

V. INTERNATIONAL RIVERS

Flood Forecasting and Control

- 26.1 For effective flood forecasting and control, Bangladesh needs to strengthen the cooperative arrangement with India. Two areas require particular attention:
- i) FFWC and IWM are advised to incorporate all the data / information obtained from India into the modeling system of FFWC and undertake simulations to determine the usefulness and limitation of the existing data and to identify the exact contribution of the additional data from India and Nepal. Such exercises are expected to promote the JRC (Joint Rivers Commission) talks.
 - ii) Operation rules and records of barrages on key rivers in India should be made available and a transboundary water release warning system must be established as essential measures to mitigate artificial flood damage. MoWR is advised to (re)include this issue in the JRC agenda.
- 26.2 To promote an environment for the necessary dialogue and exchanges at the government level, “second track” activities can be supported with a particular focus on technical aspects of flood management.

Comprehensive Management Frameworks for the GBM Rivers

27. In addition to flood management, other issues such as water shortage (draught), water quality, sedimentation, bank erosion, ecology and environment require urgent, coordinated attention throughout the river basins. Discussions between Bangladesh and India have so far been mainly focusing on water-sharing and augmentation on the Ganges and water-sharing on other seven medium rivers. In the absence of any breakthrough in the talks on the augmentation of the Ganges, the attention in Bangladesh is on the proposed Ganges barrage and similar schemes on other rivers. The proposed projects, however, require detailed feasibility studies. Simultaneously, efforts aiming at long-term, rational solutions need to be pursued, which can be facilitated by a skilled and neutral intervention of a third party at the government level and “second track” activities in unofficial arenas. The first necessary step is to conduct an objective study to determine water balance in the GBM (Ganges-Brahmaputra-Meghna) basins, toward the ultimate goal of agreeing on comprehensive management frameworks for the GBM rivers.

Part-III FEASIBILITY STUDY

VI. BASIC APPROACH TO THE FEASIBILITY STUDY

Basic Approach

28. The Framework Plan of FFWS proposed by the Study Team is Alternative 2-3, namely, “Regional Control System with Combined System of Manual and Telemeter System”, and this was finalized through the discussion with GOB taking the possibility of re-organization or organizational improvement into account. The F/S on the selected project scheme was conducted through following steps:
- i) Feasibility Design of FFWS Facilities
 - ii) Feasibility Design of Evacuation System
 - iii) Formulation of Institutional Strengthening Plan
 - iv) Project Evaluation
 - v) Selection of Priority Project and Formulation of its Implementation Plan

VII. FEASIBILITY DESIGN

Optimum Scheme Subject to Feasibility Study

29. The proposed optimum scheme is summarized below, and region division together with location of hydrometeorological observatories is illustrated in **Figure 2**. Data communication network and data transmission flow are shown in **Figures 3 and 4**, respectively.

Control System:

- a) Central Control System
 - Dhaka
- b) Regional Control System
 - NE Region (Control station: Sylhet)
 - NW Region (Control station: Rangpur)
 - SE Region (Control station: Chittagong)
 - SW Region (Control station: Barisal)
 - NC Region (Control station: Dhaka)

Manual-Telemeter Combined Observation System:

Number of Hydrometeorological Gauges by Region

Region	NE	NW	SE	SW	NC	Total
Control Station	Sylhet	Rangpur	Chittagong	Barisal	Dhaka	
Water Level	18	22	9	17	25	91
Manual	11	17	7	12	21	68
Telemeter	7	5	2	5	4	23
Rainfall	14	15	11	15	13	68
Manual	7	10	9	10	9	45
Telemeter	7	5	2	5	4	23
Total	32	37	20	32	38	159

Observation System

- 30.1 The exact locations of the proposed 23 telemetric gauging stations were decided through the field reconnaissance conducted by the Study Team and counterpart personnel.
- 30.2 For the automatic rainfall gauge, tipping bucket type is selected. In terms of water level gauge, sensing pole type and supersonic sensor (sonar) type are adopted considering suitable for the sustainable operation.

Data Transmission System

- 31.1 The designed data transmission network diagram is presented in **Figure 5**. VHF Link and HF Link are selected for telemeter system considering sustainable operation and maintenance.

31.2 Data Transmission System for Observation System

[Manual Observation System]

- Digital transmission system: Mobile communication system and Digital HF communication system
- Automatic recording system in computer in control station

[Telemeter System]

- From gauging stations to regional stations
→ BWDB VHF Link
- From regional stations to central control station
→ BWDB HF Link

31.3 Data Transmission System for Warning Dissemination System

[Warning Message Dissemination]

- From regional control station to O&M office, DC office, Upazilla office:
→ E-mail, Fax, Telephone with T&T public line

[Point to Point Direct Data Dissemination]

- From Telemeter Gauging Station to O&M office, Upazilla office
→ VHF Link

Analysis System

32.1 Flood analysis and forecasting of nationwide scale is based on the MIKE11 hydraulic model (Supermodel) operated centrally in Dhaka.

32.2 Based on the proposed telemetry network to be installed, it is recommended that flood models (again based on MIKE11) be installed in the proposed five regional control stations. Regional models previously developed for FFWC is applied.

32.3 The existing Supermodel will continue to be operated in Dhaka on a daily basis using data from the existing hydrometric network of FFWC and proposed telemetry network.

32.4 If telemetry data indicates the possibility of floods occurring locally, the regional models (using output from the Supermodel in conjunction with data from the telemetry network) can be applied to update flood forecasts more frequently through the day.

32.5 The telemetry data should be disseminated directly to those border areas of flash flood regions where lead times are insufficient for flood forecasting.

Warning Dissemination System

33.1 It is strongly requested to UNDP and DMB to take up part of the warning dissemination in their Comprehensive Disaster Management Plan (CDMP) to be launched soon.

33.2 It is proposed to provide real-time water level and rainfall data to Upazilla

administration located within the flash flood area by means of a special terminal.

- 33.3 Required components related to flood warning dissemination for inhabitants are,
- Being in place of e-mail, internet, or auto-dial fax in proposed Flood Hydrology Circle (FHC) for speedy warning dissemination,
 - Preparation of area specific flood hazard maps,
 - Installation of water level gauges in village level for tying up with disseminated water level,
 - Review of danger level,
 - Preparation of new topographic maps,
 - Lengthening of the lead time,
 - Interpretation of disseminated warning message by local BWDB staff,
 - Improvement of the method of warning dissemination between District and Upazilla DMCs, and between Upazilla and Union DMCs,
 - Involvement of NGOs into the Union DMC,
 - Responsibility of Union DMC on the dissemination to end users,
 - Monitoring of dissemination process by BWDB staff,
 - Introduction of 'feedback system',
 - Introduction of Flood Preparedness Program (FPP) with training program of volunteers, and
 - Installation and periodic maintenance of the terminals by BWDB.
- 33.4 Required components related to flood warning dissemination for river structures are,
- Being in place of e-mail, internet, or auto-dial fax in proposed Flood Hydrology Circle (FHC) for speedy warning dissemination,
 - Direct warning dissemination from FHC to field operation offices of major water-related facilities,
 - Preparation of specific warning messages for major structures by FHC,
 - Warning dissemination by BWDB O&M zonal offices to all divisional offices and major structures,
 - Warning dissemination by BWDB O&M divisional offices to field operation offices, and
 - Warning dissemination by relevant agencies to their field operation offices.

Response System

- 34.1 The proposed project for response system is divided into 2 parts, i.e. 1) for evacuation system for inhabitants to be executed by local government institutions and 2) for response system for river structures to be executed by BWDB.
- 34.2 Required components related to response system for inhabitants are,
- Preparation of evacuation manual by DMB,
 - Campaign for awareness building organized by DMB with involvement of

NGOs,

- Flood drills provided by FHC,
- Fixation of flood shelter both for inhabitants and livestock by Upazilla DMC,
- Preparation of new flood shelters by DMB,
- Monitoring of evacuation process by Upazilla DMC,
- Preparation of list of required facilities for flood shelters by Upazilla DMC,
- Laying actual responsibility on Union DMC,
- Training of volunteers under proposed Flood Preparedness Program (FPP),
- Earmarking of transportation for evacuation by Union DMC,
- Arrangement of security of evacuated houses by Upazilla DMC,
- Preparation of response management guideline for agriculture and fisheries by DMB,
- Issuing of response measures for agricultures and fisheries by District DMC, and
- Monitoring of the response activities by Union DMC.

34.3 Required components related to response system for river structures are,

- Preparation of response management guidelines by all concerned agencies,
- Issuing of response directives by O&M offices of each agency,
- Undertaking of proper response measures by field operation offices, and
- Monitoring of the action taken by field offices by O&M office of each agency.

Overall Components

35. Overall components of the proposed project are summarized in **Figure 6**. Block diagrams of 1) central office, 2) regional office, 3) repeater station, 4) telemeter station, 5) manual gauging station, and 6) point-to-point direct dissemination are presented in **Figures 7 to 12**, respectively.

VIII. INSTITUTIONAL ARRANGEMENT

General

- 36.1 The option of setting up the regional office of BWDB is the best. However, it appeared from the discussion with Bangladesh side that it would be rather difficult to implement this without detail in depth study. The Study Team therefore proposes the regional system of Hydrology.
- 36.2 Comparative merit of the centralized and decentralized administration of Hydrology service in respect to FFWS is analyzed and the result revealed that the relative advantages of the regional system over the central system. The concept of regional office is proposed also in line with the understanding of BWDB, World Bank and other development partners.

Organizational Setup

37. Proposed organization of both central and regional Hydrology is presented in **Figure 13**.

Regulation on New Setup

38. MOWR should act promptly to start the institutional reform study and recommendations coming out from that study should also be implemented urgently. The mandate of such new re-organization should also be clearly stated.

Manpower Requirement

- 39.1 Manpower Requirement for Improved FFWS: One Superintending Engineer (SE) will head the central Flood Hydrology Circle (FHC). There will be three Executive Engineers (XEN) for three divisions at central office. Each regional FHC will be headed by one XEN. In this setup, there are 45 manager level staff, 51 technical staff, 47 support staff, and 90 gauge readers.

It should also be noted that the job of manual gauge readers of FHC requires special skills. After taking the gauge reading, they should conduct the operation of special data input device for real-time data transmission.

- 39.2 Manpower Requirement for Improved Hydrology: Manpower requirement for improved Hydrology is also assessed roughly, although details should be clarified by proposed institutional reform study. Central Hydrology will be headed by Chief Engineer. There will be four SEs for four circles, i.e. Flood Hydrology Circle, Groundwater Hydrology Circle, Surface Water Hydrology Circle, and River Morphology & Research Circle. One SE will head the regional Hydrology. There will be four XENs for four divisions including regional FHC.

