

CHAPTER 2 WATER SECTOR ENTITIES

2.1 NWPo: National Water Policy

2.1.1 Policy Overview

The NWPo (National Water Policy) introduces its Institutional Policy by stating:

“The governance and management of the national water resources require a great deal of coordination of existing institutions and in some cases reform and creation of new community-based institutions. Water resources management extends across many water using sectors as well as political jurisdictions and geographically and hydrologically diverse areas. Properly functioning institutions are essential for effective implementation and administration of the country’s water and related environmental resource management policies and directives. The Government will restructure and strengthen, where appropriate, the existing institutions to ensure that the agenda for reform and the action plan is implemented efficiently. Two important principles will govern institutional restructuring. Firstly, there should be separation of policy, planning, and regulatory functions from implementation and operational functions at each level of government. Secondly, each institution must be held accountable for financial and operational performance.”

With regard to legislation, the NWPo further states that:

“Setting the appropriate legislative framework is fundamental to effective implementation of the water policy. The existing legislation related to any form of water management in Bangladesh requires supplementing in a number of key areas. This policy will be given effect through a National Water Code encoding specific provisions of the water policy to facilitate its implementation. The policy of the Government in this regard is: a. To periodically review the provisions of the body of laws and regulations that have an impact on water resource management and to recommend changes and amendments in them for efficient coordination of the work of different water-related sub-sectors. b. To enact a National Water Code revising and consolidating the laws governing ownership, development, appropriation, utilisation, conservation, and protection of water resources.”

Accordingly, the NWMP needs to provide guidance on: (i) Institutional Framework (what institutions are needed to implement policy and their relationship with each other); (ii) institutional responsibilities (what actions to implement policy each one is responsible for), and (iii) Institutional Reform (changes in the current arrangements that are needed). It will be noted that NWPo is very specific regarding the duties of NWRC, ECNWRC, WARPO and JRC, but far less specific regarding the responsibilities of other agencies that NWMP is required to elaborate.

The original NWPo is attached to Appendix Document AA1 in PDF format.

2.1.2 Current Institutional Framework

Altogether some 35 central Government organisations, affiliated with 13 different Ministries, have been identified with functions relevant to the water sector. The agencies and their main areas of responsibility are shown in Table A2.1-1 below and these are described in more detail in the following Sections.

Table A2.1-1: Organisations Relevant to the Water Sector

Ministry	Organisation	National/Regional							Regional/Sub-Regional						Local Rural/Sei-Rural						Urban						
		Policy	International river basins	National/regional planning & coordination	Laws, regulations, rules, guidelines etc	Economic instruments	Research/service/education	Flood warning dissemination	Data collection	Programme planning and coordination	Standards monitoring	Major river maintenance & erosion control	Barrages and transfers	Management of medium/large FCD	Regl river maintenance & erosion control	Large scale irrigation projects	Local area development planning	Rural/village water supply and sanitation	Management of small water bodies	Minor irrigation	Maintenance of local drainage	Flood proofing	Management of small FCD	Promotion/education/awareness raising	Urban development planning	Town water supply and sanitation	Flood protection/proofing and drainage
Inter-Ministrial	National Water Resources Council	■		■																							
	Executive Committee of NWRC	■		■																							
	National Economic Council				■				■																		
	Executive Committee of NEC				■				■																		
MoWR	MoWR Water Resources Planning Organisation	■	■	■	■																						
	Joint Rivers Commission		■																								
	Flood Forecasting and Warning Centre								■																		
	River Research Institute					■																					
	Surface Water Modelling Centre 1					■																					
	Environment and GIS Project 2					■																					
	B'desh Water Development Board							■	■	■	■	■	■	■	■				■	■	■	■				■	
MoA	B'desh Agricultural Development Corporation							■											■	■							
	Dept of Agricultural Extension							■											■			■					
	Soil Research and Development Institute					■																					
	B'desh Agricultural Research Council	=				■																					
	B'desh Agricultural Research Institute					■																					
	B'desh Rice Research Institute					■																					
LGRD&C	Local Government Division																										
	Local Government Engineering Dept.							■												■	■	■			■		
	Dept of Public Health and Education							■																	■	■	
	Dhaka Water Supply&Sanitation Authority																								■	■	
	Chittagong WASA																								■	■	
Works	Rajdhani Unnayan Katripakha																								■		
Science & Tech	Space Research & Remote Sensing Org				■																						
MoEF	Dept of Environment			■				■	■																		
	Forestry Department								=																		
Communications	Dept of Roads and Highways												=														
MoPS&IWT	B'desh Inland Water Transport Authority							■				■															
MoFL	Dept of Fisheries							■	■											■							
MoPlan	Planning Commission			■	■	■			■																■		
	B'desh Institute of Develop'm't Studies1					■			■																		
	B'desh Bureau of Statistics								■																		
MoL	Ministry of lands				■													■									
Moi	Ministry of Industry				■																				■		
MRDM	Disaster Management Bureau							■													■						
Other organisations																											
	LGi: Paurashava																								■	■	
	LGi: Parishads																								■		
	Community Based Organisations												■	■													
	Non-Government Organisations	■	■	■	■	■	■																				
	Co-operatives																										
	Private Sector 3						■																				

Notes 1 Established as a not-for-profit trust 2 At present a project, becoming a trust in 2001
3 Excluding consultants and contractors = Indirectly related to water sector activities

(Source: NWMP Draft Annex H)

2.2 NWRC: National Water Resources Council

2.2.1 The Council

The National Water Resources Council (NWRC) is the highest national body for the formulation of water policy, including inter-agency co-ordination, and is charged with making recommendations to the Cabinet on all water policy issues. The present NWRC was created by an order from the Cabinet Division on 6 June 1992 and was reconstituted on 17 November 1996 with the following membership:

1.	Hon'ble Prime Minister		Chair
2.	Hon'ble Minister	Ministry of Foreign Affairs	Member
3.	Hon'ble Minister	Ministry of Finance	Member
4.	Hon'ble Minister	Ministry of Water Resources	Member
5.	Hon'ble Minister	Ministry of Home Affairs	Member
6.	Hon'ble Minister	Ministry of Agriculture	Member
7.	Hon'ble Minister	Ministry of Ports, Shipping and IWT	Member
8.	Hon'ble Minister/State Minister	Ministry of Fisheries and Livestock	Member
9.	Hon'ble Minister/State Minister	Ministry of Land	Member
10.	Hon'ble Minister/State Minister	Ministry of Environment & Forest	Member
11.	Secretary	Cabinet Division	Member
12-20	Chairman & all Members	Parliamentary Standing Committee Member for MoWR (excluding Min. MoWR)	
21-26	Six MPs	From Six Divisions nominated by the PM	Member
27.	Secretary	Economic Relations Division	Member
28.	Secretary	Ministry of Foreign Affairs	Member
29.	Secretary	Ministry of Fisheries and Livestock	Member
30.	Concerned Member	Planning Commission	Member
31.	Secretary	Ministry of Home Affairs	Member
32.	Secretary	Ministry of Water Resources	Member
33.	Secretary	Ministry of Agriculture	Member
34.	Secretary	Ministry of Food	Member
35.	Secretary	Ministry of Environment & Forest	Member
36.	Secretary	Ministry of Land	Member
37.	Secretary	Ministry of Law, Justice & Parliament Affairs	Member
38.	Dean	Faculty of Law, Dhaka University	Member
39.	Chairman	Department of Water Resources Engineering, BUET, Dhaka	Member
40.	Director General	Water Development Board	Member
41.	Director General	Water Resources Planning Organisation	Member
42.	Member	Joint Rivers Commission	Member

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43.	President	Institution of Engineers	Member
44.	President	Institute of Diploma Engineers	Member
45.	Chairman	Association of Development Agencies in Bangladesh (ADAB)	Member
46-48.	Three Experts	Nominated by the Prime Minister	Member

The publication of the National Water Policy (NWPo) in January 1999 was a major achievement for the NWRC and promises well for the future.

The NWPo determines a clear strategic role for NWRC to co-ordinate all water resources management activities in the country. It is particularly charged with:

- formulating policy on different aspects of water resource management;
- giving direction for optimal development and utilisation of the national water resources;
- overseeing the preparation and implementation of the National Water Management Plan;
- providing directions on the development of efficient institutions for managing water resources; and
- providing policy directives for appropriate co-ordination among different water sector agencies.

Key areas of future activity are therefore expected to include adoption and oversight of the National Water Management Plan and updates, resolution of inter-agency conflicts, and adoption of common standards for the water sector.

2.2.2 The Executive Committee of the NWRC

To support the NWRC, an Executive Committee of the NWRC (ECNWRC) was constituted on 4 June 1997 by an order of the Government and membership is shown in the following Table. In carrying out its responsibilities to the ECNWRC, it is incumbent upon WARPO to provide a high calibre Secretariat and to ensure that routine matters are addressed without delay and that issues requiring the attention of the full Council are properly presented, recorded and executed.

Membership of the ECNWRC

1	Hon'ble Minister	Ministry of Water Resources	Chair
2	Hon'ble Minister	Ministry of LGRD & Co-operatives	Member
3	Hon'ble Minister	Ministry of Food	Member
4	Hon'ble Minister	Ministry of Environment and Forests	Member
5	Hon'ble Min./State Min.	Ministry of Fisheries and Livestock	Member
6	Secretary	Ministry of Water Resources	Member
7	Secretary	Ministry of Agriculture	Member
8	Secretary	Local Government Division, Ministry of LGRD&C	Member
9	Secretary	Ministry of Environment and Forest	Member

10	Secretary	Ministry of Fisheries and Livestock	Member
11	Chairman	Bangladesh Water Development Board	Member
12	Member	Agric., WR & RI Div, Planning Com.	Member
13	Director General	WARPO	Member
14	Dr. Ainun Nishat	Engineering Expert	Member
15	Dr. M Manowar Hossain	Engineering Expert	Member

In addition to ECNWRC, the Secretary Water Resources has established a temporary Water Policy Advisory Group (WPAG) consisting of three national and three international members to advise the Ministry on a range of issues. Responsibilities ascribed to the ECNWRC under the NWPo include:

- providing directives on all matters relating to the planning, management, and co-ordination of water resources across all sectors;
- guiding water management institutions at the national, regional, and local levels in the formulation and implementation of policies and plans for improved water management and investment;
- appraising and advising the National Water Resources Council periodically on matters of water resource management.

2.2.3 NWRC and ECNWRC

It will be noted that eleven members of ECNWRC are also members of NWRC. Some rationalisation of membership may be desirable to (a) emphasise the increasing importance of the private sector, and (b) make provision to co-opt non-voting members onto ECNWRC to broaden its perspective. Local Government representation on the Council appears very desirable.

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2.3 MoWR: Ministry of Water Resources

Formerly designated the Ministry of Irrigation, Water Development and Flood Control, the Ministry of Water Resources (MoWR) was established in 1994. MoWR is the executive responsible to the Government for all aspects of the water sector including expansion of irrigated areas, water conservation, surface and groundwater use, and river management. In addition to the Minister and State Minister, the MoWR consists of the Secretary, an administrative group of sixteen Class I officers and a small Planning Cell.

