2.7 Irrigation Area in Chao Phraya Basin

This paragraph is supported by the following tables;

- Irrigation Project Area, Irrigable Area and Land Use in Chao Phraya Delta
- Paddy Planted Area in Chao Phraya Delta and Phitsanulok Project Area (Wet Season)
- Paddy Planted Area in Chao Phraya Delta and Phitsanulok Project Area (Dry Season)

Table 2.7.1 Irrigation Project Area, Irrigable Area and Land Use in Chao Phraya Delta

Name of Project	Project Area (ha)	Irrigable Area (ha)	Land Use (ha)				
			Paddy	Vegeatble	Sugarcane	Tree Crop	Fish Pond
1.Phonlathep	16,480	15,411	15,161	-	293	87	15
2.Thabote	34,937	31,424	28,053	-	960	316	36
3.Sam Chuk	59,536	48,800	39,540	18	1,342	494	260
4.Don Chedi	26,000	23,360	20,904	248	2,236	353	45
5.Pho Phraya	66,550	59,200	44,663	129	-	1,871	670
6.Borommathat	64,800	58,400	55,193	-	2,099	94	197
7.Chanasutr	84,320	71,712	57,817	203	12,387	618	224
8.Yangmance	38,783	33,648	29,576	108	94	340	-
9.Phak Hai	35,146	32,960	31,005	2	-	264	417
10.Bang Ban	26,244	21,920	18,400	1	-	11	1
11.Chao C.B.Y.	70,056	64,960	35,199	151	4	1,517	2,592
12.Phraya B.L.	77,685	57,384	48,388	1,068	-	3,790	1,296
13.Phraya Phim.	45,690	42,560	31,000	1,547	271	3,571	55
14.Phasi Char.	46,056	19,968	5,264	2,032	-	7,441	1,106
Region 7 Total	692,283	581,707	460,163	5,507	19,686	20,767	5,467
15.Manoram/K.K	42,258	38,736	40,646	9	1,292	69	24
16.Chong Kae	45,060	38,192	37,905	34	196	106	72
17.Koke Kathi.	36,528	32,880	32,875	98	25	4	-
18.Reong Rang	28,832	28,640	28,240	89	-	-	-
19.Maharaj	83,828	67,520	73,505	62	605	524	27
20.Pasak Tai	43,520	38,496	34,070	170	-	2,935	304
21.Tangsit Nua	72,640	71,280	27,847	29	-	22,470	568
22.Nakhon Lua.	48,295	42,720	38,037	10	-	349	199
23.Rangsit Tai	90,560	84,160	68,779	71	-	5,122	1,354
24.Khlong Dam	91,040	84,000	24,432	3	-	-	9,010
Region 8 Total	582,561	526,624	406,336	575	2,118	31,579	11,558
25.Phra Ong C.	95,040	81,600	45,429	-	-	-	6,100
Grand Total	1,369,884	1,189,931	911,928	6,082	21,804	52,346	23,125
Phitsanulok	128,456	108,453	104,307	9	8	396	48

Note: Data on land use are for the year 1994.

Data Source: Water Management Section, O&M Division, RID

Table 2.7.2(1)   Paddy Planted Area in Chao Phraya Delta and Pitsanulok Project Area (Wet Season)

No.	Project Area	Irrigable	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	Phoniathep	15,411	15,411	15,411	15,411	15,411	15,411	15,411	15,411	15,411	15,366	15,411	15,411
2	Thabore	31,924	24,907	25,679	25,709	25,725	25,725	25,628	25,517	25,571	25,004	25,567	28,698
3	Sam Chuk	48,800	42,983	42,105	43,615	43,325	43,216	37,268	44,012	44,367	43,582	42,477	43,761
4	Don Chedi	23,360	21,289	21,401	21,188	21,295	23,030	23,035	23,112	23,112	23,096	22,872	23,112
5	Pho Phraya	59,200	56,103	54,394	54,311	49,746	44,298	41,630	46,482	42,971	38,095	34,936	39,512
6	Borommathat	58,400	58,400	58,400	58,400	58,400	58,400	57,830	58,400	58,400	58,400	58,400	58,294
7	Chanasut	71,712	75,384	75,271	74,764	74,764	74,560	74,512	74,512	74,292	72,500	70,792	70,770
8	Yangmanee	33,648	30,242	31,115	31,092	31,561	31,064	31,064	31,026	30,123	29,500	29,921	30,152
9	Phak Hai	32,960	31,920	29,372	32,725	32,000	32,307	31,700	32,106	31,218	30,984	29,664	29,224
10	Bang Ban	21,920	-	1,600	1,672	21,553	20,614	22,323	23,072	19,616	19,520	19,920	17,835
11	Chao Chet-Bang Y	64,960	50,895	52,415	48,237	42,337	29,862	19,057	9,501	7,651	10,155	15,765	24,024
12	Phraya Ban Lu	57,384	16,098	22,958	4,463	3,314	4,728	4,307	7,985	20,154	17,206	28,080	28,200
13	Phraa Phimol	42,560	8,000	9,120	5,600	4,354	6,752	4,880	7,656	16,750	19,920	28,550	33,440
14	Phasi Charoen	19,968	31,976	31,976	31,976	31,976	31,976	23,192	21,528	24,915	23,766	20,999	19,184
	Region 7 Total	581,707	463,608	471,217	449,163	455,761	441,943	412,173	420,320	434,551	427,094	443,354	461,617
15	Manorom/Khao K	38,736	36,918	36,604	37,760	37,124	37,124	37,124	36,575	37,124	37,124	37,131	37,760
16	Chong Kae	38,192	36,918	25,506	36,918	36,816	46,786	38,441	38,152	38,001	37,214	36,207	36,604
17	Koke Kathiem	32,880	32,867	30,682	32,875	32,174	35,227	27,969	32,888	32,876	32,875	32,875	32,872
18	Roeng Rang	28,640	28,640	24,528	28,640	28,640	28,640	29,282	28,292	28,640	28,640	28,840	28,832
19	Maharat	67,520	75,244	64,051	76,208	76,208	76,286	76,131	76,112	76,200	76,179	76,208	76,128
20	Pasak Tai	38,496	34,624	37,840	38,496	38,496	38,496	38,146	37,875	37,618	32,017	38,128	37,647
21	Rangsit Nua	71,280	67,012	64,781	66,696	62,638	62,638	60,478	57,563	56,893	62,478	57,268	47,501
22	Nakhon Luang	42,720	42,658	42,149	42,658	42,728	40,971	42,602	42,591	42,660	42,548	42,132	41,656
23	Rangsit Tai	84,160	48,000	48,000	48,000	48,000	48,000	84,468	84,468	83,293	84,163	71,448	78,375
24	Khlong Dan	84,000	61,302	66,394	48,982	59,000	58,112	54,061	56,195	45,304	48,729	45,948	48,329
	Region 8 Total	526,624	464,183	440,535	457,233	461,824	468,280	488,702	490,711	478,609	481,967	466,185	465,704
25	Phra Ong C.	81,600	70,814	70,814	70,814	70,828	58,180	70,814	70,814	70,814	70,814	70,574	70,814
26	Pitsanulok	108,453	-	-	-	-	-	-	-	-	-	30,733	56,604
	Grand Total	1,298,384	998,605	982,586	977,210	988,413	968,403	971,689	981,845	983,974	979,875	1,010,848	1,054,739

Data Source : Water Management Section, O&M Division, RID   (Unit: ha)

Table 2.7.2(2)　Paddy Planted Area in Chao Phraya Delta and Pitsanulok Project Area (Wet Season, continued)

Pro.	Irrigable	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Average
1	Phonlathon	15,410	15,360	15,360	15,360	15,356	15,281	15,195	15,236	14,901	15,014	14,949	15,314
2	Thabote	29,698	28,698	30,575	29,523	29,002	28,976	28,300	28,310	25,628	26,763	25,762	27,044
3	Sam Chuk	44,286	43,077	42,709	40,838	42,164	42,193	40,544	39,812	39,541	37,952	34,578	41,746
4	Don Chedi	23,112	23,096	21,806	20,741	21,947	21,929	21,354	20,698	21,258	19,877	19,828	21,918
5	Pho Phraya	31,566	22,861	26,922	24,202	25,400	26,653	25,390	44,663	44,663	45,516	45,915	39,374
6	Borommathat	58,370	55,894	56,636	57,658	58,024	57,754	56,360	55,350	55,192	54,243	54,590	57,354
7	Chanasutr	69,389	75,888	66,828	66,792	66,549	63,515	56,643	57,492	58,002	55,588	51,291	68,202
8	Yangmanee	29,812	29,697	29,821	29,913	29,940	28,658	29,450	29,352	29,576	29,727	29,089	30,086
9	Phak Hai	32,468	31,446	31,485	30,225	30,336	30,893	29,206	30,753	31,010	14,683	18,416	29,734
10	Banx Ban	18,352	23,072	21,920	21,760	21,552	21,328	19,088	15,360	18,400	18,080	16,000	18,221
11	Chao Chet-Banz Y	29,075	20,221	23,346	34,186	41,326	42,293	37,952	23,814	35,198	32,928	41,422	30,530
12	Phraya Ban Lu	45,296	35,760	41,358	47,560	47,560	41,610	49,136	49,594	49,347	48,675	28,896	29,195
13	Phraa Phimol	33,024	32,480	31,045	31,683	31,184	31,526	30,918	31,014	31,000	30,494	48,675	23,092
14	Phasi Charoen	13,502	14,162	14,080	10,648	8,648	9,414	8,086	6,440	5,265	3,927	3,171	17,764
	Region 7 Total	473,360	451,712	453,893	461,045	468,989	462,024	447,624	447,888	458,981	433,648	432,583	449,572
15	Manorom/Khao Kaeo	37,760	37,760	38,737	38,739.41	26	41,526	39,908	40,728	40,645	40,548	40,508	38,489
16	Chong Kae	37,953	34,016	38,150	38,150	38,186	36,307	38,012	38,070	37,928	37,928	37,905	37,280
17	Koke Kathiem	32,872	32,875	32,794	32,875	32,875	26,872	32,856	32,861	32,961	32,875	32,875	32,353
18	Roeng Rang	28,840	28,832	28,160	28,176	27,536	24,224	27,589	27,264	28,169	26,160	24,844	27,791
19	Mahараj	76,208	61,998	76,181	71,408	76,208	73,918	76,208	75,825	75,862	68,891	68,008	73,712
20	Pasak Tai	37,563	36,640	37,120	21,998	34,489	33,437	34,356	32,085	34,069	32,362	32,410	35,269
21	Rangsit Nua	46,413	45,676	42,388	26,766	40,633	35,980	28,185	38,577	38,303	34,619	33,772	48,966
22	Nakhon Luang	40,303	41,447	43,614	41,378	39,872	38,144	34,009	29,598	27,846	21,399	21,859	38,401
23	Rangsit Tai	79,981	76,700	71,076	69,203	68,121	66,816	66,816	68,773	68,778	66,240	64,320	67,865
24	Khlong Dan	43,769	42,948	40,859	37,499	40,464	39,154	32,145	26,570	24,432	21,935	21,371	43,796
	Region 8 Total	461,662	438,892	449,079	406,193	439,212	416,379	410,084	410,350	408,983	382,959	377,874	443,923
25	Phra Ong C	70,814	70,814	70,542	67,368	65,393	59,757	48,019	46,801	45,429	42,875	40,141	63,366
26	Pitsanulok	87,785	101,645	101,782	104,570	102,799	96,306	102,164	95,502	107,026	106,887	87,330	90,856
	Grand Total	1,093,621	1,063,063	1,075,298	1,039,176	1,077,094	1,034,468	1,007,891	1,000,542	1,020,419	966,189	937,928	1,047,717

Data Source : Water Management Section, O&M Division, RID,　(Unit: ha)

Table 2.7.3(1)   Paddy Planted Area in Chao Phraya Delta and Pitsanulok Project Area (Dry Season)

	Project Area	Irrable	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	Phonlathep	15,411	1,879	2,876	4,044	324	5,037	1,021	6,523	10,703	10,327	11,444	10,277
2	Thabote	31,424	6,079	4,530	9,481	6,338	16,121	757	21,566	20,646	23,764	20,032	21,299
3	Sam Chuk	48,800	21,058	23,285	23,520	13,546	29,296	3,528	26,233	34,807	37,194	29,014	18,312
4	Don Chedi	23,360	9,793	10,028	10,378	9,503	10,058	24	14,114	15,326	15,216	15,232	10,851
5	Pho Phraya	59,200	12,553	16,173	25,547	21,581	34,402	7,826	26,185	38,125	36,498	40,782	38,488
6	Borommathat	58,400	4,617	8,456	9,847	11,740	25,893	1,071	29,469	24,723	23,441	21,769	21,804
7	Chanasut	71,712	18,821	30,713	27,940	12,324	41,846	3,018	39,360	42,140	50,575	30,923	32,117
8	Yangmanee	33,648	1,377	2,218	3,471	614	6,346	292	8,045	6,637	4,483	5,797	6,553
9	Phak Hai	32,960	1,002	1,135	1,120	756	1,472	906	2,336	2,347	1,564	1,688	2,105
10	Bang Ban	21,920	2,835	2,875	368	1,567	4,277	1,417	3,440	3,216	2,992	3,776	3,680
11	Chao Chet-Bang Y	64,960	12,136	15,067	21,304	20,952	32,698	29,312	31,000	37,229	33,644	36,045	38,903
12	Phraya Ban Lu	57,384	55,432	63,112	49,066	63,680	67,183	65,282	65,981	64,682	59,571	69,270	56,208
13	Phraa Phimol	42,560	35,632	35,536	35,632	35,126	33,444	33,530	34,848	33,344	34,496	34,481	33,740
14	Phasi Charoen	19,968	12,368	17,520	16,485	20,805	15,250	7,606	14,723	14,592	15,856	12,995	11,728
	Region 7 Total	581,707	195,582	233,524	238,203	218,856	323,323	155,590	323,823	348,517	349,621	333,248	306,065
15	Manorom/Khao Kaeo	38,736	5,381	3,733	9,226	2,858	13,386	280	6,986	8,808	9,926	13,171	12,464
16	Chong Kae	38,192	497	370	2,389	2,880	6,914	170	4,539	2,601	2,020	4,827	5,055
17	Koke Kathiem	32,880	383	537	1,366	1,837	4,090	-	3,012	7,654	4,039	8,476	7,079
18	Roeng Rang	28,640	466	522	694	856	1,552	-	3,928	1,400	800	1,440	1,920
19	Maharaj	67,520	1,548	1,359	1,940	3,810	13,150	90	15,613	18,480	3,975	20,836	3,138
20	Pasak Tai	38,496	1,170	749	761	1,357	4,045	198	5,650	7,469	6,096	6,640	6,656
21	Rangsit Nua	71,280	12,218	10,587	14,765	17,845	18,614	4,111	18,667	23,802	23,094	19,674	22,009
22	Nakhon Luang	42,720	166	419	1,024	453	1,336	92	1,239	122	130	106	325
23	Rangsit Tai	84,160	27,119	37,606	37,884	37,524	49,911	13,630	54,199	51,026	50,832	33,427	30,405
24	Khlong Dan	84,000	6,948	6,985	14,054	13,388	10,431	7,986	25,946	19,759	18,630	22,916	18,497
	Region 8 Total	526,624	55,896	62,867	84,103	82,808	123,429	26,557	139,779	141,121	119,552	131,513	107,548
25	Phra Ong C.	81,600	12,041	24,274	34,267	37,323	36,551	29,390	39,978	42,484	45,408	49,845	47,916
26	Pitsanulok	108,453	-	-	-	-	-	-	-	-	-	15,841	22,039
	Grand Total	1,298,384	263,519	320,665	356,573	338,987	483,303	211,537	503,580	532,122	514,581	530,447	483,568

Data Source : Water Management Section, O&M Division, RID.   (Unit: ha)

Table 2.7.3(2)   Paddy Planted Area in Chao Phraya Delta and Pitsanulok Project Area (Dry Season, continued)