IX. COST ESTIMATE

Investment Cost

40. Estimated total investment cost is about 1,148 million Taka as shown in the table below:

Investment Cost

(Unit: Million Taka)

Item	Currency Portion		Total
	Foreign	Local	
A Direct Installation Cost			
A-1 Equipment	494.6	0.0	494.6
A-2 Civil works	0.0	144.0	144.0
A-3 Installation	93.8	0.6	94.4
A-4 Maintenance tools	25.0	0.0	25.0
A-5 Spare parts	98.9	0.0	98.9
A-6 Ocean and inland transportation	44.6	4.9	49.5
A-7 Office Equipment	0.0	18.4	18.4
Sub Total	756.9	167.9	924.8
B Administration Cost	0.0	9.2	9.2
C Engineering	129.5	9.2	138.7
D Training	5.3	0.6	5.9
E Contingency	46.7	4.4	51.1
F Price Escalation	3.8	14.7	18.5
Total	942.2	206.0	1,148.2

Annual Operation and Maintenance Cost

41. Estimated annual operation and maintenance cost is tabulated below. The O&M cost will become higher in order to make proper O&M activities both for existing and improved FFWS. In terms of staff cost, it will decrease by about 1.4 million Taka due to reduction of the number of staff.

Annual O&M Cost

(Unit: Million Taka/year)

Items	Actual O&M cost (for existing FFWS)	Required O&M cost (for existing FFWS)	Project O&M Cost (for proposed FFWS)
Staff	24.4	24.4	23.0
Repair, Maintenance	1.7	10.5	27.1
Other O&Ms	8.0	9.4	15.5
Subtotal	34.1	44.3	65.6
Depreciation	0.0	26.3	136.8
Total	34.1	70.6	202.4

X. PROJECT EVALUATION

Economic Evaluation

42. The economic evaluation was conducted with regard to the indicators of EIRR, NPV, and B/C by comparing with cash flow of the economic benefits and cost during the project life. The discount rate of 12% was applied for the calculation of NPV and B/C. The benefits of the improved FFWS were calculated based mainly on the result of interview survey conducted on the course of the Study. The result of economic evaluation is shown in the table below:

Result of Economic Evaluation

EIRR (%)	26.4
NPV (million Taka)	708
B/C	1.1

Based on the result of economic evaluation and the result of sensitivity analysis for EIRR, it is concluded that this project has satisfactory viability, stability and credibility.

Social Impact Evaluation

43. This project would bring mostly positive impact and no negative impact from the viewpoint of social impact. There are however many kinds of necessary supporting conditions so that the flood warning could activate its effects at maximum. There supporting conditions are, 1) dissemination organization, 2) response system including warning/evacuation awareness campaign, 3) security of the community, 4) supply of foodstuffs, 5) transport means and routs, 6) financial support, 7) rescue and relief activities, and so on.

Environmental Impact Evaluation

44. According to the brief study conducted as a part of the Study, it is concluded that this project would bring mostly positive effect to the environment and no peculiar or negative impact are found out from this project.

XI. IMPLEMENTATION PROGRAM

General

45. Proposed project, covering entire Bangladesh, should be implemented as soon as possible. But the application of a pilot project, the idea of which was raised by Bangladesh side, is proposed. The pilot project is selected taking necessary funding, available manpower into account. However, FFWS may not become effective only by the installation of proposed equipment or facilities. Some priority studies should be done in parallel with pilot project.

Selection of Pilot Project

- 46.1 Northeastern (NE) regional operation system (Sylhet) is selected as the area subject to pilot project because the area is affected by flood damage relatively more frequent than other areas. The proposed nationwide observation system and associated data transmission system will also be installed in the pilot project.
- 46.2 Data transmission network and flow for the pilot project are shown in **Figures 14 and 15**. Main features of the pilot project are given below:

[Observation System]: All regions will be subject to improvement.

Manual Observation System

- No change (staff gauge)

Telemeter System

- Sensing pole or supersonic sensor (sonar) type for water level gauge, tipping bucket type for rainfall gauge

[Data Transmission System]

From Manual Observatories

- Digital data transmission system (mobile or digital HF)
- Automatic recording system (Sylhet and Dhaka)

From Telemetric Observatories: All regions will be subject to improvement.

- BWDB VHF link between gauging station and regional stations
- BWDB HF link between regional station and central control station

[Analysis System]

Sylhet Regional Control System

- Forecasting analysis using Sylhet (NE) regional model

Central Control System

- Forecasting analysis using Supermodel

[Warning Dissemination System]

Warning Dissemination for NE Region

- E-mail, fax, telephone (from regional control station to O&M office, DC office, and Upazilla office)

Point-to-point Direct Data Dissemination

- VHF link (from telemeter gauging station to O&M office and Upazilla office)

Warning Dissemination in Local Level

- Fax, telephone, speaker or visit (from Upazilla / Union to inhabitants)

Priority Study in the Project Component

47. Other than the implementation of the pilot project, the implementation of the priority studies listed below is necessary.
- a. Formulation of O&M plan of improved FFWS
 - b. Clarification of river management
 - c. Strengthening of dissemination and evacuation (response) system
 - d. Institutional study
 - Regional organization plan for pilot project
 - Monitoring of pilot project
 - Institutional study for regionalization
 - e. Collection of the information on river management and review of danger level
 - Collection of the information on river structures
 - Preparation of operation manual
 - Preparation of digital elevation model (DEM)
 - Preparation of flood hazard map
 - Review / identification of danger level
 - Survey the river cross-sections

Financial Arrangement (Cost for the Pilot Project)

48. Investment cost and annual operation and maintenance (O&M) cost of the pilot project are estimated as follows:

Investment Cost (Unit: Million Taka)

Item	Foreign	Local	Total
A Direct Cost for Installation	523.7	130.9	654.6
B Administration	0.0	6.5	6.5
C Engineering	91.6	6.5	98.2
D Training	3.6	0.4	4.0
E Contingency	33.2	3.1	36.3
F Price Escalation	2.6	11.5	14.1
Total	654.7	158.9	813.7

Annual O&M Cost (Unit: Million Taka)

Items	Cost
A. Staff	20.6
B. Repair, maintenance	17.3
C. Other O&M	13.3
Subtotal	51.2
D. Depreciation	90.8
Total	142.0

Implementation Schedule

49. The overall implementation schedule is given in **Table 3**, and summarized below:

[Pilot Project]

- a. Financial Arrangement: 2004
- b. Design and Preparation of Tender Document: 2005
- c. Tendering, Implementation and Supervising of Pilot Project: 2006
- d. Guidance Period: 2007 ~ 2008

[Priority Study]

- a. Formulation of O&M Plan: 2003
- b. Clarification of River Management: 2003 ~ 2004
- c. Strengthening of dissemination and response system: 2004 ~ the middle of 2005
- d. Institutional Study: 2005 ~ 2008
- e. Collection of the information on river management and review of danger level: 2004 ~ 2006

Implementing Agencies

50.1 The implementing agency of the pilot project is Planning (ADG) of BWDB. For the implementation of the priority studies, the coordination with other sectors and some donors are necessary. The implementing agencies of the priority studies are assumed as follows:

Implementing Agencies by the Component of the Priority Studies

Priority Study	Implementing Agency	
	Bangladesh side	Foreign side
a. Formulation of O&M Plan	BWDB	
b. Clarification of River Management	MOWR	
c. Strengthening of Dissemination and Response System	MOWR and MDMR	UNDP
d. Institutional Study	BWDB	Foreign Assistance
e. Collection of the Information on river management and review of danger level		
- Collection of the information on river structures - Preparation of operation manual - review / identification of danger level	BWDB	Foreign Assistance
- Preparation of digital elevation model (DEM) - Preparation of flood hazard map - Survey the river cross-sections	BWDB, Survey of Bangladesh, and LGED BWDB	

50.2 For the implementation of the pilot project, BWDB Planning should make sufficient coordination with O&M. For better coordination, "Task Force System" is

proposed. Planning and O&M will work together under the task force formed by the staff of both Planning and O&M.

XII. CONCLUSION AND RECOMMENDATIONS

Conclusion and Recommendations

- 51.1 The project would be highly evaluated as economically viable, socially and environmentally sound and technically feasible. It is however noticeable that the project involves rather sophisticated system and therefore sound operation and maintenance works should be conducted in due attention on the well managed annual operation and maintenance works.
- 51.2 It is strongly suggested that BWDB consider the following for at-most effective utilization of the system once implemented.
- a. To secure the necessary O&M budget for operation and maintenance works
 - b. To set up an appropriate organizations with well-experienced and capable manager and staff for overall supervising the system operation
 - c. To work out necessary prearrangement on the following for pre-requisite for comprehensive river management.
 - Water code or river code be promulgated
 - Ledger sheets of river structures be ready for O&M of their structures including FFWS itself
- 51.3 As a conclusion, it is recommended that this proposed project be implemented in the earliest possible time on the conditions that appropriate O&M works can be secured.
- 51.4 Pilot project is proposed to be established in terms of regional operation system as itemized below:
- a. Project implementation is to be conducted on pilot project basis.
 - b. 1st pilot project is for Sylhet area where the most serious flood damage is anticipated as flash flood areas.
 - c. The other areas for regional operation system will be implemented after due experience in the pilot project.
 - d. 1st pilot project will include the FFWS covering whole areas subject to the proposed nation-wide FFWS as well as the regional operation system for Sylhet Region, namely, inclusive the following:
 - Regional operation system for Sylhet Region consisting of regional FFWC in Sylhet
 - All other regional operation system will be implemented in future.
 - In this stage development, all the proposed observation system will be constructed, but regional office of FHC for remaining 4 regions will not be established in the pilot project stage. Temporarily, all the regional FFWS will be conducted in the Central Office of FHC other than the Sylhet Regional Operation System.

Pre-arrangement for the Project Implementation

52. The O&M Plan for the proposed project was submitted by the GOB to the JICA Study Team (see **Attachment-4** of the **Supporting Report**). The comments of the Study Team on the O&M Plan are given in **Attachment-5** of the **Supporting Report**.

The Study Team recognizes that the plan need to be revised, and also that some gaps, which lie mainly on the institutional aspect, between the Team and the GOB still remain unsolved.

On the basis of this recognition, the Study Team recommends to undertake an institutional study of BWDB from much wider view point. The Draft Terms of Reference (TOR) of this institutional study is given as **Attachment-1** in the **Supporting Report**.