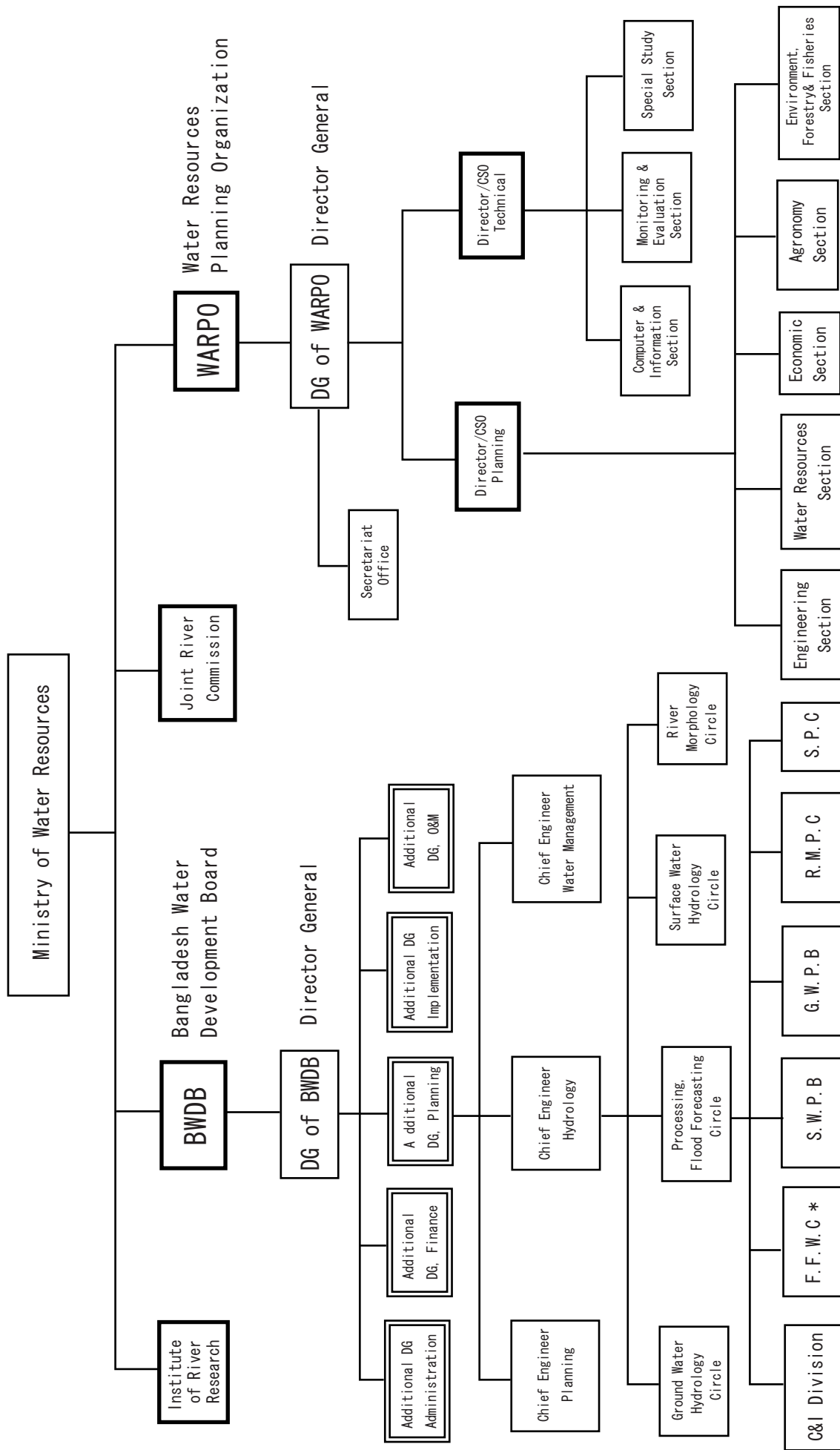
The Fifth Five Year Plan (FFYP) proposes 1.04 million hectares of irrigation additional to the existing 4Mha, and an additional 0.7Mha of new flood control and drainage facilities, up from 4.20Mha at the end of the Fourth Five Year Plan. Public sector outlay over the period 1996-97 to 2001-02 is estimated at Tk73,373 million, with the major portion (46%) being assigned to flood control and drainage, including river and town protection.

The NWPo charges MoWR with formulating a framework for institutional reforms to guide all water sector related activities. It is required to periodically review the mandates of all water sector institutions and redefine their respective roles, as necessary, to ensure efficient and effective institutions commensurate with changing needs and priorities.

In addition, MoWR assisted by specialist agencies and Local Government will:

- exercise water allocation powers in identified scarcity zones on the basis of specified priorities and determine the priority for allocating water during critical periods;
- sustain shallow groundwater aquifers, regulating the extraction of water in identified scarcity zones with full public knowledge;
- prepare specific drought monitoring and contingency plans for each region experiencing recurrent seasonal shortages of water etc;
- empower local government or any other body, to allocate water in scarcity zones during periods of severe drought, monitor the water regimes and enforce the regulations etc;
- confer water rights on private and community bodies to provide secure, defensible and enforceable rights to ground/surface water etc;
- ensure that minimum stream-flows are maintained.

Organization chart of MoWR is as shown in Figure A2.3-1.



* Flood Forecasting and Warning Centre

(As of July 1, 2001)

Figure A2.3-1: Organization Chart of MoWR

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2.4 HWDB: Flood Forecasting and Warning Centre

2.4.1 Background

The Haor and Wetland Development Board (HWDB) was initiated under the following background. The Prime Minister, Sheikh Hasina addressed about the importance of Haor development 1st February 2001 at Jamalganj, Sunamganj District. After sequential authorization procedures the following Notification was issued and announced to establish the Secretary Office of the Haor Development Board in BWDB on 4th February 2001 through TV interview of the Prime Minister.

Government of Bangladesh
Ministry of Water Resources
Development Section- 5

Notification

Dhaka 10 January 2001

Through the memorandum dated 11 September 2000, Clause 3-A, the Bangladesh Haor and Wetland Development Board formed with the following members.

A.	Honourable Prime Minister	Chairperson
B.	Minister, LGRDC	Member
C.	Minister, Finance	Member
D.	Minister, Environment & Forests	Member
E.	Minister, Water Resources	Member
F.	Minister, Agriculture	Member
G.	Minister, Fishery & Livestock	Member
H.	State Minister, Land	Member
I.	State Minister, Planning	Member
J.	Mr. Abdul Momin, MP	Member
K.	Mr. Absus Samad, MP	Member
L.	Mr. Suranjit Sengupta, MP	Member
M.	Secretary, Water Resources	Member

Function of the Board

The Board will coordinate the development activities of different organizations of the Ministries in order to bring development for the Haor and Wetlands.

The Board will formulate projects to develop the Haor and Wetland areas and on the basis of size

and nature of the project will engage a local government or other organization for implementation.

The Board will review the on-going projects of organizations under different ministries under implementation now and will advise the related implementing agency accordingly.

To carry out the relevant works, the Board will take any necessary action required.

Generally, the Board will sit in a meeting every six months in a place decided by the Chairperson. He can authorize any member to preside over such meeting during his absence.

By order of the President

(Azad Ruhul Amin)
Secretary

2.4.2 Current Situation

HWDB has started functioning in May 2001 with Head Quarter at Dhaka. It will have two Zonal Offices; one at Kishoreganj and the other at Sunamganj. The Kishoreganj Zonal Office has already started functioning without adequate staff, while the Sunamganj Zonal Office has not yet been opened.

A PCP from the HWDB has been submitted to the External Resources Division (ERD) in which the development work has been envisaged for more than Tk. 3,500 million. The PCP envisages that infrastructure will be developed through LGED (Tk. 2,500 million), BWDB (Tk.800 million) and HWDB itself will spend Tk.300 million mainly through research and studies.

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2.5 BWDB: Bangladesh Water Development Board

2.5.1 Organisation

Originally established in 1959 as the Water Wing of the East Pakistan Water and Power Development Board, the organisation was restructured in 1972 as BWDB and its mandate limited to water resource development by the Bangladesh Water and Power Development Boards Ordinance. It carries responsibility for the planning and execution of over 400 projects throughout the country including flood control, drainage, irrigation, town/coastal protection and erosion control.

BWDB shares an interest in groundwater irrigation and also in minor surface irrigation with BRDB, BADC and LGED. It has five main operating directorates for (i) Implementation of Major Projects; (ii) Operation and Maintenance; (iii) Planning; (iv) Finance and (v) Administration. In 1998-99 the organisation's revenue budget was Tk1293 million and development budget Tk9663 million. Total staff strength was 10,956 including 1500 engineers (ratio of engineers to expenditure of 1:Tk7.3M).

However, as the result of a 1997 study, BWDB is undergoing drastic re-organisation that seeks to privatise the Mechanical/Engineering Workshops and reduce staff numbers to less than 9000 by 2001 through progressive retirement.

BWDB has been reconstituted in July 2000 under a new Act that repositions the organisation and aligns its responsibilities to those set out in the NWPO. A key element of the new Act is the establishment of a Board of Directors, who are responsible for setting policies and strategies governing BWDB activities, as well as overall management. The new Board is headed by the Minister for Water Resources, and comprises four Secretaries, Director General WARPO, Director General BWDB and four appointed members from outside Government. The former Chairman BWDB has been designated as the new Director General, and the former five Members as Deputy DG's. This change separates policy from day-to-day operation, and distances the new BWDB from the Ministry of Water Resources. These will serve to increase the accountability of the organisation and should streamline decision taking.

The Act removes any overlap between BWDB and WARPO with regard to planning responsibilities. WARPO is entrusted with preparing national and regional level plans. It is envisaged that BWDB and others would then develop projects that would fulfil the requirements of the plans. BWDB is also a major collector of water resources information and as such will be an important partner to WARPO in sustaining the NWRD.

2.5.2 Mandate

Under the BWDB Act, the Board is empowered, inter alia, to exercise the right to control the flow in all channels and rivers, underground aquifers, develop standards and guidelines for water management structures, levy and collect charges in FCDI schemes, undertake projects and sign

contracts.

The functions of the Board include construction water management structures, dredging and re-excavation of channels, land reclamation works, river training and erosion control, construction and maintenance of coastal embankments, and rain water harvesting. It is also responsible for flood and drought forecasting, hydrological survey and investigations, research, establishment and training of water user associations and other stakeholder organisations.

Organization chart of BWDB associating with MoWR and WARPO is presented in Figure A2.3-1.

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2.6 FFWC: Flood Forecasting and Warning Centre

2.6.1 Overview of Present Status

(1) Historical Background

Flood forecasting and Warning Centre (FFWC) of Bangladesh Water Development Board (BWDB) was established as a permanent entity in 1972. Since its inception UNDP, WMO supported different activities of FFWC through different projects till 1992. During the period 1991-1995 the center again received assistance from DANIDA through a component of the Flood Action Plan (FAP), to improve and expand the flood forecasting and warning services. Currently DANIDA assisted project "Consolidation and Strengthening of Flood Forecasting and Warning Services" is under implementation for the period January 2000 to December 2004. The project has started functioning from mid January 2000.

During early period till 1990, the centre used to forecast flood by Co-axial correlation, gauge to gauge relation and Muskingum-Cunge Routing Model. From 1991 onwards the forecasting activities at FFWC have been based on the flood modeling technology developed by the Danish Hydraulic Institute (DHI) with the support service from the Surface Water Modelling Centre (SWMC) in Dhaka. Today the forecasting and warning services are carried out by the expertise/staffs of FFWC using the MIKE 11 and FLOOD WATCH modelling systems.

