Thailand Country Paper for the Third Annual Mekong Flood Forum

Prepared by
Thai National Mekong Committee

This report consists of five sections that address (1) nature and extent of flooding, (2) data collection and forecasting, (3) flood forecasting and warning, (4) communication of flood-warning information and (5) other relevant information within the country.

1. Nature and Extent of Flooding

1.1 Flood in the Northeast of Thailand (the Central Mekong Basin)

Flood in the northeast of Thailand, flowing into the Mekong river, is consisting of two groups from the Khong basin (tributaries of the Mekong river) and the Chi and Mun basins as shown in Figure 1.1. The flood in the Khong basin, covering catchment area of 50,000 sq.km., has brought from tributaries flowing directly into the Mekong river while the flood in the Chi and Mun basins with a large catchment area of 119,000 sq.km. has collected the flood in many sub-basins, flown down in the main river course and emptied finally into the Mekong river at the Mun river mouth.

Though the flood in the Khong basin appears generally in August to September, the flood in the Chi and Mun basins take place in September to October with the following reason.

- Large rainfed farm area is expanding in the Chi and Mun basins and has stored and used the rain water from June to August for plantation of paddy and other crops in the wet season.
- Many large, medium and small scale dams are constructed in the Chi and Mun basins for irrigation purpose. Those dams have operated so as to store rich inflow in July and August and release rich inflow in September and October to downstream without storage in the reservoir because the proper reservoir operation rule to have a surcharge volume in the reservoir to control the flood discharge in September and October is not set up.

1.2 Flood Condition in the Khong Basin

Although the large flood is not existing in the tributaries of the Khong basin due to their small basin area consisting of plateau and plain to diffuse rain water, the lower basin of all tributaries flowing into the Mekong river is suffered from inundation problem in the flood season from August to September caused by invasion of high backwater of the Mekong river

In order to protect the flood damage by the high water level of the Mekong river, the flood protection dike with a long distance of about 800 km. form the Chaing Khan to the Mun river mouth has been constructed along the Mekong river. This dike is used for provincial and nation roads and protects the farm area at the low land area in the Khong basin.

However, the low land area along many tributaries has still suffered from inundation problem caused by the backwater invaded through tributaries connecting with the Mekong river. The estuary barrage to protect the invasion of the water of the Mekong river was constructed at the Huai Laung and the Nam Mong tributaries in Nong Khai province and is under planning at their other tributaries in the Khong basin.

Though those flood protection dike and estuary barrage will be effective for the elimination and mitigation of inundation problem in the lower land area of the Khong basin, the flood water level of the Mekong river may raise up by releasing the existing inundated water to the Mekong river.

1.3 Flood Condition in the Chi and Mun Basins

The flood discharge in the Chi and Mun rivers have observed for a long period of about 40 years from 1962 to 2002 and the maximum flood discharge at major stations are shown in Table 1.1

Flood in the Chi and Mun basins appear generally in September and October, which is one month delay as compared with that in August and September in the Khong basin and the rivers in Lao as mentioned in the above (1.1).

The maximum flood in the past is 3,960 cms at E20 station of the Chi river and 9,876 cms at M7 station of the Mun river, which takes place in October 1978. The maximum flood in the recent years is 2,706 cms at E20 station of the Chi and 6,381 cms at M7 station of Mun river.

The low land area along the upper, middle and lower Chi river and along the middle and lower Mun river have suffered from inundation problem during the flood season from September to October.

In accordance with RID data, the inundation area is estimated at 109,000 ha in the Lower Mun and 430,000 ha in the Chi. About 22 barrages are constructed crossing the Chi and Mun rivers by the Department of Energy Development and Promotion (DEDP) related to Khong-Chi-Mun project as shown in Figure 1.2. They said the poor water management of those barrages in the flood season has accelerated the flood and inundation damages at the low land area along both rivers.

The reservoir operation result in two large dams of the Ubol Ratana dam for hydropower and irrigation and the Lam Pao dam for irrigation. The reservoir water level reaches the lowest water level in May to June by water use in the dry

season from December to May and the supplemental irrigation in the wet season paddy in June and recovers in July to August.

When rich inflow appears in the reservoir from July to August, the reservoir reaches the full water level at the end of August and as a result, the additional flood in September and October can't be controlled by the reservoir and is forced to release to the downstream. Accordingly a large flood appears at the downstream in September and October. In order to mitigate the flood damage in the Chi and Mun rivers, the reservoir operation rules of many existing dams and barrages shall be reviewed taking into account the provision of surcharge capacity so as to be able to control a part of flood in September to October by the reservoirs.

In accordance with the monthly runoff data from September to October at the Seri Prachtipatai Bridge station (M7) with a catchments area of 106,673 sq.km in Ubol Ratchathani province, monthly flood from the Chi and Mun rivers to the Mekong river is estimated as follows:

- Monthly average flood: 3,900 MCM (1,500 cms)
- Average maximum flood: 7,700 MCM (3,000 cms) in October 1991