Necessary Arrangements for Effective FFWS Operation

- 53.1 Water Code or River Code is essential for river management covering all the sectors relating to river and water, watershed management, water use including water resources development, flood control, water quality management and river environment management. It is recommended that the following are to be clearly stated in them on top of the existing regulations from the view point of flood control.
- a. Classification of rivers with definition and fixing up of responsibility for the river management,
 - b. River area and land ownership of the river area,
 - c. Utilization of river area, and
 - d. Others relevant
- 53.2 It is important for FFWC to take the following actions as soon as possible:
- a. To collect all the data and information transmitted from India through the point-to-point exchange arrangement on a continuous basis;
 - b. To incorporate all the data and information sent from India, i.e. those coming through the IMD-BMD arrangement, the point-to-point exchange data, the rainfall data obtained from the website, and any other relevant information into the modeling system of FFWC; and
 - c. To conduct simulations using the available data from India to determine their usefulness and limitation and present the results to the Bangladesh JRC for further negotiations with the Indian side.

In addition, the operation rules and records of barrages on key rivers in India should be made available and a transboundary water release warning system must be established as essential measures to mitigate artificial flood damage.

- 53.3 While pursuing further dialogue and negotiations at the government level,

supplemental efforts at the non-governmental level would be needed for building trust and understanding between Bangladesh, India and Nepal. “Second track” approaches being undertaken or planned for this purpose can be supported with a particular focus on flood management.

- 53.4 In terms of comprehensive management of international rivers, the first step that is needed toward such a direction is to conduct an objective study to determine water balance in the GBM, based on which a master plan can be developed. Simultaneously, free and wider sharing of all relevant information and data on the common rivers and projects and interventions thereon needs be promoted. “Second track,” non-governmental level dialogue and activities and a skilled and neutral intervention of a third party at the government level would be required to facilitate the process.
- 53.5 In the meantime, BWDB needs to strengthen its domestic river management system as part of its efforts toward international river management. In particular, it is important to consistently monitor, analyze and report on such aspects as water level, discharge, sedimentation, groundwater, water quality, salinity on key rivers.
- 53.6 Flood damage data are indispensable and basic data for estimation of the benefits of the FFWS. But there are no comprehensive and continuous official flood damage data in the BWDB. Then the flood damage survey is necessary to get more detail and objective flood damage data. The following matters are recommendation for it.
- a. Integration of information on flood damage
 - b. Establishment of information system of flood damage
 - c. Preparation of database
 - d. Preparation of manual for flood damage survey
- 53.7 The ledger sheets are pre-requisite for operation and maintenance of the river structures. Therefore, it is strongly recommended to prepare as soon as possible the ledger sheets of all the river structures and FFWS including the following items.
- a. Project Features
 - b. Operation and Maintenance Records
 - c. Damage and Repair Records
 - d. Emergency Protection Works
 - e. Large Scale Rehabilitation Works

This ledger sheets should be updated annually reflecting the activities taken during the past one year.

TABLES

Table 1 Task of Improved FFWS

Task of FFWS	Operation		Maintenance	
	Item	Division in charge	Item	Division in charge
Observation	Gauge Reading	Regional FH	Discharge measurement	Surface Water (Region)
			Measurement of the cross section	River Morphology (Region)
			Restoration of gauging structure Set staff gauge and measure the level Automatic gauge maintenance Telemeter system maintenance	Regional FH
			Correction of gauging tool (Discharge) Making gauging tool (Staff gauge, Rainfall gauge)	Instrumentation Division
Transmitting	HF Transceiver Operation	Central FHC Regional FH	HF Transceiver Maintenance	Central FHC Regional FH
Analysis	Collect the observed data Analysis Supervise Edit	Central FHC Regional FH	Store the Posted data	Processing Division
			Store the cross section data Store the discharge data	
			Modification of analysing model Modification of Hazard map System Hardware Maintenance	Central FHC Regional FH
Dissemination	Send Fax and E-mail	Central FHC Regional FH		
Response	Help in the evacuation	Regional FH		

Hatched: Task of Improved Organization or New Organization

Not Hatched: Task of Surface Water(Region) and River Morphology (Region) (the same task as existing.)

Table 2 Staffing of Improved FFWS

Division	Operation Task	Maintenance Task	Manager				Technical Staff	Support Staff	Gauge Reader	
			SE	XEN	SDE	AE				
Regional FH	(Data Collection Division)	(Data Collection Division)		1x5	1x5	1x5	3x5	8x5	85	
	Gauge Reading and Sending by mobile (or HF Tranciever)	Restoration of gauging structure Set staff gauge and measure the level							(Manual)	5
									(Telmeter)	
	(Data Transmission Division)	(Data Transmission Division)	(Data Transmission Division)			1x5	1x5	3x5		
			Automatic gauge Maintenance							
			Telemeter system Maintenance							
			HF Tranciever Maintenance							
			FFWS Hardware Maintenance							
	(Forecasting Division)	(Forecasting Division)	(Forecasting Division)			1x5	1x5	3x5		
		Set boundary condition	Validation of analysing model							
		Run the Regional Model (Making Regional BULLETIN)	Computer System Maintenance							
		Edit the BULLETIN	FFWS Software Maintenance							
Confirm dissemination of Fax, E-mail Communicate with local O&M staff										
Central FHC	(Data Collection Division)	(Data Collection Division)	1	1				7		
	(Data Transmission Division)	(Data Transmission Division)	(Data Transmission Division)		1	1	1	3		
			HF Tranciever Maintenance							
			FFWS Hardware Maintenance							
	(Forecasting Division)	(Forecasting Division)	(Forecasting Division)		1	1	1	3		
		Set boundary condition	Validation of analysing model							
		Run the Super Model (Making Country BULLETIN and Hazard Map)	Modification of Hazard map Computer System Maintenance							
		Edit the BULLETIN	FFWS Software Maintenance							
		Confirm dissemination of Fax, E-mail, and WebSite-Upload								
Total			1	8	17	17	51	47	90	
Grand Total									231	

Table 3 Implementation Schedule

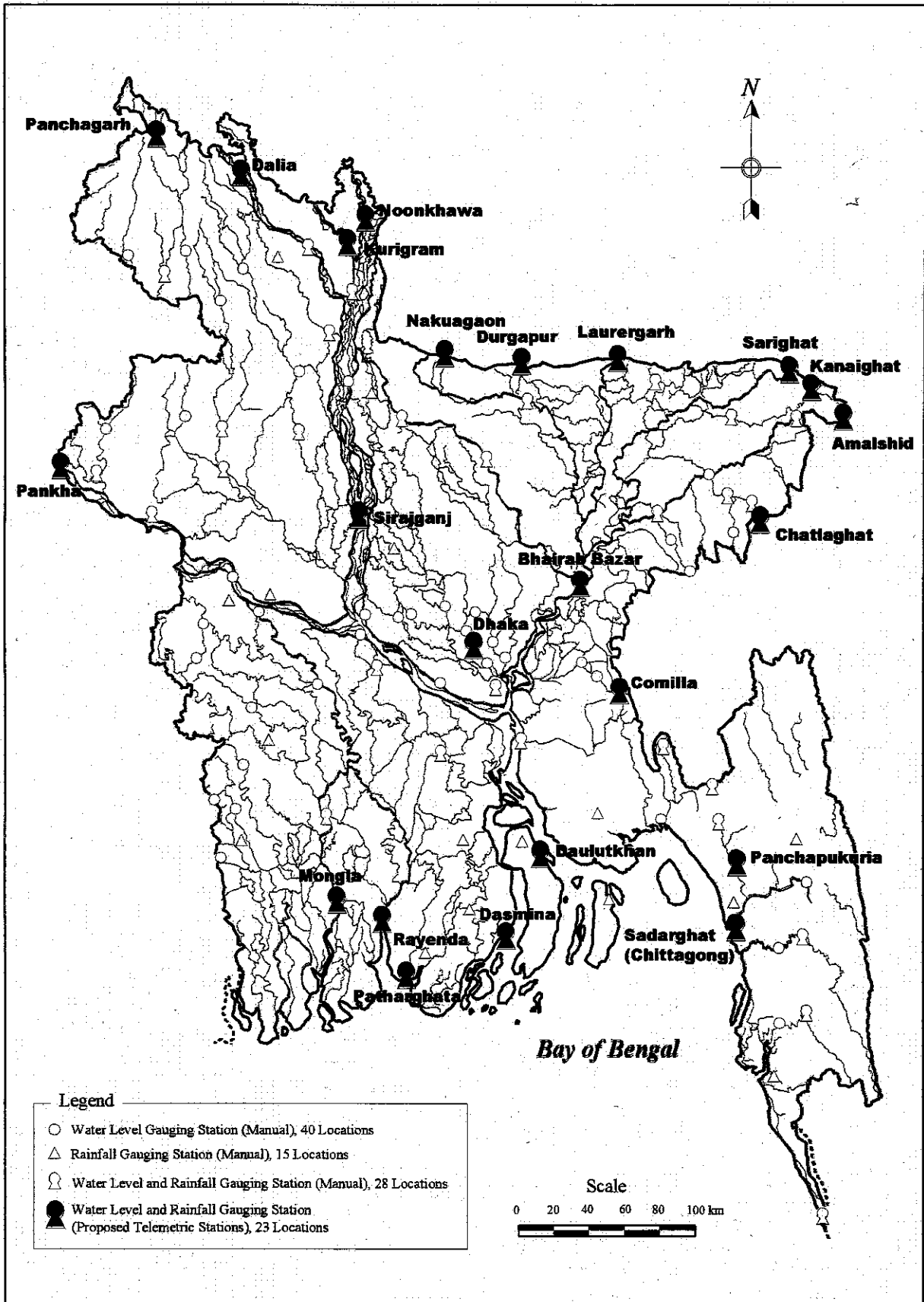
Pilot Project

Work Item	2003	2004	2005	2006	2007	2008	Local	Foreign
Completion of F/S	█						BWDB	
Financial Arrangement		█						
Design			█				BWDB	Foreign Assistance
Implementation and supervising of Pilot Project				█			BWDB	Foreign Assistance
Guidance Period					█	█	BWDB	Foreign Assistance

Priority Study

Work Item	2003	2004	2005	2006	2007	2008	Local	Foreign
1) Formulation of O&M Plan	█						BWDB	
2) Clarification of River management								
National Water Code	█	█					MOWR	
3) Strengthen of dissemination and evacuation (Response)								
FFWS is to be included in NWMP		█	█				MOWR and MDMR	UNDP
FFWS is to be included in CDMP		█	█				MOWR and MDMR	UNDP
4) Institutional study								
Institutional study			█	█	█	█	BWDB	Foreign Assistance
Regional organization plan for pilot project			█	█			BWDB	Foreign Assistance
Operating and Monitoring of Pilot project					█	█	BWDB	Foreign Assistance
5) Collecting the information on river management and review of danger level								
Collecting the information of river structures		█	█	█			BWDB	Foreign Assistance
Preparation of Operation manual		█	█	█			BWDB	Foreign Assistance
Preparation of DEM			█	█			BWDB, Survey of Bangladesh, and LGED	
Preparation of Flood Hazard map			█	█			BWDB	
Review / identification of danger level			█	█	█		BWDB	Foreign Assistance
Survey the river cross-sections			█	█			BWDB	