The recent flood of 1998 was of unprecedented magnitude and duration causing colossal damages to life, property and infrastructure in Bangladesh. The services of the FFWC were very much effective in disseminating accurate flood information and forecasts efficiently. The information was used by various organisations: national and international relief operators, the Water Board itself and many Government and non-government agencies.

However due to the limited scope of the centre itself, the services were limited to the following:

- the flood forecast and warning covered only the northern regions of Bangladesh at 30 points till the major and secondary river systems,
- the forecast accuracy and lead time has been constrained by the lack of data and rainfall forecast in upper catchments in India,
- area inundation forecasts were indicative, based on a coarse model and old topographic maps,
- Thana level flood maps were provided based on assumptions of the effect of river proximity,
- information on flash floods was limited for the non-availability of data at close intervals, and
- limitations of dissemination to the public was due to fact that information were sent regularly only to Radio and TV news & News Agencies.

FFWC is working as the focal point in respect of monitoring the natural disaster and disseminating information of disaster and calamities to BWDB's field offices and related organizations since long past. After the flood of 1988, the need for modernization and up-gradation of the Centre was

realized and modern techniques of flood monitoring have been introduced with the aid of computerized programs and models. Flood Forecasting messages issued from the Centre during the flood 1998 had remarkably appreciated by the different Government Agencies, National and International Organizations, Scientists, News Media, Radio, Television of both National and International level.

(2) Activities

The main activities of the center are the following:

- Collection, entry, checking and processing of hydro-meteorological data
- Automated generation of bulletin
- Daily river situation including warning messages & forecast
- Model operation and forecast preparation
- Flood map generation
- Dissemination of the products to all concerned sectors.

(3) Collection of data & information

The Centre collects data from more than 60 water level stations and 55 rainfall stations through 60 single site band (SSB) wireless sets and over telephone throughout the country. The following data and information are collected:

- a) Five times water level at 3-hour interval (6 A.M to 6 P.M) from 60 BWDB's stations including experimental hourly water level data of 14 stations through telemetry system for flash flood forecast.
- b) Daily rainfall from 55 stations is received regularly.
- c) A detail weather forecast report is received everyday from BMD through teleprinter, which provides next 36 hours weather forecast with extended outlook for next 2-5 days.
- d) A surface chart with pressure isolines is received through FAX from BMD, which contains low & high-pressure isolines over the Indo-Bangladesh subcontinent and its adjoining areas.
- e) NOAA-12 and NOAA-14 picture are received through satellite receiver. Due to some technical problem NOAA-15 picture can not be received at present. NOAA-12 is received daily in the morning and evening while NOAA-14 is received at noon and mid-night. Satellite tracking is accomplished by the software Qtrack(1.31). This program control the satellite movement, their present location, access time, duration and the area covered during the pass of the satellite. The raw data are processed with the image processing software WJNCIPS (4.3).
- f) BMD RADAR pictures are received from 4 different locations (Dhaka, Rangpur, Cox's Bazar and Khepupara) of the country through on line dedicated RADAR display unit at FFWC. These

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Radar stations transmit cloud information at every 2-3 minutes interval.

Each Radar station covers a circular area of 300-KM radius.

g) Weather forecast, Surface pressure charts, Media Charts, Marine forecast, Storm Warning messages and Mean Sea level pressure charts are browsed from on-line internet connection with BMD. The web-site also includes GMS satellite image in different channel update hourly.

h) FFWC receives satellite imagery of Japanese satellite GMS (Geo-stationary Meteorological Satellite) through FAX from SPARRSO which provides information and cloud distribution over a large area.

i) Actual water levels as well as forecast water levels (at Farakka on the river Ganges, Goalpara/Dhubri on the river Brahmaputra, Silchar on the river Barak and Domohoni on the river Teesta) and rainfall from India are received at BMD through Global Telecommunication system (GTS) which are then transmitted to the FFWC through a dedicated teleprinter link. Data transmission from India are very limited and the transmission will be started whenever the water level is at or below the warning stage i.e. one meter below danger level and rainfall exceeds 50.0 mm.

j) Heavy rainfall forecast from Alipore Meteorology Office are received through BMD.

Normally, the water level and rainfall data are registered before 10 AM each day. The data are then entered into the computer, checked and stored in the database. These data are used for the preparation of the 'Statistical Statement of Water Level & Rainfall', 'Rainfall and River situation Summary' as well as forecast formulation.

(4) Forecast formulation

Earlier before 1990, forecast for six locations viz. Bahadurabad, Serajganj, Aricha, Goalondo, Bhagyakul and Hardinge Bridge on the Ganges-Brahmaputra System were issued by Co-axial correlation, gauge to gauge relation and Muskingum-Cunge Routing Model. After the devastating flood of 1987 and catastrophic flood of 1988, it was deeply realized that the forecast formulation should be introduced in the process of river modelling. In view of the above, the simulation model MIKE11 developed by Danish Hydraulic Institute (DHI) was installed at FFWC and a special version of MIKE11-Super model is in operation for forecast formulation.

The direct input to the model are real-time water level and rainfall as well as estimated water level & rainfall to the model boundaries for the next 24 hours, 48 hours & 72 hours. At present the Centre issues river stage forecasts for 30 stations out of which 10 established stations viz. Chilmari, Bahadurabad, Serajganj, Aricha, Goalondo, Rajshahi, Hardinge Bridge, Bhagyakul, Mymensingh and Dhaka issued in the daily bulletin for 24 hours & 48 hours. Forecasts are formulated for lead time of 24 hours, 48 hours and 72 hours.

(5) Generation of Thana Status Maps

Thana flood status maps are very powerful media to visualize the extent and severity of flooding and for disseminating information in an easily understandable format. Thana status map displays the flood status of all Thanas for any day associated with super model forecast simulation. Thana flood status maps are based on difference between water level and danger level. At present FF&WC can generate coarse flood maps upto the extent of Thana level which are proved to be very helpful for the policy maker and government high officials.

(6) Reports & Others

Apart from the monsoon flood bulletins, FFWC issues 'Weekly Dry Season Bulletin' in the dry months from November to April. The bulletin contains WL & RF for limited stations and are disseminated to the concerned offices.

Special flood report during flood time containing forecast, flood maps, hydrographs, extended outlook for next 7 days (qualitative) and BWDB's damages and losses information were prepared and distributed to the high officials. Monthly flood report from May to September and Annual Flood Report are also prepare and distributed by the Centre.

(7) Dissemination

The preparation of output bulletins viz. Statistical Statement of Water Level & Rainfall and 'River Situation Summary' including forecasts and warning messages are completed around 12:00 AM. Once the river situation and forecast has been prepared, it is disseminated to the followings (complying Standing Orders for Flood).

- (1) President's and Prime Minister's secretariat.
- (2) News Agencies
- (3) Radio & TV
- (4) Public Information Department
- (5) Ministry of Relief & Rehabilitation
- (6) Concerned Government Officials
- (7) Concerned Water Development Board's Officials
- (8) Field Wireless Stations (to inform Water Development Board's Officials, when the river crosses danger level at that point)

(8) Mode of communication

- (1) E-mail
- (2) Internet website
- (3) FAX
- (4) Over telephone
- (5) Messenger

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(6) Wireless

(9) Conclusion

Total protection of flood is not either possible nor it is feasible. We have to live with flooding. During flood, the early warning system can help lot to mitigate flood hazards and to take appropriate protective measures like evacuation of affected people, movable properties and safety of the structure.

Dissemination of flood warning messages to the target people at the proper time is very important. Till now dissemination activities are limited to such extent as to fulfil the duty of high officials, policy makers, news media and researcher only. Through the ongoing project "Consolidation and strengthening of flood forecasting and warning services" the center has a target to cover the whole flood prone area of the country under the flood forecasting model. Easy understandable forecast preparation for the flood prone people and disseminate the warning messages at grass root level through local bodies, News Papers, NGO's, Radio, TV and by other agencies in proper time is the prime target.

2.6.2 Brief Description

(1) AT A GLANCE

- Established as a permanent entity at 8th floor WAPDA building, Motijheel, Dhaka, in 1972.
- Chief Engineer, Hydrology and Director, Processing & Flood Forecasting as controlling office.
- Total manpower: 22
- Received UNDP/WMO assistance from 1981 to 1986 and 1989 to 1992.
- Danida (Denmark) technical & financial assistance from 1995 to 1997
- Currently implementing a 5-year consolidation and strengthening programme with Danida support. Main consultant: DHI
- Operates "Flood Information Centre" as focal point in connection with Disaster Management both for Cyclone & Flood

(2) FUNCTIONS

A. Data collection

- data (HF Wireless network, 67 stations)
- Mobile telephone (3 stations)
- Telemetry System (14 stations)
- Satellite Imagery (GMS, NOAA-12 & NOAA-14)
- On-line data from Bangladesh Meteorological Department, including satellite and rainfall

radar data

B. Satellite Imagery

- Reception of NOAA-12 and NOAA-11 images via direct acquisition facilities
- Monitoring of cloud & depression movements, precipitation estimation from cloud temperature analysis
- Cyclone monitoring

C. Real Time Data Management

- GIS based map display showing water level and rainfall status (Flood Watch)
- Data entry & processing
- Automatic data exchange to and from forecasting model
- Display of forecast water levels and discharges
- Automatic generation of flood forecast bulletins
- Generation of flood status at local administrative unit (thana) level
- Automatic statistics generation

D. Flood Forecast Model

Basis: - One dimensional fully hydrodynamic model (MIKE 11 HD) incorporating all major rivers and floodplains. This is linked to a lumped conceptual rainfall-runoff model (MIKE 11 RR) which generates inflows from catchments within the country.

Details:

- Catchment Area = 82,000 sq. km.
- Total length of modelled rivers = 7270 km.
- No. of catchments = 216
- Total number of forecast stations = 30
- Inflow boundaries (at international border) = under study
- Flood maps generated from model results via GIS link to model (MIKE 11 GIS)

(3) OUTPUT

- Daily monsoon bulletin & river situation report
- River level forecasts for 24, 48 and 72 hours
- Current warning messages
- Special flood situation report
- Thana inundation status map
- Flood forecast maps
- Monthly flood report
- Dry season bulletin (weekly)
- Annual Flood Report

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(4) DISSEMINATION

A. Media

- Internet
- Email
- Fax, Telephone & Wireless
- Radio & Television

B. Destination

- President's Office
- Prime Minister's Office
- Ministry of Water Resources
- Ministry of Relief & Rehabilitation
- Disaster Management Bureau
- Army Headquarters
- Public Information Department
- Government Departments
- News Agencies - Radio & TV
- NGO's & International relief organisations (MSF, Red Cross)
- Foreign embassies and consulates in Dhaka
- Field Wireless Stations
- And other places as directed by Disaster Management Bureau

(Source of Brief Description: FFWC website About us)

2.6.3 Website Information

FFWC has reinforced its website activities for dissemination of real time flood related information and up-to-date hydrological/meteorological data. Table A2.6-1, Table A2.6-2 and Figure A2.6-1 are cited from FFWC website for reference sake. Figure A2.6-2 indicates the general work flow of FFWC operation.