Table 1.1 Maximum Flood Discharge at Chi and Mun Rivers

Year	Chi River								Mun River					
	A Mueang Chaiyaphum (E21) CA=8,912 sq.km		A Kosum Phisai, Maha Sarakham (E1) CA=29,788 sq.km		A Sila phum Roi-Et (E18) CA=39,210 sq.km		A Mueang Chai Yasothon (E20) CA=47,818 sq.km		A Chaloem Phra Kiat Nakhon Ratchasima (M2) CA=4,800 sq.km		Rasi Salai Si Saket (M5) CA=44,275 sq.km		Si Phrachathipatai Ubon Ratchathani (M7) CA=106,673 sq.km	
	W.L. (m)	D (cms)	W.L. (m)	D (cms)	W.L. (m)	D (cms)	W.L. (m)	D (cms)	W.L. (m)	D (cms)	W.L. (m)	D (cms)	W.L. (m)	D (cms)
62	-	-	147.7	1,453	-	-	-	-	166.0	280	121.5	2,411	115.5	6,782
63	-	-	147.3	1,322	-	-	-	-	165.8	226	116.2	744	111.6	1,976
64	-	-	147.4	1,354	-	-	-	-	166.0	280	119.3	1,420	114.7	4,582
65	-	-	142.2	308	-	-	-	-	166.1	318	115.3	590	109.9	1,249
66	-	-	144.8	585	-	-	-	-	165.7	182	121.5	2,395	115.8	5,817
67	-	-	144.1	489	-	-	-	-	165.0	96	118.7	1,232	112.1	2,552
68	168.9	202	139.4	127	-	-	-	-	161.5	11	117.3	946	112.4	2,396
69	174.7	1,789	146.9	1,120	-	-	-	-	166.2	255	118.3	1,135	111.7	2,299
70	171.0	148	144.8	584	-	-	-	-	164.0	64	116.9	874	112.1	2,592
71	172.5	199	144.0	483	-	-	-	-	163.1	55	117.1	896	111.9	2,270
72	172.1	184	140.2	188	-	-	-	-	166.2	243	120.5	2,565	113.0	2,946
73	172.2	185	141.4	286	-	-	-	-	166.2	121	113.9	390	109.4	1,166
74	170.2	112	139.5	150	131.3	520	122.1	1,210	163.9	72	114.5	483	111.7	2,345
75	173.7	253	144.7	579	131.3	866	121.8	999	165.8	175	118.3	1,034	112.7	2,932
76	173.8	258	145.2	662	129.7	605	121.2	766	166.3	264	119.6	1,709	112.6	2,964
77	173.5	247	144.2	520	130.9	713	122.5	1,529	165.1	113	119.5	1,529	114.0	3,690
78	175.4	2,836	148.0	1,482	133.5	3,662	124.5	3,960	165.7	171	122.0	3,289	117.8	9,876
79	172.2	188	144.4	546	130.2	654	121.5	970	164.1	77	117.0	862	112.7	2,540
80	174.0	271	147.3	1,245	132.6	1,952	123.2	2,250	165.3	132	120.0	1,637	113.8	3,676
81	168.3	67	141.8	299	130.0	605	121.6	1,012	162.4	41	118.0	985	112.5	2,445
82	173.6	484	145.1	635	131.4	911	122.3	1,444	165.7	160	121.4	3,220	113.0	3,191
83	171.4	187	144.5	562	131.4	906	122.1	1,206	167.3	1,074	120.7	2,563	112.9	2,331
84	172.4	236	142.0	345	129.4	568	120.5	781	163.5	67	117.8	876	111.5	2,122
85	172.9	279	140.6	263	128.1	302	121.1	792	164.7	95	117.2	808	111.0	1,733
86	168.7	92	140.4	216	129.5	578	120.7	693	166.1	256	116.4	718	112.2	2,664
87	173.6	363	143.3	431	129.8	595	121.4	632	164.4	74	116.8	769	110.9	1,745
88	172.5	271	143.2	473	128.5	427	120.0	658	165.9	187	114.8	438	110.5	1,622
89	170.3	126	142.3	414	129.1	538	120.6	715	164.4	89	114.5	437	112.3	2,625
90	173.6	352	144.7	608	131.0	796	122.1	1,171	166.5	347	117.2	804	113.3	3,224
91	173.8	427	146.8	847	132.1	948	122.7	1,771	165.1	135	119.5	1,619	111.7	2,314
92	171.7	195	141.2	264	129.7	563	121.7	1,104	163.9	66	115.7	538	109.5	1,075
93	170.1	130	140.7	278	127.4	349	119.2	566	163.4	60	113.9	363	111.6	2,523
94	173.2	341	143.5	449	130.2	663	121.9	1,076	163.7	64	116.7	692	111.6	2,282
95	174.3	628	146.0	718	131.0	784	121.4	986	164.7	89	119.0	1,464	113.2	3,332
96	174.2	535	145.6	721	131.0	717	122.3	1,336	167.0	530	116.6	1,306	111.0	1,712
97	168.5	80	140.7	327	128.7	468	120.6	709	-	-	117.5	854	109.4	918
98	170.7	153	141.2	317	127.6	382	119.4	565	-	-	113.7	332	110.5	1,477
99	172.3	229	143.1	444	129.6	544	121.3	893	-	-	115.7	652	114.6	4,356
2000	174.9	606	147.4	1,092	132.1	1,020	122.7	1,840	-	-	121.1	2,406	115.8	6,381
2001	170.1	121	145.5	799	132.7	2,044	123.7	2,706	-	-	121.7	2,330	-	-
2002	174.1	537	147.8	1,120	132.7	1,475	123.0	1,943	-	-	-	-	-	-
Max.		2,836		1,482		3,662		3,960		1,074		3,289		9,876
Return Period (Year)		350		22		170		99		65		35		140

