2.5: Water level gauge data from 20/08/2016 to 03/09/2016

Date	Time	Titkata	Kanta	Moishkata
20/08/2016	6:00	0.88	0.72	1.48
	7:00	0.61	0.47	1.40
	8:00	0.46(LTL)	0.42	1.30
	9:00	0.61	0.38 (LTL)	1.25(LTL)
	10:00	1.31	1.38	1.38
	11:00	1.83	1.95	1.85
	12:00	1.96	2.60	2.30
	13:00	2.26	2.72 (HTL)	2.55
	14:00	2.51 (HTL)	2.52	2.76 (HTL)
	15:00	2.26	2.04	2.68
	16:00	1.61	1.46	2.58
	17:00	1.41	1.15	2.25
	18:00	0.91	0.78	1.90

Date	Time	Titkata	Kanta	Moishkata
21/08/2016	6:00	0.78	0.65	1.40
	7:00	0.55	0.40	1.30
	8:00	0.4 (LTL)	0.3 (LTL)	1.2 (LTL)
	9:00	0.55	0.40	1.25
	10:00	1.25	1.30	1.28
	11:00	1.77	1.90	1.80
	12:00	1.90	2.50	2.26
	13:00	2.20	2.6 (HTL)	2.44
	14:00	2.45 (HTL)	2.50	2.58
	15:00	2.20	2.00	2.68 (HTL)
	16:00	1.55	1.40	2.52
	17:00	1.35	1.10	2.21
	18:00	0.85	0.70	1.85

Date	Time	Titkata	Kanta	Moishkata
22/08/2016	6:00	1.50	1.60	1.80
	7:00	0.97	0.80	1.60
	8:00	0.80	0.50	1.50
	9:00	0.68 (LTL)	0.4 (LTL)	1.46
	10:00	0.72	0.70	1.44 (LTL)
	11:00	1.45	1.75	1.48
	12:00	2.05	2.20	1.85
	13:00	2.54 (HTL)	2.75 (HTL)	2.20
	14:00	2.50	2.60	2.43
	15:00	2.40	2.25	2.54 (HTL)
	16:00	2.05	1.90	2.50
	17:00	1.72	1.50	2.28
	18:00	1.42	1.20	1.88

Date	Time	Titkata	Kanta	Moishkata
23/08/2016	6:00	1.17	0.90	1.85
	7:00	1.02	0.85	1.65
	8:00	0.92	0.65	1.55
	9:00	0.72	0.55	1.47
	10:00	0.62 (LTL)	0.6 (LTL)	1.40
	11:00	0.82	0.80	1.35 (LTL)
	12:00	1.42	1.50	1.42
	13:00	2.02	2.00	1.80
	14:00	2.32	2.4 (HTL)	2.13
	15:00	2.42 (HTL)	2.35	2.33
	16:00	2.27	2.15	2.4 (HTL)
	17:00	1.82	1.70	2.24
18:00	1.47	1.40	1.93	

Date	Time	Titkata	Kanta	Moishkata
24/08/2016	6:00	1.52	1.40	1.92
	7:00	1.32	1.10	1.66
	8:00	1.02	0.80	1.54
	9:00	0.87	0.60	1.44
	10:00	0.72	0.55 (LTL)	1.36
	11:00	0.62 (LTL)	0.60	1.30
	12:00	0.87	0.90	1.25 (LTL)
	13:00	1.37	1.45	1.36
	14:00	1.82	1.90	1.73
	15:00	2.07	2.25	2.00
	16:00	2.12 (HTL)	2.3 (HTL)	2.14
	17:00	1.90	1.80	2.15 (HTL)
18:00	1.62	1.50	1.88	

Date	Time	Titkata	Kanta	Moishkata
25/08/2016	6:00	1.82	1.70	2.01
	7:00	1.57	1.25	1.71
	8:00	1.27	1.15	1.55
	9:00	1.07	1.00	1.45
	10:00	0.92	0.70	1.35
	11:00	0.82	0.6 (LTL)	1.26
	12:00	0.77 (LTL)	0.70	1.22
	13:00	1.02	1.10	1.17 (LTL)
	14:00	1.42	1.45	1.40
	15:00	1.80	1.85	1.70
	16:00	1.90	2 (HTL)	1.90
	17:00	1.97 (HTL)	1.80	2 (HTL)
18:00	1.82	1.60	1.95	

Date	Time	Titkata	Kanta	Moishkata
26/08/2016	6:00	1.92 (HTL)	1.8 (HTL)	2.01 (HTL)
	7:00	1.77	1.70	1.90
	8:00	1.57	1.40	1.65
	9:00	1.32	1.20	1.50
	10:00	1.12	1.00	1.38
	11:00	0.97	0.80	1.30
	12:00	0.87	0.6 (LTL)	1.21
	13:00	0.82 (LTL)	0.75	1.12
	14:00	0.85	0.90	1.08 (LTL)
	15:00	1.27	1.30	1.23
	16:00	1.55	1.60	1.60
	17:00	1.77	1.90	1.77
	18:00	1.82	2.00	1.88