	Project Area	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Average
1	Phoniathep	9,480	9,312	4,674	12,560	8,683	5,899	7,525	8,952	7,033	11,341	14,400	7,222
2	Thabote	13,568	14,120	12,751	21,823	13,682	6,207	7,060	9,128	5,141	21,664	25,079	13,248
3	Sam Chuk	26,293	15,500	24,916	32,092	37,344	12,984	24,522	16,402	11,784	23,391	35,887	23,336
4	Don Chedi	13,754	8,634	12,976	11,620	12,769	7,085	2,323	2,060	2,734	12,945	15,960	9,988
5	Pho Phraya	35,925	28,403	17,793	34,141	25,272	19,628	24,962	24,829	27,620	43,466	44,710	27,537
6	Borommathat	23,341	20,267	21,455	15,980	25,632	2,793	9,171	4,852	5,061	22,969	41,363	16,485
7	Chanasutr	22,482	31,778	32,734	38,690	29,530	14,862	9,763	5,387	2,562	14,971	40,324	25,558
8	Yangmanee	1,981	5,131	3,607	7,295	4,395	3,751	1,684	659	433	2,038	7,093	3,694
9	Phak Hai	1,781	1,108	1,059	954	1,448	1,256	1,291	1,436	1,812	1,957	3,761	1,536
10	Bang Ban	432	0	173	288	64	0	80	85	0	48	320	1,452
11	Chao Che-Bang Y	40,716	38,999	34,797	40,253	42,350	42,483	40,589	40,719	39,926	42,083	42,690	33,282
12	Phraya Ban Lu	54,050	52,451	50,309	49,049	52,023	49,226	49,467	49,390	48,675	28,880	46,480	54,773
13	Phra Phimol	34,892	31,280	32,535	31,287	31,179	30,914	31,005	30,982	30,640	48,675	26,872	33,627
14	Phasi Charoen	11,315	9,852	5,851	6,642	6,497	5,468	7,920	4,666	3,332	3,049	3,100	10,370
	Region 7 Total	290,010	266,834	255,630	302,675	290,869	202,557	217,362	199,549	186,754	277,477	348,039	262,108
15	Mancrom/Khao Kaeo	816	10,000	10,610	4,190	26,325	373	5,932	3,969	3,946	11,562	35,087	8,735
16	Chong Kae	4,732	5,656	4,906	4,623	13,280	0	54	10	0	6,401	26,170	4,280
17	Koke Kathem	4,944	2,992	5,346	4,482	6,230	1,448	1,847	31	13	6,569	14,086	3,943
18	Roeng Rang	-	0	2,416	1,840	2,559	131	1,141	37	5	744	5,240	1,329
19	Maharat	12,592	2,014	14,783	3,072	20,689	1,171	1,117	316	424	4,345	32,444	7,713
20	Pasak Tai	6,482	4,897	6,321	3,816	7,031	3,119	5,795	136	0	3,070	9,209	4,010
21	Rangsit Nua	20,238	0	135	209	574	42	328	44	19	99	2,471	9,451
22	Nakhon Luang	367	21,340	13,743	20,308	19,366	10,307	13,029	10,905	5,307	10,698	13,751	6,295
23	Rangsit Tai	28,063	20,832	27,648	41,041	28,670	13,128	35,352	38,713	27,229	29,472	41,056	33,559
24	Khlong Dan	15,315	14,848	11,220	12,626	10,514	12,749	11,109	9,937	7,978	12,197	12,840	13,096
	Region 8 Total	93,549	82,579	97,128	96,207	135,238	42,467	75,775	64,100	44,920	85,157	192,354	92,412
25	Phra Ong C.	50,656	46,226	47,009	44,235	43,817	39,092	37,512	35,685	34,324	31,030	29,314	36,639
26	Pitsanulok	19,564	20,587	27,722	58,157	51,452	34,172	48,417	22,274	18,116	53,867	94,638	37,450
	Grand Total	453,779	416,226	427,490	501,274	521,376	318,288	379,065	321,808	284,113	447,532	664,345	428,608

Data Source : Water Management Section, O&M Division, RID,   (Unit: ha)

2.9   Current Status of Water Operation

This paragraph is supported by the following tables and figures;

Table

- Bhumibol Reservoir Inflow
- Bhumibol Reservoir Outflow
- Bhumibol Reservoir Storage at the End of Month
- Sirikit Reservoir Inflow
- Sirikit Reservoir Outflow
- Sirikit Reservoir Storage at the End of Month
- Inflow at Naresuan Dam
- Diversion from Naresuan Dam
- Downstream Release from Naresuan Diversion Dam
- Inflow at Chainat Dam
- Diversion from Chainat Dam
- Downstream Release of Chainat Dam

Figure

- Recorded Inflow, Outflow and Storage of Bhumibol Reservoir
- Recorded Inflow, Outflow and Storage of Sirikit Reservoir
- Seasonal Water Balance and Storage Condition of Sirikit Reservoir
- Naresuan Barrage Operation
- Chao Phraya Diversion Dam Operation
- Downstream Release of Chao Phraya Dam

Table 2.9.1 Bhumiphol Reservoir Inflow

Year	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
1974	48	364	285	151	957	1482	1128	1424	363	437	154	92	6885
1975	0	121	543	592	1426	2473	1777	843	430	240	150	112	8707
1976	38	180	141	0	510	1014	1504	869	281	353	74	0	4964
1977	35	150	64	61	523	2356	1014	663	282	325	64	35	5572
1978	0	131	25	1169	1475	1716	1580	414	237	95	9	0	6851
1979	0	129	423	114	524	702	994	92	21	0	0	0	2999
1980	0	304	436	335	665	2019	1658	483	313	124	13	0	6350
1981	34	168	304	641	1090	946	695	923	381	172	4	9	5367
1982	72	240	634	309	679	1504	1174	425	205	108	46	14	5410
1983	0	36	68	37	402	1139	1485	1407	370	150	75	9	5178
1984	18	53	304	189	514	940	1311	398	191	70	34	13	4035
1985	24	112	272	414	523	1241	1207	1467	424	193	127	75	6079
1986	93	297	225	329	679	938	615	286	183	104	30	12	3791
1987	46	43	228	20	893	1246	979	793	268	110	45	2	4673
1988	18	340	769	533	752	848	1813	714	326	166	77	16	6372
1989	4	151	368	351	514	664	1458	448	216	78	28	5	4285
1990	18	277	293	205	440	1014	943	465	182	52	21	0	3910
1991	0	41	247	182	924	1227	863	505	168	102	35	6	4300
1992	0	1	31	143	611	1305	1208	353	351	151	32	31	4217
1993	1	50	69	73	174	925	612	164	102	32	12	62	2276
1994	84	253	510	718	1997	2381	988	441	334	168	88	91	8053
1995	46	234	170	337	1453	2191	1118	468	243	173	244	131	6808
Average	26	167	291	314	806	1376	1187	638	267	155	62	33	5322
Maximum	93	364	769	1169	1997	2473	1813	1467	430	437	244	131	8707
Minimum	0	1	25	0	174	664	612	92	21	0	0	0	2276

(Unit: MCM)

Data collected from O&M Division of Royal Irrigation Department.

Table 2.9.2 Bhumiphol Reservoir Outflow

	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
1974	617	610	558	609	403	278	292	251	261	294	483	700	5356
1975	786	599	570	611	515	382	701	953	557	469	533	801	7457
1976	799	749	942	1005	514	308	307	347	396	402	502	758	7029
1977	895	921	728	736	655	318	452	718	412	332	500	635	7302
1978	614	473	529	423	339	270	230	264	361	383	466	806	5158
1979	823	712	552	681	664	429	466	890	545	322	287	338	6709
1980	292	236	165	174	127	42	37	114	159	274	450	662	2732
1981	765	685	598	117	125	183	222	333	192	295	606	872	4993
1982	579	541	493	780	772	235	142	269	233	401	700	978	6123
1983	676	594	357	444	178	54	17	13	31	136	664	832	3996
1984	745	512	192	303	451	204	44	213	109	280	504	685	4242
1985	527	389	190	199	293	127	31	34	73	213	634	797	3507
1986	704	518	539	516	335	234	486	613	213	297	593	926	5974
1987	806	486	290	629	587	109	38	270	42	205	364	1074	4900
1988	944	225	60	124	21	21	17	15	118	421	812	1253	4031
1989	1140	579	166	231	699	356	39	430	152	363	552	919	5626
1990	824	572	416	314	368	410	317	385	305	372	351	571	5205
1991	482	196	87	183	254	135	35	309	308	411	529	669	3598
1992	600	418	103	84	22	48	35	137	323	241	450	602	3063
1993	553	435	409	330	396	54	182	431	127	138	185	220	3460
1994	168	150	75	38	46	81	195	413	339	307	516	848	3176
1995	690	594	620	294	102	33	62	249	328	566	865	1088	5491
Average	683	509	393	401	358	196	198	347	254	324	525	774	4960
Maximum	1140	921	942	1005	772	429	701	933	557	566	865	1253	7457
Minimum	168	150	60	38	21	21	17	13	31	136	185	220	2732

(Unit: MCM)

Data collected from O&M Division of Royal Irrigation Department.

Table 2.9.3 Bhumiphol Reservoir Storage at the End of Month

	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
1974	9000	8725	8435	7966	8511	9705	10531	11687	11766	11880	11511	10858	120575
1975	10018	9509	9462	9431	10332	12412	13476	13366	13213	12951	12524	11810	138504
1976	11026	10424	9610	8593	8508	9277	10464	10965	10828	10752	10287	9488	120222
1977	8591	7786	7108	6424	6286	8318	8871	8806	8658	8628	8160	7528	95164
1978	6832	6470	5955	6693	7822	9259	10598	10732	10587	10273	9786	8883	103890
1979	7970	7366	7224	6648	6501	6767	7288	6480	5943	5590	5260	4867	77904
1980	4530	4583	4845	5000	5583	7503	9115	9475	9610	9431	8960	8254	86889
1981	7618	7079	6773	7288	8272	9026	9490	10051	10228	10084	9455	8563	103927
1982	8008	7662	7778	7290	7182	8435	9447	9588	9539	9216	8527	7515	100187
1983	6755	6120	5808	5374	5585	6658	8110	9413	9766	9742	9098	8230	88659
1984	7464	6967	7055	6926	6974	7694	8879	9040	9090	8863	8351	7636	94939
1985	7062	6741	6801	7007	7207	8272	9326	10776	11080	11016	10517	9671	105476
1986	9015	8751	8415	8217	8531	9180	9283	8970	8920	8703	8118	7142	104245
1987	6276	5756	5678	5071	5342	6498	7442	7933	8130	8011	7646	6468	80251
1988	5457	5545	6235	6629	7346	8157	9934	10611	10796	10506	9712	8371	99299
1989	7108	6616	6812	6917	6717	7012	8414	8414	8461	8148	7570	6565	83754
1990	5667	5332	5191	5070	5131	5724	6337	6404	6268	5926	5545	4884	67479
1991	4286	4109	4254	4242	4902	5983	6798	6980	6824	6494	5961	5211	66044
1992	4494	3996	3902	3951	4529	5776	6935	7136	7149	7036	6584	5953	67441
1993	5318	4867	4507	4240	4009	4871	5289	5011	4976	4853	4644	4440	57025
1994	4324	4404	4822	5490	7427	9709	10481	10486	10458	10285	9809	8991	96686
1995	8293	7891	7415	7441	8774	10912	11944	12138	12027	11596	10921	9891	119243
Average	7051	6714	6458	6450	6885	8052	9021	9294	9287	9090	8588	7783	94673
Maximum	11026	10424	9610	9431	10332	12412	13476	13366	13213	12951	12524	11810	138504
Minimum	4286	3996	3808	3951	4009	4871	5289	5011	4976	4853	4644	4440	57025

(Unit: MCM)

Data collected from O&M Division of Royal Irrigation Department.

Table 2.9.4 Sirikit Reservoir Inflow

	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
1974	191.9	247.7	297.4	399.5	1295.8	885.0	401.9	225.6	127.7	157.7	94.6	94.9	4419.7
1975	64.3	184.4	669.4	1091.4	2767.3	1923.6	886.7	311.0	167.0	167.4	170.3	126.7	8529.5
1976	107.3	186.0	356.7	599.9	1431.0	1596.5	993.4	369.8	223.0	202.4	77.2	138.0	6281.2
1977	117.9	217.7	148.6	529.7	998.2	1047.3	444.8	265.5	144.0	122.2	98.8	94.8	4229.5
1978	128.8	117.6	356.1	1004.8	1803.8	1642.9	735.1	250.2	139.9	123.4	61.0	96.4	6460.0
1979	69.7	237.2	532.0	306.2	1084.8	687.7	311.5	145.8	92.0	95.7	43.5	78.1	3684.2
1980	69.0	130.1	382.2	1069.1	1129.6	2327.2	503.6	223.1	134.7	100.1	34.0	99.1	6301.8
1981	79.1	435.3	379.9	2792.4	1583.4	1171.2	618.4	313.0	155.4	130.7	114.3	55.2	7828.3
1982	137.0	124.6	212.2	695.4	1069.2	1457.4	924.8	255.5	115.1	101.6	69.2	74.6	5236.6
1983	112.7	221.4	196.3	572.2	1251.3	1347.4	896.2	328.8	159.2	129.8	120.2	106.1	5441.6
1984	121.6	221.0	375.5	1230.3	1500.3	1637.4	626.7	270.6	136.5	126.8	104.7	95.0	6446.4
1985	128.8	179.1	219.8	589.7	1868.0	1053.6	439.4	346.8	168.4	124.3	115.1	131.8	5364.8
1986	164.1	466.2	410.2	912.7	865.7	812.1	384.3	208.0	121.4	75.9	66.4	72.1	4559.1
1987	61.6	88.0	160.6	142.1	951.6	661.1	414.9	221.7	89.8	78.8	66.0	50.0	2986.2
1988	89.2	310.8	346.5	817.7	1464.3	635.6	413.6	165.3	103.5	74.1	76.1	63.1	4559.8
1989	47.2	279.4	237.2	642.8	828.4	941.2	492.3	173.7	93.0	84.0	80.4	59.4	3959.0
1990	48.6	239.9	360.7	730.5	884.0	885.6	395.5	219.8	97.2	86.4	44.6	29.3	4022.1
1991	67.9	226.7	260.8	347.9	826.5	846.4	413.1	167.4	85.6	82.0	66.5	64.2	3455.0
1992	44.5	58.7	88.7	417.3	691.8	742.1	441.1	174.4	147.4	93.8	49.4	77.1	3026.3
1993	69.9	125.6	204.2	788.6	642.9	653.1	322.4	132.0	81.6	65.5	58.4	92.2	3236.4
1994	67.3	218.0	411.5	875.2	3273.3	1665.7	631.9	254.5	184.2	119.5	85.0	51.5	7837.6
1995	51.0	132.3	210.7	1018.7	3300.8	2615.1	744.9	510.8	213.2	158.8	149.6	129.9	9235.8
Average	92.7	211.3	309.9	798.8	1432.4	1242.5	565.3	251.5	135.4	113.7	83.9	85.4	5322.8
Maximum	191.9	466.2	669.4	2792.4	3300.8	2615.1	993.4	510.8	223.0	202.4	170.3	138.0	9235.8
Minimum	44.5	58.7	88.7	142.1	642.9	635.6	311.5	132.0	81.6	65.5	34.0	29.3	2986.2

(Unit: MCM)

Data collected from Sirikit Dam Control Office of EGAT

Table 2.9.5 Sirikit Reservoir Outflow

	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
1974	179.8	361.8	373.8	607.6	680.1	489.1	415.9	295.3	276.0	273.8	298.4	467.3	4718.9
1975	573.0	440.3	350.0	599.2	728.5	709.2	640.8	494.4	467.9	341.1	546.2	702.0	6592.6
1976	825.6	814.6	814.1	625.8	623.2	476.4	449.5	443.4	530.5	533.8	545.6	713.8	7396.3
1977	713.6	752.4	732.2	723.4	737.4	268.0	301.9	527.4	267.2	192.8	238.9	414.4	5869.6
1978	478.4	258.7	302.1	311.2	206.4	286.3	292.8	276.2	376.0	410.2	490.1	855.8	4544.2
1979	793.1	734.8	458.8	553.9	673.4	417.8	469.5	519.2	307.7	213.2	175.3	277.4	5594.1
1980	296.6	309.4	188.1	192.4	138.3	286.9	305.5	206.0	258.3	376.1	472.1	626.4	3656.1
1981	714.4	646.9	737.6	429.9	1061.7	536.3	418.4	527.7	322.8	416.7	604.7	792.8	7209.9
1982	848.6	587.3	265.3	470.8	656.5	199.6	215.5	339.8	262.0	456.8	550.6	679.5	5532.3
1983	997.2	665.9	287.5	524.7	328.2	111.3	42.0	60.0	47.6	187.2	478.2	776.8	4506.6
1984	756.2	488.7	263.9	345.2	602.4	708.8	228.1	517.9	164.6	457.0	665.4	971.7	6169.9
1985	983.0	573.3	299.5	270.3	193.0	223.6	64.3	113.5	126.7	192.9	544.3	850.0	4434.4
1986	728.7	677.7	681.6	555.2	397.2	303.3	422.6	668.4	233.3	319.3	686.9	657.8	6332.0
1987	633.5	571.4	266.2	452.5	303.7	118.3	72.0	189.8	45.9	192.6	542.5	412.3	3800.7
1988	237.1	140.0	63.5	147.5	118.3	180.3	140.7	171.8	77.3	210.9	339.8	356.9	2184.1
1989	556.4	558.8	143.6	168.0	430.8	475.5	202.9	341.0	105.4	267.0	428.8	727.4	4405.6
1990	635.8	479.8	374.8	410.9	411.9	430.6	322.1	321.4	169.8	209.1	506.7	656.0	4928.9
1991	586.7	318.1	149.9	331.8	312.8	59.9	181.7	261.0	160.1	215.6	340.3	465.9	3383.8
1992	464.4	320.2	118.9	118.5	25.7	58.0	40.1	207.9	210.7	148.9	292.8	412.8	2418.9
1993	417.5	353.2	293.5	427.5	735.4	260.9	125.5	458.4	195.9	174.5	238.2	274.9	3955.4
1994	136.7	102.5	30.2	14.5	101.7	302.4	160.0	446.2	341.5	369.2	629.0	820.4	3454.3
1995	745.6	598.7	472.6	268.1	823.3	1177.4	753.6	526.7	377.5	484.4	798.3	1082.4	8108.6
Average	604.6	488.8	348.5	388.6	467.7	367.3	284.8	359.7	242.0	302.0	473.3	626.1	4963.5
Maximum	997.2	814.6	814.1	723.4	1061.7	1177.4	753.6	668.4	530.5	533.3	798.3	1082.4	8108.6
Minimum	136.7	102.5	30.2	14.5	25.7	58.0	40.1	60.0	45.9	148.9	175.3	274.9	2184.1

Data collected from Sirikit Dam Control Office of EGAT

(Unit: MCM)