Data Source; RID

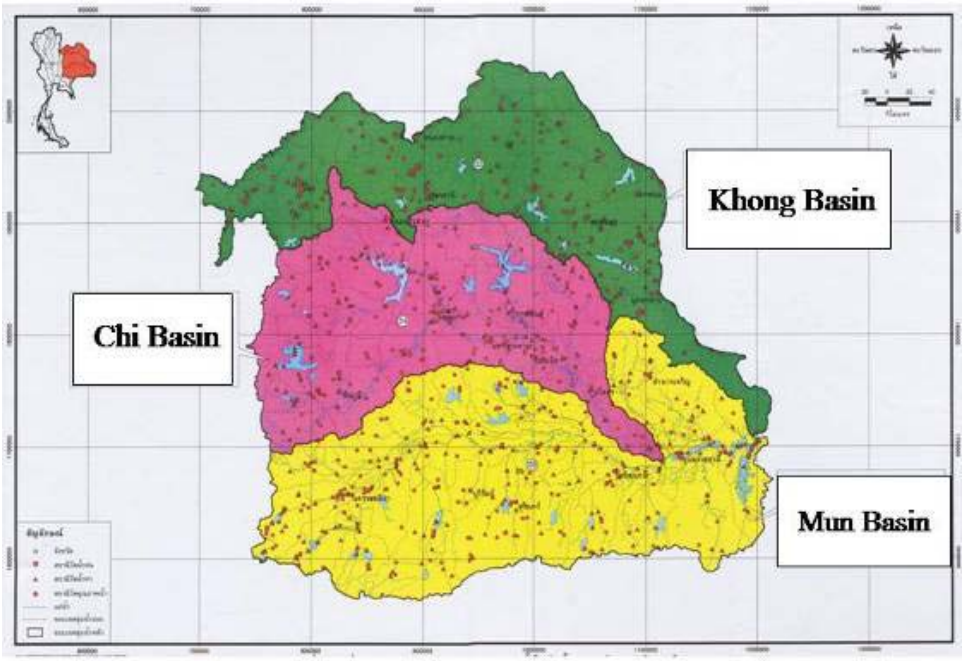

Figure 1.1 River System in Northeast Thai Region

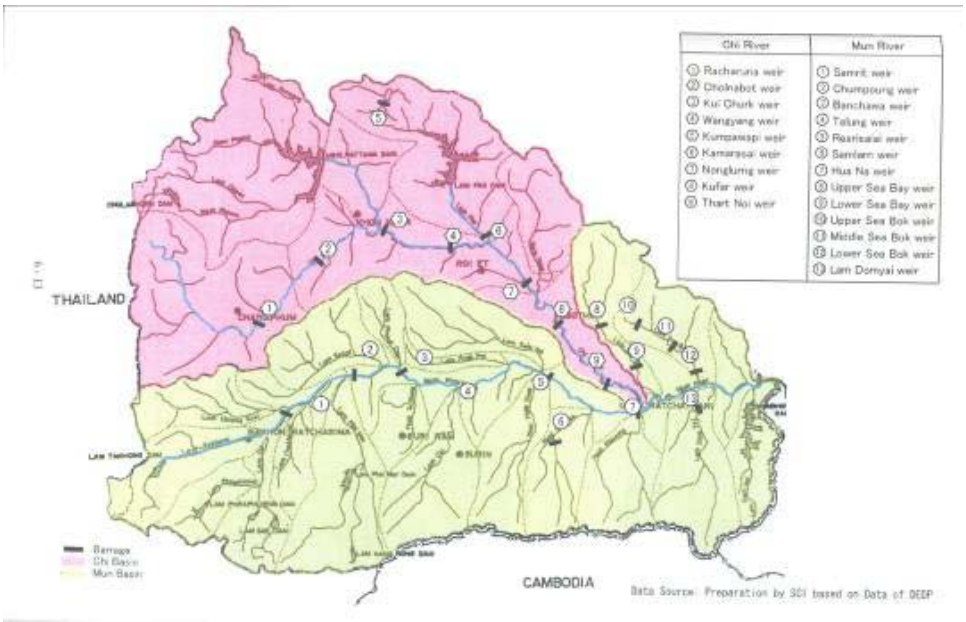

Figure 1.2 Existing Barrage Constructed in Chi and Mun

2. Data Collection and Forecasting

Available data in the northeast of Thailand and the whole country consist of:

- Hydrological Data
- Meteorological Data
- Dam Operation Data
- Other Data

Which are observed by four main agencies, the Royal Irrigation Department (RID), the Meteorological Department (MD), the Electricity Generating Authority of Thailand (EGAT), and the Department of Water Resources (DWR). The data of each agency is carried out by purpose such as MD recorded rainfall data for forecasting weather condition while RID recorded the data for forecasting flooding condition. Totally, rainfall and runoff gauging stations in all river basins in Thailand have 1,940 and 627 stations respectively. For Khong, Chi, and Mun basins, rainfall and runoff gauging stations have 617 and 191 stations respectively. RID is the main agency in operating the runoff gauging stations while MD is the main agency in operating the rainfall gauging stations. The data of each agency will be reviewed as follows;

2.1 The Royal Irrigation Department, RID

Recorded data are as follows:

- Statistical daily data of reservoirs
- Statistical daily data of barrages
- Daily or hourly or automatic water level data
- Daily or hourly or automatic rainfall data
- Daily evaporation data

Most of the data are manually recorded and stored in digital form in the computer mainframe at the RID's head office in Bangkok. Forecasting of the water level in a river has been carried out by considering the statistical relationship among data of gauging stations. Real-time water level and rainfall data by the telemetering system are also carried out in some basins where the flood damage is frequently occurred. More information can be obtained in www.rid.go.th. The locations of the gauging stations are illustrated in Figure 2.1

2.2 The Meteorological Department, MD

Recorded data are as follows:

- Daily or hourly or automatic rainfall data
- Daily meteorological Data
- Rainfall data by radar

Most of the data are manually recorded and stored in digital form in the computer mainframe at the MD's head office in Bangkok. Forecasting of the rainfall and weather condition has been carried out by super computer.