Table A2.6-1: Danger Level and Recorded Highest Water Level

(Unit: m PWD)

River	Station	Recorded Maximum	Danger Level (m)	Peak of the Year (m)		Days above Danger	
				1998	1988	1998	1988
Dhalia	Kurigram	27.50	26.50	27.22	27.25	30	16
Teesta	Dalia	52.97	52.25	52.20	52.89	NA	8
Teesta	Kaunia	30.52	30.00	29.91	30.43	NA	38
Brahmaputra	Noonkhawa *	28.10	27.89	27.35	NA-	NA	2
Brahmaputra	Chilmari *	25.06	24.00	24.77	25.04	22	15
Jamuna	Bahadurabad *	20.62	19.50	20.37	20.62	66	27
Jamuna	Serajganj *	15.12	13.75	14.76	15.12	48	44
Jamuna	Aricha *	10.58	9.14	10.76	10.58	68	31
Old Brahmaputra	Jamalpur *	18.00	17.00	17.47	17.83	31	8
Old Brahmaputra	Mymensingh	14.02	12.50	13.04	13.69	33	10
Buriganga	Dhaka	7.58	6.00	7.24	7.58	57	23
Lakhya	Narayanganj	6.71	5.50	6.93	6.71	71	36
Turag	Mirpur	8.35	5.94	7.97	NA	70	NA
Turag	Tongi	7.84	6.08	7.54	NA	66	NA
Kaliganga	Taraghat	10.39	8.38	10.21	10.39	66	65
Karatoa	Panchagarh	72.65	70.75	71.08	70.95	3	1
Punarbhaba	Dinajpur	34.40	33.50	34.09	34.25	3	4
Mahananda	Chapai Nawabganj	22.25	21.00	23.01	21.98	60	32
Little Jamuna	Naogaon	15.63	15.24	15.48	NA	17	NA
Padma	Pankha	22.97	21.50	24.14	NA	66	NA
Padma	Rajshahi	20.00	18.50	19.68	19.18	28	24
Padma	Hardinge Bridge	15.04	14.25	15.19	14.87	27	23
Padma	Goalundo	9.83	9.83	10.21	9.83	68	41
Padma	Bhagyakul	7.58	7.58	7.50	7.43	72	47
Gorai	Gorai Rly Br	13.65	13.65	13.45	13.65	25	25
Surma	Kanaighat	15.26	13.20	15.00	15.10	73	75
Surma	Sylhet	11.95	11.25	11.72	11.95	14	21
Surma	Sunamganj +	9.46	8.25	8.90	9.30	56	62
Kushiyara	Amalshid +	18.28	15.85	17.61	17.50	54	65
Kushiyara	Sheola +	14.33	13.50	14.14	14.09	37	80
Manu	Manu Rly Br +	19.39	17.07	18.63	18.95	6	66
Manu	Moulvi Bazar +	13.25	11.75	11.68	13.01	NA	25
Khowai	Habiganj +	11.55	9.50	11.44	11.00	8	14
Someswari	Durgapur +	15.15	13.00	13.92	14.31	7	30
Upper Meghna	Bhairab Bazar +	7.66	6.25	7.33	7.66	68	68
Gumti	Comilla	13.56	11.75	12.90	12.79	11	17
Muhuri	Parshuram	14.85	13.00	14.60	12.42	9	48
Halda	Narayangat	18.25	14.63	16.57	NA	21	NA
Halda	Panchpukuria	11.55	9.50	10.44	10.05	4	6
Sangu	Bandarban	20.38	15.25	15.25	16.80	1	3
Sangu	Dohazari	9.05	7.00	7.42	NA	2	NA
Matamuhuri	Lama	15.45	12.25	13.05	12.18	2	NA
Feni	Ramgarh	21.41	17.37	17.50	NA	1	NA

Remarks: * Char Area + Haor Area

(Source: FFWC website)

Table A2.6-2: Recorded Highest Rainfall during Wet Season

(Unit: mm/month)

Basin: Brahmaputra										
Station	May		June		July		August		September	
	Max.	Nor.	Max.	Nor.	Max.	Nor.	Max.	Nor.	Max.	Nor.
Kurigram	646.7	343	1433.7	502	969.3	519	722.5	291	678.1	348
Dalia	646	329	861.9	595	1137.5	751	1247.5	570	634.2	470
Kaunia	795.1	334	1155.7	504	1554.5	594	729.9	345	1046	366
Rangpur	486.7	280	987.6	449	1378.4	490	610.1	318	696.5	347
Chilmari	682.2	326	1139	480	1265.8	496	834.4	299	728.8	270
Dewanganj	586	310	984.2	425	1158.2	503	618.7	377	742.1	306
Gaibandha	463.6	270	820.4	418	680	387	593.8	288	762.6	231
Jamalpur	1114.9	274	953.5	455	864.5	489	702.2	361	509.3	312
Mymensingh	801.1	330	888.9	468	891	531	800.1	362	714.3	336
Dhaka	754.5	260	678.2	376	673.1	360	704.8	337	607.4	232
Basin: Ganges										
Station	May		June		July		August		September	
	Max.	Nor.	Max.	Nor.	Max.	Nor.	Max.	Nor.	Max.	Nor.
Panchagarh	-----	-----	980.3	445	1440.2	891	1604.2	572	535.9	398
Dinajpur	440	195	631.8	336	990.3	495	892.7	366	604	295
Pabna	396.6	189	584.7	279	577.3	290	639	264	541.7	222
Naogaon	-----	-----	771.1	300	-----	-----	858.9	289	616.3	237
Rajshahi	220.1	130	662.4	251	893.6	345	537.8	251	650.7	253
Kushtia	390.4	186	989.3	251	439.4	297	774.8	268	381	197
Jessore	318.5	180	739.6	316	702.1	353	751.1	314	560.9	253
Khulna	360.2	183	630.7	354	638.3	346	666.2	347	692.1	236
Satkhira	270.2	102	808.9	310	679.7	399	548.8	332	940.3	326
Faridpur	560.6	245	797.8	366	660.9	335	650	289	524.8	269
Barisal	520.5	211	895.4	437	1116.8	416	994.2	398	719.1	313
Patuakhali	694.7	244	1166	590	1269.2	611	1049.8	551	886.3	395
Basin: Meghna										
Station	May		June		July		August		September	
	Max.	Nor.	Max.	Nor.	Max.	Nor.	Max.	Nor.	Max.	Nor.
Kanaighat	1428.5	872	1119	872	1072	755	1227	763	998.3	769
Sylhet	1270	547	1609.5	903	1820.2	824	1152.2	637	1218.2	537
Sunamganj	1218.4	548	2465.7	1060	2097.3	1402	2514.7	1089	1130.3	733
Sheola	1294.5	541	1714.3	905	1220.5	748	850.6	561	853.3	470
Moulvi Bazar	1236	426	1092.9	534	724.4	441	666.9	393	486.6	289
Manu Rly Br	450.8	587	884.9	579	643.1	413	520.6	406	640	462
Habiganj	1000.5	446	987.1	493	816.1	417	955.5	398	497.8	263
Durgapur	911.9	414	1242.1	707	1862.3	807	1093.7	617	1525.2	533
Bhairab Bazar	-----	-----	752.4	411	638	404	526.3	337	534.7	276
Comilla	791.2	310	1049	429	1144	470	692.2	566	570.5	257
Chandpur	529.8	255	656.5	393	840.7	373	588.6	334	602	235
Basin: South Eastern Hill										
Station	May		June		July		August		September	
	Max.	Nor.	Max.	Nor.	Max.	Nor.	Max.	Nor.	Max.	Nor.
Parshuram	871.6	307	912.8	477	1133.6	576	671.1	410	378.5	236
Narayanhat	597.5	255	1110	581	1446	747	928.1	584	497.9	267
Panchpukuria	679.8	241	1256.3	576	1201.9	702	860.3	478	493.5	236
Bandarban	519.2	251	938.8	576	1345.4	703	911.1	464	574.2	247
Rangamati	784.6	286	1420.2	780	1491.7	642	1377.9	507	436.8	289
Lama	602.2	256	1306.2	710	1809.5	800	1048.7	571	662.2	319
Chittagong	545.3	247	1472	613	1527	816	1086.9	548	638.8	275
Ramgarh	994.4	280	1696.9	609	1539	626	1075.7	467	472.3	260

(Source: FFWC website)

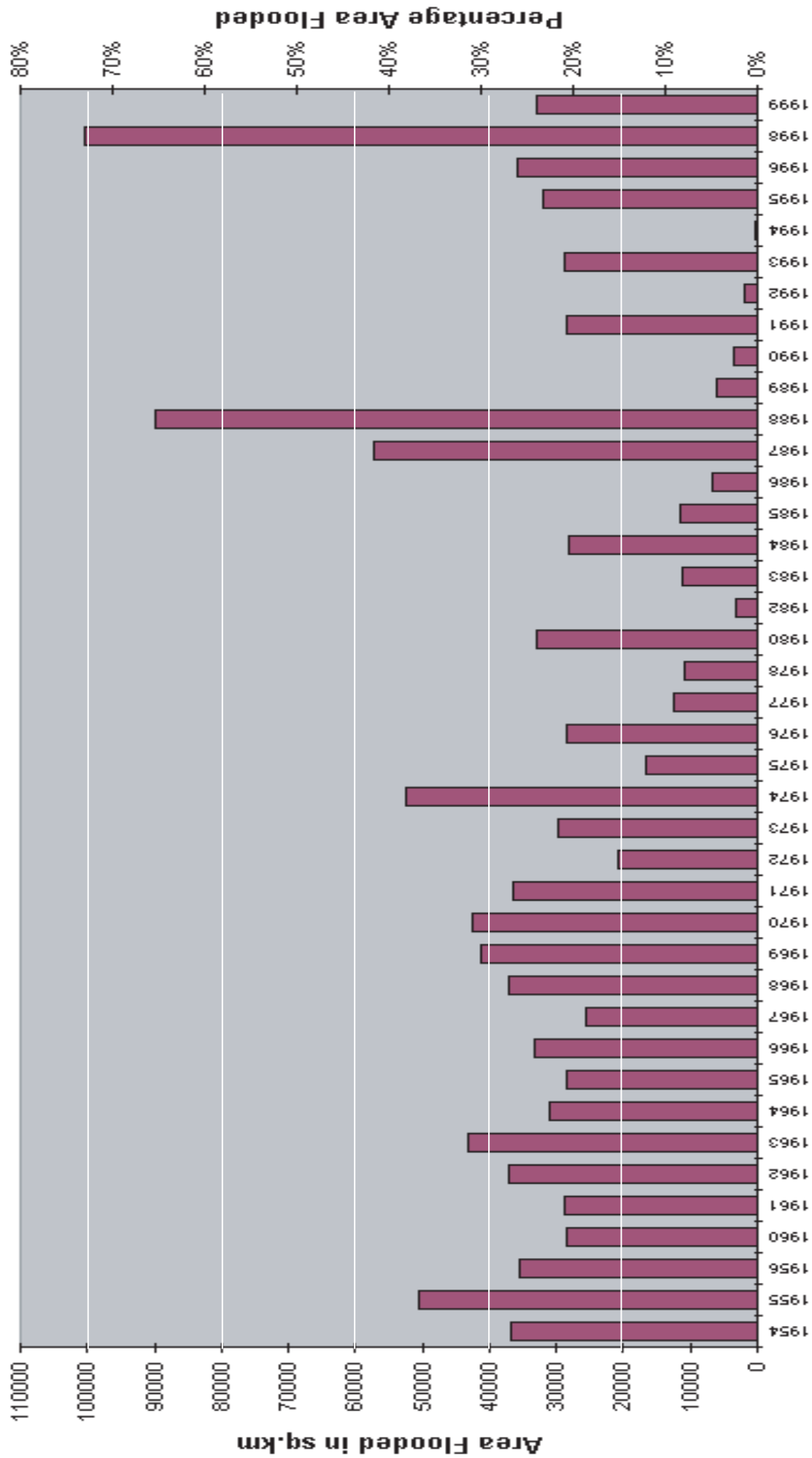


Figure A2.6-1: Historical Flood Extents in Bangladesh

(Source: FFWC website)