Table 2.9.6 Sirikit Reservoir Storage Volume at the End of Month

	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Annual
1974	7674	7458	7352	7102	7674	8065	8025	7928	7753	7613	7388	6988	91020
1975	6474	6160	6442	6918	8835	9680	9550	9345	9015	8795	8360	7758	97332
1976	6990	6318	5902	5786	6552	7590	8203	8113	7743	7358	6885	6272	83712
1977	5694	5168	4577	4318	4565	5322	5444	5189	5047	4963	4807	4474	59568
1978	4083	3911	3919	4597	6086	7378	7843	7803	7505	7184	6751	5994	73054
1979	5284	4777	4828	4563	4940	5172	5018	4635	4405	4264	4113	3890	55889
1980	3627	3414	3578	4425	5355	7388	7593	7588	7425	7140	6691	6126	70350
1981	5468	5193	4830	7137	7663	8279	8454	8216	8022	7711	7187	6410	84570
1982	5666	5150	5073	5277	5672	6910	7596	7488	7318	6937	6426	5789	75302
1983	4863	4388	4273	4302	5208	6424	7316	7562	7649	7566	7173	6416	73140
1984	5721	5400	5494	6392	7313	8209	8577	8310	8257	7902	7299	6534	85208
1985	5407	4988	4891	5180	6885	7723	8065	8274	8291	8195	7741	6967	82607
1986	6344	6095	5777	6132	6570	7105	7037	6519	6392	6126	5439	4839	74373
1987	4260	3758	3629	3300	3946	4449	4762	4776	4800	4670	4169	3782	50301
1988	3606	3750	4012	4664	5990	6425	6676	6648	6652	6494	6214	5876	67007
1989	5333	5022	5092	5546	5926	6371	6639	6448	6414	6208	5831	5131	69961
1990	4507	4238	4202	4504	4958	5394	5449	5320	5228	5085	4598	3946	57429
1991	3401	3284	3376	3376	3875	4645	4858	4746	4654	4500	4203	3776	48694
1992	3330	3043	2997	3275	3929	4596	4979	4927	4845	4770	4502	4141	49334
1993	3765	3511	3402	3747	3639	4016	4196	3853	3722	3596	3395	3190	44052
1994	3096	3186	3549	4392	7543	8882	9327	9108	8925	8646	8068	7263	81985
1995	6530	6027	5739	6468	8900	9476	9440	9397	9205	8850	8164	7143	95339
Average	5051	4738	4679	5064	6001	6795	7048	6918	6785	6572	6155	5568	71373
Maximum	7674	7458	7352	7137	8900	9680	9550	9397	9205	8850	8360	7758	97332
Minimum	3096	3043	2997	3275	3639	4016	4196	3853	3722	3596	3395	3190	44052

Data collected from O&M Division, Royal Irrigation Department

(Unit: MCM)

Table 2.9.7 Inflow at Naresuan Dam

	4	5	6	7	8	9	10	11	12	1	2	3	Year
1982	924.3	726.5	397.4	543.6	700.3	688.1	494.7	363.5	309.4	442.7	549.3	578.4	6218.2
1983	994.6	718	310.6	471.9	377.7	386.7	363.2	155.3	48.9	99	423.1	753.1	5102.1
1984	710.7	465.1	366	325.4	590.4	695.9	574.6	537.7	153	388.4	612.4	905.7	6325.3
1985	949.7	601.3	269	330.2	206.4	473.2	360.4	278.8	158.7	115.7	440.2	760.6	4944.2
1986	660.3	694	751.7	611.7	458.8	471.3	325.9	583.5	216	211.1	621.4	585	6190.7
1987	545.8	530.4	276.6	347	475.7	436.1	212.4	165.9	16	94	508.5	383.9	3992.3
1988	138.7	397	130.9	336.3	420.5	352.1	341.7	257.2	243	373	384.3	394.1	3768.8
1989	630.9	730.8	354.4	238.8	356.8	225.9	204.8	292.1	135.4	208.6	309.2	710.7	4398.4
1990	652.4	607.8	680	374.6	375.5	761.9	323.7	327.7	203	158.1	466	683.1	5613.8
1991	592.6	304.3	177.6	233.2	418.4	269.6	222	251.4	138.6	160	254.6	324.6	3346.9
1992	340.5	268.1	112	89	210.9	262.6	186.4	183.8	204.2	117	202.5	283.3	2460.3
1993	314.2	340	258.5	322.6	626.6	486.8	116.5	328.7	173.6	120.4	150	188.9	3426.8
1994	106	172	389	131.9	605.9	881.7	234.6	324	297.1	241	521.7	789.6	4694.5
Ave.	581.6	504.3	344.1	335.1	448.0	491.7	304.7	311.5	176.7	209.9	418.7	564.7	4690.9
Max.	994.6	730.8	751.7	611.7	700.3	881.7	574.6	583.5	309.4	442.7	621.4	905.7	6218.2
Min.	106	172	112	89	206.4	225.9	116.5	155.3	16	94	150	188.9	2460.3

(Unit:MCM)

Table 2.9.8 Diversion from Naresuan Dam

	4	5	6	7	8	9	10	11	12	1	2	3	Year
1982	41.3	36.5	4.4	40.6	86.3	94.1	92.7	39.5	3.4	6.7	26.3	40.4	512.2
1983	36.6	32	14.6	82.9	96.7	78.7	89.2	24.3	5.9	6	57.1	68.1	592.1
1984	72.7	45.1	0	52.4	125.4	133.9	121.6	55.7	2	7.4	54.4	73.7	744.3
1985	75.2	43.3	0	28.2	82.4	103.2	83.4	56.8	0.7	2.7	61.2	73.6	611.2
1986	78.3	31	6.7	60.7	151.8	181.3	204.9	125.5	0	7.1	51.4	100	998.7
1987	97.8	77.4	26.6	111	114.7	182.1	174.4	77.9	0	0	42.5	81.9	986.3
1988	78.7	28	0.9	96.3	158.5	170.1	173.7	118.2	0	20	121.3	156.1	1121.8
1989	150.9	92.8	1.4	44.8	158.8	188.9	162.8	125.1	6.4	18.6	64.2	133.7	1148.4
1990	145.4	67.8	0	41.6	173.5	194.9	201.7	111.7	5	22.1	73	109.1	1145.8
1991	100.6	50.3	3.6	15.2	88.4	156.6	161	126.4	4.6	13	76.6	136.6	932.9
1992	132.5	113.1	16	0	49.9	84.6	116.4	111.8	15.2	3	0.5	5.3	648.3
1993	82	0	9.5	84.6	147.6	129.8	97.5	81.7	13.6	4.4	7	0.9	584.8
1994	0	0	0	7.9	123.9	74.7	121.6	85	11.1	46	93.7	143.6	702.5
Ave.	78.4	47.5	6.4	51.2	119.8	136.4	138.5	87.7	5.2	12.1	56.1	86.4	825.7
Max.	150.9	113.1	26.6	111	173.5	194.9	204.9	126.4	15.2	46	121.3	156.1	1148.4
Min.	0	0	0	0	49.9	74.7	83.4	24.3	0	0	0.5	0.9	512.2

(Unit: MCM)

Table 2.9.9 Downstream Release from Naresuan Diversion Dam

	4	5	6	7	8	9	10	11	12	1	2	3	Year
1982	883	690	393	503	614	594	402	324	306	436	523	538	6206
1983	958	686	296	389	281	308	274	131	43	93	366	685	4510
1984	638	420	366	273	465	562	453	482	151	381	558	832	5581
1985	874	558	269	302	124	370	277	222	158	113	379	687	4333
1986	582	663	745	551	307	290	121	458	216	204	570	485	5192
1987	448	453	250	236	361	254	38	88	16	94	466	302	3006
1988	60	369	130	240	262	182	168	139	243	353	263	238	2647
1989	480	638	353	194	198	37	42	167	129	190	245	577	3250
1990	507	540	680	333	202	567	122	216	198	136	393	574	4468
1991	492	254	174	218	330	113	61	125	134	147	178	188	2414
1992	208	155	96	89	161	178	70	72	189	114	202	278	1812
1993	306	340	249	238	479	357	19	247	160	116	143	188	2842
1994	106	172	389	124	482	807	113	239	286	195	428	646	3987
Ave.	503	457	338	284	328	355	166	224	171	198	363	478	3865
Max.	958	690	745	551	614	807	453	482	306	436	570	832	6206
Min.	60	155	96	89	124	37	19	72	16	93	143	188	1812

(Unit: MCM)

Table 2.9.10 Inflow at Chainat Dam

	4	5	6	7	8	9	10	11	12	1	2	3	Annual
1974	1060	1266	1169	1125	2074	3222	4913	4468	1730	831	716	1082	23656
1975	1177	1176	1436	1811	2714	6680	11573	5549	2009	946	1009	1438	37518
1976	1511	2095	2025	1720	2271	4652	6303	4930	1851	1138	1011	1385	30892
1977	1487	1783	1469	1377	1658	3717	3125	1955	1115	648	631	884	19849
1978	943	852	896	3289	4095	4549	9375	3299	1294	814	859	1476	31741
1979	1617	1607	2059	1674	1843	2076	2392	1571	1157	656	450	533	17635
1980	549	1031	1977	2285	3463	5137	10544	3579	1149	638	871	1163	32386
1981	1399	1717	2244	2250	4562	4363	2946	4176	2070	959	1053	1623	29362
1982	1477	1224	985	1195	1556	2862	4178	2525	1257	780	1120	1492	20651
1983	1537	1392	1008	879	1899	3294	6728	6498	2068	622	902	1522	28349
1984	1402	1192	1498	1095	1380	2595	3233	2457	1257	702	985	1507	19303
1985	1446	1178	1021	1374	1883	2939	4987	4917	2539	621	939	1414	25258
1986	1327	2486	2224	1620	1784	2439	2137	1838	1272	553	1033	1376	20069
1987	1283	1090	909	747	1245	2934	4125	2065	1256	425	530	1149	17758
1988	959	1406	1592	1631	1666	3354	5370	3204	1257	685	757	1130	23011
1989	1260	1216	1763	953	1249	1809	2582	1975	1149	539	600	1176	16271
1990	1154	1227	2380	1208	1240	2037	2732	1736	1283	531	562	913	17003
1991	920	595	519	359	1347	2906	2566	1537	959	463	489	638	13298
1992	601	581	267	189	1582	979	3603	1884	1043	430	497	716	12372
1993	695	716	948	591	837	1706	1453	720	621	210	253	315	9065
1994	190	743	2758	2235	2419	5836	5706	1533	1357	485	699	1109	25070
Average	1143	1265	1483	1410	2037	3337	4789	2972	1414	650	760	1145	22406
Maximum	1617	2486	2758	3289	4562	6680	11573	6498	2539	1138	1120	1623	37518
Minimum	190	581	267	189	837	979	1453	720	621	210	253	315	9065

Data Source: O/M Division of Royal Irrigation Department.   (Unit: MCM)

Table 2.9.11 Diversion from Chainat Dam

	4	5	6	7	8	9	10	11	12	1	2	3	Annual
1974	853	795	785	908	1487	1903	1203	1065	321	244	460	865	10889
1975	941	809	697	1085	1720	1400	2006	1884	362	212	491	1020	12627
1976	1236	603	975	1120	1334	1407	2210	1949	608	576	595	1112	13725
1977	1166	1170	1083	1106	1337	1553	2161	1667	729	308	387	678	13345
1978	749	592	632	426	1240	1796	1385	1884	790	479	675	1270	11918
1979	1379	1213	1001	1243	1503	1506	1516	1379	715	343	215	356	12369
1980	368	600	754	1235	1650	1630	1786	1135	386	394	617	895	11450
1981	1122	1136	1065	951	1353	1680	2089	1973	522	536	806	1347	14580
1982	1166	967	718	916	1267	1703	2290	1921	587	520	885	1216	14156
1983	1275	1138	700	662	945	1703	1181	863	391	295	687	1262	11102
1984	1153	962	897	637	1136	2040	2279	2110	978	450	750	1245	14637
1985	1182	873	718	1039	1578	1472	1784	1677	493	324	697	1141	12978
1986	1063	860	1024	991	1042	1581	1805	1602	870	321	798	1095	13052
1987	1032	836	671	560	1039	897	1623	1661	726	262	363	895	10565
1988	793	852	669	809	1015	1192	1205	1299	753	455	605	908	10555
1989	1024	980	835	707	1029	1335	1620	1654	771	386	462	924	11727
1990	923	836	923	948	1010	1602	680	1205	876	370	402	720	10495
1991	715	445	389	225	817	1405	1489	1288	726	321	329	434	8583
1992	407	391	137	82	961	756	1643	1381	707	268	314	470	7517
1993	486	509	620	450	683	1048	1018	616	489	96	132	156	6303
1994	104	525	1011	878	1375	1618	1475	1398	1051	383	551	960	11329
Average	911	814	776	808	1215	1487	1640	1505	660	359	534	903	11614
Maximum	1379	1213	1083	1243	1720	2040	2290	2110	1051	576	885	1347	14637
Minimum	104	391	137	82	683	756	680	616	321	96	132	156	6303

Data Source: O/M Division of Royal Irrigation Department.　　(Unit: MCM)

Table 2.9.12 Downstream Release of Chainat Dam

	4	5	6	7	8	9	10	11	12	1	2	3	Annual
1974	207	471	384	217	587	1319	3710	3403	1409	587	256	217	12767
1975	236	367	739	726	994	5280	9567	3665	1647	734	518	418	24891
1976	275	1492	1050	600	937	3245	4093	2981	1243	562	416	273	17167
1977	321	613	386	271	321	2164	964	288	386	340	244	206	6504
1978	194	260	264	2863	2855	2753	7990	1415	504	335	184	206	19823
1979	238	394	1058	431	340	570	876	192	442	313	235	177	5266
1980	181	431	1223	1050	1813	3507	8758	2444	763	244	254	268	20936
1981	277	581	1179	1299	3209	2683	857	2203	1548	423	247	276	14782
1982	311	257	267	279	289	1159	1888	604	670	260	235	276	6495
1983	262	254	308	217	954	1591	5547	5635	1677	327	215	260	17247
1984	249	230	601	458	244	555	954	347	279	252	235	262	4666
1985	264	305	303	335	305	1467	3203	3240	2046	297	242	273	12280
1986	264	1626	1200	629	742	858	332	236	402	212	235	281	7017
1987	251	254	238	187	206	2037	2502	404	530	163	167	254	7193
1988	166	554	923	822	651	2162	4165	1905	504	230	152	222	12456
1989	236	236	928	246	220	474	962	321	378	153	138	252	4544
1990	231	391	1457	260	230	435	2052	531	407	161	160	193	6508
1991	205	150	130	134	530	1501	1077	249	233	142	160	204	4715
1992	194	190	130	107	621	223	1960	503	336	162	183	246	4855
1993	209	207	328	141	154	658	435	104	132	114	121	159	2762
1994	86	218	1747	1357	1044	4218	4231	135	306	102	148	149	13741
Average	231	451	707	601	821	1850	3149	1467	754	291	226	242	10791
Maximum	321	1626	1747	2863	3209	5280	9567	5635	2046	734	518	418	24891
Minimum	86	150	130	107	154	223	332	104	132	102	121	149	2762

Data Source: O/M Division of Royal Irrigation Department.　　(Unit: MCM)