Real-time water level and rainfall data by the telemetering system are also carried out in some basins where the flood damage is frequently occurred, especially in the area of Bangkok Metropolitan Administration (BMA). More information can be obtained in www.tmd.go.th. The locations of the gauging stations are illustrated in Figure 2.2

2.3 The Electricity Generating Authority of Thailand, EGAT

Data recorded are as follows:

- Statistical daily data of reservoirs
- Daily or hourly or automatic water level data
- Daily or hourly or automatic rainfall data
- Daily evaporation data

Most of the data are manually recorded and stored in digital form in the computer mainframe at the EGAT's head office in Nonthaburi. Forecasting of the runoff into a reservoir has been carried out by statistical data analysis. Real-time water level and rainfall data by the telemetering system are also carried out in some basins where the flood damage is frequently occurred and a large reservoir is situated. More information can be obtained in www.egat.or.th. The locations of the gauging stations are illustrated in Figure 2.3

2.4 The Department of Water Resources (DWR)

Recorded data are as follows:

- Daily or hourly or automatic water level data
- Daily or hourly or automatic rainfall data
- Daily evaporation data

Most of the data are manually recorded and stored in digital form in the computer mainframe at the DWR's head office in Bangkok. More information can be obtained in www.dwr.go.th. The locations of the gauging stations are illustrated in Figure 2.4

2.5 The land Development Department (LDD)

Disaster warning done as follows:

- Daily landslide (mostly in rainy season)
- Daily flood (mostly in rainy season)
- Daily drought (in dry season)

The information send directly to the organization that the disaster may occur and can be obtained through www.ldd.go.th