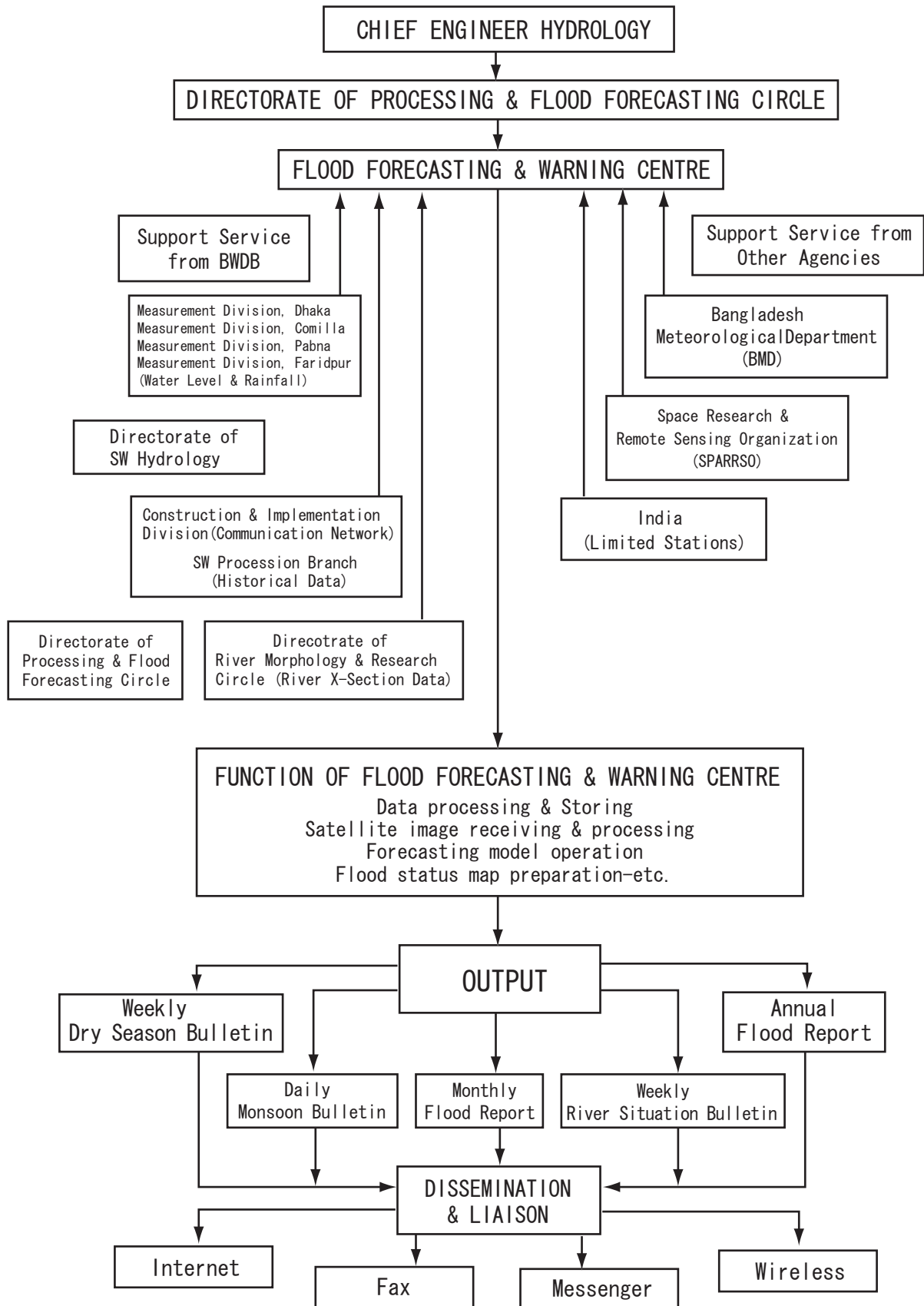


Figure A2.6-2: General Flow Chart of FFWC Operation

2.7 WARPO: Water Resources Planning Organization

2.7.1 Background

The Water Resources Planning Organization (WARPO) is an agency of the Government of the People's Republic of Bangladesh under the Ministry of Water Resources. WARPO came into being in June, 1992.

WARPO is a key organization of the Government dealing with nation wide water resources planning and management and, thus, forming an apex body in the water sector. WARPO is responsible for three main assignments. First, it will prepare and update National Water Management Plan. Second, it will update and maintain a National Water Resources Database. Third, WARPO will act as a clearing house for all water sector projects undertaken by any agency involved in the water sector. WARPO is a multi-disciplinary organization with a team of some 35 professionals from a wide range of disciplines.

Presently, WARPO is engaged in preparing a National Water Management Plan and setting up the National Water Resources Database.

The alluvial soil of Bengal delta inundated and/or flooded annually from time immemorial produced enough food for the population of the region. However, with the passage of time and increase of population, the damaging effects of flood and need for dry season irrigation started gaining prominence.

After the consecutive floods of 1954 and 1955, in the then East Pakistan, as per recommendations of a UN Mission the East Pakistan Water and Power Development Authority (EPWAPDA) was created in 1959. A Master Plan was prepared by EPWAPDA in 1964 which an IBRD mission in 1966 thought was based on insufficient data and was over ambitious. But the Plan continued to provide direction for identifying water-sector projects of EPWAPDA and its successor the BWDB. A joint GOB-World Bank Mission in 1970 recommended that a new Master Plan (National Water Plan-NWP) was needed for assessment of availability and demands of each sector of water use.

The government then created the Master Plan Organization (MPO) under the Ministry of Water Resources in 1983. The NWP-I was completed in 1987 and was updated as NWP-II in 1991. But the plan was never either accepted or rejected by the Government. In June 1992 MPO was renamed as the Water Resources Planning Organization (WARPO) and the mandate for the organization was published in Bangladesh Gazette on the 22nd December 1991. The Water Resources Planning Act (Act no XII of 1992) provides the legal framework for the Organization.

Meanwhile the severe floods in 1987 and 1988 triggered a remarkable response from the international community and 16 donor countries came forward to finance the Flood Action Plan (FAP) with 11 main and 15 supporting studies including 2 pilot projects on FCD and river bank protection respectively. The Flood Plan Coordination Organization (FPCO) drew together the

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findings of the various studies under FAP which led to the preparation of Bangladesh Water and Flood Management Strategy which was approved by the government in 1995. From 1990 to 1995 when FAP studies were being undertaken with vigor and perhaps some fanfare WARPO remained a more or less dormant organization. But after the adoption of the Water and Flood Management Strategy, the government decided to abolish FPCO and merge it with WARPO in January 1996 giving it a new lease of life and the responsibility of preparing a new National Water Management Plan (NWMP) and a National Water Sector database.

The National Water Policy (NWPo), published in January 1999, establishes a clear role for WARPO as an apex planning body in the water sector. WARPO will also act as a secretariat to the Executive Committee to the National Water Resources Council.

To align with its new responsibilities, WARPO's mandate is being revised; the organization is being restructured, establishing the necessary information and analytical tools within WARPO; steps are being taken to create a better working environment.

WARPO is now all set to prepare the National WATER MANAGEMENT PLAN.

2.7.2 Legal Basis of Activities

There are two sources in WARPO's activities; one is Act No.12 of 1992 as described below and the other is NWPo, 1999 which is attached to the Appendix as Document AA1.

The Water Resources Planning Act (Act No. 12 of 1992) provides the legal framework for WARPO and there is provision in Article 23 to enact the Rules and Regulations which were gazetted on 27th February 1996. WARPO's roots however lie in the Master Planning Organization (MPO) established in 1983. Evolution to the current organisation has been as follows:

- (1) MPO established and responsible for the National Water Plan (NWP) completed in 1987, and followed by a two year bridging period in 1987-89;
- (2) at the end of the "bridge", all staff were sent back to their parent organisations
- (3) a second National Water Plan (NWP II) started in May 1989, with new staff drafted into MPO in October 1989;
- (4) NWP II was completed in 1991 and most staff were again returned to their parent organisations with only 6 or 7 officers remaining;
- (5) MPO became WARPO in June 1991 and a mandate for the organisation was gazetted on 22th December 1991;
- (6) apart from some UNDP funds in 1992, WARPO was both under funded and under-utilised for a number of years;

(7) Flood Plan Go-ordination Organisation (FPCO) was established in 1989 to manage the FAP projects identified following the disastrous floods of 1988;

(8) FPCO merged with WARPO in January 1996 - WARPO offices at Dhanmondi were vacated and staff moved to the FPCO offices at Green Road, which then changed its name to WARPO;

(9) WARPO moved to new office at Mohakhali in April 1998, at the start of NWMP, and in July 1999 moved again to more suitable premises in Gulshan.

Thus, the WARPO organisation at the start of NWMP (April 1998) had lost much of its institutional memory as a result of constant changes of organisation, staff and even office location.

2.7.3 WARPO Responsibilities under NWPo

A mandate for WARPO was gazetted in December 1991, but no longer reflects the organisation's new vision and responsibilities. In consequence a new mandate is under preparation but, unlike the NWPo, has not yet been finalised. Nevertheless, WARPO's responsibilities are stated in §4.02a, b and §5.00d of NWPo and include:

- Delineating the hydrological regions of the country based on appropriate natural features for planning their water resources.
- Providing administrative, technical and legal support to the ECNWRC.
- Advising the ECNWRC on policy, planning and regulatory matters of water resources and related land and environmental management.
- Preparing and periodically updating the National Water Management Plan for NWRC approval.
- Setting out and updating the National Water Resources Database (NWRD) and Information Management System.
- Acting as a "clearing house" for all water sector projects identified by different agencies and reporting to the ECNWRC on their conformity to the NWMP.
- Undertaking special studies, required by the ECNWRC, to fulfil the objectives and programmes envisaged in the NWPo and the Bangladesh Water and Flood Management Strategy.
- Performing any other function as may be assigned to it from time to time by the Government.

The NWPo in §4.02m further implies that WARPO will be responsible for delineating water stress areas based on land characteristics and assessing water availability from all sources for managing dry season demand.

The present organisation of WARPO and the structure needed for it to fulfil its obligations to the water sector are presented in Section 16 of NWMP.

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2.7.4 Discussion Documents

WARPO is preparing consultation documents as part of the process for preparation of the National Water Management Plan (NWMP).

Topic Paper 1: Defining the Issues

Topic Paper 2: Economic Setting

Topic Paper 3: Social and Gender Issues

Topic Paper 4: Environmental Setting

Topic Paper 5: Institutional Setting

Topic Paper 6: Legacies and Lessons

Topic Paper 7: Land and Water Resources

Topic Paper 8: Water and Basic Human Needs

Topic Paper 9: Regulatory and Economic Instruments

Topic Paper 10: Managing Data

Topic Paper 11: Managing the Environment

Topic Paper 12: Managing in the Monsoon Season

Topic Paper 13: Managing in the Dry Season

Topic Paper 14: Managing Land and Rivers

Topic Paper 15: Major Investments

Topic Paper 16: Strategy Alternatives

Topic Paper 17: Planning and Process

Topic Paper 18: Conclusions

2.8 RRI: River Research Institute

2.8.1 Brief Description

River Research Institute (RRI) is a national institute with the mandate of a statutory Public Authority working under the Ministry of Water Resources, Government of the People's Republic of Bangladesh. The Institute is headed by a Director General. RRI has three research Directorates. The scope of works comprises conducting of multidisciplinary tests and research in the fields of River Engineering, Hydraulics, Soil Mechanics, Concrete Technology, Material Testing & Quality Control, Sediment Technology, Hydro-Chemistry, Geo-Chemistry, Physical & Mathematical Modelling etc.