Figure 2.9.1 Recorded Inflow, Outflow and Storage of Bhumibol Reservoir
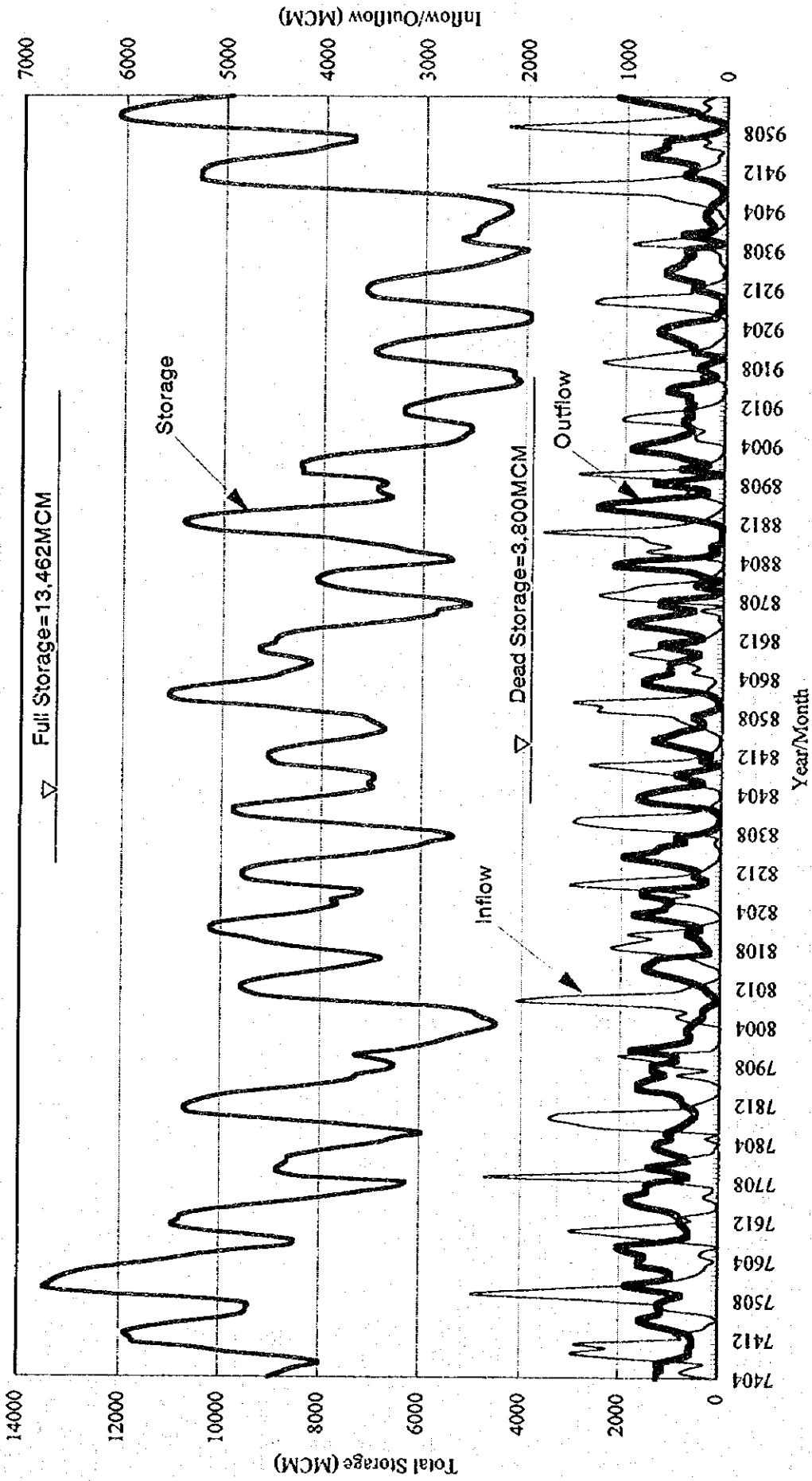
Figure 2.9.2   Recorded Inflow, Outflow and Storage of Sirikit Reservoir
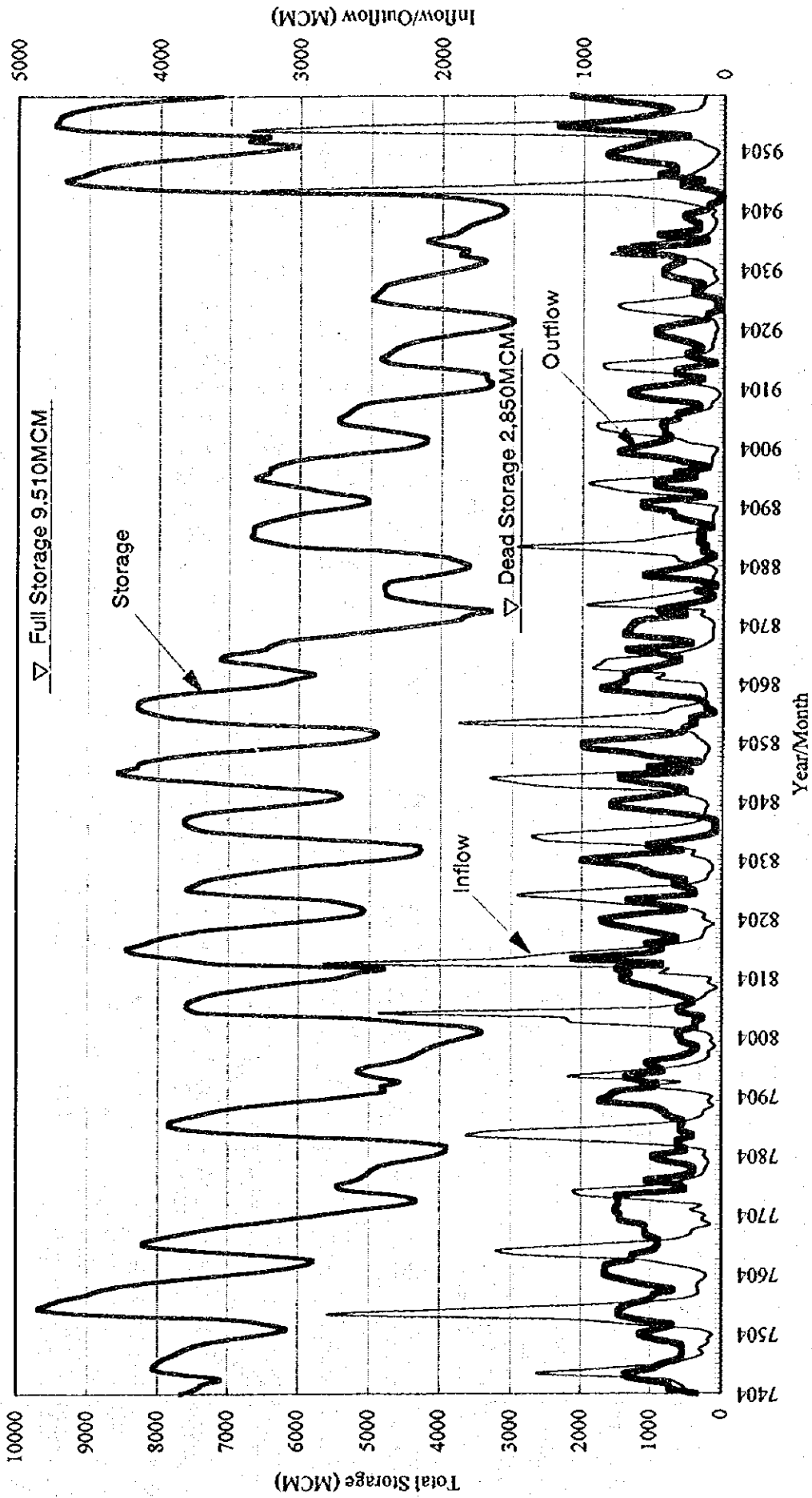
Figure 2.9.3 Seasonal Water Balance and Storage Condition of Sirikit Reservoir
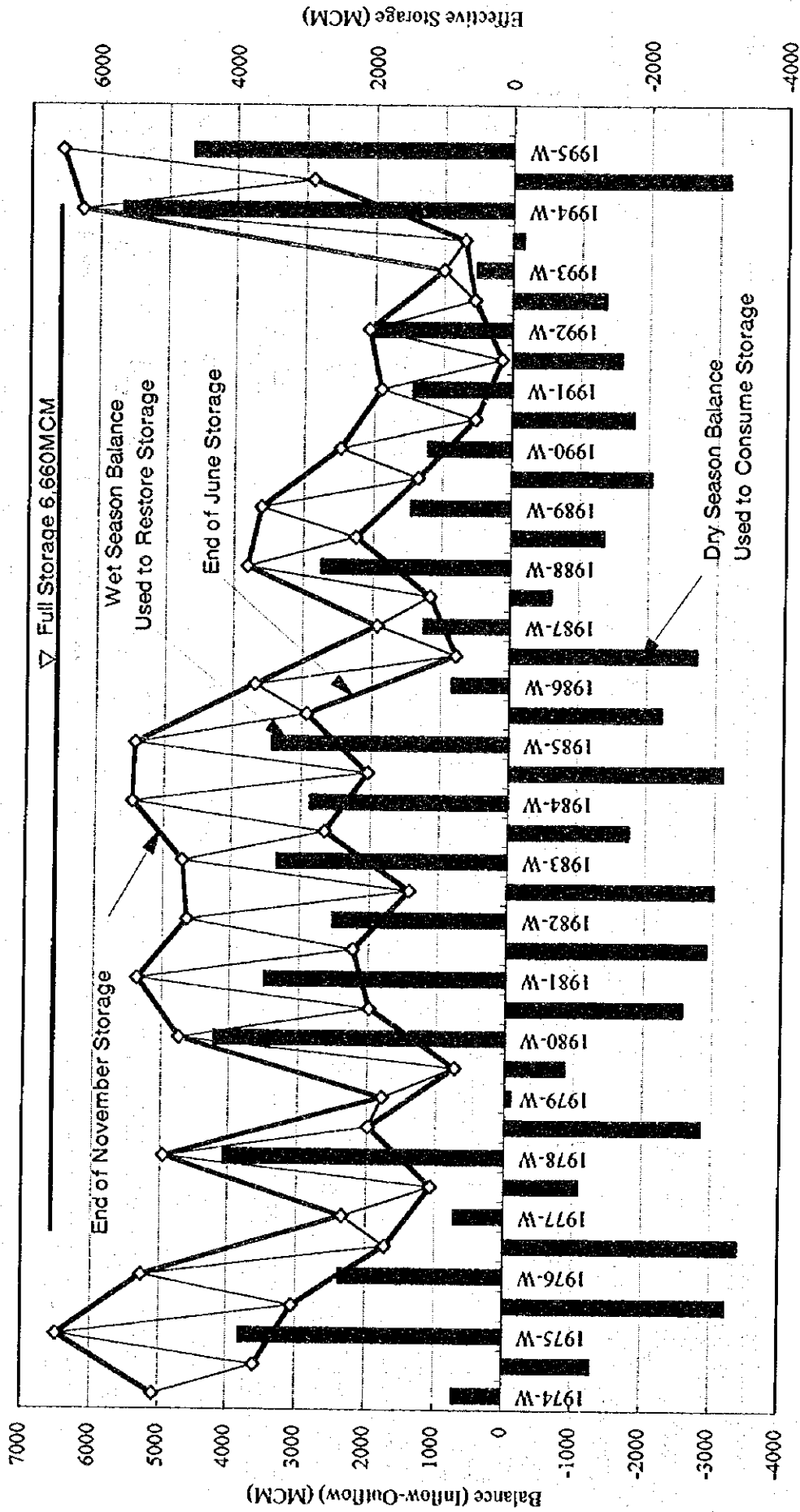
Figure 2.9.4 Narasuan Barrage Operation

Legend:
- Release
- Diversion

Labels on chart:
- Nan River Flow at Diversion Site
- Downstream Release
- Diversion

Y-axis: MCM/Month (0, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000)

X-axis: Year/Month (198201, 198301, 198401, 198501, 198601, 198701, 198801, 198901, 199001, 199101, 199201, 199301, 199401)
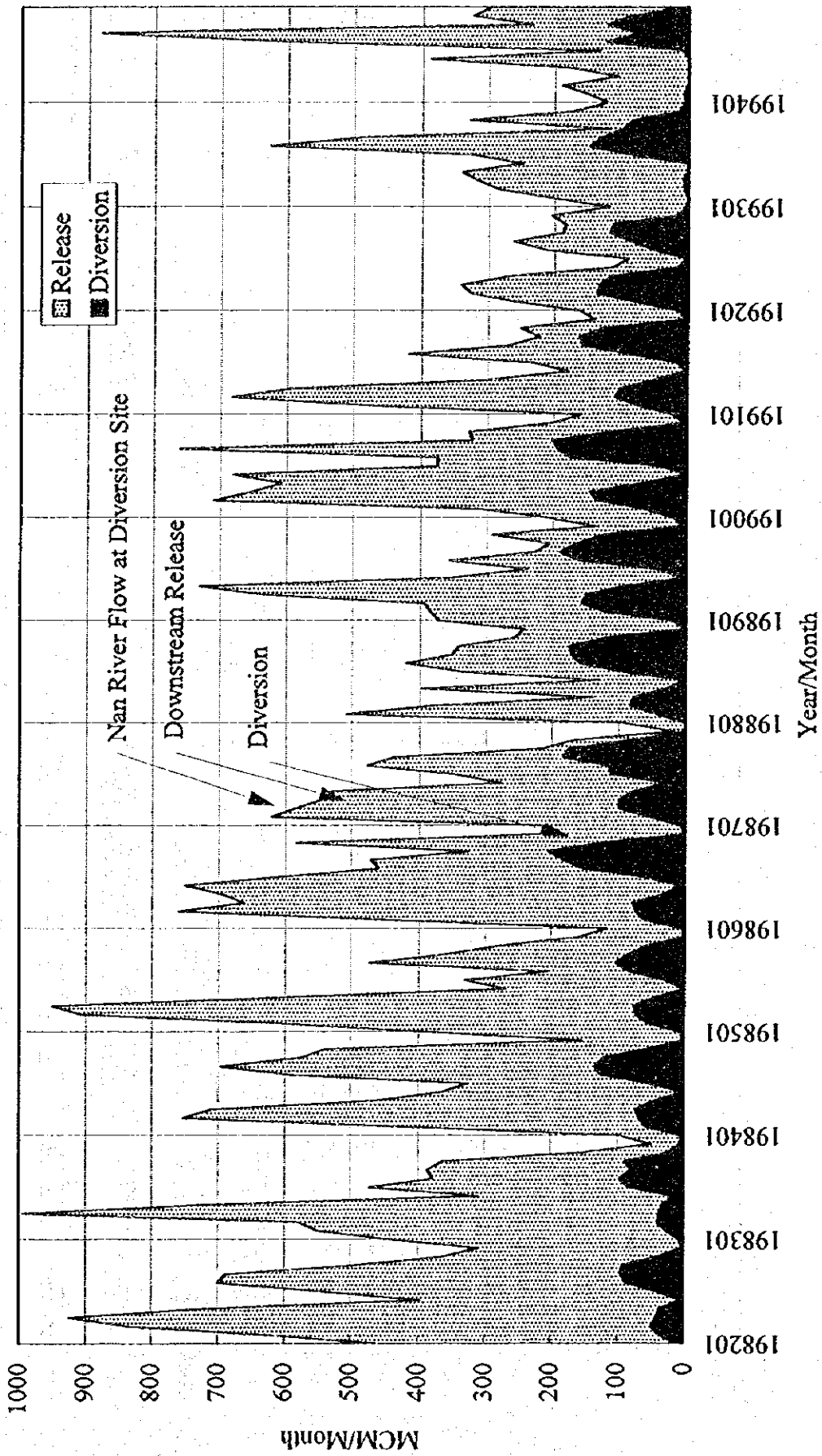
Fifure 2.9.5   Chao Phraya Diversion Dam Operation
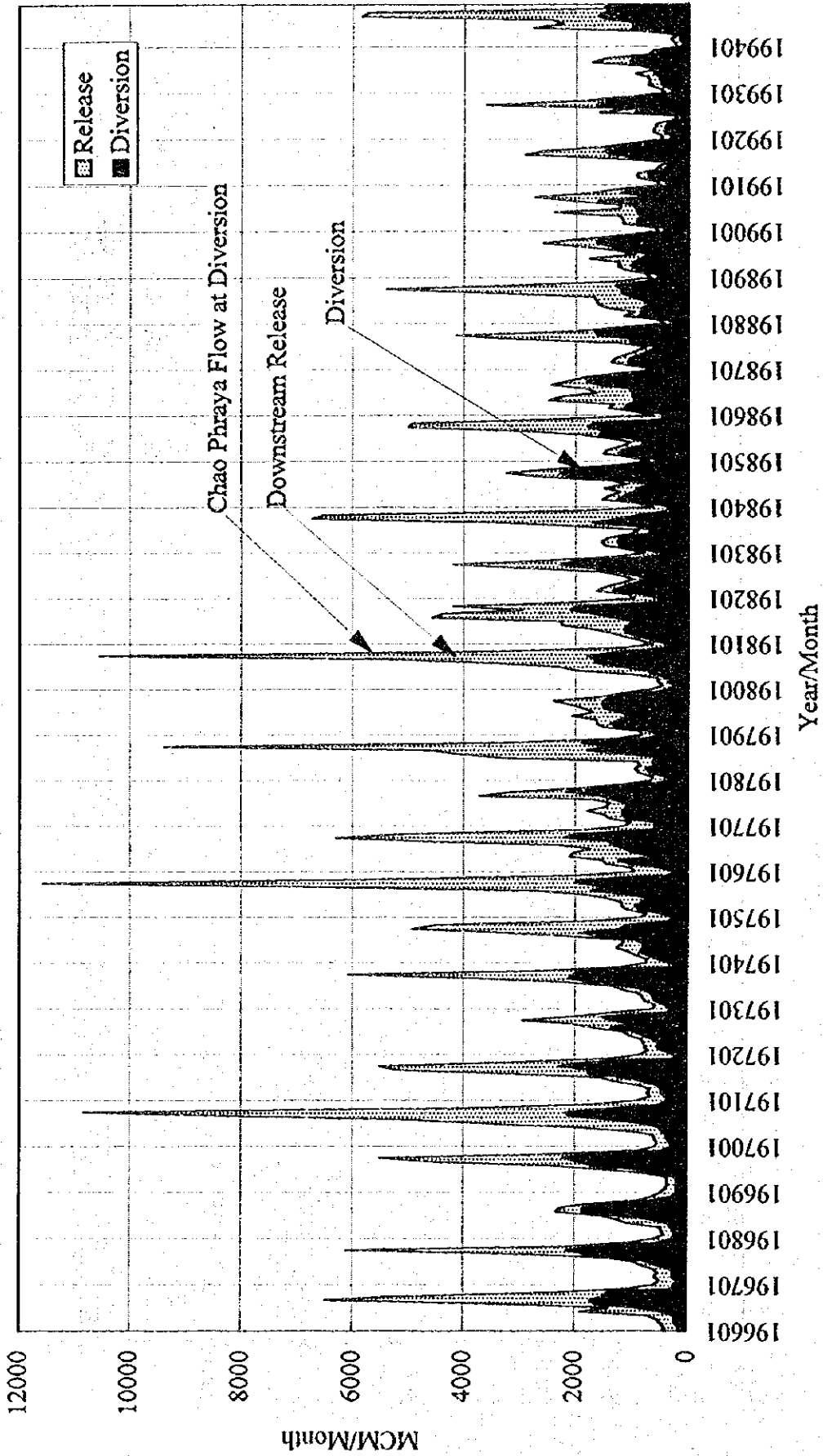
Figure 2.9.6   Downstream Release of Chao Phraya Dam
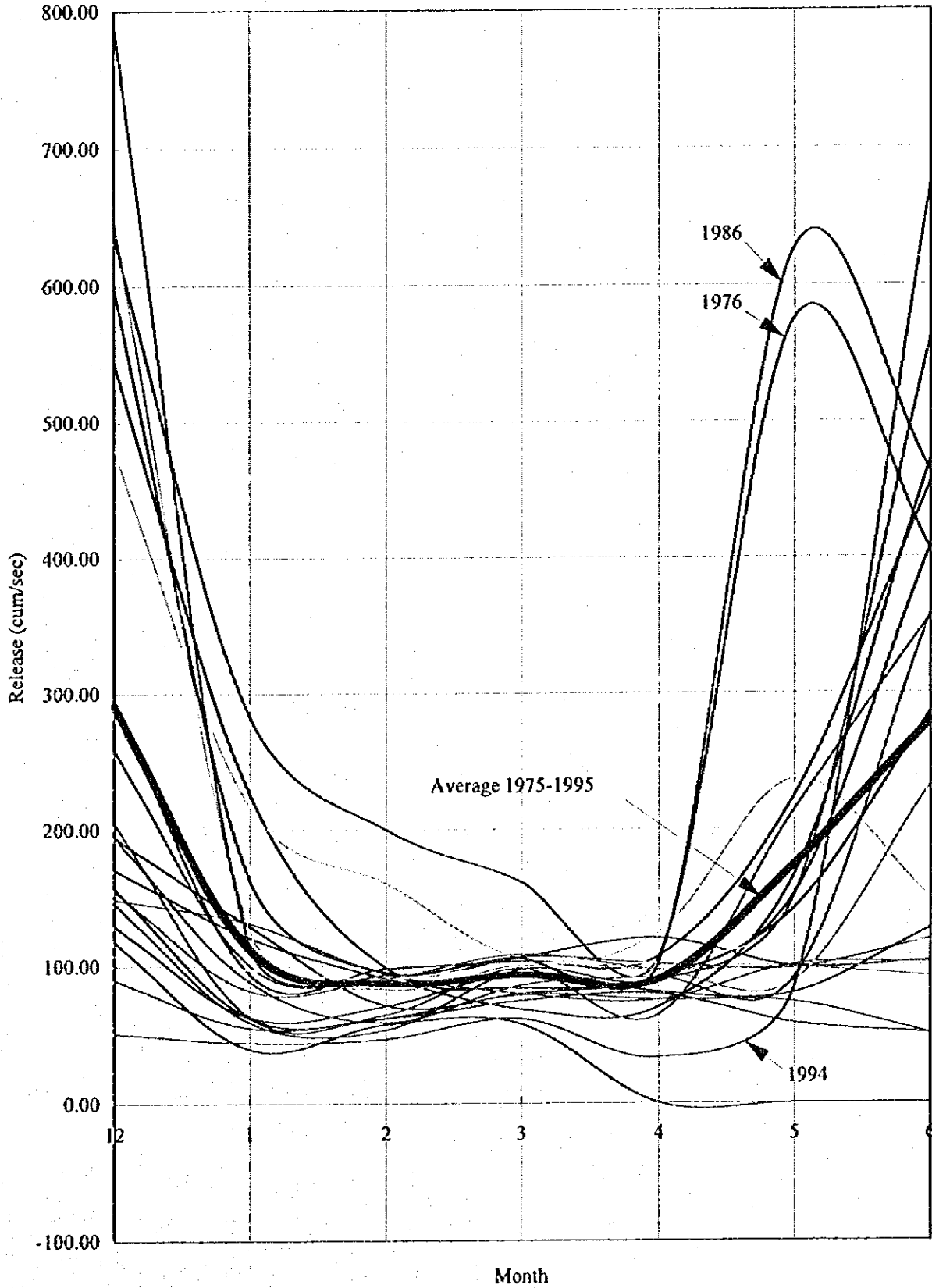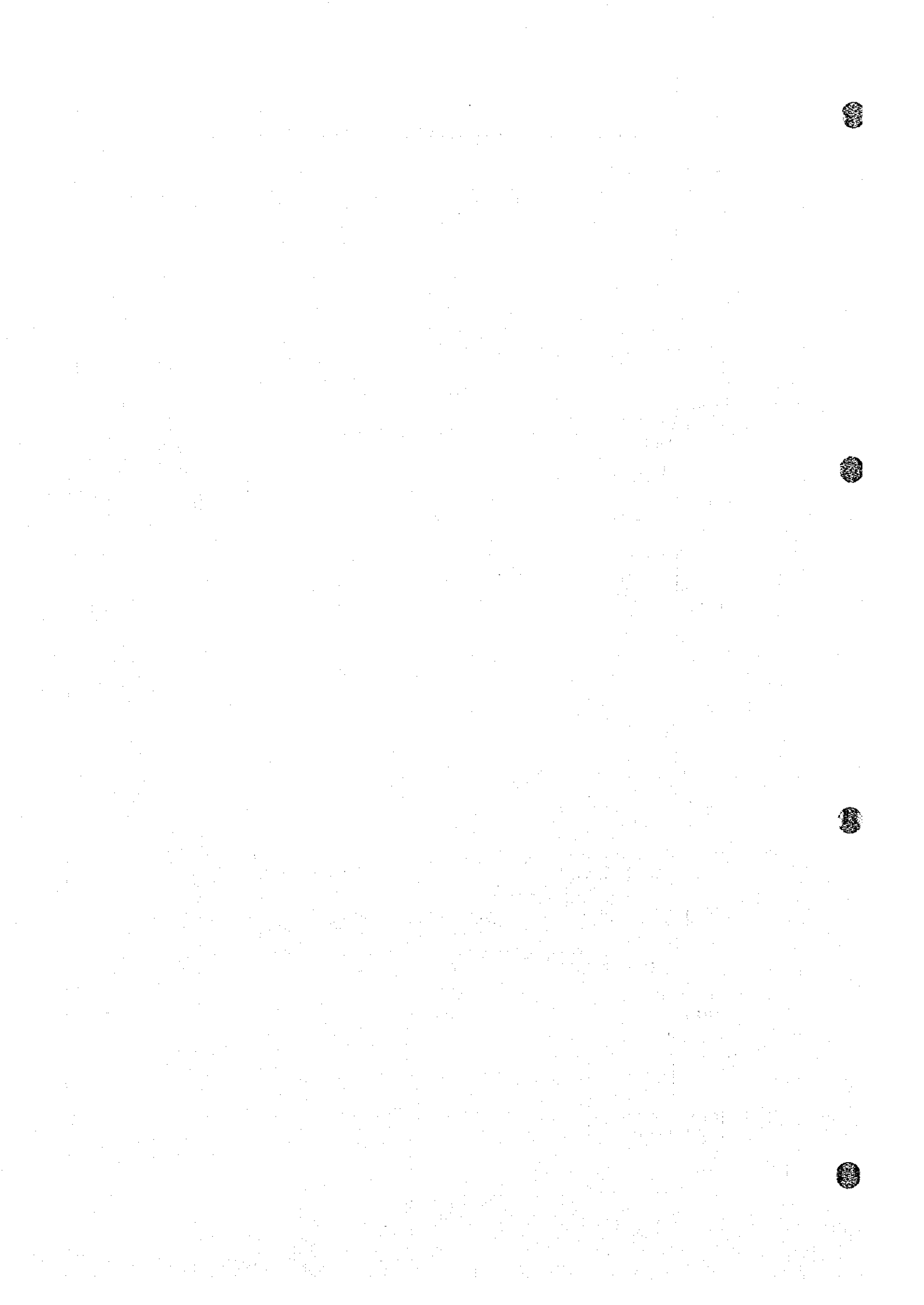
2.10 Present Status of Hydro-Power Generation