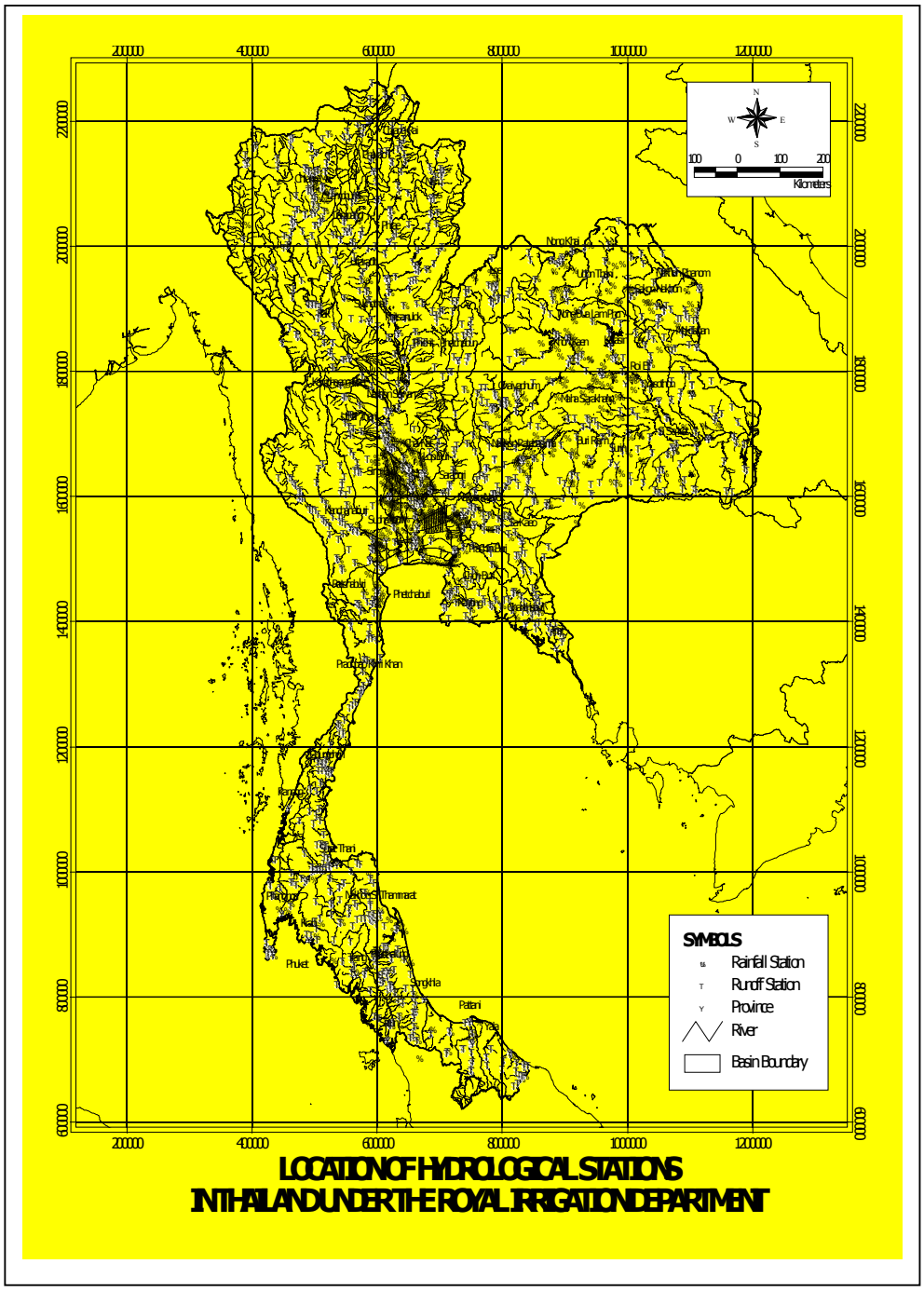

Figure 2.1 Location of Hydrological Stations Operated by RID

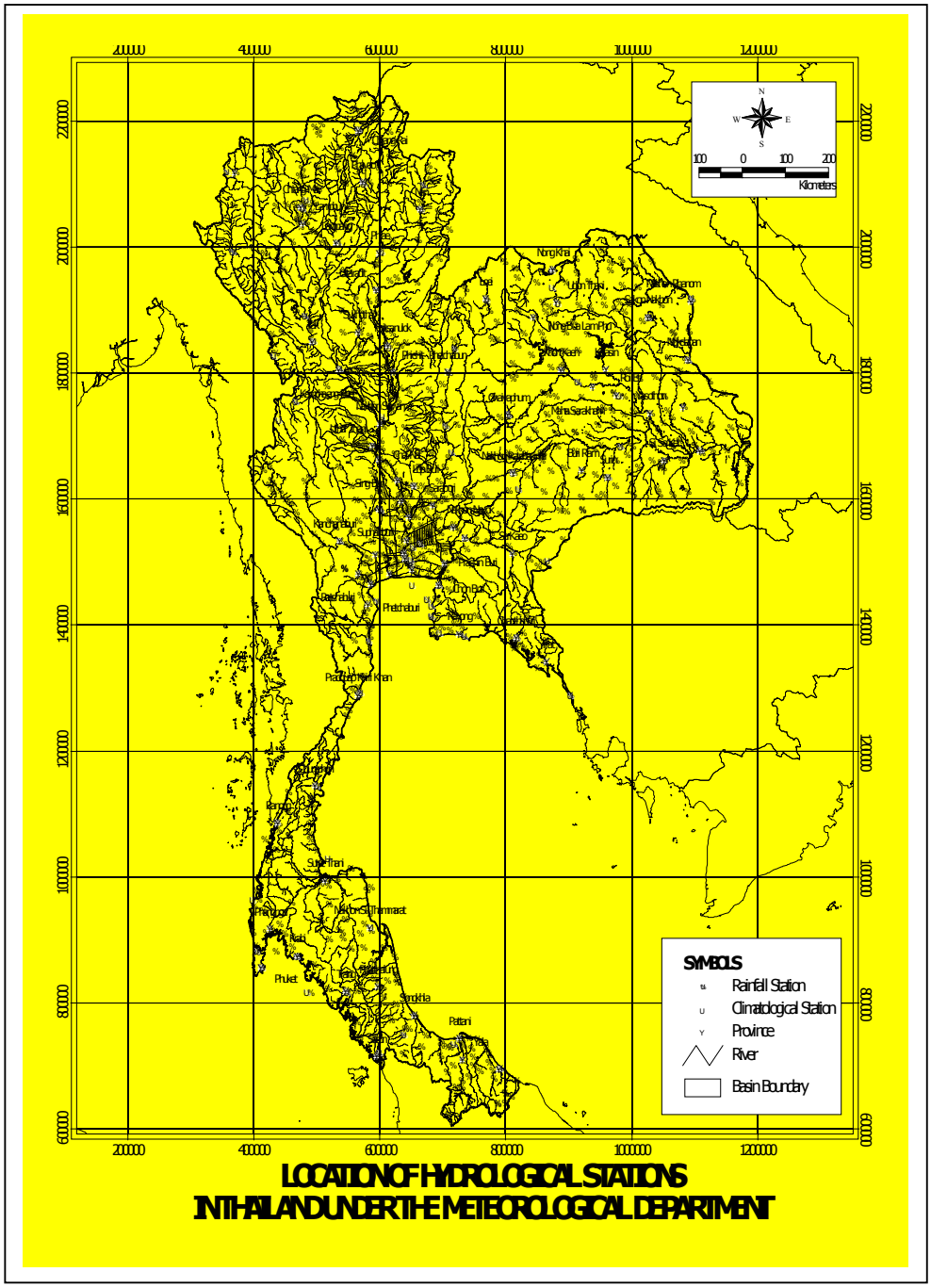

Figure 2.2 Location of Hydrological Stations Operated by MD

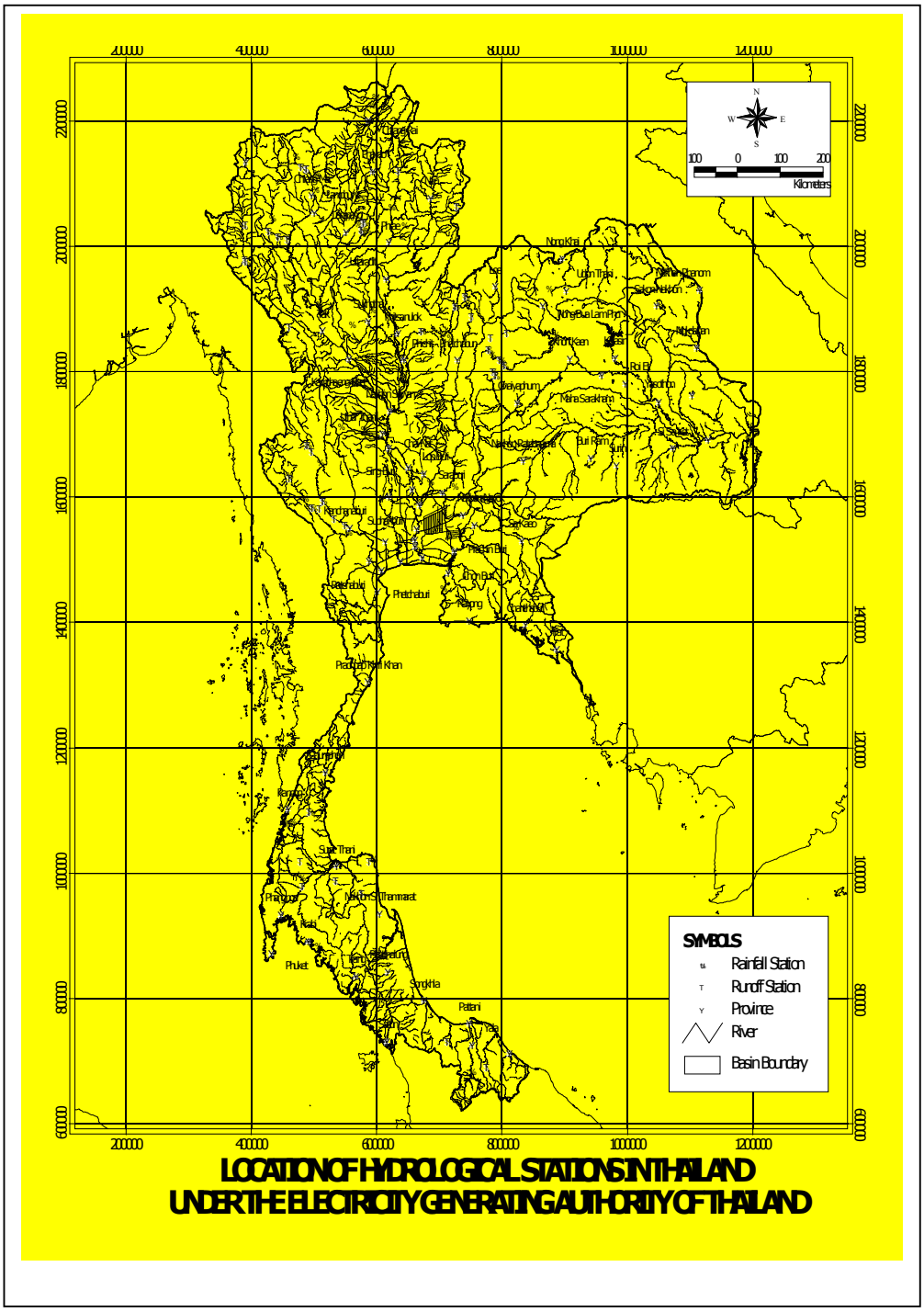

Figure 2.3 Location of Hydrological Stations Operated by EGAT

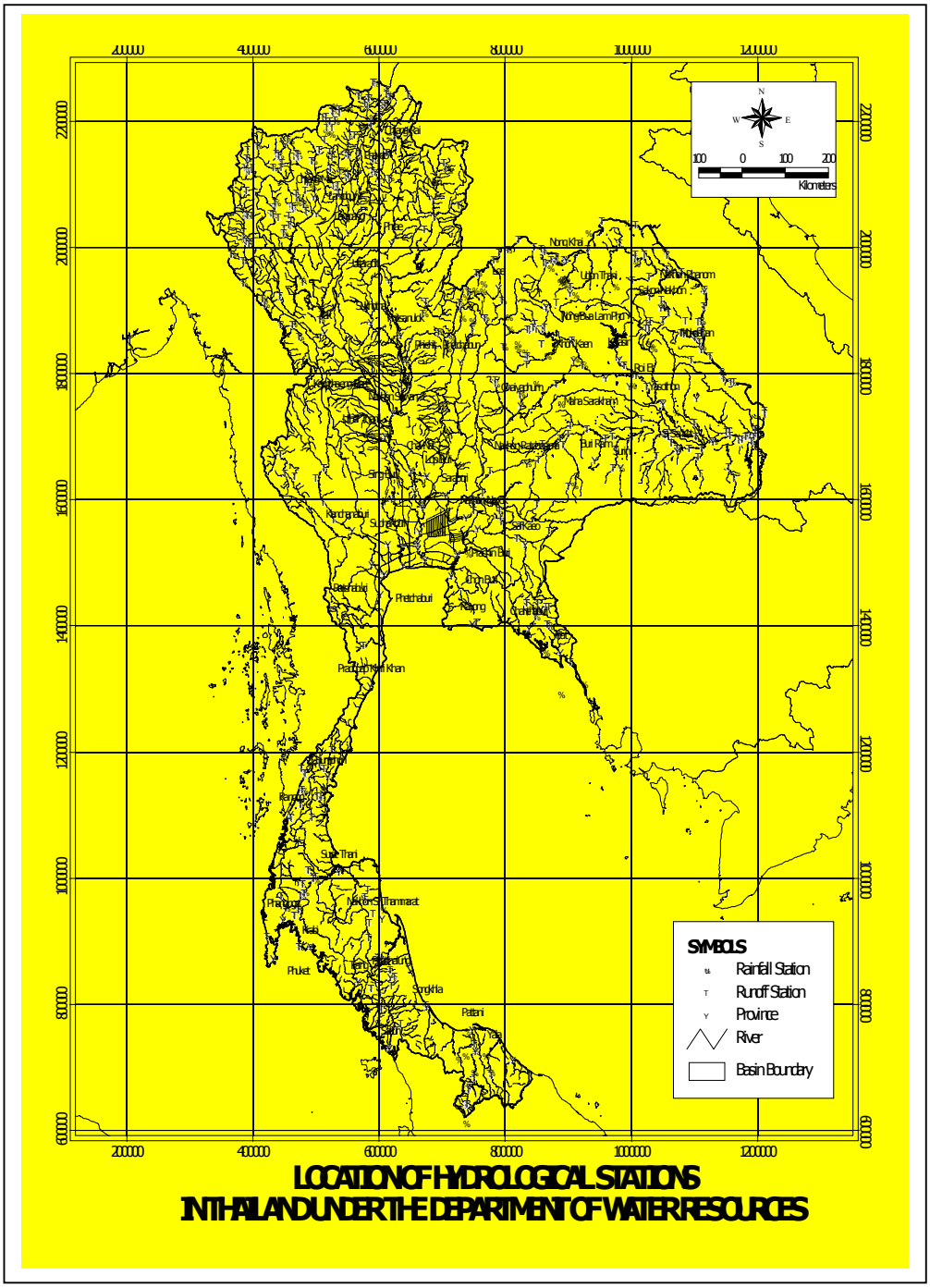

Figure 2.4 Location of Hydrological Stations Operated by DWR

3. Flood Forecasting and Warning

There are three agencies that carry out the flood forecasting and warning in the major river basins where the flood damages are frequently occurred. RID developed the flood forecasting and warning system in the U-Thaphao river basin in Songkhla province, the Thataphao river basin in Chumphon province, the Pasak river basin at Pasak dam in Lop Buri province, and the Chantaburi river basin in Chanthaburi province. EGAT developed the system in the Mun river basin at Pak Mun dam in Ubol Ratchatani province, the Pattani river basin at Banglang dam in Yala province, the Chi river basin at Ubol Ratana dam in Khon Kaen province, and the Khwal Noi at Khao Lam dam in Kanchana Buri province. MD and BMA developed the system in the Lower Chao Phraya river basin in Bangkok. The agencies are being carried out in development of the flood forecasting and warning system in other river basins where the system are required to warn the flooding condition. However each system has limitation of the development as shown in Table 3.1.