FIGURES



Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

Figure 1
Proposed Network of FFWC Observatories

JAPAN INTERNATIONAL COOPERATION AGENCY

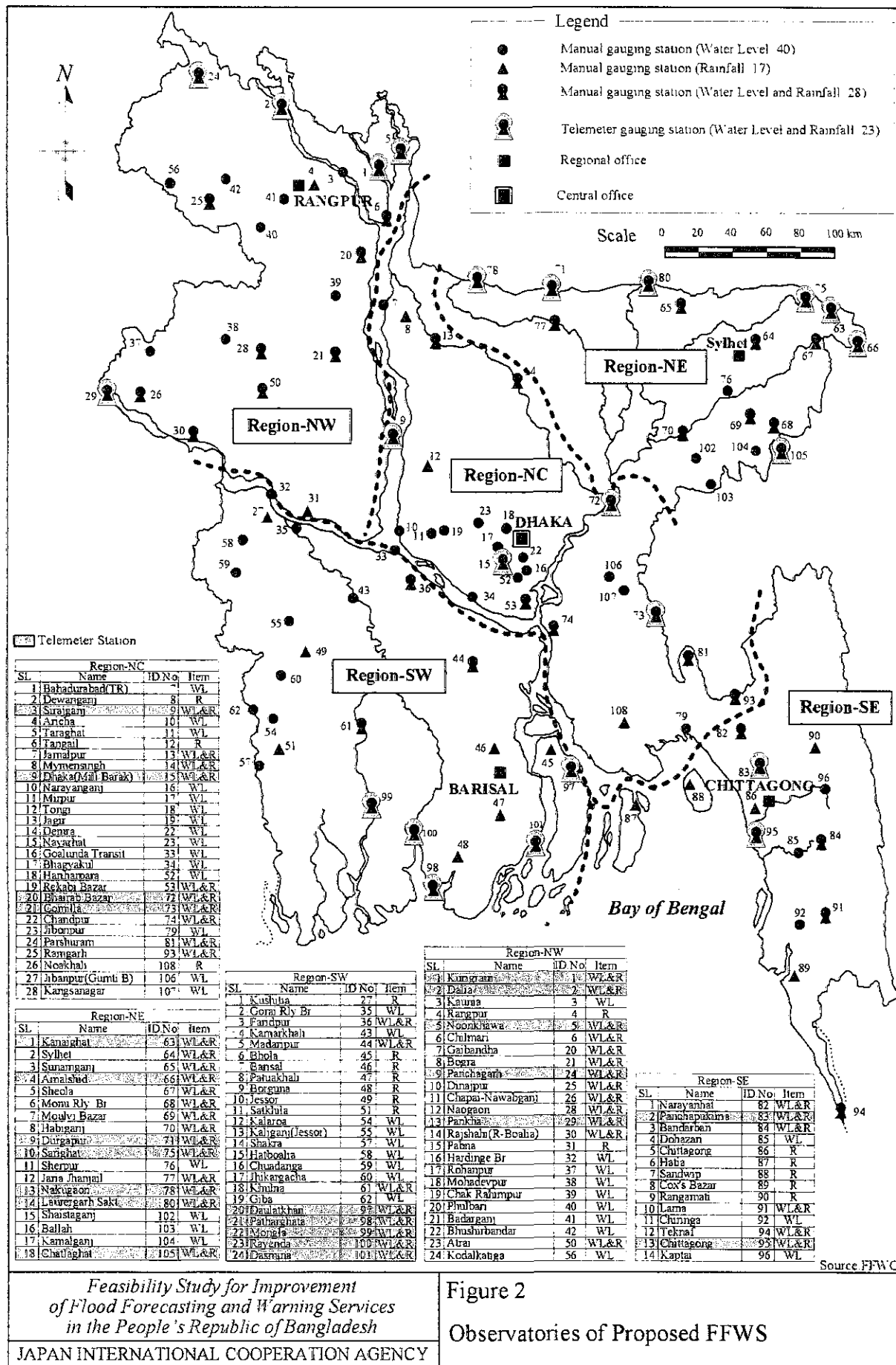
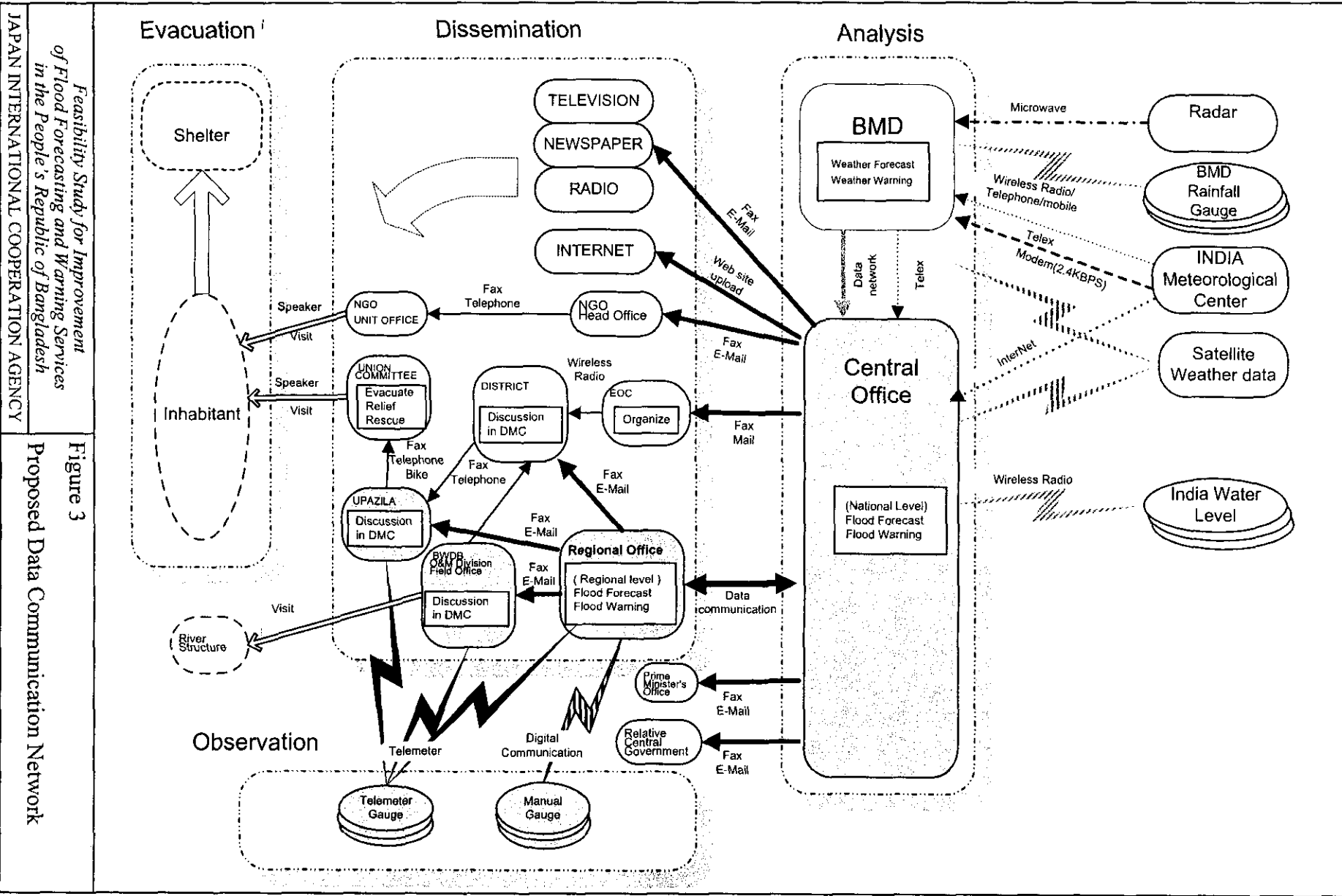


Figure 2
Observatories of Proposed FFWS

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Figure 3
 Proposed Data Communication Network