(1) General Description on Power Supply and Demand in Thailand

(a) General

The total installed power capacity is 14,685 MW as of September 1995 according to the information of EGAT, etc. The breakdown thereof is as shown below.

Hydro Power	2,690 MW	(18.3%)
Thermal Power	6,701	(45.6)
Combined Cycle	3,782	(25.8)
Gas Turbine	238	(1.6)
Diesel	13	(0.0)
Power Purchase	1,261	(8.7)
Total	14,685 MW	(100%)

While, the power demand has recently increased by approximately 10% per annum both in kW and kWh. The maximum power and energy demand in 1995 indicates 11,946 MW and 74,342 GWh respectively. The present situation of power supply and demand is consequently summarized as follows.

Dependable capacity*/ is estimated to be 13,690 MW out the said total installed capacity leading to a fact that the reserve capacity (dependable capacity minus maximum power demand) is 1,744 MW, which is about 14% in reserve capacity.

*/   Total installed capacity minus decreased supply capability due to lowered reservoir surface in hydro power station and due to station-use and/or stoppage in periodical inspection in thermal power station.

The increasing tendency will in future slow down indicating about 8% per annum as compared with 10% in the past. In order to cope with the increasing power demand, major power source is by thermal power stations followed by pumped storage hydropower stations which can make use of surplus energy in off-peak generated in thermal power stations.

Major hydropower stations in Thailand under operation as of December 1995 are as follows.

- Srinagarind   720 MW (a half of 720 MW is for pumped-storage, Quae Yai river, Kanchanaburi Province)
- Bhumibol   548 MW + 175 MW (Ping river, Tak Province)
- Sirikit   500 MW (375 kW before November 1995)
- Kao Laem   300 MW (on the Quae Noi river, Kanchanaburi Province)
- Rajjaprabha   240 MW (on the Khlong Phum Duang river, Surat Thani Province)

The maximum power demand in 1983 was about 3,500 MW which was one-third of the present demand. Sirikit and Bhumibol hydro-power stations having about 923 MW in total played important role in the supply of power (kW) and energy production (kWh), which means that hydro-power was regarded major in power supply and demand requirement. The power source have changed in this decade according to the incremental demand and expansion of the generating facilities. Change of demand pattern has forced the generation and/or supply mode to alter accordingly:

For Sirikit power station, power generation has been required to enhance qualitative mode rather than quantitative mode in order to supply reliable power capability to meet sophisticated industrialization. Lam Ta Khong (Phase-I) hydropower stations will be in operation in 2,000 with pumped-storage scheme of 500 MW. Demarcation in power supply between Sirikit and Lam Ta Khong hydropower stations will be required to study in near future.

(b)   Power Generation of Sirikit Hydropower Station

Sirikit reservoir and dam has a dam-type power station. Total installed capacity of this power station was 500 MW (125 MW x 4 unit) at the planning stage. In 1974, three (3) units each 125 MW were installed. Since then, these have been operated for 22 years from 1974 to 1995. No. 4 unit (125 MW) has been installed in November 1995. Present total installed capacity is 500 MW with four (4) units each 125 MW. According to the record of energy production from April 1974 to March 1995, an average annual energy production is 820.85 GWh in Sirikit power station. The records of RID and EGAT regarding monthly inflow, water release (for

power and irrigation purposes), storage volume in the reservoir and generation for 22 years from 1974 to 1995 are indicated in Supporting Report.

The Sirikit dam is of multipurpose for flood control, irrigation and power generation. The reservoir operation mainly depends on water release for irrigation in normal time excepting flood season. The method of reservoir operation is decided every year through discussion/consultation with RID, EGAT and other related agencies, based on which daily water release within a week is decided taking into account the inflow into the reservoir. Daily water release for the Sirikit power station, which is decided totally taking into account power supply-demand, reservoir water level, inflow etc., is a portion of water volume weekly allocated to power sector.

According to the water release records, there is daily variation within a week as follows showing some reduction on Sunday.

208 cu.m/sec on 8th (Mon) January 1996, 207 cu.m/sec on 12th (Fri)
233 cu.m/sec on 9th (Tue)   136 cu.m/sec on 13th (Sat)
232 cu.m/sec on 10th (Wed)   93 cu.m/sec on 14th (Sun).
244 cu.m/sec on 11th (Thu)

The above said water release from the reservoir will be necessary to re-regulate in order to maintain irrigation water requirement on Saturday and Sunday. The past records for 22 years from 1974 to 1995 indicate substantial variation of power discharge and energy production in year and in month. The ratio of energy production in the maximum wet year and the minimum drought year is 1:3.89. The variation of monthly power discharge in the average year in 1982 were as follows;

Monthly Power Discharge in 1982 (Unit: cu.m/sec)

Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
327.4	219.3	102.0	175.8	245.0	77.0	80.5	131.1	97.8	170.6	227.6	253.7

The minimum of monthly mean power discharge in the past 22 years is 5.4 cu.m/sec followed by 9.6 cu.m/sec, 11.7 cu.m/sec, 15.0 cu.m/sec, 15.7 cu.m/sec, 17.1 cu.m/sec, 17.8 cu.m/sec, 23.1 cu.m/sec, 23.1 cu.m/sec and 24.0 cu.m/sec. The maximum one is 454 cu.m/sec. While, normal high water level and/or its near-by level have been observed only in 3 years among 22 years. In other years, the

reservoir is operated at rather lower water level remaining 1,000 to 3,000 million cu.m vacant space or room in the reservoir capacity. Consequently annual average is 820.85 GWh in energy production for 21 years which is 68% of the designed magnitude of 1,200 GWh. The maximum is 1,363.37 GWh and the minimum is 350.33 GWh.

It is likely that the installed capacity of 375 MW (Q_{max} = 500 cu.m/sec) is rather big for the said power discharge conditions. (Since there is an additional unit of 125 MW totalling 500 MW in November 1995, the said tendency will further be enhanced). The 21 year records of energy production have showed a large variation indicating that the maximum is 1,363.37 GWh in 1976, the minimum 350.33 GWh in 1992 and the average 820 GWh. The monthly variation of energy production is fairly large such as 64.96 GWh in April and 3.44 GWh in August in 1992 (the minimum year in energy production). Total energy production in the rainy season (July ~ November) in 1992 was 64.14 GWh.

Based on the energy production as above mentioned, plant factors are estimated as follows.

- Average year: 25%
- The maximum year: 41.5%
- The minimum year: 10.7%
- The rainy season in the minimum year: 4.7%

Such yearly variations and monthly variations in a year are closely related to the power supply and demand. Even though the weight of Sirikit hydropower station has become to be smaller in the entire supply and demand, it is still important in a view of kW capability. Taking occasion to increase the installed capacity to 500 MW, the revision on the role of Sirikit hydropower station in power supply and demand will be needed.

In the period that monthly average power discharge is smaller, (the 1st drought to 10th in 22 years), power generation can last for only 1.2 hrs in a day with 375 MW and for 6.0 hrs with about 68 MW, similar situation of which continues for about one month.

An examination how 300 MW shortage in Sirikit supply capacity was coped with will be useful for future revision on reservoir operation. Since monthly variation is substantial even in the average year, an examination whether or not Sirikit hydropower station could still maintain a stable power source is also one of important study items.

Assuming that the reservoir level could be maintained 10 m higher than the past records through a year, annual energy production is expected to be increased by approximately 130 GWh. Thus, possibility of high water level operation will also be necessary to study based on water release for irrigation requirement.

(c)   Power Generation of Bhumibol Hydropower Station

Bhumibol reservoir and dam has a dam-type power station. Total installed capacity of this power station is 548 MW consisting of six (6) units each 70 MW plus one (1) unit of 128 MW. According to the record of power production in the past 21 years from 1974 to 1994, an average annual energy production is 1,143.53 GWh, which is about 73% as compared with estimated energy production at the planning stage. On examination of variation of energy production in the past 21 years, the maximum annual energy production is 1961.09 GWh, and the minimum 603.33 GWh. The ratio of the maximum to the minimum is 3.25 : 1, which seems to be great. Variation in each monthly energy production is very large. In 1980 (the minimum year in the past 21 years) 8.48 GWh was in October. It is very small as compared with 157.34 GWh in March 1980. In this rainy season from July to November total energy production is 101.73 GWh.

Based on the above energy production, plant factor is estimated 23.8% at average annual energy production, 40.9% at the maximum generating year in 1975, 12.6% at the minimum generating year in 1980. Plant factor is 5.1% at the rainy season of the minimum year in 1980. Small amount of energy production as compared with a big installed capacity is considered to be caused by small inflow into the Bhumibol reservoir and operation/generation at lower water level through the year. Small energy production in the rainy season and small plant factor is caused by a fact that the reservoir operation is mainly controlled or regulated for irrigation purpose.

Bhumibol power station, as similar to Sirikit power station, has been operated to meet peak demand. In order to maintain the same function as it is, Bhumibol power station is expected to be a stability power supply source based on adequate review of the reservoir operation.

(2) Incremental Sirikit Energy by the Kok-Ing-Nan Diversion Project

The incremental energy production in Sirikit power station is estimated to be about 400 GWh per annum by the Kok-Ing-Nan diversion project assuming that the reservoir operation presently applicable is remained unaltered. Besides, energy production is expected to increase due to enhancing the reservoir water level and flexibility in operation pattern.

In addition, a problem regarding durations or days having short power supply capability for peak load only (now less than 6 hrs.) can be improved, which will result in the equivalent to 3.5 hrs with 375 MW. Incremental benefit of Sirikit hydropower station due to this diversion project will be evaluated in the terms of the value derived from the incremental energy production.

(3) Merit of Improvement of Reservoir Operation due to Project

Sirikit reservoir was fulfilled up to the high water level only in 1975 and 1995 and up to the nearly high water level in 1994 October since its completion. There is a vacant space or room about 1,000 to 3,000 MCM (2,700 MCM on the average) in the reservoir capacity in other years. Additional inflow into the reservoir by the diversion project will be able to fulfil the said vacant space or room and be regulated the inflow by the reservoir to release for power and irrigation purposes, which means that the reservoir operation can greatly be improved by the diversion project. Assuming that the diversion water is 907 MCM per annum (175 cu.m/sec x 60 days = 10,500 cu.m/sec day), the reservoir level will be raised by about 5 m which results in 60 GWh increase per annum in energy production of Sirikit hydropower station.

(4) Subjects on Reservoir Operation from Standpoint of Power Generation

The capability or function of power generation of the Sirikit hydropower station entirely depends on its reservoir operation, improvement of which can surely lead to

enhancement of its capability or function. The reservoir capacity seems to be big as compared with the inflow conditions as shown below.

Effective storage capacity	:	9,660 MCM
Average inflow	:	5,300 MCM
Max. inflow	:	9,200 MCM
Min. inflow	:	2,900 MCM

Water release for irrigation requirement varies in year and it is difficult to in advance predict the reservoir operation. However the following subjects conceivable are studied in this report for effective reservoir operation from a view of power generation based on the present characteristics and analysis thereof.

- Study on the increasing water volume to be diverted into the reservoir.
- Study on the reservoir operation with higher water level

Regarding the present characteristics on the reservoir operation, study on the following items are important for future operation.