RRI was founded in January 1977 at Dhaka. Hydraulic Research Laboratory established in 1948 at Dhaka was merged with RRI with all assets and liabilities. RRI was shifted from Dhaka to Faridpur, 140 km. away, on 1st July 1989. The World Bank, UNDP and DANIDA played vital roles in the construction of infrastructure, procurement of equipment, training of personnel and transfer of technology. The sanctioned personnel of RRI comes to about 250 as of July 2001.

The following three Directorates of RRI are described in the subsequent sections.

- Hydraulics Research
- Geotechnical Research
- Technology and Services

2.8.2 Research Disciplines of Hydraulic Research Directorate

The objective of this Directorate is to conduct tests and researches on river engineering problems including estuarine and coastal hydraulic problems by means of physical & mathematical modelling for which the following facilities are available:

Open Air Model:

Physical model flumes-8 nos: Total area 250m x 130m
Pumping capacity to run models: 2 cum/s (60% efficiency)

Indoor Model:

2 nos 100m x 30m permanent model sheds with wave basin and river flume beds alongwith a tilting flume.

Hydraulic Research Directorate consists of the following three research disciplines.

- **River Hydraulics:**

This discipline conducts studies & research in the fields of flood control & drainage, bank

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protection & stabilisation, sedimentation & navigation etc. by means of physical scale models & supported by mathematical models, where necessary.

- **Estuarine and Coastal Hydraulics:**

This discipline conducts studies & research regarding tidal estuary system, coastal & harbour engineering, saline intrusion & land reclamation etc. by means of physical scale models & supported by mathematical models, where necessary.

- **Hydraulics of Structures & Irrigation:**

This discipline conducts studies & research regarding hydraulics of structure like barrages & dams, regulators & sluices, bridges & culverts and irrigation systems by means of physical scale models supported by mathematical models, where necessary.

2.8.3 Research Disciplines of Geotechnical Research Directorate

Geotechnical Research Directorate comprises the following four research disciplines.

- **Soil Mechanics:**

This discipline is capable of performing consolidation test, direct shear test, triaxial shear test, vane shear test, unconfined compression test, compaction test, permeability test, CBR test, apart from simple identification tests to determine the characteristics of soils to be used as foundation supporting and construction materials.

- **Concrete Technology:**

This discipline deals with quality control of concrete and concrete materials. It also runs Trial Mix Design to attain particular design strength with materials to be used in the construction.

- **Sediment Technology:**

The main function of this discipline is to determine the quantity and character of suspended sediment and bed materials transported by a flowing river and solve erosion and deposition problems.

- **Water Quality:**

This discipline is capable of determining 30 parameters of water (both inorganic & organic, specific & non-specific) such as pH, Macro and Microions, nutrients, Dissolved Oxygen, BOD, COD etc.

2.8.4 Technology and Services Directorate

Technology and Services Directorate is responsible for rendering Common and Specialized services to the other two Directorates of RRI.

The services include:

- Equipment & Transport
- Campus & Workshop Facilities
- Library & Publications
- Computer Facilities
- Mathematical Modelling

A small computer centre equipped with a modest resume of hardware and software facilities has been established for conducting the multitasking job under this directorate.

2.8.5 Surface Water Modelling Centre (SWMC)

SWMC has started to function since early 1980 and by now has developed-a) A General Model comprising the major river-systems with their major incountry tributaries and distributaries; b) Five nos. Regional models and several submodels comprising the regional river systems and subsystems respectively. Through the extensive application of its models specially in several Flood Action Plan studies, Surface Water Simulation Modelling Programme has established that the models are essentially very powerful tools for planning, design and management of water resources on an integrated multi-sectoral approach to flood control, drainage, irrigation, inland navigation, pisciculture, road and rail communication and environment.

2.8.6 RRI Involved Some Projects since 1989

- Jamuna Bank Protection at Bahadurabad & Kamarjani
- Bank Protection of Sangu River at Dohazari
- Protection of Gorai Railway Bridge
- Teesta Barrage Project
- Coastal Embankment Project
- Dhaka City Protection Project
- Kurigram Town Protection Project
- Protection of Bhairab Railway Bridge
- Brahmaputra River Training Study
- Meghna River Bank Protection Study
- Jamalpur Priority Project Study

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- Barnai Project
- Secondary Towns Integrated Flood Protection Project
- Meghna Dhanagoda Project
- Compartmentalization Pilot Project
- Sirajgong Town Protection Project.

2.8.7 Some of the Clients of RRI

Local

- Bangladesh Water Development Board
- Bangladesh Power Development Board
- Bangladesh Agricultural Development Corporation
- Bangladesh Inland Water Transport Authority
- Roads & Highways Department
- Civil Aviation Authority
- Flood Plan Coordination Organization
- Bangladesh Railway

Foreign

M/S Halcrow & Partners, U.K.

M/S Haskoning, The Netherlands

M/S SOGREAH, France

M/S Consulting Consortium, France-Germany-Netherlands

This Chapter is based on the Brochure published by the Director General, River Research Institute, Faridpur. January 1994

2.9 SWMC: Surface Water Modeling Centre

2.9.1 Overview

(1) Profile

Located in Dhaka, Bangladesh, Surface Water Modelling Centre (SWMC) is the centre of excellence in the region having sustainable technological capability in developing mathematical models of both surface and ground water systems. The application of SWMC modelling tools covers a wide range of water related issues such as: flood control, flood forecasting, irrigation and water resources management, river morphology, salinity and sediment transport, coastal hydraulics, environmental impact assessment and related infrastructure development.

SWMC is an independent trust established by the Ministry of Water Resources, Government of the Peoples Republic of Bangladesh. The origin of SWMC dates back to 1986 when Surface Water Simulation Modelling Programme, Phase-I (SWSMP-I) was launched by the Government of Bangladesh with the assistance of United Nations Development Programme (UNDP). The programme was aimed at implementing an advanced computer-integrated technology for simulation of rivers and flood flows in the complex surface water systems of Bangladesh.

The successful completion of SWSMP-J led to SWSMP-Tit in 1990, funded by the Government of Bangladesh (GOB) and the Danish International Development Agency (DANIDA). SWMC was established for institutionalising the transfer of related technology on mathematical modelling. SWSMP-II was followed by SWSMP-III, meanwhile SWMC began to emerge as an autonomous trust with the mandate of operating as a commercial organisation to work for national and international clients. SWMC Trust came into being in January 1997 and started operation as a self administered national organisation under Trust Act.

(2) Management

The Board of Trustees is the governing body of SWMC and gives policy guidelines to the management. Thirteen trustees have been drawn from different ministries, departments and organisations of Bangladesh and outside. They are: Ministry of Water Resources of the Government of Bangladesh, Bangladesh Water Development Board, Water Resources Planning Organisation, River Research Institute, Ministry of Finance, Ministry of Planning, Bangladesh University of Engineering & Technology, Association of Development Agencies in Bangladesh, Federation of Bangladesh Chambers of Commerce & Industry, Private Commercial Banks, National Consulting Houses and the Danish Hydraulic Institute. The day to day management is the responsibility of the Director of the SWMC, who is assisted by the deputy director and division heads. He is also a member of the Board of Trustees.

(3) Staff Resources

The staff of SWMC number more than 110, of whom 65% are engineering professionals. Of these

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professional staff 25% have a master's degree and some of them also have PhD. from leading institutes and universities in Bangladesh and abroad. The professionals are highly trained in their respective field of work. Many staff contribute to and participate in national and international seminars and conferences with technical papers. At some recent seminars and conferences, the papers presented by SWMC staff have highly acclaimed.

These is a regular training programme at home and abroad to develop their expertise in relevant fields. Senior staff are being trained in modern management techniques. some staff are currently pursuing higher studies (MS and PHd) abroad and the Centre encourages such programmes for upgrading expertise.

(4) Computer Network and Facilities

SWMC has a sophisticated computer network consisting of 6 SCO servers, 2 high powered Workstations, 3 Dec Alpha Workstations plus 9 portable Notebook Pcs and 60 entry point Desktop Personal Computers. The operating systems used are DOS, WINDOWS 97 and UNIX. It has 2 Summagraphics Microgrid Digitizers with 19.6 KVA unitary Back-up Power System. A 45 KVA generator helps the computer network to run on a non-stop basis. All the professionals are connected with on-line internet. SWMC enjoys the exclusive agency right of Danish Hydraulic Institute's (DHI) software in Bangladesh.

2.9.2 Field of Services

(1) National and Regional Models

SWMC entered the arena of mathematical modelling in 1986. Since then the entire Bangladesh has been brought under review by the method of mathematical modelling with the General Model and six Regional Models, which are calibrated each year with the latest available data. The General Model includes three major rivers - the Ganges, Jamuna and Meghna and a number of other large rivers covering the main drainage system of the country. These models have been extensively used in numerous water resources planning applications including the component studies of the Flood Action Plan which was initiated following the disastrous floods of 1987 and 1988. The country's Flood Forecasting and Warning Centre uses this model on a routine basis for generating flood level forecasts during the flood season. The General Model is also suitable for long term global planning.

The Regional Models cover the entire drainage system of the country's six regions, namely: northwest region, northcentral region, northeast region, southast region, Chittagong area, southwest region and southcentral region. These models capable of simulating the fast catchment response from foothill areas across the border, spill characteristics of the big rivers, flood plain flows in the depression areas and tidal flows in the estuaries.

These models have been calibrated and verified for the last 10 years. The regional models are being used by both local and international organisations for carrying out water resources planning

investigations at pre-feasibility and feasibility stages and also for detailed investigation of local problems. In short the regional models provide the only framework of modelling studies in water resource related issues for the country.

(2) Flood forecasting and Management

Flooding is an annual event in Bangladesh with both beneficial and adverse effects. Extreme floods cause disasters like loss of life, property and resources. With accurate flood forecasting and efficient management of facilities and resources, the damaging effects can be reduced. To mitigate the damaging effects, flood forecasting and flood preparedness are very important and should be integrated with detailed and meaningful information on water level, area and depth of flood in the flood plains either quantitatively or qualitatively.

SWMC carried out various flood forecasting projects such as:

- Real time forecasting at regional level and real time coarse area inundation forecasting for the major flood plains of the northern region in Bangladesh;
- A pilot forecasting system for two flashy rivers;
- An improved data exchange system for the countries in the Ganges-Brahmaputra-Meghna basin;
- Public awareness programme on flood warning and forecasting information;
- Training of staff and institutional improvement of the Flood Forecasting and Warning Centre (FFWC) under the Bangladesh Water Development Board.

(3) Survey, Data Acquisition and Mapping

Planning and design of water resources development projects covering large area require detailed topographical information. Up-to-date topographic maps are often scarce in a developing country like Bangladesh. SWMC utilises satellite based Global Positioning System (GPS) for surveying topographical details like; land levels, layout of drainage dividers, infrastructures and outlay of land use features. Use of GPS technology coupled with other state-of-the-art survey equipment enables SWMC to acquire highly accurate topographic data in a relatively short time compared to traditional ground survey.