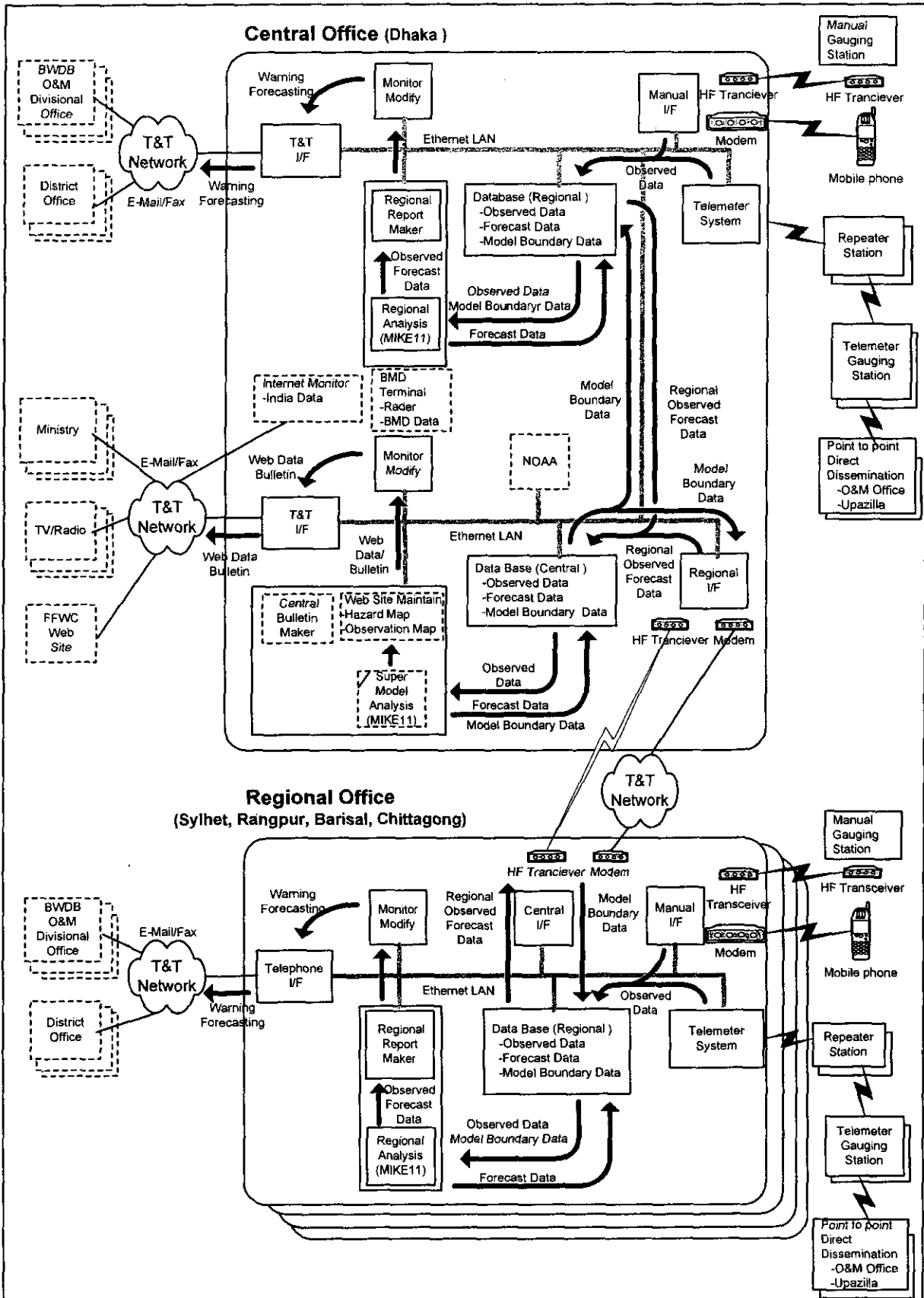
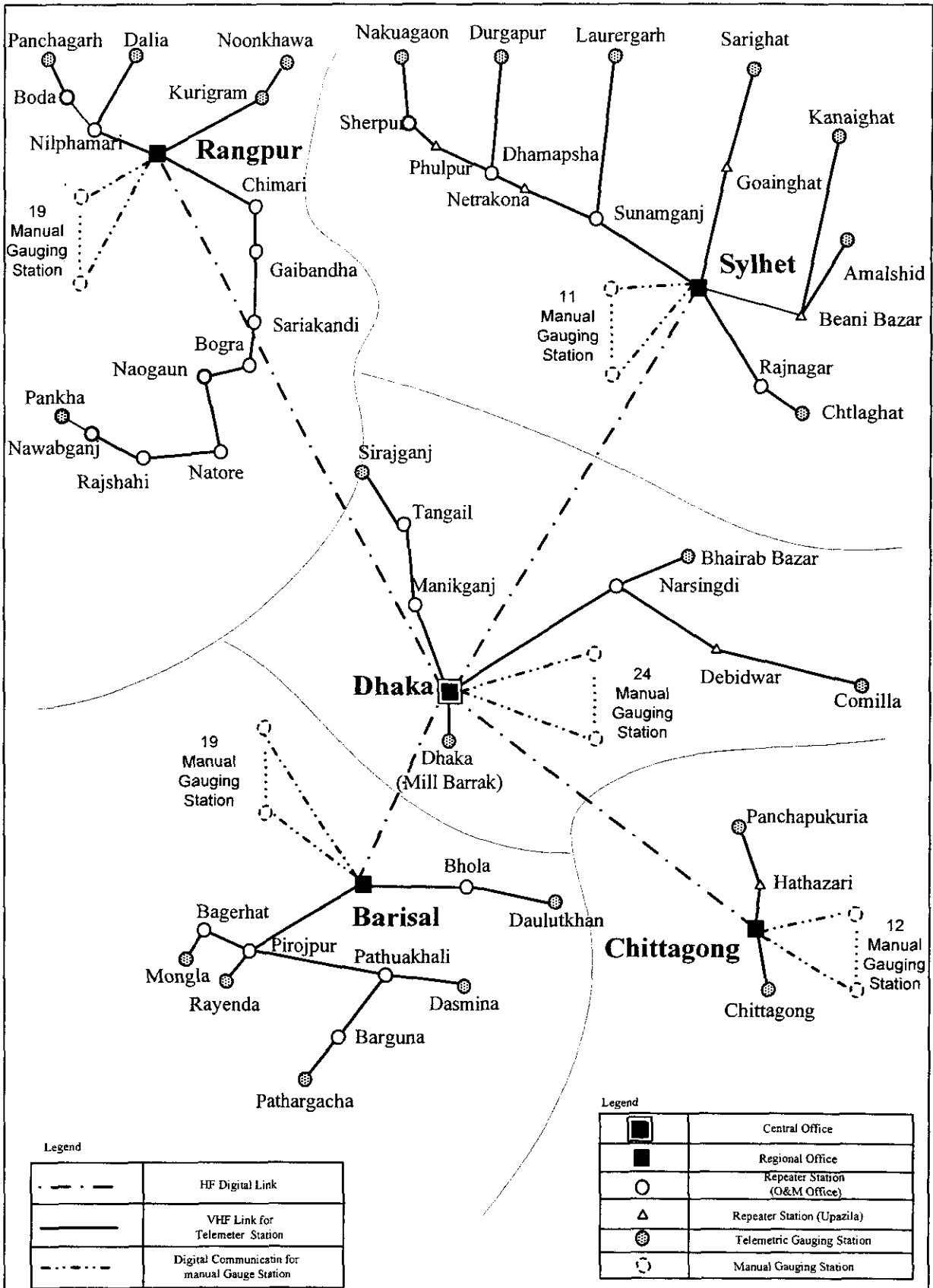


Figure 4
Data Transmission Flow

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Figure 5 Data Transmission Network Diagram

Project Features

(1) Observation System

Manual Observation System

No change

Telemeter System

Water level observation: sonar type sensor / sensing pole type sensor

Rainfall observation: tipping bucket type

(2) Data Transmission System

Manual Observation System

Digital transmission system:

- mobile communication system (HF data transmission system)

Automatic recording system in computer in control station

Telemeter System

From Gauging station to Regional station:

- BWDB VHF Link

From Regional station to Central control station:

- BWDB HF Link

(3) Analysis System

All the data, manual observation and telemeter, are to be used

Regional control system

- Forecasting with Regional model

- Monitoring with telemeter observed data

Central control system

- Forecasting with Nationwide model (Supermodel)

(4) Warning Dissemination System

Warning Message Dissemination (Forecasted)

From Regional control station to O&M office, DC office, Upazilla office:

- E-mail, Fax, Telephone with T&T public line

Point to Point Direct Data Dissemination (Telemeter only)

From Telemeter Gauging Station to O&M office, Upazilla office:

- VHF Link

Warning Dissemination in Local Level

From Upazilla/Union to Inhabitant / Shelter:

- Fax, Telephone, Bike, Speaker & visit.

Main Components

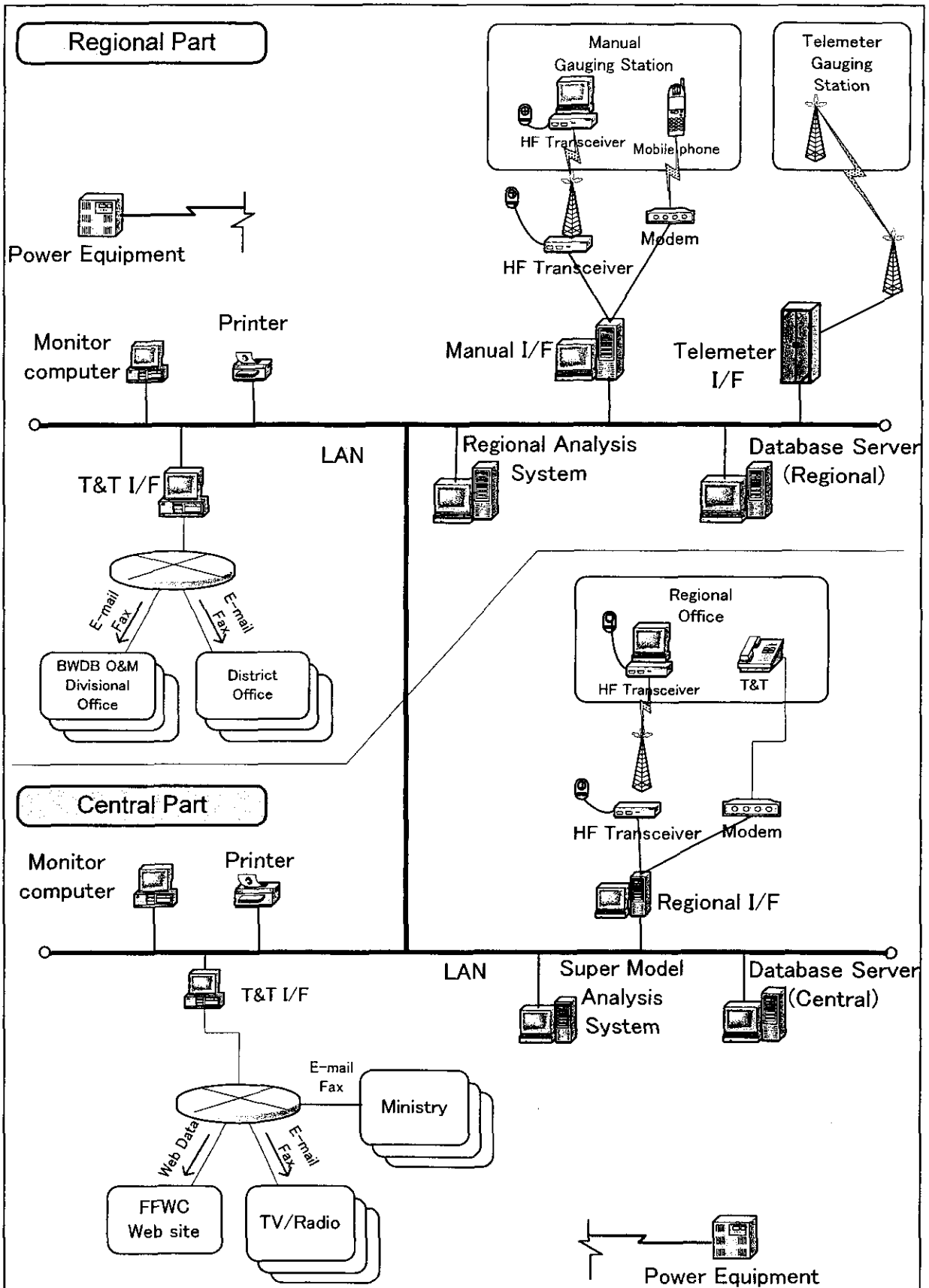
Place	Main Item	Item	Number
Central Office (Dhaka)	Equipment	Database Server (central)	1
		Super Model Analysis System	1
		Database Server (regional)	1
		Regional Analysis System	1
		Monitor Computer	2
	Office	(Existing FFWC)	
	Others	Vehicle	4
		Speed Boat	1
Regional Office	Equipment	Database Server (regional)	1x4
		Regional Analysis System	1x4
		Monitor Computer	1x4
	Office	New Office	1x4
	Others	Vehicle	3x4
		Speed Boat	1x4
Repeater Station (O&M office)	Equipment	Repeater Equipment	21
		Monitoring equipment	9
	Space	(Existing O&M office)	
Repeater Station (not O&M office)	Equipment	Repeater Equipment	6
	Space	New House	6
Telemeter Gauging Station	Equipment	Telemeter equipment	23
		Sonar type sensor	7
		Sensing pole type sensor	16
	Space	New House	23
Manual Gauging Station	Equipment	Mobile Phone	42
		Digital HF system	43
	Space	(Existing Wireless station)	
Point to Point Direct Dissemination	Equipment	Monitoring equipment	32
	Space	(Existing Upazilla office)	