- Study/analysis on lower reservoir levels and its causes whether or not it is due to irrigation water release or due to power release.
- Adequate allocation of the effective reservoir capacity into the respective purposes, i.e. flood control, irrigation, power generation and miscellaneous uses
- Water release (either of weekly or monthly) for power and irrigation requirements.
- Reservoir operation rule for a case of high water level in wet year, a standard average year and a case of lower water level in drought year to meet the irrigation requirement. Setting forth the standard of monthly and/or ten-days water release and the storage water volume at the end of each month in order to maintain higher water level.
- Analysis on hydrological data (monthly inflow and water level).
- Trial operations according to the assumed standards and operation rules.
- Preparation of a standard reservoir operation rule.
- Estimate of energy production for 22 years to compare with the past records.

(5) Power Generation for Peak Load and Re-regulation of Power Discharge.

(a) Seasonal Peak Load and/or Demand

Reservoir-type power station, such as Sirikit power station and Bhumibol power station and so on, is, in general, to supply power to meet peak demand. Magnitude of demand varies at every time, which is caused by variation of industry activity and climate. Annual maximum power demand was recorded in March in 1993, April in 1992 and September in 1991. The annual maximum has been renewed every year because the demand growth is increased by about 10% in Thailand.

The variation is also changeable weekly. Demand considerably decreases on Saturday and Sunday. Maximum demand is occurred at 14 o'clock in a day, variation of which is larger as compared with another variations. But pattern of peak demand is almost not changeable by season. While, the critical generating capability of hydro-electric power station thoroughly depends on reservoir water level.

Taking Sirikit power station for example, the critical electric power in each month is shown in the following in case that the reservoir operation is undertaken in accordance with the reservoir operation rule curve.

Critical Max Power at Sirikit Power Station (Unit: MW)

Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
319.8	313.9	301.8	295.8	307.8	332.1	375.0	375.0	375.0	344.0	338.2	332.1

In the case of Sirikit power station, energy production extremely decreases in the rainy season. Assuming that 6 hours' operation is required to meet the demand, monthly maximum generating power from April to March in 1992 is shown below;

Maximum Generating Power at Sirikit Power Station in 1992 (Unit: MW)

Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
318.9	300.0	110.0	104.0	24.0	60.0	45.0	240.0	236.0	153.0	338.3	332.1

(b) Daily Peak Load and/or Demand and Necessity of Re-regulation of Power Discharge

Based on the data available for Sirikit hydropower station, a study on its supply capability is performed as follows;

There are substantial variations of power demand in year, month, day and hour. Hourly variation in a day is indicated in the Supporting Report. Daily variation patterns in a week are in general similar every week.

Power generation is expected to fulfil the said variable demand patterns by hydro, thermal and their combination making use of the respective generating characteristics. In general, power for peak load and/or demand is supplied by reservoir-type hydropower station and so does Sirikit hydropower station. In this sense, hydropower stations owned by EGAT are operated to meet peak demands from 8 AM to 12 noon, 14 to 16 PM and 18 to 21 PM totalling for 9 hours as a general operation rule. Peak power generation has to be operated and/or regulated within limited water quantity daily allocated to the power sector. If daily available quantity is critically limited, power generation is undertaken only for 6 hours by eliminating the supply for the evening from 18 to 21 PM.

The power generation of Sirikit hydropower station greatly depends on water release for irrigation requirements, which means that the inflow in the rainy season is entirely impounded in the reservoir and thus stored water is released for irrigation purpose in the dry season. Consequently daily available water is greatly variable in month as shown in the past records.

The power generation pattern on 17th October 1996 was referred as follows;

-	Operation unit	:	3 units among 4 units
-	Average power discharge	:	127.8 cu.m/sec
-	Max. power output	:	319 MW
-	Generating Hours	:	11 hrs.

The said pattern is equivalent to only 6 hrs generation with 3 units each 125 MW which is not necessarily favorable pattern from a standpoint of hydropower planning because an important factor thereof is generating hours with the installed capacity. In this context, the generating and/or operating pattern is regarded to be a questionable case in a power supply view point.

Daily average power discharges in the monthly average records of Sirikit hydropower station are 5.4 cu.m/sec in the minimum and 454.2 cu.m/sec in the maximum. In between, there are power discharges of 9.6, 11.7, 15.0, 15.7, 17.8, 22.3, 23.1, 23.1 and 24.0 cu.m/sec for smaller power discharge months. Assuming that discharge available for power generation is 10 cu.m/sec through a day, power discharge for 3 hr. peak time generation will be 80 cu.m/sec with 54 MW, which lasts for 1 month. While, there are substantial variations in daily average power discharge of respective months in 1982 (an average year) as follows.

Daily Average Power Discharge in 1982 (Unit: cu.m/sec)

Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
223.4	202.0	190.2	291.2	288.2	90.7	53.0	103.8	87.0	149.7	289.4	365.1

If the generation will be performed according to the patterns as referred to the present operation patterns, fluctuation of the river discharge or water surface will be taken place which can be gradually eliminated in the downstream. However, diversion of irrigation water will face a trouble of such water surface fluctuation at the diversion site under the condition that the power discharge varies from 0 to 500 cu.m/sec. In order to get rid of the trouble, a pond is conceivable in the downstream of Sirikit power station to re-regulate or to balance the fluctuation of power discharge. A 14.5 MCM pond will be sufficient for the case of 4 units operation.

For reference, weekly operation pattern of Sirikit hydropower station is to reduce power discharge on Sunday and to increase it in week days. The records in January 1996 in terms of cu.m/sec are as follows.

8th(Mon)	9th(Tue)	10th(Wed)	11th(Thu)	12th(Fri)	13th(Sat)	14th(Sun)
208	233	232	244	207	136	93

If there is a re-regulating or balancing pond, the operation and/or generation of Sirikit hydropower station will become more flexible to meet the pattern of power demand. It is desirable for the downstream water-use to study possibility of such concept.

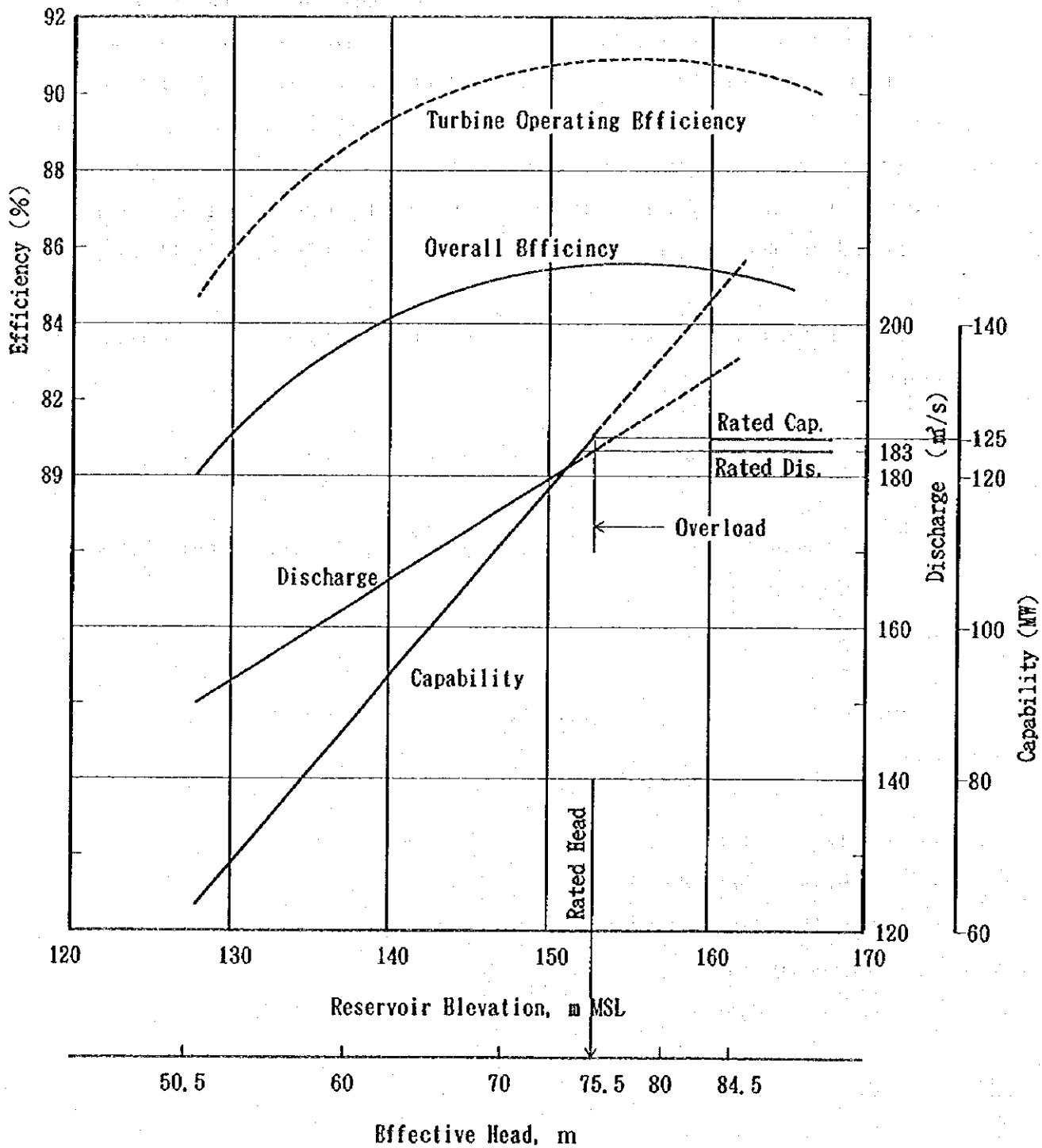## (6) Evaluation on KW-value in Peak Time of Hydropower Station

Reservoir-type hydropower station is, in general, operated for supply the power of peak load and/or demand. KW-value in peak time is evaluated in the terms of the cost incurred to an alternative power source which can provide the equivalent function to the proposed hydropower station. The feasibility study on Lam Ta Khong hydropower station on-going has proposed a gas turbine station as best alternative power source. A portion of fixed-cost thereof is used for evaluating KW-value of the hydropower station, and the portion of variable-cost (fuel, a portion of O&M expense, etc.) for evaluating kWh-value.

Incremental energy production due to the Kok-Ing-Nan diversion project will be evaluated:

- in terms of the current tariff of EGAT (approximately 1.5 Baht/kWh on the average)
- in terms of the present-value of the original kWh cost at the completion of Sirikit hydropower station.

The following tables and figures explain the present situation of the Sirikit hydro-power generation;

- Hydropower Turbine Capacity of Sirikit Hydropower Station
- Daily Load Curve on Peak Day
- Daily Water Release Records from Sirikit Hydropower Station (from September 1995 to February 1996)
- Generation Records of Sirikit Hydropower Station (17th October 1996)

Efficiency (%) (y-axis left): 92, 90, 88, 86, 84, 82, 89

Turbine Operating Efficiency

Overall Efficincy

Discharge (m³/s) (right axis): 200, 183, 180, 160, 140, 120

Capability (MW) (right axis): 140, 125, 120, 100, 80, 60

Rated Cap.

Rated Dis.

Overload

Discharge

Capability

Rated Head

Reservoir Elevation, m MSL (x-axis): 120, 130, 140, 150, 160, 170

Effective Head, m: 50.5, 60, 70, 75.5, 80, 84.5

Note:
Operating Curve Base on : Tailwater Level 75.00 m MSL
Generator Efficiency 97.00 %
Penstock Efficiency 97.00 %

Figure 2.10.1   EGAT Hydropower Turbine Capacity
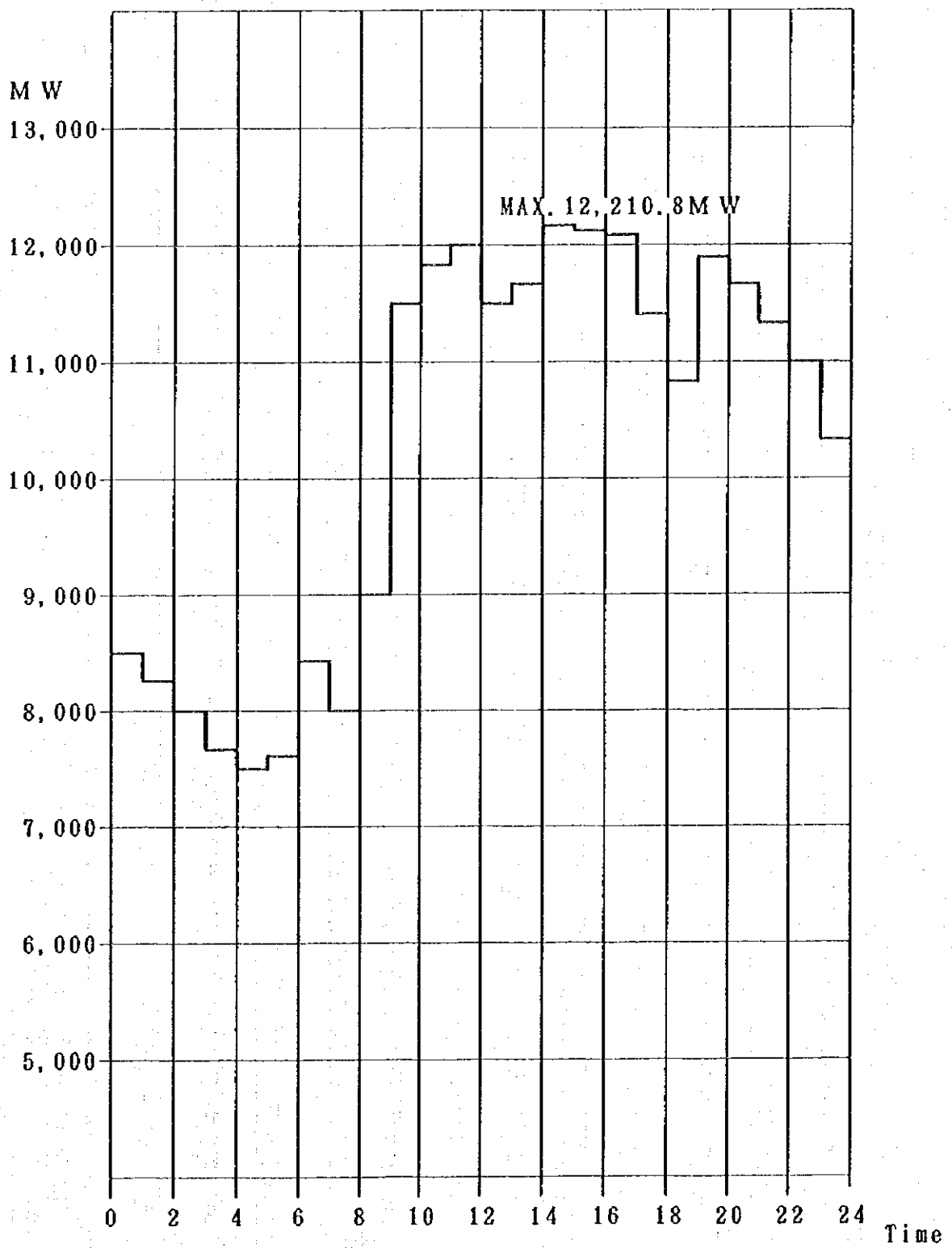
**Figure 2.10.2   Daily Load Curve on Peak Day
(at 25th Apr. 1995)**

Table 2.10.1 Daily Water Release for Power Generation Sirikit Power Station

Unit m³/s

Month Date	1995 9 Daily Average		10 Daily Average	Peak	11 Daily Average	Peak	12 Daily Average	Peak	1996 1 Daily Average	Peak	2 Daily Average	Peak
1	980		227(Sun)		196		215		–		223	
2	1,223(Sat)		277		141		211(Sat)		79		215	
3	1,388(Sun)		278		120		45(Sun)		169		227(Sat)	
4	1,605		230		121(Sat)		75		203		135(Sun)	
5	1,957		343		11(Sun)		0		206		300	
6	1,953		528		201		156		106(Sat)		328	
7	1,651		569(Sat)		251		90		60(Sun)		326	
8	557		511(Sun)		200		85		208		332	
9	569(Sat)		375		104		132(Sat)		233		343	
10	560(Sun)		425		130		21(Sun)		232		238(Sat)	
11	560		459		115(Sat)		228		244		96(Sun)	
12	629		325		20(Sun)		225		207		347	
13	725		318		165		184		136(Sat)		351	
14	694		421(Sat)		266		183		93(Sun)		357	
15	585		78(Sun)		287		168		215		360	
16	527(Sat)		289		433		201(Sat)		243		366	
17	672(Sun)		251		358		128(Sun)		202		326(Sat)	
18	645		349		392(Sat)		270		209		185(Sun)	
19	553		353		127(Sun)		264		222		327	
20	520		333		208		260		206(Sat)		340	
21	450		231(Sat)		242		277		112(Sun)		394	
22	472		15(Sun)		274		198		200		405	
23	783(Sat)		17		202		167(Sat)		–		376	
24	641(Sun)		240		253		0(Sun)		–		376(Sat)	
25	447		257		145(Sat)		142		215		344(Sun)	
26	472		191		12(Sun)		157		210		404	
27	472		129		259		123		217(Sat)		410	
28	388		154(Sat)		289		25		149(Sun)		398	
29	458		60(Sun)		286		–		196		423	
30	333(Sat)		230		288		–(Sat)		189			
31			258				–(Sun)		205			
Average	455.2		281.4		203.2		140.9		180.9		318.6	