Date	Time	Titkata	Kanta	Moishkata
27/08/2016	6:00	1.77	1.75	1.82
	7:00	1.87 (HTL)	1.8 (HTL)	1.9 (HTL)
	8:00	1.82	1.70	1.90
	9:00	1.67	1.55	1.73
	10:00	1.47	1.30	1.53
	11:00	1.27	1.10	1.40
	12:00	1.12	0.80	1.30
	13:00	0.92	0.70	1.18
	14:00	0.85 (LTL)	0.6 (LTL)	1.08
	15:00	0.87	0.70	1.01 (LTL)
	16:00	1.07	1.20	1.03
	17:00	1.32	1.35	1.28
	18:00	1.50	1.55	1.58

Date	Time	Titkata	Kanta	Moishkata
28/08/2016	6:00	1.65	1.60	1.51
	7:00	1.87	1.80	1.82
	8:00	2.02	2.05 (HTL)	2.00
	9:00	2.07 (HTL)	1.90	2.08 (HTL)
	10:00	1.92	1.75	2.05
	11:00	1.67	1.50	1.88
	12:00	1.42	1.25	1.52
	13:00	1.22	1.15	1.35
	14:00	1.07	0.80	1.23
	15:00	0.92	0.70	1.11
	16:00	0.82 (LTL)	0.6 (LTL)	1.00
	17:00	0.90	0.80	0.93 (LTL)
	18:00	1.00	1.10	1.05

Date	Time	Titkata	Kanta	Moishkata
29/08/2016	6:00	0.90	0.79	0.92
	7:00	1.16	1.10	1.50
	8:00	1.80	1.60	1.85
	9:00	2.2 (HTL)	1.80	2.06
	10:00	2.15	2.10	2.20
	11:00	2.15	2.2 (HTL)	2.21 (HTL)
	12:00	1.80	1.95	1.98
	13:00	1.55	1.60	1.63
	14:00	1.40	1.40	1.36
	15:00	1.10	1.05	1.20
	16:00	0.95	0.85	1.05
	17:00	0.80	0.70	0.93
	18:00	0.70	0.60	0.86

Date	Time	Titkata	Kanta	Moishkata
30/08/2016	6:00	0.62 (LTL)	0.6 (LTL)	0.75 (LTL)
	7:00	0.96	1.10	0.95
	8:00	1.58	1.60	1.50
	9:00	1.90	2.00	1.93
	10:00	2.12	2.25	2.14
	11:00	2.24 (HTL)	2.3 (HTL)	2.25
	12:00	2.07	1.95	2.28 (HTL)
	13:00	1.72	1.60	2.00
	14:00	1.42	1.30	1.67
	15:00	1.17	1.05	1.35
	16:00	0.92	0.75	1.15
	17:00	0.77	0.60	1.00
	18:00	0.62	0.55	0.83

Date	Time	Titkata	Kanta	Moishkata
31/08/2016	6:00	0.7 (LTL)	0.55 (LTL)	0.85
	7:00	0.72	0.65	0.72 (LTL)
	8:00	1.08	1.05	1.12
	9:00	1.70	1.85	1.75
	10:00	2.15	2.20	2.12
	11:00	2.4 (HTL)	2.45 (HTL)	2.33
	12:00	2.37	2.25	2.42 (HTL)
	13:00	2.10	2.00	2.35
	14:00	1.72	1.40	2.08
	15:00	1.42	1.10	1.64
	16:00	1.12	0.90	1.35
	17:00	1.02	0.80	1.23
	18:00	0.86	0.65	1.08

Date	Time	Titkata	Kanta	Moishkata
01/09/2016	6:00	0.72 (LTL)	0.55 (LTL)	1.02
	7:00	0.75	0.65	0.97
	8:00	0.97	1.05	0.9 (LTL)
	9:00	1.72	1.90	1.54
	10:00	2.18	2.20	2.03
	11:00	2.45	2.5 (HTL)	2.30
	12:00	2.6 (HTL)	2.40	2.44
	13:00	2.45	2.10	2.47 (HTL)
	14:00	1.92	1.90	2.33
	15:00	1.52	1.70	2.04
	16:00	1.37	1.30	1.65
	17:00	1.02	0.95	1.40
	18:00	0.87	0.80	1.34

Date	Time	Titkata	Kanta	Moishkata
02/09/2016	6:00	0.72	0.55 (LTL)	1.20
	7:00	0.65	0.60	1.15
	8:00	0.62 (LTL)	0.65	1 (LTL)
	9:00	1.22	1.40	1.20
	10:00	1.72	2.10	1.68
	11:00	2.35	2.40	2.08
	12:00	2.62 (HTL)	2.7 (HTL)	2.30
	13:00	2.44	2.30	2.42 (HTL)
	14:00	2.24	2.00	2.38
	15:00	1.53	1.40	2.10
	16:00	1.22	1.10	1.84
	17:00	1.12	0.90	1.50
	18:00	0.92	0.70	1.35

Date	Time	Titkata	Kanta	Moishkata
03/09/2016	6:00	0.80	0.63	1.30
	7:00	0.73	0.68 (LTL)	1.22
	8:00	0.7 (LTL)	0.73	1.08 (LTL)
	9:00	1.30	1.48	1.28
	10:00	1.80	2.18	1.76
	11:00	2.43	2.48	2.16
	12:00	2.72 (HTL)	2.8 (HTL)	2.38
	13:00	2.52	2.40	2.5 (HTL)
	14:00	2.34	2.07	2.45
	15:00	1.60	1.48	2.16
	16:00	1.30	1.18	1.90
	17:00	1.20	0.98	1.55
	18:00	1.00	0.78	1.40