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Figure 6

Summarized Features of Proposed Project

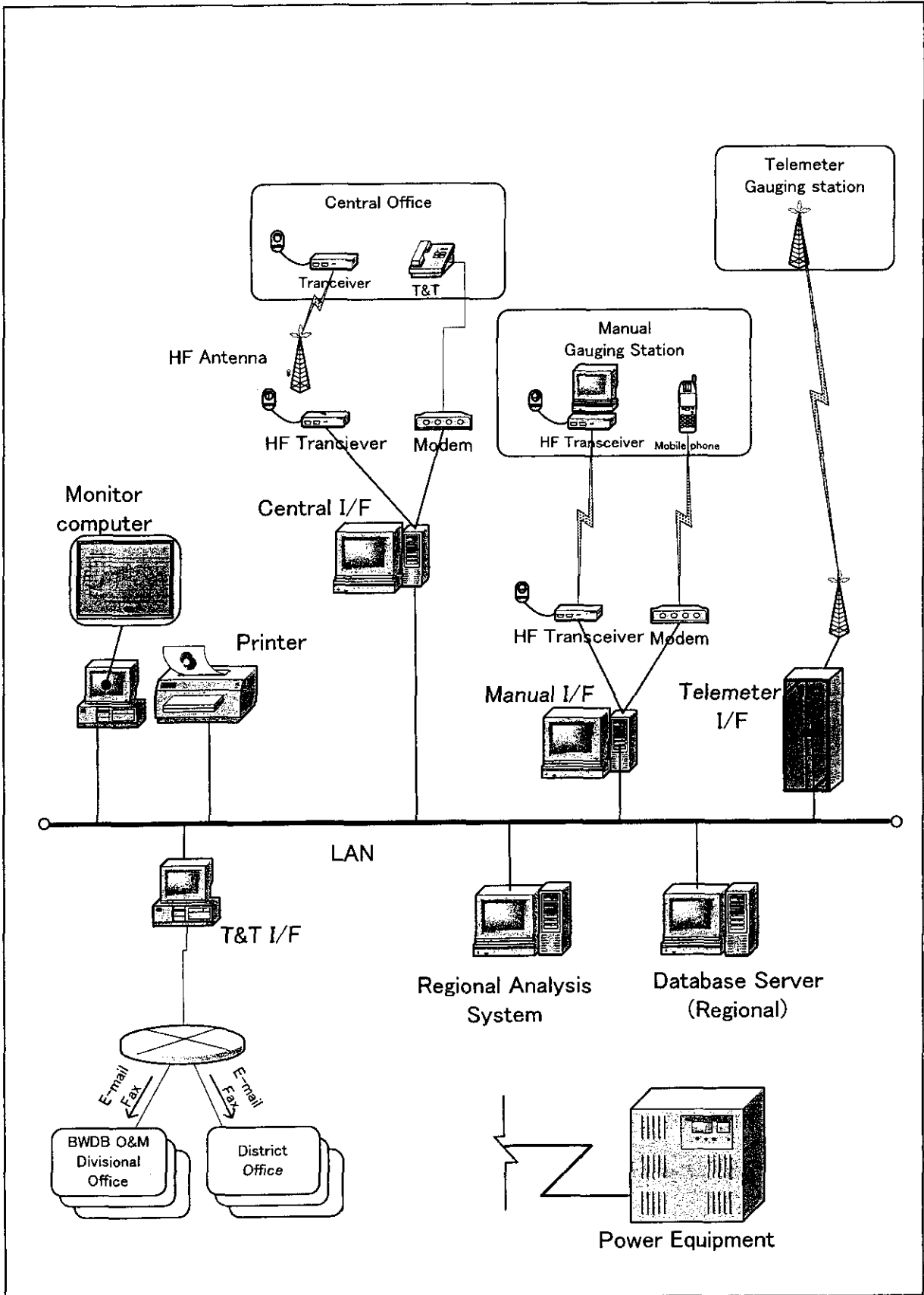


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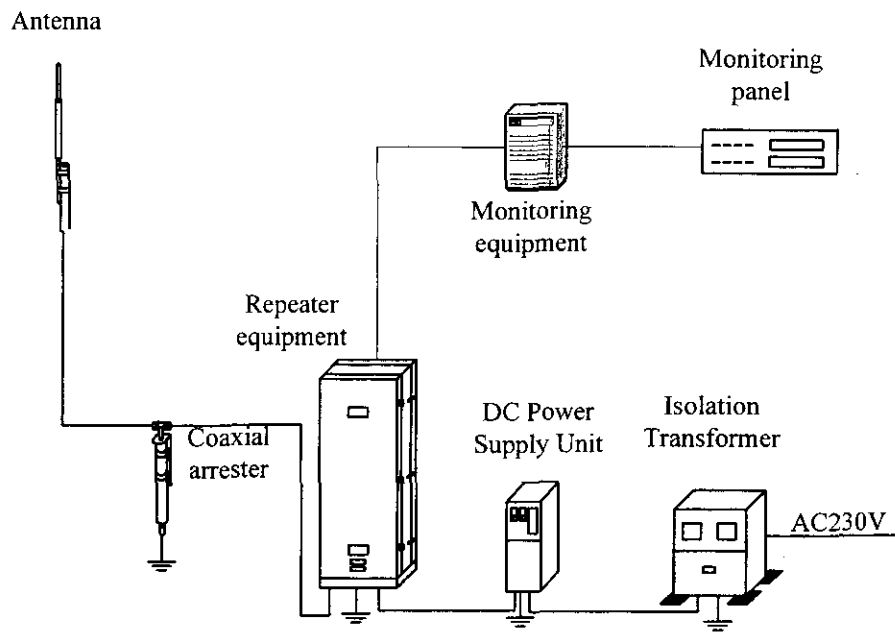
Figure 7

Block Diagram of Central Office

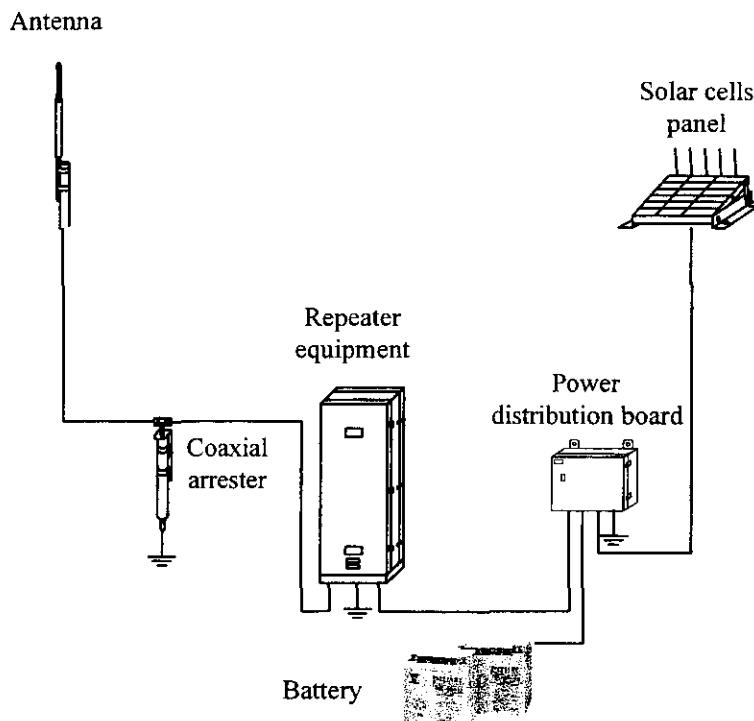


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Figure 8
 Block Diagram of Regional Office



Repeater Station in O&M Office



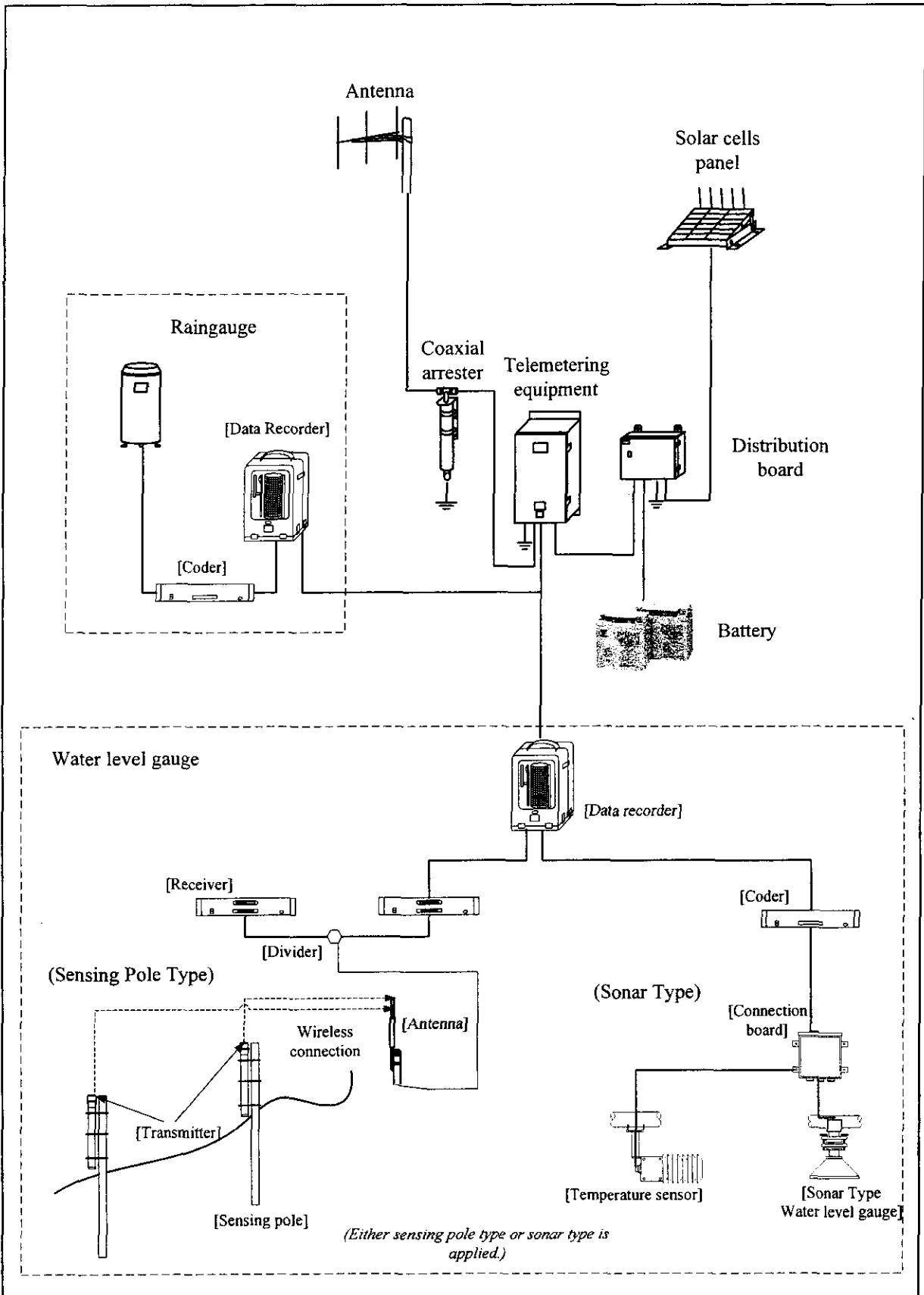
Repeater Station in Upazilla without O&M Office (not Upazilla office)