Table 2.10.2   Generation Records at 17th Oct. 1996, Sirikit Power Station

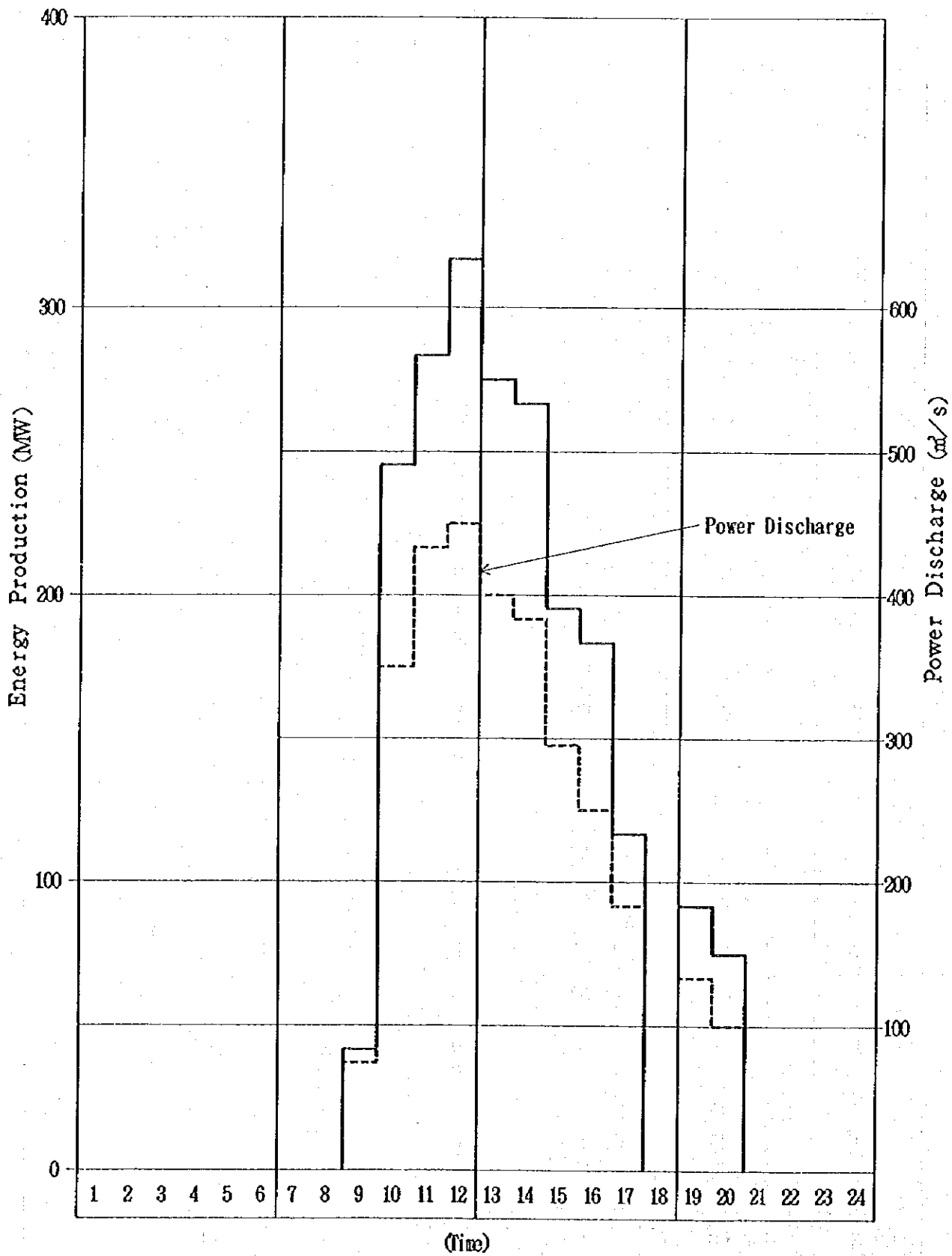| Time	Reservoir Surface Level (El. m)	Effective Head (m)	Power Generation (MW)	Water Release (m³/s)	Inflow (m³/s)	Operation Unit
0	154.01					0
1	154.01				8.3	0
2	154.02				652.8	0
3	154.02				8.3	0
4	154.03				652.8	0
5	154.03				8.3	0
6	154.03	81.43	0	0	8.3	0
7	154.04	81.44	0	0	652.8	0
8	154.04	81.44	0	0	8.3	0
9	154.05	80.17	40	75	727.8	2
10	154.05	79.27	247	361	369.4	3
11	154.05	78.84	287	433	441.7	3
12	154.05	79.00	319	447	455.6	3
13	154.04	78.97	279	400	263.0	3
14	154.04	79.08	267	386	394.4	3
15	154.04	79.82	199	294	302.8	3
16	154.04	79.90	180	256	263.9	2
17	154.05	81.05	120	183	836	2
18	154.05	81.05	0	0	8.3	0
19	154.05	80.60	90	128	136.1	1
20	154.05	81.45	70	102	136.3	1
21	154.05	81.45	0	0	111.1	0
22	154.05	81.45	0	0	8.0	0
23	154.06		0	0	8.3	0
24	154.06		0	0	8.3	0
Total				127.8	270.72	

Figure 2.10.3   Generation Records at 17 Oct. 1996, Sirikit Hydropower Station

2.11 Socio-Economic Conditions

The Study Area is composed of the Chao Phraya Basin and the Project Area. The Chao Phraya Basin is consisting of 7 basins, namely Nan, Yom, Wang, Ping, Sakae Krang and Chao Phraya Delta. Also, the Project Area incorporates Kok and Ing Basin and Upper Nan Basin.

The Provinces covered by the above basins and their population are shown in Table 2.11.1.

(1)   Population

(a)   The Existing Population

The population of the Study Area was about 23.9 million in 1994, accounted for 40.4% of the national population. The population of the Chao Phraya Basin accounted for 92.3% of that of the Study Area with about 22 million, and the population of the Project Area accounted for the remaining 7.7% with 1.4 million in the same year. The population of the Chao Phraya Delta was 12.6 million, accounting for 57.0% of that of the Chao Phraya Basin.

(b)   Growth of Population

The population of the whole kingdom grew during the 6 years 1989 to 1994 at the average annual rate of 1.12%. During the same period the population of the Study Area grew at the average annual rate of 0.93%. This rate is lower than the national average. The annual growth rate of the population of the Chao Phraya Basin was 0.79%, while that of the Project Area was 3.12%. The former is even lower than the Study Area average, whereas the latter is remarkably high. The growth of the population of the Chao Phraya Delta was very low with the average annual rate of only 0.3%.

(c)   Agricultural Population

Table 2.5.2 was formulated from the information on the number of land holdings and the estimated average number of members per agricultural household. According to the same table, the agricultural population in the whole kingdom was

22.6 million in 1993, accounting for 38.7% of the total population. It grew during the 5 year period 1988 to 1993 at the average annual rate of 2.97%. The agricultural population of the Study Area was 7.1 million in the same year, accounting for 31.3% of that of the whole nation. It accounted for 29.8% of the total population of the same area. It is to be noted that the ratio of agricultural population to the total population is by around 9% lower in the Study Area, compared to the whole nation. It grew during the above-mentioned period at the average annual rate of 2.50%. It is to be noted again that this rate is considerably lower than that of the national average.

The agricultural population of the Chao Phraya Basin was 6.1 million, accounting for 86.2% of that of the Study Area. It accounted for 27.8% of the total population of the same area. The ratio is lower than the Study Area average. It grew at the average annual rate of 2.43%. The rate is also lower than the Study Area average. The agricultural population of the Project Area was 0.7 million, accounting for 13.8% of that of the Study Area. It accounted for 51.0% of the total population of the same area. The ratio is by around 21% higher than the Study Area average. It grew at the average annual rate of 3.39%. The rate is also around 0.9% higher than the Study Area average. The agricultural population of the Chao Phraya Delta was 1.8 million accounting for 28.8% of that of the Chao Phraya Basin. It accounted for 14.1% of the total population of the same area. The ratio is by around 14% lower than the Chao Phraya Basin average. It grew at the average annual rate of 2.58%. The rate is similar to the Chao Phraya Basin average.

(d)   Projection of Population

The population of the Study Area and the whole country was preliminarily projected based on the average annual growth rates 1989 to 1994. In the Study Area future population was estimated basin-wise. According to the projection, the population of the kingdom will be 75.6 million in 2016. On the other hand, the population of the Study Area will be 30.0 million in 2016, accounting for 39.6% of the national population. It is to be noted that the share of the population of the Study Area in that of the whole nation is forecast to slightly decline in the future. The population of the Chao Phraya Basin will be 26.7 million in 2016, occupying 89.0% of that of the Study Area. It will be noted that the share of the population of the Chao Phraya

Basin in that of the Study Area is estimated to go down in the future.

The population of the Project Area will be 3.3 million in 2016, occupying 11.0% of that of the Study Area. It is to be noticed that the share of the population of the Project Area in that of the Study Area will go up in the future. The population of the Chao Phraya Delta will be 13.4 million in 2016, sharing 50.3% of that of the Chao Phraya Basin. The share will be thus in the downward direction.

(2) GDP

(a) The Existing GDP and Growth Rate

The GDP of the Study Area was baht 1,780,859 million in 1994 at the 1988 constant prices. In terms of the 1996 prices it is calculated at baht 2,387,420 million. It accounted for 66.3% of that of the whole country. It is to be noted that the share of the Study Area in terms of GDP is as high as two thirds of the entire kingdom. It grew during the 6 years 1989 to 1994 at the average annual rate of 9.53%. For comparison, the national GDP grew during the same period at the average annual rate of 8.95%. That is to say, the economy of the Study Area is growing at a faster pace than that of the whole nation.

The GDP of the Chao Phraya Basin and the Project Area was baht 1,748,971 million and baht 31,888 million, accounting for 98.2% and 1.8% of that of the Study Area in 1994 respectively. The respective GDP can be calculated at baht 2,344,671 million and baht 42,749 million at the 1996 prices. The GDP of the Chao Phraya Delta was baht 1,515,453 million, accounting for 86.6% of that of the Chao Phraya Basin. In terms of the 1996 prices it is calculated at baht 2,031,616 million.

The agricultural sector accounted for 7.3% of the GDP of the Study Area. In the whole nation, the sector accounted for 11.5%. That is to say, the share of the primary sector in the Study Area is less than the national average. Moreover, it is declining every year. The agricultural sector of the Study Area grew during the 6 years 1989 to 1994 at the average annual rate of 1.88%, while that of the whole country grew during the same period at the average annual rate of 2.20%. In other words, the growth rate of the primary sector in the Study Area is lower than the

national average. In 1994 the agricultural sector of the Study Area occupied 42.1% of that of the whole country.

The non-agricultural sectors accounted for 92.7% of the GDP of the Study Area. In the whole nation the sectors accounted for 88.5%. That is to say, the share of the secondary and tertiary sectors in the Study Area is greater than the national average. Moreover, it is growing every year. The non-agricultural sectors of the Study Area grew during the 6 years 1989 to 1994 at the average annual rate of 10.30%, while that of the whole country grew during the same period at the average annual rate of 10.04%. In other words, the growth rate of the secondary and tertiary sectors in the Study Area is higher than the national average. In 1994 the non-agricultural sectors of the Study Area occupied 69.4% of that of the whole country.

(b)   Projection of Economic Growth

Economic growth rates of the whole country and the Study Area were preliminarily estimated based on the past trends, recent performances and the projection in the 8th National Economic and Social Development Plan. In the Study Area, the basin-wise estimation of growth rate was done. They are shown in Table 2.5.1(5). The GDP of the country is projected to grow at the average annual rate of 6.54% to 10,823,888 million in 2016 at the 1988 constant prices. In terms of the 1996 prices it is calculated at baht 14,510,504 million.

On the other hand, the GDP of the Study Area is projected to grow at the average annual rate of 6.76% to baht 7,509,682 million in 2016 at the 1988 constant prices. In terms of the 1996 prices it will be baht 10,067,480 million. It will account for 69.4% of that of the country. The economy of the Chao Phraya Basin will grow at the average annual rate of 6.78% to baht 7,409,345 million in 2016 at the 1988 constant prices. It will worth baht 9,932,968 million at the 1996 prices. It will account for 98.7% of that of the Study Area.

Turning to the economy of the Project Area, it will grow at the average annual rate of 5.35% to baht 100,337 million in 2016 at the 1988 constant prices. It will amount to baht 134,512 million at the 1996 prices. It will share 1.3% of that of the Study Area. The economy of the Chao Phraya Delta will get bigger at the average

annual pace of 6.90% to 6,581,713 million in 2016 at the 1988 constant prices. It will amount to baht 8,823,444 million at the 1996 prices. It will share 88.8% of that of the Chao Phraya Basin.

(c) Per Capita GDP

The per capita GDP of the country is calculated at baht 60,900 or US$ 2,390 in 1994 at the 1996 prices. On the other hand, that of the Study Area works out to baht 100,000 or US$ 3,920 in the same year at the 1996 prices. That is to say, the latter was by 64.2% higher than the former. The per capita GDP of the Chao Phraya Basin was baht 106,400 or US$ 4,170 in 1994 at the 1996 prices, while that of the Project Area was baht 23,300 or US$ 910 in the same year at the 1996 prices. It means that the former was by 6.3% higher and the latter was by 76.6% lower than the Study Area average. The per capita GDP of the Chao Phraya Delta was baht 161,700 or US$ 6,340 in 1994 at the 1996 prices. That is, it was by 61.6% higher than the Chao Phraya Basin average.

In 1996, the per capita GDP of the country is estimated to come to baht 68,100 or US$ 2,670 at the 1966 prices. Likewise, the per capita GDP of the Study Area is estimated at baht 113,900 or US$ 4,470. The per capita GDP of the Chao Phraya Basin and the Project Area in the same year works out to baht 121,600 or US$ 4,770 and baht 24,746 or US$ 970 respectively. Similarly, the per capita GDP of the Chao Phraya Delta is calculated at baht 187,500 or US$ 7,350.

In the target year of 2016, the per capita GDP of the country is projected to come to baht 191,900 or US$ 7,530 at the 1996 prices. Likewise, the per capita GDP of the Study Area is projected to reach baht 335,900 or US$ 13,170. The per capita GDP of the Chao Phraya Basin and the Project Area in the same year works out to baht 372,300 or US$ 14,600 and baht 40,900 or US$ 1,600 respectively. Similarly, the per capita GDP of the Chao Phraya Delta is calculated at baht 657,400 or US$ 25,780.

Table 2.11.1(1) Population and GDP in the Study Area

1. Population and GDP in the Past

(1) Population in the Past

Area	1989	1990	1991	1992	1993	1994	Ave. Annual Growth Rate (%)
1. Chao Phraya Basin							
(1) Nan Basin							
Nan	419,014	426,794	428,911	434,745	436,946	441,753	1.06
Uttaradit	456,158	460,516	461,722	475,564	474,872	476,938	0.89
Phitsanulok	698,166	707,858	712,151	757,814	755,346	764,032	1.82
Phichit	332,264	335,291	335,894	347,048	353,950	355,907	1.38
Petchabun	141,382	143,320	143,792	149,438	155,603	156,314	2.03
Nakhon Sawan	108,150	108,821	108,829	109,397	110,955	111,720	0.65
Sub-Total	2,155,134	2,182,600	2,191,299	2,274,006	2,287,672	2,306,664	1.37
(2) Yom Basin							
Nan	22,053	22,463	22,574	22,881	22,997	23,250	1.06
Phayao	220,254	226,670	228,129	230,613	229,861	231,062	0.96
Lampang	152,871	154,527	155,162	155,250	159,569	160,746	1.01
Phrae	491,352	493,530	494,129	493,532	491,194	494,355	0.12
Sukhothai	588,890	592,658	593,689	606,823	613,143	617,096	0.94
Phitsanulok	77,574	78,651	79,128	84,202	83,927	84,892	1.82
Kamphaeng Phet	98,706	100,200	100,905	109,703	113,371	113,918	2.91
Phichit	221,509	223,527	223,929	231,366	235,967	237,271	1.38
Sub-Total	1,873,209	1,892,226	1,897,645	1,934,370	1,950,029	1,962,590	0.94
(3) Wang Basin							
Lampang	611,483	618,108	620,650	621,001	638,277	642,986	1.01
Tak	17,325	17,690	17,817	21,283	21,380	22,009	4.90
Sub-Total	628,808	635,798	638,467	642,284	659,657	664,995	1.13
(4) Ping Basin							
Kamphaeng Phet	460,627	467,601	470,889	511,949	529,066	531,617	2.91
Tak	138,597	141,521	142,537	170,267	171,044	176,074	4.90
Lamphun	414,515	417,565	419,633	397,712	402,765	405,735	-0.43
Chiang Mai	1,157,122	1,169,702	1,174,816	1,301,162	1,303,963	1,315,022	2.59
Sub-Total	2,170,861	2,196,389	2,207,875	2,381,090	2,406,838	2,428,448	2.27
(5) Pasak Basin							
Petchabun	754,038	764,374	766,892	797,005	829,882	833,675	2.03
Lop Buri	444,156	448,292	451,798	443,022	440,021	442,841	-0.06
Saraburi	371,197	374,612	376,442	382,231	390,651	395,547	1.28
Sub-Total	1,569,391	1,587,278	1,595,132	1,622,258	1,660,554	1,672,063	1.28
(6) Sakae Krang Basin							
Kamphaeng Phet	98,706	100,200	100,905	109,703	113,371	113,918	2.91
Nakhon Sawan	216,300	217,643	217,658	218,795	221,910	223,441	0.65
Uthai Thani	90,366	91,433	91,757	95,579	95,728	96,801	1.39
Sub-Total	405,372	409,276	410,320	424,077	431,009	434,160	1.38
(7) Chao Phraya Delta							
Nakhon Sawan	757,051	761,749	761,802	765,781	776,684	782,042	0.65
Lop Buri	296,104	298,862	301,199	295,348	293,347	295,227	-0.06
Uthai Thani	105,427	106,672	107,050	111,508	111,683	112,935	1.39
Chai Nat	353,953	356,297	357,014	339,329	348,333	348,311	-0.32
Ang Thong	277,682	279,032	279,756	284,138	283,055	284,420	0.48
Saraburi	106,056	107,032	107,555	109,209	111,615	113,013	1.28
Sing Buri	230,094	230,913	231,164	221,407	221,264	222,027	-0.71
Ayutthaya	680,100	685,394	688,887	693,230	691,569	699,400	0.56
Pathum Thani	441,930	452,693	460,055	484,586	500,086	511,448	2.96
Nonthaburi	627,667	668,760	687,733	698,704	717,405	740,565	3.36
Bangkok Met.	5,832,843	5,546,937	5,620,591	5,562,141	5,572,712	5,584,226	-0.87
Samut Prakan	829,412	854,883	868,400	871,806	895,384	914,360	1.97
Samut Sakhon	314,712	322,340	326,337	335,345	336,118	343,184	1.75
Chachoengsao	57,573	58,278	58,722	59,317	59,739	60,533	1.01
Nakhon Pathom	646,803	657,182	661,482	671,386	710,290	719,265	2.15
Suphan Buri	820,229	827,951	831,207	825,451	842,052	834,646	0.35
Sub-Total	12,377,636	12,214,975	12,348,954	12,328,686	12,471,336	12,565,602	0.30
Total	21,180,411	21,118,542	21,289,692	21,606,771	21,867,095	22,034,522	0.79