Table 3.1 Telemetering and Flood Forecasting System in Thailand

Project	Real-time Data by Telemetering System	Flood Forecasting by Math. Model	Integrated Data Base and Math. Model, Working as a Network	Integrated Math. Model and GIS for Output Presentation	Rainfall Forecasting by Radar	Warning to the Public via Communication Media
Ubol Ratana Dam (1988)	■					
Pak Mun Dam (1995)	■	■				
Khao Lam Dam (1995)	■					
Pasak Dam (1999)	■	■				
Banglang Dam (2002)	■	■	■			
Thataphao river basin (2002)	■	■	■	■		
U-Thaphao river basin (2004)	■	■	■	■		
Chantaburi river basin (2004)	■	■	■	■		
Chao Phraya river basin (2004)	■	■	■	■	■	

A flood forecasting and warning system (FFWS) integrates the data collection system, data communication system, data management system, and computer modeling system to accurately forecast the amount of flooding that may occur in an area. The integrated system also allows for water resources management decision-making at the reservoir level to limit flooding as shown in Figure 3.1.

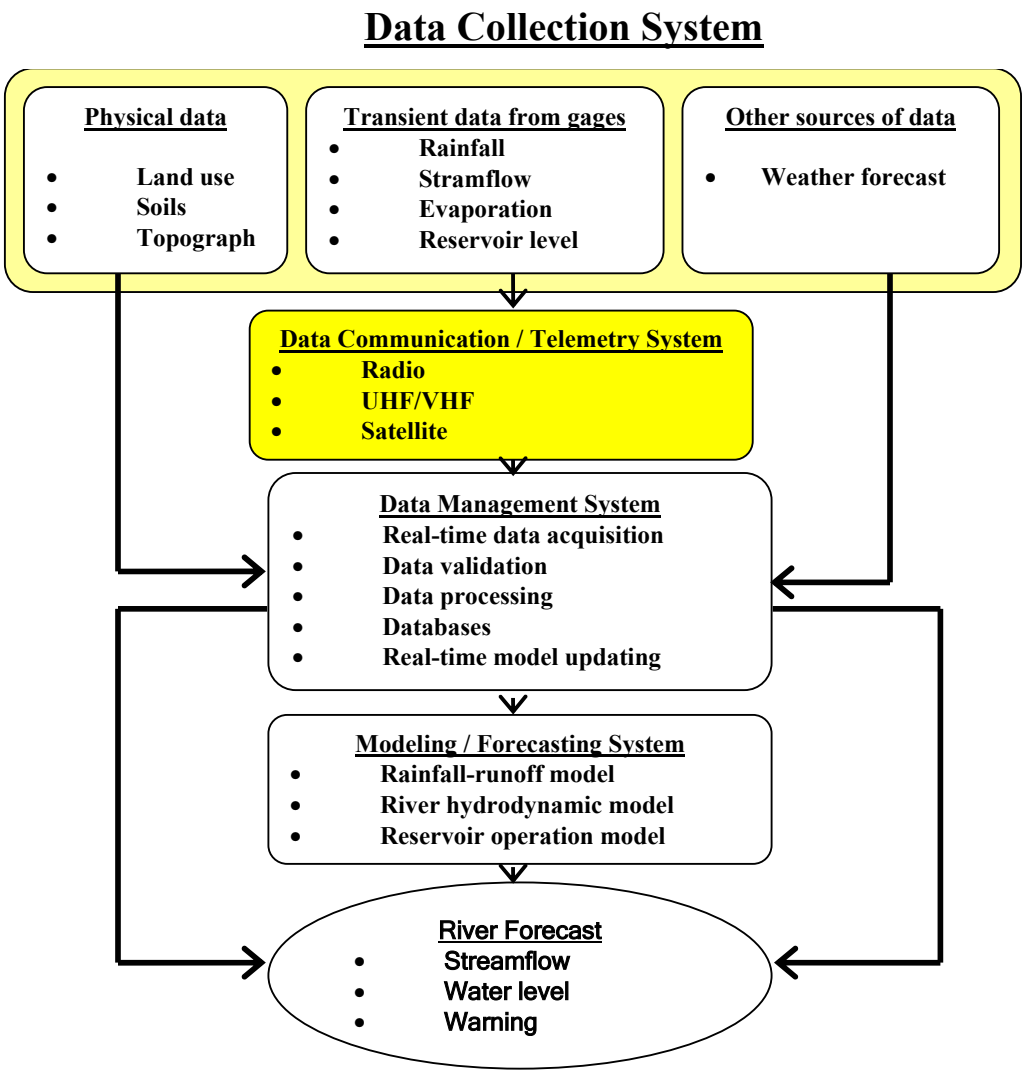

Figure 3.1 System Concept of a FFWS

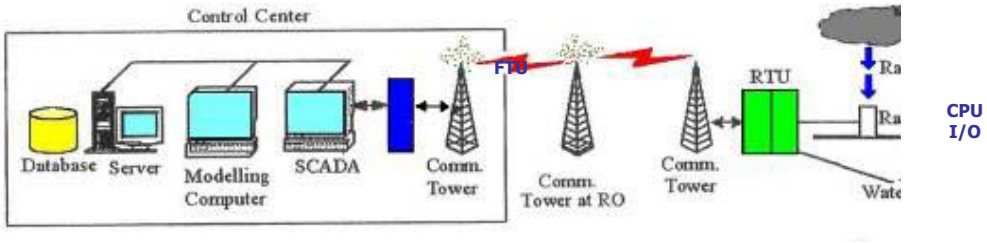

Figure 3.2 Schematic Layout of the FFWS

The FFWS consists of real-time rainfall and water level data collection at the selected stations in the river basin, with the data transmitted to the central computer at the master station over radio links. In addition to rainfall and water level data, the communication system is also used for transmitting alarms, system status, diagnostics, and error logging information from the remote stations to the control center and vice versa. The information collected at the control center computer is then input into a modeling software system capable of predicting flood elevations and inundation extents. Figure 3.2 illustrates a schematic layout of the FFWS.