SWMC represents one of the most comprehensive high quality computerised water resources, topographic and hydrometric database systems in Bangladesh, which are continually being updated through collection of routine data from various agencies and also through SWMC's own field campaign. The database contains two categories of data, Temporal and Spatial. Temporal ie. time series database comprises hydro-meteorological, climatic, salinity, water quality, sediments, ground water level data while the Spatial Database comprises topographic data, river cross-section, river and coastal bathymetry, hydro-geological, national coverage for rivers, roads and land use data. As the national custodian of all the models SWMC also possesses other historical water resources planning databases built by the FAP and other studies.

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Spatial information such as; land levels, river coverage and infrastructure are also stored in digital format via a Geographic Information System (GIS). SWMC embarked upon developing a central database system, where all types of data would be maintained under a unified operating system with the provision of data querying, plotting, extraction and interfacing with advanced GIS software.

(4) Variety of Services

In addition to mathematical modelling study, system review, detail structural design and irrigation applications, SWMC is conducting varieties of technology services such as:

- Infrastructure Development,
- River Morphology,
- Irrigation Management,
- Groundwater Management,
- Urban Drainage,
- Coastal Zone Engineering,
- Environmental Impact Assessment,
- Environmental Management, and
- Scientific Research.

2.10 EGIS: Environmental and Geographical Information System support Project for Water Sector Planning

2.10.1 Introduction

The Environment and GIS Support Project for Water Sector Planning (EGIS) is an initiative of the Ministry of Water Resources as the center for environmental and geographic information services for water and land management in Bangladesh. EGIS is a project funded by the Government of Netherlands consisting of a multidisciplinary team of individuals who study land and water management problems in Bangladesh with the help of remote sensing, geographical information system, spatial databases and environmental impact assessment.

2.10.2 Background

EGIS was formed by merging two components of the Flood Action Plan (FAP) both of which were funded by USAID in 1991. These were the Environmental Study (FAP 16) and the Geographical Information System (FAP 19).

The Environmental Study program carried out environmental studies of the Jamuna, Ganges, Meghna plains and looked at the socio-economic aspects of the char lands along these rivers. It also established a Environmental Impact Assessment guideline for the sector.

The Geographical Information System study started the establishment of a national database that incorporated information from different agencies as well as data gleaned from satellite images. It also carried out research on the morphological dynamics of the Brahmaputra Jamuna floodplain and carried out training in GIS.

When the projects finished in August 1995, the government of Bangladesh felt the need to continue the expertise developed under the two projects. It sought funding from the Netherlands government for another project that would integrate the environmental and geographic information functions. The Netherlands agreed to an 18 month initial funding until February 1997. The new project was named Environmental and GIS Support for Water Sector Planning (EGIS). In 1996 a joint mission of the governments of Bangladesh and Netherlands reviewed the activities of EGIS. The mission recommended that EGIS should be allowed to operate until December 2000 during which period it would turn itself into a self supporting independent institution.

Subsequently a new phase of EGIS started from March 1997 to December 2000, a phase called EGIS-II, to distinguish it from the initial funding period. The Dutch firm Resource Analysis was entrusted with the responsibility of carrying out the implementation of EGIS II.

2.10.3 Objectives

EGIS-II started off with the following objectives:

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- (1) To assist the Water Resources Planning Organization (WARPO) in the development of its capacities in environmental and spatial analysis for strategic planning of water resources and in the development and institutionalization of the National Water Resource Database (NWRD).
- (2) To develop and apply the organization's professional and technical capacity and capability for research, advisory services and training. Activities are structured through the following three specific objectives:
 - to establish cross-sectoral links for resource analysis and planning, and to assist agencies both within the water sector and in related sectors to enhance their capacities for spatial and resource data management and analysis;
 - to undertake data collection and management and to generate analytical and planning tools for water-related resource management in Bangladesh; and
 - to undertake research on sustainable resource management planning and to contribute to national awareness and policy making in this respect.
- (3) To establish an independent organization for spatial and environmental information management, analysis and dissemination.

The governments of Bangladesh and the Netherlands have held two joint review missions in October 1998 and October 1999. Both missions reaffirmed that EGIS should continue to support WARPO in developing its environmental and spatial analysis capabilities. Both mission also reaffirmed the support for the establishment of an independent institution to be called the Center for Environmental and Geographical Information Services (CEGIS).

2.10.4 Activities

EGIS has been meeting its objectives through a series of activities that support each objective. EGIS has helped WARPO build up the National Water Resource Database. This is one of the largest and most significant databases in Bangladesh and has incorporated many layers of information culled from government agencies engaged in sectors such as water, environment, forestry, fisheries, agriculture, engineering, roads, health engineering, statistics, water transport, water supply and sewerage, soil resources, meteorology etc.

EGIS has also helped the WARPO environmental section by locating several experts in the field of environment, fisheries, ecology and water quality to help the WARPO section in their task of setting up guidelines for the environment assessment criteria, identification of potential impacts, impact assessment of options and strategy development.

In addition, EGIS has embarked on several advisory projects under contract with clients, including major assignments from the Bangladesh Water Development Board for environmental studies for the Khulna-Jessore Drainage Rehabilitation Project and the Gorai River Restoration Project.

EGIS has carried out studies of projects such as the Early Implementation Projects, the Systems Rehabilitation Project, River Morphology, Floodplain Fisheries, etc. It is carrying out research on topics such as flood plain, river morphology, integrated environment management, metadata, estimates of boro production, near real time monitoring of floods, droughts etc. It has developed tools for the databases such as a time series viewer.

EGIS applies remote sensing and geographical information systems for supporting planning in the water sector. It also uses these tools for the purpose of environmental studies ranging from environmental profiles to the environmental impact assessment. EGIS sets up databases and trains people in the spatial analysis and environmental impact assessment.

EGIS has a network of organizations with which it works. These include the Department of Fisheries, the Water Resources Planning Organization (WARPO), the Bangladesh Water Development Board (BWDB), Bangladesh Agriculture Research Council (BARC), Survey of Bangladesh (SOB), Surface Water Modelling Centre (SWMC), the Local Government Engineering Department (LGED), the Bangladesh Bureau of Statistic (BBS) and the Space Research and Remote Sensing Organization (SPARRSO). EGIS has built up relationships with satellite companies such as RADARSAT and NRSA and is a distributor of satellite images for these companies. EGIS has a substantial program for training its staff. Staff have gone to Singapore and the Netherlands for training in GIS and remote sensing skills. EGIS has also brought in instructors from ESRI and ITC to provide training to its staff. The training facilities in EGIS include a lecture hall and a computer classroom where staff can get hands on training for their activities. EGIS now has a staff of 40 professionals and total employee strength of 70 persons.

The EGIS II project is in its final year. EGIS is now in the process of setting up the independent institution the Center for Environmental and Geographical Information Services (CEGIS). The Deed of Trust of the new CEGIS has been drawn up and has gone through several revisions. The Ministry of Water Resources has placed it before the Establishment Ministry, Finance Ministry, Planning Commission and the Law Ministry for comment. After their comments it will go to the Cabinet for approval after which the Board will be formally formed.

2.10.5 Spatial Analysis

(1) Promoter of RS and GIS

EGIS is one of the leading user and promoter of Remote Sensing (RS) and Geographic Information System (GIS) technologies in Bangladesh. The spatial analysis cluster consists of a group of highly skilled professionals who hold advanced degrees in remote sensing and GIS from reputed international academic institutions. They also have extensive experience in working in Bangladesh in remote sensing and GIS and so they are among the best GIS/RS professional in Bangladesh. These professionals have made significant contributions in their fields. This has earned them a high reputation among their peers in Bangladesh. Currently there are nine professionals working with remote sensing technology and another ten in GIS. Beside their analytical work involving RS/GIS

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techniques they are also responsible for production of reports, notes describing their work.

The spatial analysis cluster works in the Windows NT platform with ERDAS and ESRI software. The hardware support includes the digital global positioning systems, digitizers and raster plotters.

(2) Activities

The activities of this cluster include applications of RS/GIS techniques to extract information for use in characterizing earth systems and to provide support to integrated environmental studies. Some of the key applications project currently in hand includes:

- Morphological studies of the major river systems of Bangladesh,
- Near-Real-Time Flood mapping and monitoring,
- Landuse mapping and suitability analysis,
- Mapping the dynamics of the Meghna Estuary,
- Development of GIS tools to characterize Arsenic contamination,
- Landtype mapping,
- Monitoring of structures along Jamuna River using satellite images,
- EIA of Gorai River Restoration Project.

Spatial analysis cluster is also actively involved in research and development studies to investigate and establish new tools and techniques to better utilize the information extracted from images and GIS layers. Current focus of the R&D studies is on:

- Development of hydrological models for the Ganges-Brahmaputra-Meghna Basin
- GCP bank for Bangladesh,
- Application of ERS-2 images in landuse mapping,
- Development of the Mauza database,
- Development of methods for DTM of Bangladesh.

EGIS is also a reseller of images from several satellites. The spatial analysis cluster is responsible for this distributor responsibilities and works to promote the use of these images within Bangladesh. The vendors that are represented by EGIS include the National Remote Sensing Agency (NRSA, India), Radarsat International (RSI, Canada), and Space Imaging (SICorp, USA). The images sold includes Landsat TM, IRS, Radarsat and IKONOS products.

The spatial analysis cluster keeps abreast of international developments in remote sensing and GIS through collaborative research with international partners. In 1999, EGIS took the initiative to bring in a transportable Ground Receiving Station RAPIDS, to Bangladesh for receiving real-time images from ERS-2 satellite. This was funded by European Space Agency (ESA) and executed by a consortium of European companies, EGIS and the Space Research and Remote Sensing Organization (SPARRSO).

EGIS maintains a large archive of imageries from various satellites and GIS database, which are

used for the aforementioned studies. These images and database are also provided to academic institutions and other Bangladeshi government agencies to support their activities. EGIS also provides training in GIS and RS software to persons from the private and public sector. EGIS maintains liaison with international associations of RS/GIS organizations. Professionals of spatial analysis cluster frequently publish scientific articles for international conferences and journals. Currently EGIS represents Bangladesh in the International Society for Photogrammetry and Remote Sensing (ISPRS).

2.10.6 Database and IT

(1) Decision Support System

The quality of decision making, be it strategic, tactical or operational, depends to a large extent on the quality of the available information and its accessibility. Nowadays computerized decision support systems based on digital geographic information play an increasingly important role enabling better decisions to be made. The proper structure and use of these information systems has become a critical component, for example, in the strategic planning of natural resources.

The spatial information systems and databases that are emerging in this field have a long-term purpose. Their proper set-up is sure to have positive practical and financial consequences for many years to come. Through playing a leading role in many development efforts in the recent past, EGIS has acquired unique capabilities in the design, development and implementation of spatial information systems. For example, one of EGIS' core present day activities is to support the design and development of the National Water Resources Database in Bangladesh for the Water Resources Planning Organization of the Ministry of Water Resources.

(2) Resources

The EGIS resource base consists of a modern hardware/network configuration with up-to-date versions of software complimented by competent human resources. In addition, EGIS has access to international and national expertise through a network of supporting institutes.