Table 2.11.1(2) Population and GDP in the Study Area

Area	1989	1990	1991	1992	1993	1994	Ave. Annual Growth Rate (%)
2. Project Area							
(1) Kok & Ing Basin							
Chiang Mai	204,198	206,418	207,320	229,617	230,111	232,063	2.59
Chiang Rai	719,353	727,572	733,809	860,591	869,306	876,107	4.02
Phayao	269,200	277,041	278,824	281,860	280,942	282,409	0.96
Sub-Total	1,192,751	1,211,031	1,219,953	1,372,068	1,380,359	1,390,579	3.12
(2) Upper Nan Basin							
Nan	419,014	426,794	428,911	434,745	436,946	441,753	1.06
Sub-Total	419,014	426,794	428,911	434,745	436,946	441,753	1.06
Total	1,611,765	1,637,825	1,648,864	1,806,813	1,817,305	1,832,332	2.60
Grand Total (A)	22,792,176	22,756,367	22,938,556	23,413,584	23,684,400	23,866,854	0.93
National Total (B)	55,888,000	56,303,000	56,961,000	57,789,000	58,336,000	59,095,419	1.12
A/Bx100	40.8	40.4	40.3	40.5	40.6	40.4	-

Source: Interior Ministry

(2) GDP (at 1988 Constant Prices) in the Past

Unit: baht million

Area	1989	1990	1991	1992	1993	1994	Ave. Annual Growth Rate (%)
1. Chao Phraya Basin							
(1) Nan Basin							
Nan	5,267	5,402	5,614	5,724	6,119	6,490	4.27
Uttaradit	8,242	8,494	9,090	9,004	8,688	9,697	3.30
Phitsanulok	12,063	11,717	12,574	14,014	14,458	15,111	4.61
Phichit	4,929	4,930	5,359	5,696	5,548	6,870	3.56
Petchabun	1,966	1,915	1,990	2,152	2,118	2,368	3.79
Nakhon Sawan	2,005	1,973	2,157	2,356	2,445	2,585	5.21
Sub-Total	34,472	34,431	36,784	38,946	39,376	43,121	4.58
(2) Yom Basin							
Nan	277	284	295	301	322	342	4.27
Phayao	2,675	1,296	2,975	3,102	3,643	3,916	6.26
Lampang	3,031	3,410	3,737	3,966	3,980	4,244	6.97
Phrae	6,151	6,396	6,814	7,194	7,233	7,815	4.91
Sukhothai	9,571	9,614	9,798	10,460	10,740	11,128	3.06
Phitsanulok	1,340	1,302	1,397	1,557	1,606	1,679	4.61
Kamphaeng Phet	2,066	2,055	2,275	2,428	2,229	2,408	3.11
Phichit	3,286	3,287	3,572	3,798	3,699	3,914	3.56
Sub-Total	28,397	27,644	30,863	33,616	33,452	35,446	4.53
(3) Wang Basin							
Lampang	12,123	13,638	14,949	15,862	15,921	16,976	6.97
Tak	329	334	369	394	391	423	5.12
Sub-Total	12,452	13,972	15,318	16,256	16,312	17,399	6.92
(4) Ping Basin							
Kamphaeng Phet	9,640	9,588	10,616	11,330	10,400	11,237	3.11
Tak	2,634	2,674	2,954	3,151	3,131	3,381	5.12
Lamphun	5,959	7,097	8,683	12,917	16,281	18,703	25.70
Chiang Mai	26,848	31,137	33,222	33,106	36,882	39,032	7.77
Sub-Total	45,081	50,496	55,475	60,504	66,694	72,353	9.92
(5) Pasak Basin							
Petchabun	10,485	10,215	10,613	11,479	11,297	12,630	3.79
Lop Buri	8,255	8,186	9,042	9,653	9,671	11,003	5.92
Saraburi	18,241	20,152	22,734	23,864	27,481	32,048	11.93
Sub-Total	36,981	38,553	42,389	44,996	48,449	55,681	8.53
(6) Sakae Krang Basin							
Kamphaeng Phet	2,066	2,055	2,275	2,428	2,229	2,408	3.11
Nakhon Sawan	4,010	3,945	4,315	4,713	4,891	5,170	5.21
Uthai Thani	1,504	1,505	1,726	1,760	1,758	1,940	5.23
Sub-Total	7,580	7,505	8,316	8,901	8,878	9,518	4.66

Table 2.11.1(3)   Population and GDP in the Study Area

Unit: baht million

Area	1989	1990	1991	1992	1993	1994	Ave. Annual Growth Rate (%)
(7) Chao Phraya Delta							
Nakhon Sawan	14,036	13,809	15,101	16,494	17,117	18,095	5.21
Lop Buri	5,503	5,457	6,028	6,435	6,448	7,335	5.92
Uthai Thani	1,754	1,756	2,013	2,053	2,051	2,264	5.23
Chai Nat	8,050	7,323	7,974	8,288	7,956	8,895	2.02
Ang Thong	5,412	5,283	5,754	5,723	6,036	6,461	3.61
Saraburi	5,212	5,758	6,495	6,818	7,852	9,157	11.93
Sing Buri	4,720	4,364	4,810	5,168	5,514	5,825	4.30
Ayutthaya	13,530	15,980	21,764	27,194	32,526	40,373	24.44
Pathum Thani	40,542	46,583	57,975	72,326	81,645	93,834	18.27
Nonthaburi	30,767	33,295	33,215	31,934	32,724	32,693	1.22
Bangkok Met.	657,136	765,223	814,149	880,002	962,810	1,029,141	9.39
Samut Prakan	97,317	116,728	119,476	120,906	124,983	128,440	5.71
Samut Sakhon	19,084	22,136	30,750	43,440	53,772	63,054	27.00
Chachoengsao	2,301	2,332	2,501	2,697	3,355	3,551	9.07
Nakhon Pathom	18,918	20,446	24,730	31,448	36,475	44,456	19.56
Suphan Buri	16,977	14,859	17,768	20,596	21,103	21,879	5.20
Sub-Total	941,259	1,081,332	1,170,503	1,281,522	1,402,367	1,515,453	9.99
Total	1,106,222	1,253,933	1,359,648	1,484,741	1,615,528	1,748,971	9.59
2. Project Area							
(1) Kok & Ing Basin							
Chiang Mai	4,738	5,495	5,863	5,842	6,509	6,888	7.77
Chiang Rai	10,242	11,263	11,855	11,812	13,206	13,724	6.03
Phayao	3,270	3,520	3,637	3,792	4,452	4,786	6.26
Sub-Total	18,250	20,278	21,355	21,446	24,167	25,398	6.83
(2) Upper Nan Basin							
Nan	5,267	5,402	5,614	5,724	6,119	6,490	4.27
Sub-Total	5,267	5,402	5,614	5,724	6,119	6,490	4.27
Total	23,517	25,680	26,969	27,170	30,286	31,888	6.28
Grand Total	1,129,739	1,279,613	1,386,617	1,511,911	1,645,814	1,780,859	9.53

Study Area (A)							
Agricultural (a)	118,280	113,848	121,187	130,413	124,816	129,784	1.88
Non-Agricult. (b)	1,011,459	1,165,765	1,265,430	1,381,498	1,520,998	1,651,075	10.30
Total (c)	1,129,739	1,279,613	1,386,617	1,511,911	1,645,814	1,780,859	9.53
a/cx100	10.5	8.9	8.7	9.4	7.6	7.3	-
b/cx100	89.5	91.1	91.3	90.6	92.4	92.7	-
Kingdom (B)							
Agricultural (a)	276,569	263,806	281,028	298,026	292,279	308,321	2.20
Non-Agricult. (b)	1,473,383	1,682,386	1,828,994	1,983,213	2,177,889	2,377,656	10.04
Total (c)	1,749,952	1,946,192	2,110,022	2,281,239	2,470,168	2,685,977	8.95
a/cx100	15.8	13.5	13.3	13.1	11.8	11.5	-
b/cx100	84.2	86.5	86.7	86.9	88.2	88.5	-
A/Bx100							
Agricultural	42.8	43.2	43.1	43.8	42.7	42.1	-
Non-Agricultural	68.6	69.3	69.2	69.7	69.8	69.4	-
Total	64.6	65.7	65.7	66.3	66.6	66.3	-

Source: NESDB

Table 2.11.1(4)   Population and GDP in the Study Area

2.   Projection of Population and GDP

(1)   Projection of Population

Area	1994	1996	2006	2016	Ave. Annual Growth Rate (%)
1. Chao Phraya Basin					
(1) Nan Basin	2,306,664	2,370,300	2,715,799	3,111,660	1.37
(2) Yom Basin	1,962,590	1,999,660	2,195,782	2,411,139	0.94
(3) Wang Basin	664,995	680,109	760,989	851,488	1.13
(4) Ping Basin	2,428,448	2,539,951	3,179,127	3,979,151	2.27
(5) Pasak Basin	1,672,063	1,715,142	1,947,767	2,211,943	1.28
(6) Sakae Krang Basin	434,160	446,225	511,773	691,875	1.38
(7) Chao Phraya Delta	12,565,602	12,641,109	13,025,503	13,421,586	0.30
Total	22,034,522	22,392,496	24,336,740	26,678,842	0.87
2. Project Area					
(1) Kok & Ing Basin	1,390,579	1,478,705	2,010,530	2,733,629	3.12
(2) Upper Nan Basin	441,753	451,168	501,338	557,088	1.06
Total	1,832,332	1,929,873	2,511,868	3,290,717	2.70
Grand Total	23,866,854	24,322,369	26,848,608	29,969,559	1.04
Kingdom	59,095,419	60,522,219	67,652,750	75,623,376	1.12

Source: JICA

(2)   Projection of GDP

a)   Annual Growth Rate

Area	1995-1996	1997-2001	2002-2006	2007-2011	2012-2016
1. Chao Phraya Basin					
(1) Nan Basin	4.5	4.5	4.5	4.5	4.5
(2) Yom Basin	4.5	4.5	4.5	4.5	4.5
(3) Wang Basin	6.0	6.0	6.0	5.0	5.0
(4) Ping Basin	8.0	8.3	7.3	6.3	5.3
(5) Pasak Basin	7.0	8.0	7.0	6.0	5.0
(6) Sakae Krang Basin	4.5	4.5	4.5	4.5	4.5
(7) Chao Phraya Delta	8.0	8.3	7.3	6.3	5.3
Total					
2. Project Area					
(1) Kok & Ing Basin	6.0	6.0	6.0	5.0	5.0
(2) Upper Nan Basin	4.5	4.5	4.5	4.5	4.5
Total					
Grand Total					
Kingdom	7.0	8.0	7.0	6.0	5.0

Source: JICA

Table 2.11.1(5) Population and GDP in the Study Area

b) GDP (at 1988 Constant Prices)

Unit: baht million

Area	1994	1996	2006	2016	Ave. Annual Growth Rate (%)
1. Chao Phraya Basin					
(1) Nan Basin	43,121	47,089	73,128	113,566	4.50
(2) Yom Basin	35,446	38,708	60,112	93,352	4.50
(3) Wang Basin	17,399	19,550	35,011	57,029	5.54
(4) Ping Basin	72,353	84,393	178,833	314,236	6.90
(5) Pasak Basin	55,681	63,749	131,374	224,381	6.54
(6) Sakae Krang Basin	9,518	10,394	16,142	25,068	4.50
(7) Chao Phraya Delta	1,515,453	1,767,624	3,745,681	6,581,713	6.90
Total	1,748,971	2,031,507	4,240,281	7,409,345	6.78
2. Project Area					
(1) Kok & Ing Basin	25,398	28,537	51,105	83,245	5.54
(2) Upper Nan Basin	6,490	7,087	11,006	17,092	4.50
Total	31,888	35,624	62,111	100,337	5.35
Grand Total	1,780,859	2,067,131	4,302,392	7,509,682	6.76
Kingdom	2,685,977	3,075,175	6,337,347	10,823,888	6.54

Source: JICA

Table 2.11.2(1)　　Agricultural Population in the Study Area

Area	1988	1993	Ave. Annual Growth Rate (%)	Total Population in 1993	Ratio of Agricult. Population in 1993 (%)
1. Chao Phraya Basin					
(1) Nan Basin					
Nan	249,626	271,419	1.69	436,946	62.1
Uttaradit	204,960	230,544	2.38	474,872	48.5
Phitsanulok	265,511	330,397	4.47	755,346	43.7
Phichit	126,857	131,570	0.73	353,950	37.2
Petchabun	58,279	66,242	2.59	155,603	42.6
Nakhon Sawan	39,655	45,144	2.63	110,955	40.7
Sub-Total	944,888	1,075,316	2.62	2,287,672	47.0
(2) Yom Basin					
Nan	13,138	14,285	1.69	22,997	62.1
Phayao	113,540	141,826	4.55	229,861	61.7
Lampang	75,204	84,000	2.24	159,569	52.6
Phrae	257,704	281,524	1.78	491,194	57.3
Sukhothai	284,668	333,268	3.20	613,143	54.4
Phitsanulok	29,501	36,711	4.47	83,927	43.7
Kamphaeng Phet	41,092	49,172	3.66	113,371	43.4
Phichit	84,571	87,714	0.73	235,967	37.2
Sub-Total	899,418	1,028,500	2.72	1,950,029	52.7
(3) Wang Basin					
Lampang	300,816	336,000	2.24	638,277	52.6
Tak	7,054	10,273	7.81	21,380	48.0
Sub-Total	307,870	346,273	2.38	659,657	52.5
(4) Ping Basin					
Kamphaeng Phet	191,764	229,468	3.66	529,066	43.4
Tak	56,430	82,184	7.81	171,044	48.0
Lamphun	190,620	237,116	4.46	402,765	58.9
Chiang Mai	462,706	537,853	3.06	1,303,963	41.2
Sub-Total	901,520	1,086,621	3.81	2,406,838	45.1
(5) Pasak Basin					
Petchabun	310,822	353,290	2.59	829,882	42.6
Lop Buri	138,914	160,805	2.97	440,021	36.5
Saraburi	86,926	92,744	1.30	390,651	23.7
Sub-Total	536,659	606,839	2.49	1,660,554	36.5
(6) Sakae Krang Basin					
Kamphaeng Phet	41,092	49,172	3.66	113,371	43.4
Nakhon Sawan	79,310	90,287	2.63	221,910	40.7
Uthai Thani	41,927	49,238	3.27	95,728	51.4
Sub-Total	162,329	188,697	3.06	431,009	43.8
(7) Chao Phraya Delta					
Nakhon Sawan	277,586	316,005	2.63	776,684	40.7
Lop Buri	92,610	107,203	2.97	293,347	36.5
Uthai Thani	48,915	49,238	3.27	111,683	44.1
Chai Nat	155,496	164,276	1.10	348,333	47.2
Ang Thong	101,048	104,148	0.61	283,055	36.8
Saraburi	24,836	26,498	1.30	111,615	23.7
Sing Buri	68,276	77,996	2.70	221,264	35.3
Ayutthaya	130,508	153,804	3.34	691,569	22.2
Pathum Thani	63,268	70,892	2.30	500,086	14.2
Nonthaburi	63,840	59,388	-1.44	717,405	8.3
Bangkok Met.	52,300	29,476	-10.84	5,572,712	0.5
Samut Prakan	32,232	26,728	-3.68	895,384	3.0
Samut Sakhon	36,972	39,611	1.39	336,118	11.8
Chachoengsao	18,244	18,532	0.31	59,739	31.0
Nakhon Pathom	156,228	169,060	1.59	710,290	23.8
Suphan Buri	322,424	341,992	1.19	842,052	40.6
Sub-Total	1,644,783	1,754,847	2.58	12,471,336	14.1
Total	5,397,467	6,087,093	2.43	21,867,095	27.8

Table 2.11.2(2)   Agricultural Population in the Study Area

Area	1988	1993	Ave. Annual Growth Rate (%)	Total Population in 1993	Ratio of Agricult. Population in 1993 (%)
2. Project Area					
(1) Kok & Ing Basin					
Chiang Mai	81,654	94,915	3.06	230,111	41.2
Chiang Rai	375,452	435,674	3.02	869,306	50.1
Phayao	138,772	173,342	4.55	280,942	61.7
Sub-Total	595,878	703,931	3.39	1,380,359	51.0
(2) Upper Nan Basin					
Nan	249,626	271,419	1.69	436,946	62.1
Sub-Total	249,626	271,419	1.69	436,946	62.1
Total	845,504	975,350	2.90	1,817,305	53.7
Grand Total (A)	6,242,971	7,062,443	2.50	23,684,400	29.8
National Total (B)	19,509,696	22,589,280	2.97	58,336,000	38.7
A/Bx100	32.0	31.3	-	40.6	-

Source: Agricultural Census 1993 and 1988 Intercensal Survey of Agriculture