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Figure 9

Block Diagram of Repeater Station

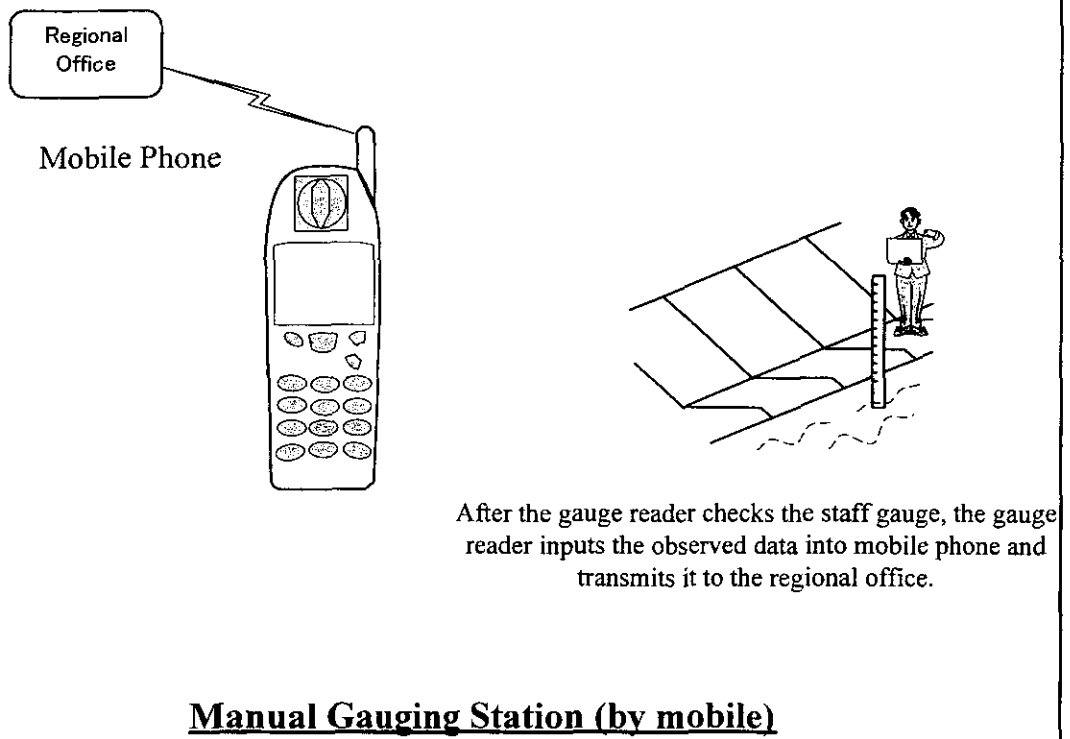
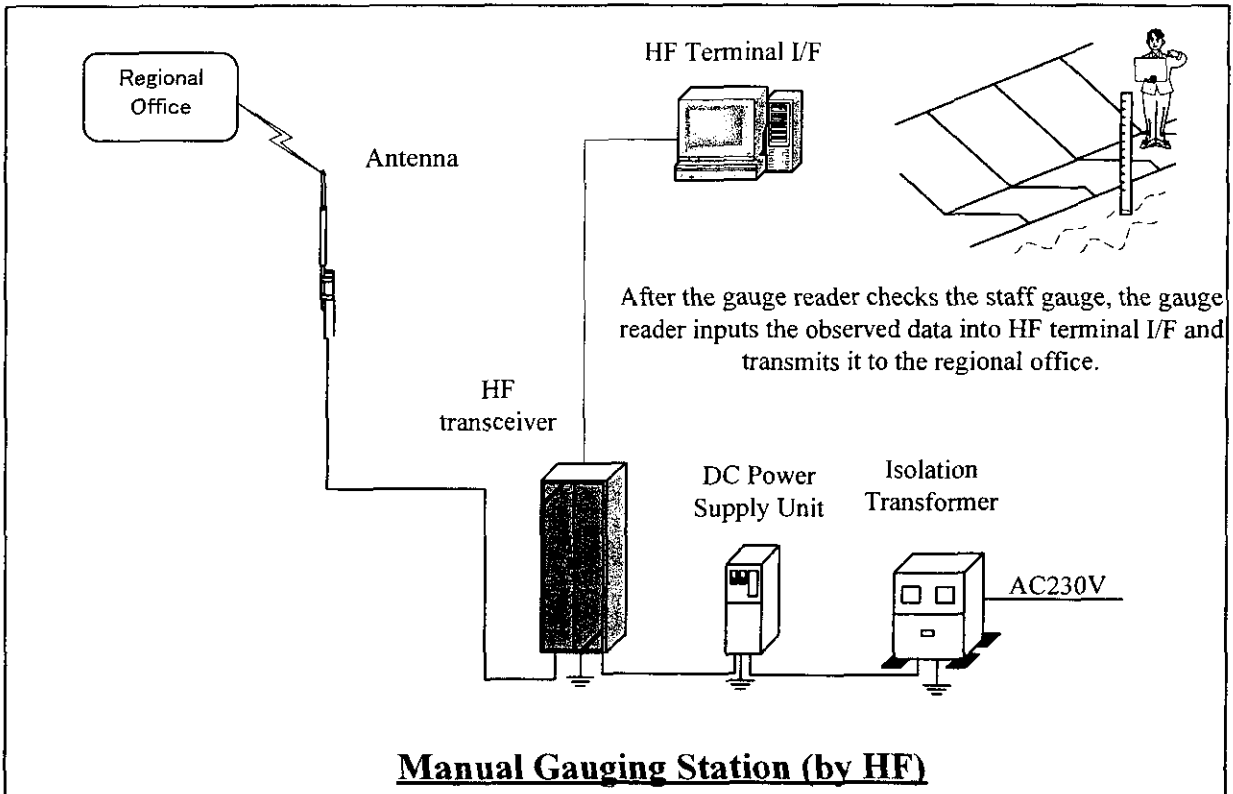


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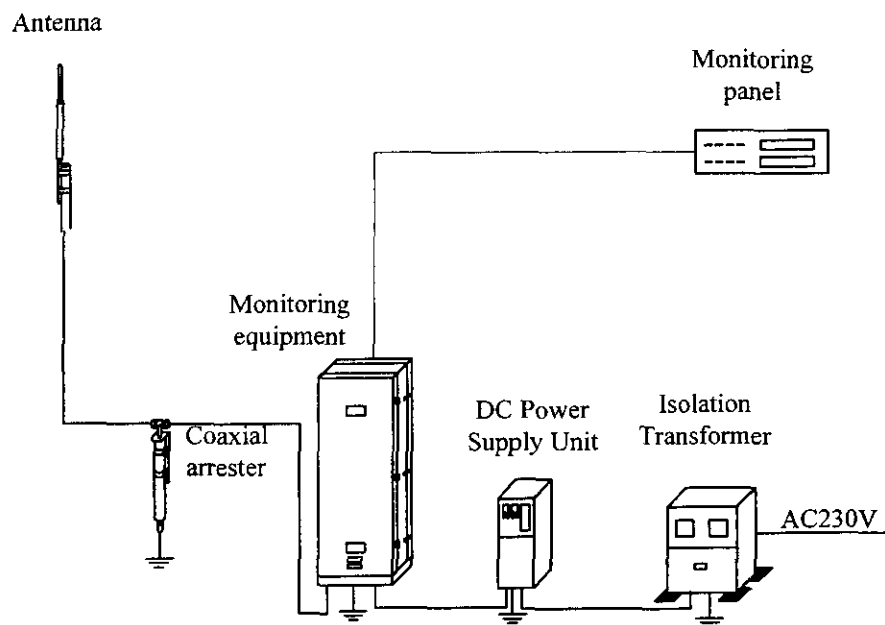
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Figure 10

Block Diagram of Telemeter Station



<p style="text-align: center;"><i>Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh</i></p> <p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	<p style="text-align: center;">Figure 11 Block Diagram of Manual Gauging Station</p>
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Point to Point Direct Dissemination

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Figure 12
Block Diagram of Point to Point Direct
Dissemination