(3) Hardware

EGIS has a unique computer base consisting of five Windows NT4 servers, 60 Pentium II computers running under Windows NT4 Workstation, two Digital Dec Alpha Workstations running under UNIX, two large raster plotters, two pen plotters, two color DeskJet printers, and four laser printers

(4) Software

EGIS uses the latest version of software for GIS, RS, database and programming. ArcInfo NT version 7.2 is used for GIS data management. For customized GIS application development, ArcView, Visual BASIC and Map Objects are used. EGIS has 10 licenses for ArcInfo NT, 16

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licenses for PC ArcInfo, 26 licenses for ArcView, seven licenses for ArcView Spatial Analyst, and development license for MapObjects, Visual BASIC, Visual C++ and Microsoft SQL Server. For image processing and analysis, EGIS has nine licenses for ERDAS Imagine. For metadata management EGIS has GeoKey 3.0. data. EGIS uses GPS surveying to geo-reference existing hardcopy maps, satellite images and aerial photos. EGIS also provides consultancies in identifying optimal survey methods.

(5) Human Resources

The core resource team consists of several senior level experts who, combined, have more than 15 years of experiences in the field of GIS, RS and database. EGIS supports this expertise with a group of young professionals with postgraduate degrees from overseas on GIS, RS and database techniques and a team of programmers with graduate degrees in computer science.

(6) International Network

EGIS has collaborative agreements with international institutes and agencies like International Institute for Aerospace Survey and Earth Sciences (ITC), Netherlands; Geodan, Netherlands; European Space Agency (ESA); National Remote Sensing Agency (INDIA); National Aerospace Laboratory, Netherlands; and Synoptics, Netherlands.

(7) Services

EGIS provides the following services in the area of database design and management:

a) System Design

EGIS provides assistance in systems design for database management systems. Services included are applications needs assessment; user needs assessment; software, hardware and platform identification; and network, software and hardware installation and configuration.

b) Data Capturing

One of the most important aspects of building a GIS database is data capturing. EGIS has experience with capturing data from most available data sources including digital and hardcopy satellite images, aerial photos, hardcopy maps, and field surveys.

c) GPS Survey

Currently, the Global-Positioning System (GPS) is being used as one of the primary method to accurately capturing positional data. EGIS uses GPS surveying to geo-reference existing hardcopy maps, satellite images and aerial photos. EGIS also provides consultancies in identifying optimal survey methods.

d) Training

EGIS conducts specialized GIS and RS software training alone and in collaboration with ESRI South Asia. EGIS is the only authorized PC ArcInfo training center in Bangladesh. Training is provided on ArcInfo for NT (Core, GRID, TIN, AML), ArcView GIS, ArcView Spatial Analyst, ArcView Avenue, ERDAS Imagine, Visual BASIC with MapObjects, and Internet Map Server.

e) Database Development

The development of large databases needs to address several critical issues including design, organization and implementation. EGIS has extensive experience in the following areas of database development: database structure design and implementation; quality assessment and refinement of existing data for satisfying organizational need; and development of data standards (accuracy, unit, format).

f) Application Tool Development

EGIS has been instrumental in the development of such application tools as decision support systems (DSS), monitoring systems, and management information systems. EGIS also has extensive experience in the customization of various software products as ArcInfo, ArcView and ERDAS for specialized applications; development of tools for data analysis; development of software by integrating common development environments (Visual BASIC, Visual C++) with GIS software like ArcView, MapObjects and database management systems using Visual Basic and SQL Server.

g) Metadata

EGIS provides support for archiving, documenting and publishing data. Services in this area include assistance in developing organizations data archiving policy; assessing metadata requirements for various types of data; customizing metadata standards for individual organizations; and implementing metadata information systems with specialized software (GeoKey).

h) Image Processing

EGIS provides a wide range of image processing services from optical and RADAR images. These include image mapping; feature extraction, e.g., for roads, rivers, settlements; classification of images for special needs, e.g., for landuse, landcover; flood mapping and damage assessment; morphological analysis of rivers with time series images. Recently, EGIS, in collaboration with SPARRO, set up a ground receiving station to receive SAR images for the monsoon of 1999.

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2.11 MIS: Management Information System and GIS in LGED

2.11.1 MIS CELL

(1) MIS Development

Current situation of MIS development in LGED is as follows:

- An MIS Cell has been established in LGED HQ.
- A Local Area Network (LAN) has been installed in HQ building (See Figure A2.11-1)
- Software development for automation in LGED are now in progress.
- A mail server is now in operation providing e-mail facility to all the users in the building.
- LGED web site development and hosting.
- Intranet Development for LAN users.
- Capacity building.

(2) Local Area Network

Installation of LAN: LGED installed a Local Area Network (LAN) connecting all computers (300 sets) at different level of twelve-storied LGED Head Quarter Building. This LAN contains a high speed fiber optics backbone. In each story, individual computers are connected via Hubs & Switches to the backbone. (See Figure A2.11-1)

Objectives of LAN:

- Sharing Information
- Sharing Hardware Resources
- Sharing Software resources
- Preserving Information

The LAN contains five Server Computers:

- A Primary Domain Controller (PDC)
- A Back-up Domain Controller (BDC)
- A Database Server (ORACLE 8)
- A Mail Server
- Web Server (Intranet)

(3) Software Development

MIS Cell is now customizing following softwares to facilitate LGED daily operation.

Completed Softwares:

- Project Monitoring System (PMS)
- Road & Bridge Database Management System
- Tendering Management System
- Dispatch Management System
- Contractor Database System
- Rate Schedule (District Module)
- Training Monitoring System

Under Development Softwares:

- Personnel Management Information System (PMIS)
- Equipment Management System

Future Plans:

- Wide Area Network (WAN) (1st Stage: for five District Offices by end of 2002)
- Multimedia Studio (Training for 20 persons completed)
- CD Authoring for RDP-21 activities (Pilot basis)

2.11.2 GIS Unit**(1) Map Production**

LGED has been playing a pioneering role in producing maps using modern cartographic methods to facilitate local level planning in Bangladesh. LGED has established a Map Library at LGED Bhaban with a view to keep these planning tools readily available in an organized fashion and to support easy distribution of these maps.

(2) Map Catalogue**Map Catalogue**

The Map Catalogue is an overview of series of maps that are currently available in the Map Library of LGED. GIS Unit of LGED has been working to consolidate their mapping activities in order to facilitate use and wider dissemination of maps available in Map Library. The objective is to assist other users to have easy access to the map resources in Map Library and this would also be useful in many respects for other Rural Development Projects of LGED for their planning purposes.

The Catalogue has three broad headings under which different maps are available. These are Maps produced by LGED/GIS, Borrowed maps from Government Organization and Other maps of

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various themes. It should be mentioned that maps produced by LGED/GIS such as digital Upazila maps, digital District maps, thematic maps like growth center connecting road maps, cyclone shelter maps are continuously updated as per requirement of LGED.

(3) Map Library

The Map Library is a non-profit unit within LGED for its Rural Development Projects. However, other agencies are also allowed to use the Map. To obtain maps from the library, forward a formal request letter stating area, scale, number of prints required etc. Only reproduction cost will be charged for each copy of maps.

(4) Map Distribution and Service

LGED has a policy of wider dissemination of map resources to the users of all levels for planning purpose. In this regards LGED has produced thana base map which include road network, river network, socioeconomic infrastructure etc. for the 460 thanas, both in colour and black & white. The printed maps have been distributed to all LGED's district and thana offices to render service to the local user. Pourashava maps are also available in four different layers.

2.11.3 RDEC

Rural Development Engineering Center (RDEC) is going to be setup under JICA Technical Cooperation Project. Rural Development Planning, Rural Infrastructure Designing and Training are under contemplation for the major subjects of the RDEC activities. The technical wing of LGED would be integrated in the new building adjacent to the HQ building.

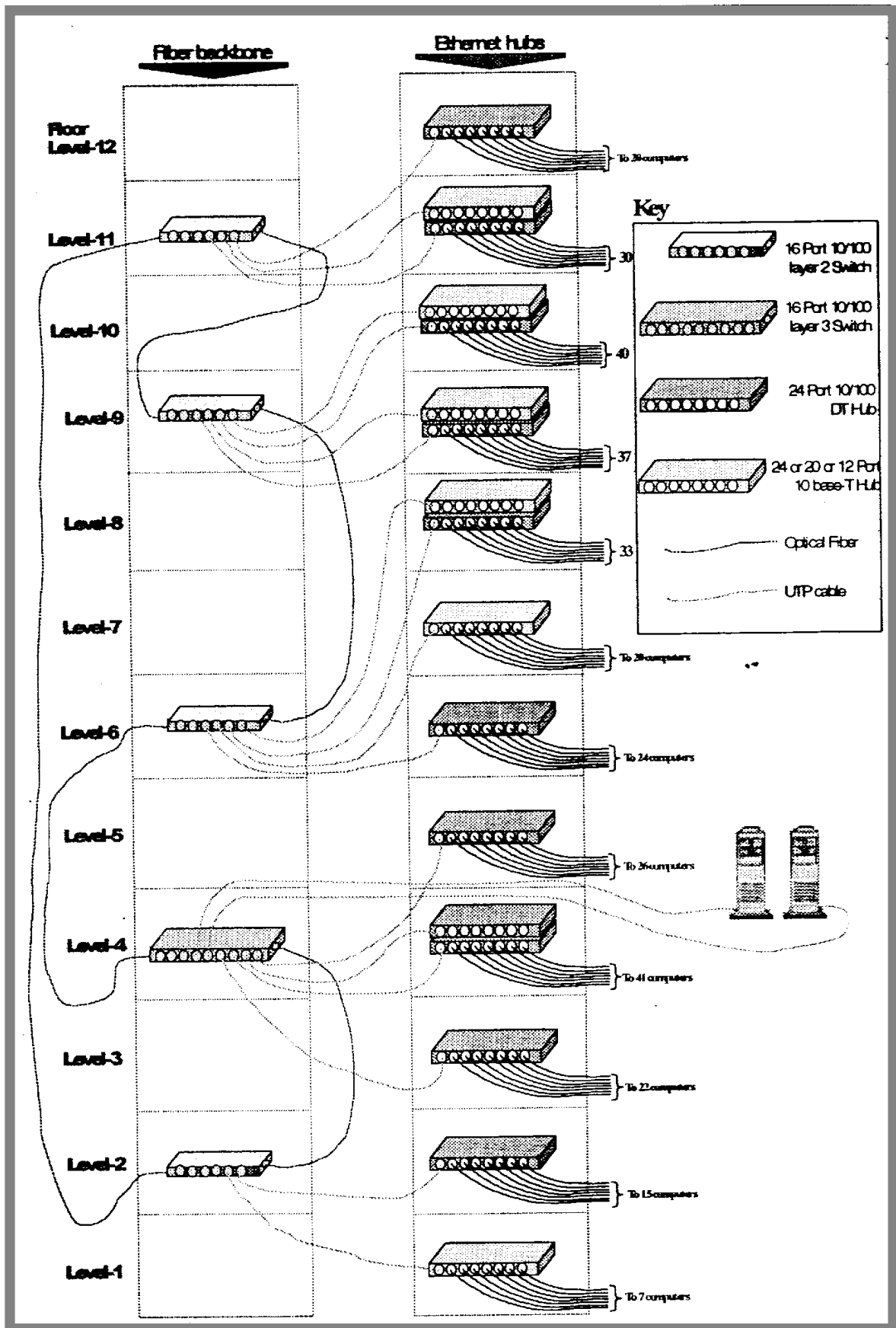


Figure A2.11-1: LGED LAN Diagram with Fiber Optics Backbone and Hubs