At present, RID, EGAT, and BMA has some hydrologic and hydraulic modeling packages available for flood forecasting. They are MIKE-11 and FLOODWATCH developed by the Danish Hydraulic Institute, Denmark, and ISIS and FloodWorks developed by Wallingford, UK. The FLOODWATCH is frequently applied by RID and EGAT and the FloodWorks is applied by BMA.

4. Communication of Flood-Warning Information

Flood warning systems require secure and reliable communications in adverse weather conditions. The previous attempts at using telephone based telemetry systems had been unsuccessful due to the poor signal conditions of the telephone lines during adverse weather conditions.

RID has an existing VHF/HF single side band (HF-SSB). Two radio system that is used within the districts for voice communications during the wet season but is not directly linked to its Bangkok office. The voice system operates with good reliability at most sites during adverse weather conditions.

EGAT has installed its own microwave communications system from its network of hydropower stations to its central office in Nonthaburi so it has reliable communications at all times. This would indicate that public switched telephone network had insufficient reliability for operational requirements.

The Communication Authority of Thailand (CAT) and the Telephone Organization of Thailand (TOT) appear to be involved in using microwave for major links within their systems.

The only satellite system allowed to be used by government departments is “THAICOM”. This would be economical only for communication from the regional offices to the Bangkok office, as a two way system, because of the high capital costs associated in establishing each ground station. This would handle data and voice communications and hence would satisfy the Flood Warning System data collection requirement.

There are existing flood preparedness plans and mitigation measures in the basin. The flood warning information from RID or EGAT's regional office is sent to the provincial officer who has responsibility in performing flood preparedness plan via telephone or radio. After that the local emergency teams make preparations to carry out works in areas of likely to be inundated by flooding. The organization of the teams and their duties are clearly indicated.

5. Other Relevant Information

As mentioned above, there are many agencies involve in flood forecasting and warning in which many data collection and method are applied in the system. The Thailand Integrated Water Resource Management (TIWRM) is established in 1998 to set up a network of water resources information by linking information of all agencies and presenting via GIS and internet media as shown in Figure 5.1. More information can be obtained in www.dwr.go.th www.rid.go.th www.egat.or.th www.tmd.go.th www. Ldd.go.th and www.thaiwater.net.

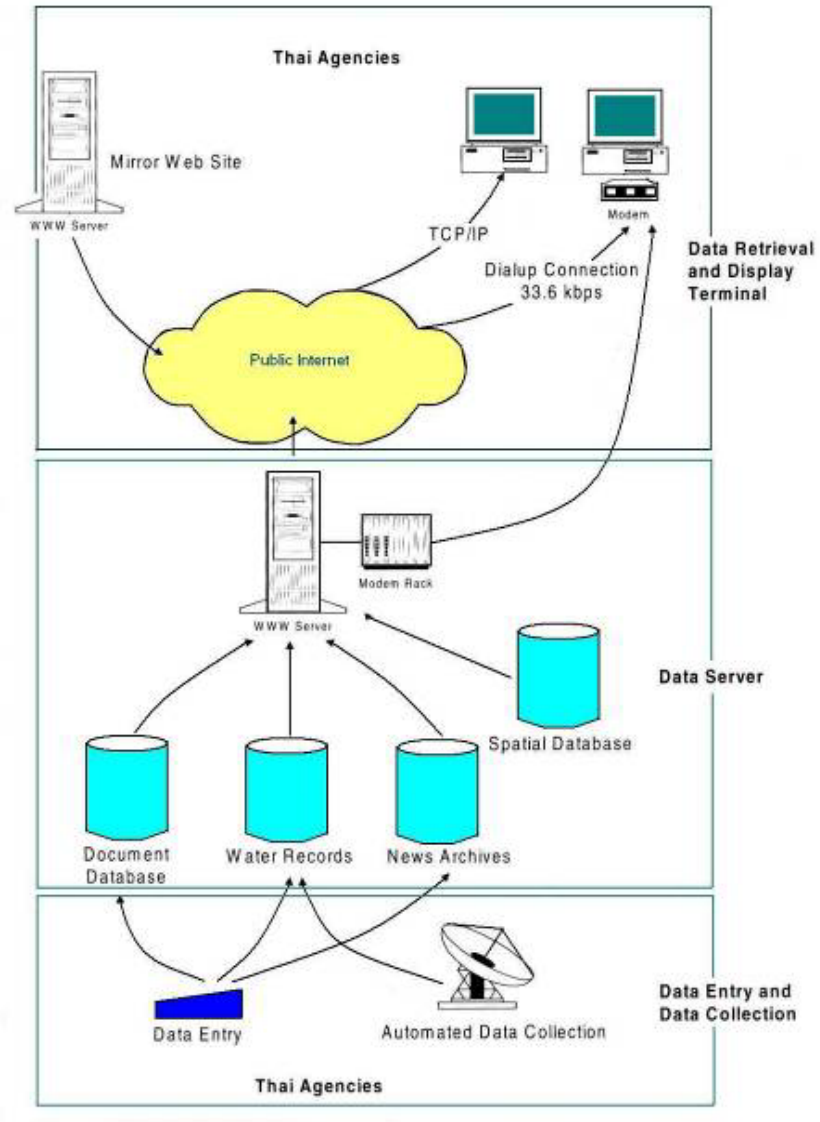

Figure 5.1 Network System of the Thailand Integrated Water Resources Management (TIWRM)