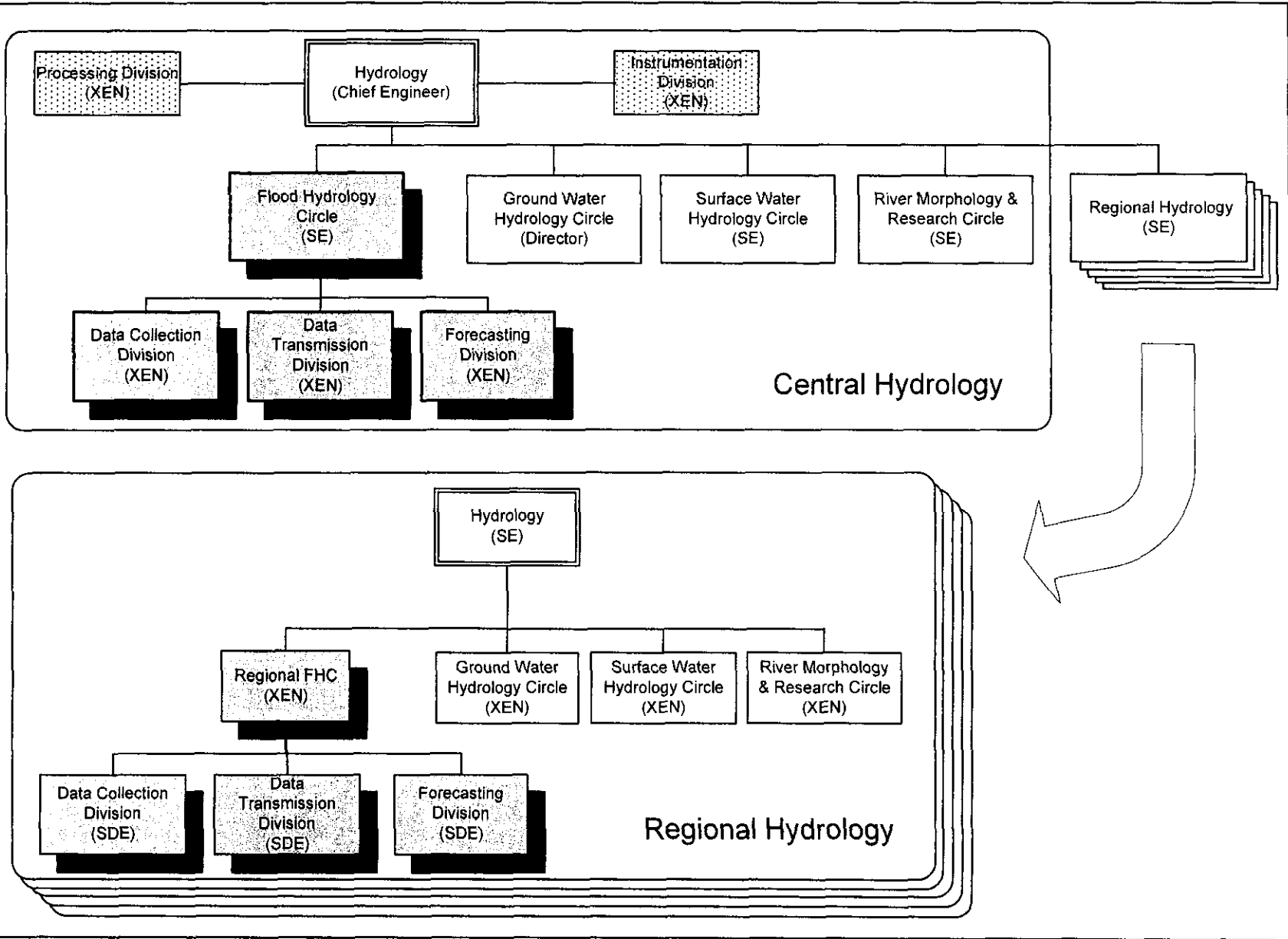
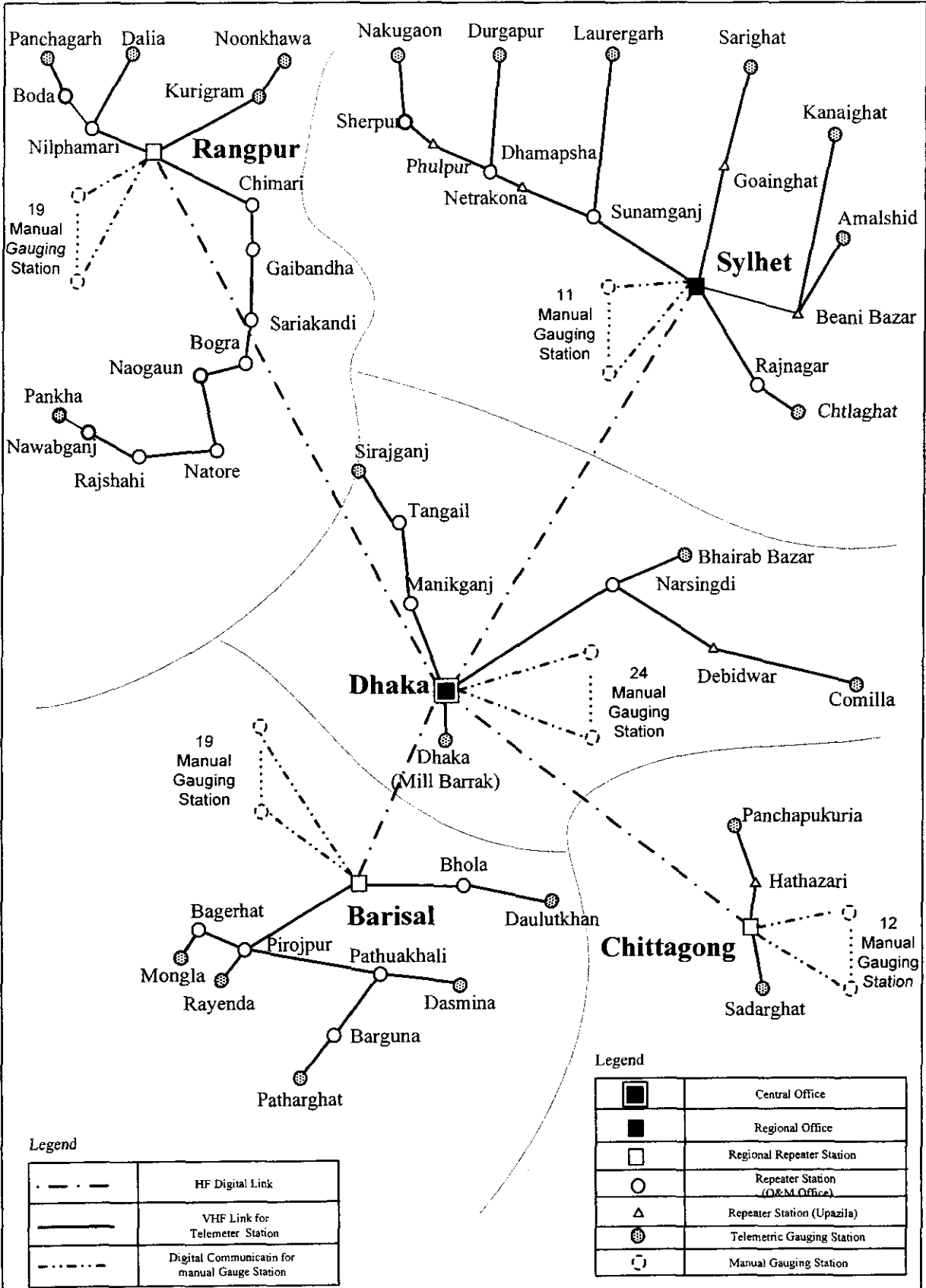


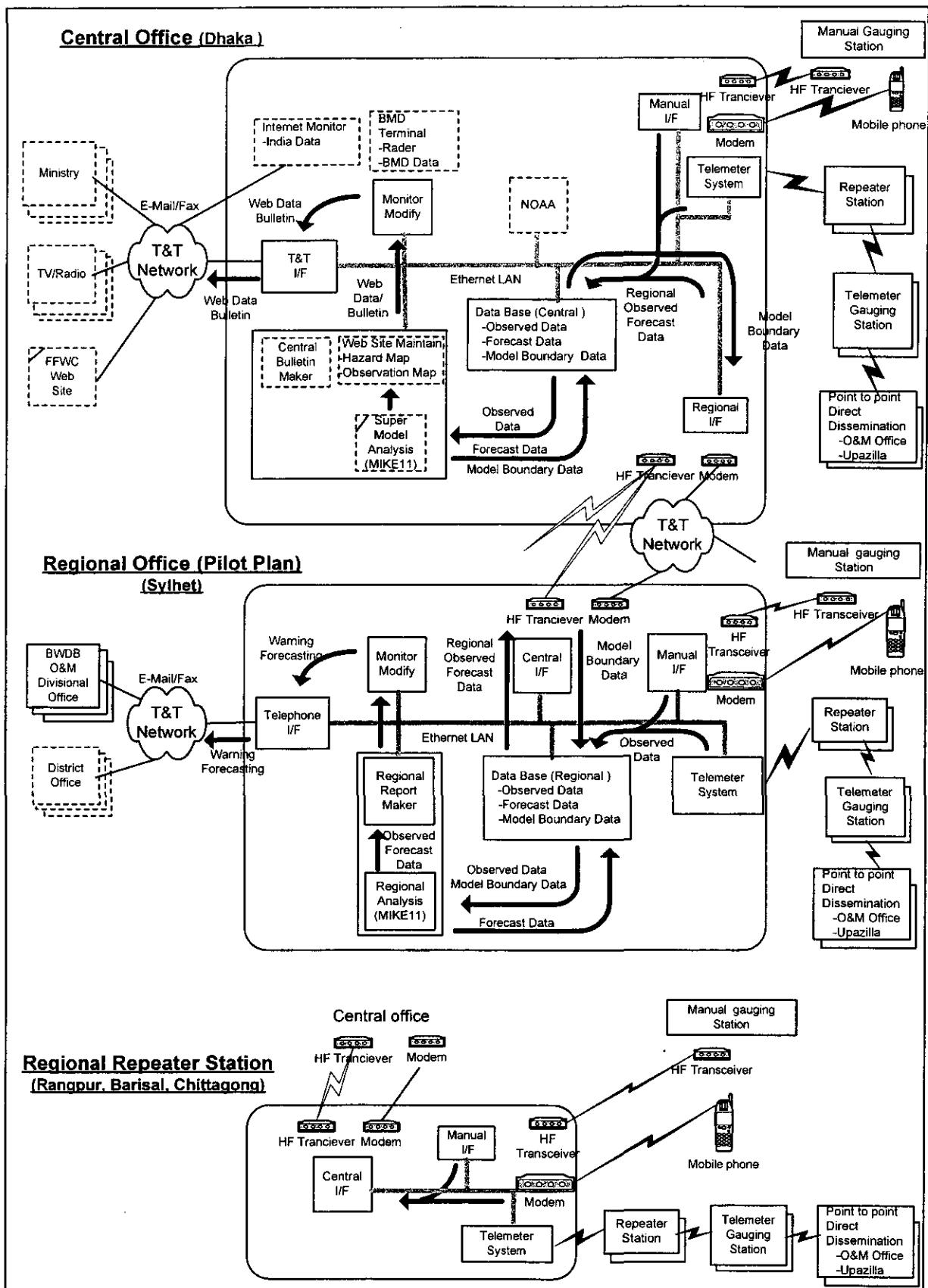
Figure 13

Proposed Organization of Hydrology



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Figure 14
 Data Transmission Network Diagram (Pilot Project)



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Figure 15
Data Transmitting Flow (Pilot Project)

